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Compendium of Organic Synthetic Methods

By Michael B. Smith

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Volume 7

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PREFACE

It has now been about twenty years since Ian and Shuyen Harrison first published the *Compendium of Organic Synthetic Methods*. Its goal was to facilitate the search for functional group transformations in the original literature of organic chemistry. In Volume 2, difunctional compounds were added and this compilation was continued by Louis Hegedus and Leroy Wade for Volume 3 of the series. Wade became the author for Volume 4 and continued with Volume 5. I edited the series beginning with Volume 6 in which I introduced an author index for the first time and added a new chapter (Chapter 15, "Oxides"). Even in this day of rapid dissemination of information by computers, the *Compendium* is a handy desktop reference that hopefully remains a valuable tool to the working organic chemist. The body of organic literature is so large that a "comprehensive one-volume listing of synthetic methods . . ." is impractical at a reasonable price. The *Compendium* is, therefore, a focused and highly representative review of the literature and is offered in that context.

Compendium of Organic Synthetic Methods, Volume 7 presents the functional group transformations, as well as many carbon bond forming reactions, for the literature appearing in the years 1987, 1988, and 1989. The classification schemes of all previous volumes has been used, including Chapter 15, which continues from Volume 6. Difunctional compound appear in Chapter 16. It was noted that many preparations of difunctional compounds include oxides of sulfur, nitrogen or phosphorous. Since the classification scheme made these functional groups "invisible," new sections have been added to the end of Chapter 16. Beginning with Section 378 ("Oxides–Alkynes") and ending with Section 389 ("Oxides–Oxides"), these important difunctional compounds can assume their rightful place in the *Compendium*. I hope these few sections will prove useful to the organic chemistry community. The experienced user of the *Compendium* will require no special instructions for the use of the new sections of Volume 7.

Author citations and the Author Index have been continued from Volume 6. Alphabetized heading have been added and the format changed slightly and it is hoped this addition to the series is useful and will facilitate it use.

The manuscript for Volume 7 was prepared on a MacIntoch-Plus® PC using Microsoft Word® (version 4.0) for word processing. All structures were prepared using ChemDraw™ (version 2.1.3, license #6021) and the manuscript was printed with a LaserWriter® II printer.

Finally, I want to thank my wife Sarah and my son Steven who have shown unfailing patience and devotion during this work. Such support is essential for the completion of any work of this nature and it was never lacking. I also wish to thank Ted Hoffman who has shown unflinching interest and dedication to this series and is truly responsible for its continued life.

MICHAEL B. SMITH

Storrs, Connecticut
July 1991

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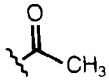
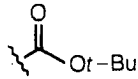
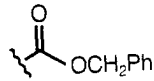
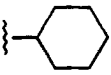
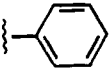
ABBREVIATIONS

Ac	Acetyl, 
acac	Acetylacetonate
AIBN	*Axo-bis*-isobutyronitrile
aq.	Aqueous
	9-Borabicyclo[3.3.1]nonylboryl
9-BBN	9-Borabicyclo[3.31]nonane
BINAP	2R,3S-2,2′-bis-(diphenylphosphino)-1,1′-binapthyl
Bn	Benzyl
Bz	Benzoyl
BOC	t-Butoxycarbonyl, 
bpy (Bipy)	2,2′-Bipyridyl
Bu	n-Butyl, $-CH_2CH_2CH_2CH_3$
CAM	Carboxamidomethyl
CAN	Ceric ammonium nitrate, $(NH_4)_2Ce(NO_3)_6$
c-	Cyclo-
cat.	Catalytic
Cbz	Carbobenzyloxy, 
Chirald	2S,3R-(+)-4-dimethylamino-1,2-diphenyl-3-methylbutan-2-ol
COD	1,5-Cyclooctadienyl
COT	1,3,5-Cyclooctatrienyl
Cp	Cyclopentadienyl
CSA	Camphorsulfonic acid
CTAB	Cetyltrimethylammonium bromide, $C_{16}H_{33}NMe_3^+Br$
Cy (c-C_6H_{11})	Cyclohexyl, 
°C	Temperature in degrees Centigrade
DABCO	1,4-Diazobicyclo[2.2.2]octane
dba	Dibenzylidene acetone
DBE	1,2-Dibromoethane, $BrCH_2CH_2Br$
DBN	1,8-Diazabicyclo[5.4.0]undec-7-ene
DBU	1,5-Diazabicyclo[4.3.0]non-5-ene

DCC	1,3-Dicyclohexylcarbodiimide, $c-C_6H_{13}-N=C=N-c-C_6H_{13}$
DCE	1,2-Dichloroethane, $ClCH_2CH_2Cl$
DDQ	2,3-Dichloro-5,6-dicyano-1,4-benzoquinone
%de	% Diasteromeric excess
DEA	Diethylamine $HN(CH_2CH_3)_2$
DEAD	Diethylazodicarboxylate $EtO_2C-N=N-CO_2Et$
Dibal-H	Diisobutylaluminum hydride $(Me_2CHCH_2)_2AlH$
Diphos (dppe)	1,2-bis-(Diphenylphosphino)ethane $Ph_2PCH_2CH_2PPh_2$
Diphos-4 (dppb)	1,4-bis-(Diphenylphosphino)butane $Ph_2P(CH_2)_4PPh_2$
DMAP	4-Dimethylaminopyridine
DME	Dimethoxyethane $MeOCH_2CH_2OMe$
DMF	N,N'-Dimethylformamide
dppf	bis-(Diphenylphosphino)ferrocene
dppp	1,3-bis-(Diphenylphosphino)propane $Ph_2P(CH_2)_3PPh_2$
dvb	Divinylbenzene
e^-	Electrolysis
%ee	% Enantiomeric excess
EE	1-Ethoxyethyl $EtO(Me)HCO-$
Et	Ethyl $-CH_2CH_3$
EDA	Ethylenediamine $H_2NCH_2CH_2NH_2$
EDTA	Ethylenediaminetetraacetic acid
FMN	Flavin mononucleotide
fod	tris-(6,6,7,7,8,8,8)-Heptafluoro-2,2-dimethyl-3,5-octanedionate
Fp	Cyclopentadieny-bis-carbonyl iron
FVP	Flash vacuum pyrolysis
h	hour (hours)
$h\nu$	Irradiation with light
1,5-HD	1,5-Hexadienyl
HMPA	Hexamethylphosphoramide $(Me_3N)_3P=O$
HMPT	Hexamethylphorous triamide $(Me_3N)_3P$
iPr	Isopropyl $-CH(CH_3)_2$
LICA (LIPCA)	Lithium cyclohexylisopropylamide
LDA	Lithium diisopropylamide $LiN(iPr)_2$
LHMDS	Lithium hexamethyl disilazide $LiN(SiMe_3)_2$
LTMP	Lithium 2,2,6,6-tetramethylpiperidide
mCPBA	meta-Chloroperoxybenzoic acid
Me	Methyl $-CH_3$
MEM	β-Methoxyethoxymethyl $MeOCH_2CH_2OCH_2-$
Mes	Mesityl 2,4,6-tri-Me$-C_6H_2$
MOM	Methoxymethyl $MeOCH_2-$
Ms	Methanesulfonyl CH_3SO_2-

MS	Molecular sieves (3Å or 4Å)
MTM	Methylthiomethyl CH_3SCH_2-
NAD	Nicotinamide adenine dinucleotide
NADP	Sodium triphosphopyridine nucleotide
Napth	Napthyl ($C_{10}H_8$)
NBD	Norbornadiene
NBS	N-Bromosuccinimide
NCS	N-Chlorosuccinimide
NIS	N-Iodosuccinimide
Ni(R)	Raney nickel
Oxone	$2\ KHSO_5 \cdot KHSO_4 \cdot K_2SO_4$
Ⓟ	Polymeric backbone
PCC	Pyridinium chlorochromate
PDC	Pyridinium dichromate
PEG	Polyethylene glycol
Ph	Phenyl 
PhH	Benzene
PhMe	Toluene
Phth	Phthaloyl
Pip	Piperidine
Pr	*n*-Propyl $-CH_2CH_2CH_3$
Py	Pyridine
quant.	Quantitative yield
Red-Al	$[(MeOCH_2CH_2O)_2AlH_2]Na$
sBu	*sec*-Butyl $CH_3CH_2CH(CH_3)$
sBuLi	*sec*-Butyllithium $CH_3CH_2CH(Li)CH_3$
Siamyl	Diisoamyl $(CH_3)_2CHCH(CH_3)-$
TASF	*tris*-(Diethylamino)sulfonium difluorotrimethyl silicate
TBAF	Tetrabutylammonium fluoride $n\text{-}Bu_4N^+F^-$
TBDMS	*t*-Butyldimethylsilyl $t\text{-}BuMe_2Si$
TBHP (*t*-BuOOH)	*t*-Butylhydroperoxide $Me_3C-COOH$
t-Bu	*tert*-Butyl $-C(CH_3)_3$
TEBA	Triethylbenzylammonium $Bn(CH_3)_3N^+$
TEMPO	Tetramethylpiperdinyloxy free radical
TFA	Trifluoroacetic acid CF_3COOH
TFAA	Trifluoroacetic anhydride $(CF_3CO)_2O$
Tf (OTf)	Triflate $-SO_2CF_3(-OSO_2CF_3)$
THF	Tetrahydrofuran
THP	Tetrahydropyran
TMEDA	Tetramethylethylenediamine $Me_2NCH_2CH_2NMe_2$
TMS	Trimethylsilyl $-Si(CH_3)_3$

TMP	2,2,6,6-Tetramethylpiperidine
Tol	Tolyl 4−$C_6H_4CH_3$
Tr	Trityl −CPh_3
TRIS	Triisopropylphenylsulfonyl
Ts(Tos)	Tosyl = *p*-Toluenesulfonyl 4−MeC_6H_4
	Sonication
X_c	Chiral auxiliary

INDEX, MONOFUNCTIONAL COMPOUNDS

Sections—heavy type
Pages—light type

PREPARATION OF →

FROM ↓

FROM	Alkynes	Carboxylic acids, acid halides, anhydrides	Alcohols, phenols	Aldehydes	Alkyls, methylenes, aryls	Amides	Amines	Esters	Ethers, epoxides	Halides, sulfonates	Hydrides (RH)	Ketones	Nitriles	Alkenes	Oxides
Alkynes	**1** 1	**16** 6	**31** 15	**46** 59	**61** 72			**106** 165	**121** 188			**166** 230		**196** 264	**211** 290
Carboxylic acids acid halides, anhydrides		**17** 7		**47** 59	**62** 73	**77** 121		**107** 166	**122** 189	**137** 206		**167** 232		**197** 267	**212** 290
Alcohols, phenols		**18** 7	**33** 16	**48** 60	**63** 73	**78** 123	**93** 141	**108** 169	**123** 189	**138** 207	**153** 219	**168** 235	**183** 258	**198** 268	**213** 291
Aldehydes	**4** 2	**19** 8	**34** 17	**49** 62	**64** 74	**79** 124	**94** 142	**109** 171	**124** 192	**139** 210		**169** 241	**184** 254	**199** 270	
Alkyls, methylenes, aryls			**35** 30	**50** 63	**65** 75		**95** 143			**140** 211	**155** 221			**200** 275	**215** 291
Amides		**21** 9	**36** 31	**51** 64		**81** 125	**96** 143	**111** 173	**126** 194			**171** 242	**186** 260		
Amines			**37** 31	**52** 64	**67** 78	**82** 131	**97** 145			**142** 213		**172** 243	**187** 260	**202** 276	**217** 292
Esters		**23** 10	**38** 31	**53** 65	**68** 79	**83** 134	**98** 154	**113** 174	**128** 194	**143** 213	**158** 221	**173** 245	**188** 261	**203** 277	
Ethers, epoxides			**39** 33	**54** 65	**69** 80	**84** 135		**114** 178	**129** 196	**144** 214	**159** 222			**204** 278	**219** 293
Halides, sulfonates, sulfates	**10** 3	**25** 11	**40** 36	**55** 66	**70** 81	**85** 135	**100** 155	**115** 179	**130** 197	**145** 214	**160** 223	**175** 246	**190** 261	**205** 279	**220** 295
Hydrides (RH)		**26** 11	**41** 37	**56** 67	**71** 86		**101** 156	**116** 181	**131** 198	**146** 216		**176** 247			**221** 296
Ketones	**12** 4	**27** 12	**42** 38	**57** 67	**72** 87	**87** 136	**102** 156	**117** 182	**132** 199	**147** 217	**162** 227	**177** 248	**192** 262	**207** 282	
Nitriles		**28** 12		**58** 68	**73** 87	**88** 137	**103** 157	**118** 185			**163** 228			**208**	
Alkenes	**14** 4	**29** 12	**44** 48	**59** 68	**74** 88	**89** 137	**104** 157	**119** 186	**134** 201	**149** 217		**179** 252	**194** 263	**209** 286	
Miscellaneous compounds	**15** 4	**30** 13	**45** 51	**60** 69	**75** 118	**90** 138	**105** 158	**120** 187	**135** 204	**150** 218	**165** 229	**180** 253		**210** 288	**225** 297

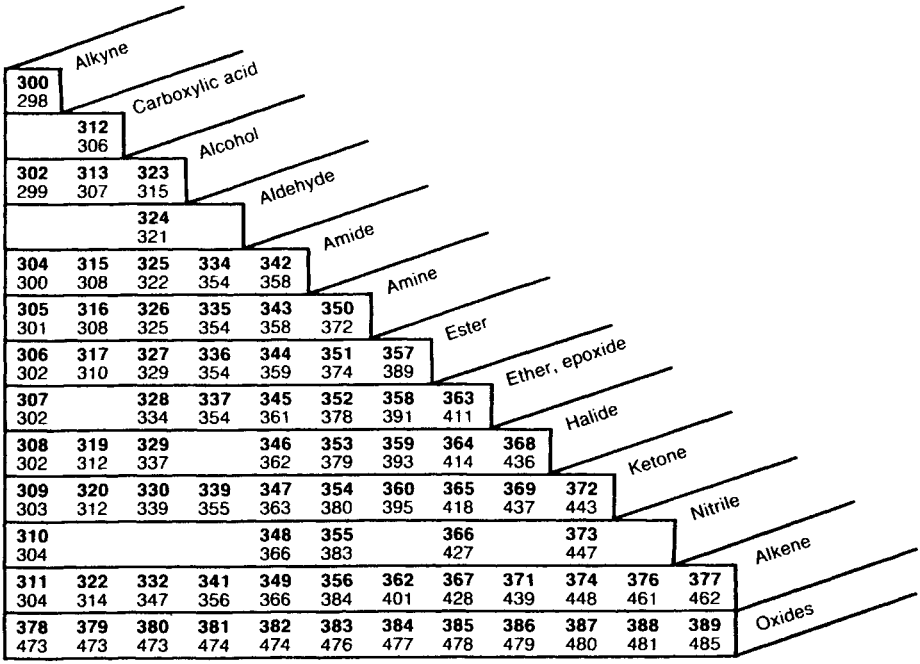
PROTECTION

	Sect.	Pg.
Carboxylic acids	30A	13
Alcohols, phenols	45A	51
Aldehydes	60A	70
Amines	105A	163
Ketones	180A	255

Blanks in the table correspond to sections for which no additional examples were found in the literature.

INDEX, DIFUNCTIONAL COMPOUNDS

Sections—heavy type
Pages—light type



Alkyne	Carboxylic acid	Alcohol	Aldehyde	Amide	Amine	Ester	Ether, epoxide	Halide	Ketone	Nitrile	Alkene	Oxides
300 298												
	312 306											
302 299	**313** 307	**323** 315										
		324 321										
304 300	**315** 308	**325** 322	**334** 354	**342** 358								
305 301	**316** 308	**326** 325	**335** 354	**343** 358	**350** 372							
306 302	**317** 310	**327** 329	**336** 354	**344** 359	**351** 374	**357** 389						
307 302		**328** 334	**337** 354	**345** 361	**352** 378	**358** 391	**363** 411					
308 302	**319** 312	**329** 337		**346** 362	**353** 379	**359** 393	**364** 414	**368** 436				
309 303	**320** 312	**330** 339	**339** 355	**347** 363	**354** 380	**360** 395	**365** 418	**369** 437	**372** 443			
310 304				**348** 366	**355** 383		**366** 427		**373** 447			
311 304	**322** 314	**332** 347	**341** 356	**349** 366	**356** 384	**362** 401	**367** 428	**371** 439	**374** 448	**376** 461	**377** 462	
378 473	**379** 473	**380** 473	**381** 474	**382** 474	**383** 476	**384** 477	**385** 478	**386** 479	**387** 480	**388** 481	**389** 485	

Blanks in the table correspond to sections for which no additional examples were found in the literature.

INTRODUCTION

Relationship between Volume 7 and Previous Volumes. *Compendium of Organic Synthetic Methods, Volume 7* presents about 1250 examples of published methods for the preparation of monofunctional compounds, updating the 8100 in Volumes 1–6. In addition, Volume 7 contains about 850 examples of preparations of difunctional compounds with various functional groups, updating the sections introduced in Volume 2. Reviews have long been a feature of this series and Volume 7 adds almost 100 pertinent reviews in the various sections. Chapters 1–14 continue as in Volumes 1–6 and Chapter 15, introduced in Volume 6 continues. Difunctional compounds appear in Chapter 15 in Volumes 1–5 but in Chapter 16 in Volumes 6 and 7. In order to identify oxides of sulfur, nitrogen, and phosphorous that are a key functional group when present with alkynes through alkenes (as the *Compendium* is organized), new sections have been added to the end of Chapter 16. The new sections begin with Section 378 (Oxides–Alkynes), progress to Section 388 (Oxides–Alkenes), and end with Section 389 (Oxides–Oxides). These oxides are integral functional groups throughout organic chemistry and the new sections allow proper attention to be drawn to their preparation in the presence of other functionalities. As in Volume 6, all references to alcohols include thiols, ethers, and thioethers.

The authors for each citation appear below the reaction. The principle author is indicated by underlining (i.e., Zezza, C. A.; Smith, M. B.) rather than the asterisk (*) that was used in Volume 6. Following Chapter 16 is a complete alphabetical listing of all authors (last name, initials).

Classification and Organization of Reactions Forming Monofunctional Compounds. Chemical transformations are classified according to the reacting functional group of the starting material and the functional group formed. Those reactions that give products with the same functional group form a chapter. The reactions in each chapter are further classified into sections on the basis of the functional group of the starting material. Within each section, reactions are loosely arranged in ascending order of year cited (1987–1989), although an effort has been made to put similar reactions together when possible. Review articles are collected at the end of each appropriate section.

The classification is unaffected by allylic, vinylic, or acetylenic unsaturation appearing in both starting material and product, or by increases or decreases in the length of carbon chains; for example, the reactions *t*-BuOH → *t*-BuCOOH, $PhCH_2OH$ → PhCOOH, and $PhCH{=}CHCH_2OH$ → $PhCH{=}CHCOOH$ would all be considered as preparations of carboxylic acids from alcohols. Conjugate reduction and alkylation of unsaturated ketones, aldehydes, esters, acids, and nitriles have been placed in category 74 (alkyls from olefins).

The terms hydrides, alkyls, and aryls classify compounds containing reacting hydrogens, alkyl groups, and aryl groups, respectively; for example, $RCH_2{-}H$ → RCH_2COOH (carboxylic acids from hydrides), RMe → RCOOH (carboxylic acids from alkyls), RPh → RCOOH (carboxylic acids from aryls). Note the distinction between R_2CO → R_2CH_2 (methylenes from ketones) and RCOR′ → RH (hydrides from ketones). Alkylations involving additions across double bonds are found in Section 74 (alkyls, methylenes, and aryls from olefins).

The following examples illustrate the classification of some potentially confusing cases:

$RCH{=}CHCOOH \rightarrow RCH{=}CH_2$	Hydrides from carboxylic acids
$RCH{=}CH_2 \rightarrow RCH{=}CHCOOH$	Carboxylic acids from hydrides
$ArH \rightarrow ArCOOH$	Carboxylic acids from hydrides
$ArH \rightarrow ArOAc$	Esters from hydrides
$RCHO \rightarrow RH$	Hydrides from aldehydes
$RCH{=}CHCHO \rightarrow RCH{=}CH_2$	Hydrides from aldehydes
$RCHO \rightarrow RCH_3$	Alkyls from aldehydes
$R_2CH_2 \rightarrow R_2CO$	Ketones from methylenes
$RCH_2COR \rightarrow R_2CHCOR$	Ketones from ketones
$RCH{=}CH_2 \rightarrow RCH_2CH_3$	Alkyls from olefins
$RBr + CHCH \rightarrow RC{\equiv}CR$	*Acetylenes from halides; also* acetylenes from acetylenes
$ROH + RCOOH \rightarrow RCOOR$	Esters from alcohols; also esters from carboxylic acids
$RCH{=}CHCHO \rightarrow RCH_2CH_2CHO$	Alkyls from olefins
$RCH{=}CHCN \rightarrow RCH_2CH_2CN$	Alkyls from olefins

How to Use the Book to Locate Examples of the Preparation of Protection of Monofunctional Compounds. Examples of the preparation of one functional group from another are located via the monofunctional index on p. xiii, which lists the corresponding section and page. Thus Section 1 contains examples of the preparation of acetylenes from other acetylenes; Section 2, acetylenes from carboxylic acids; and so forth.

Sections that contain examples of the reactions of a functional group are found in the horizontal rows of the index. Thus Section 1 gives examples of the reactions of acetylenes that form acetylenes; Section 16, reactions of acetylenes that form carboxylic acids; and Section 31, reactions of acetylenes that form alcohols.

Examples of alkylation, dealkylation, homologation, isomerization, and transposition are found in Sections 1, 17, 33, and so on, lying close to a diagonal of the index. These sections correspond to such topics as the preparation of acetylenes from acetylenes; carboxylic acids from carboxylic acids; and alcohols, thiols, and phenols from alcohols, thiols, and phenols. Alkylations that involve conjugate additions across a double bond are found in Section 74 (alkyls, methylenes, and aryls from olefins).

Examples of name reactions can be found by first considering the nature of the starting material and product. The Wittig reaction, for instance is in Section 199 (olefins from aldehydes) and Section 207 (olefins from ketones). The aldol condensation can be found in the chapters on difunctional compounds in Section 324 (alcohol, thiol–aldehyde) and in Section 330 (alcohol, thiol-ketone).

Examples of the protection of acetylenes, carboxylic acids, alcohols, phenols, aldehydes, amides, amines, esters, ketones, and olefins are also indexed on p. xiii.

The pairs of functional groups alcohol, ester; carboxylic acid, ester; amine, amide; and carboxylic acid, amide can be interconverted by simple reactions. When a member of these groups is the desired product or starting material, the other member should, of course, also be consulted in the text.

The original literature must be used to determine the generality of reactions, although this is occasionally stated in the citation. This is only done in cases where such generality is stated clearly in the original citation. A reaction given in this book for a primary aliphatic substrate may also be applicable to tertiary or aromatic compounds. This book provides very limited experimental conditions or precautions and the reader is referred to the original literature before attempting a reaction. In no instance should the citation be taken as a complete experimental procedure. Not to refer to the original literature could be hazardous. The original papers usually yield a further set of references to previous work. Subsequent publications can be found by consulting the *Science Citation Index*.

Classification and Organization of Reactions Forming Difunctional Compounds. This chapter considers all possible difunctional compounds formed from the groups acetylene, carboxylic acid, alcohol, thiol, aldehyde, amide, amine, ester, ether, epoxide, thioether, halide, ketone, nitrile,

and olefin. Reactions that form difunctional compounds are classified into sections on the basis of the two functional groups of the product. The relative positions of the groups do not affect the classification. Thus preparations of 1,2-aminoalcohols, 1,3-aminoalcohols, and 1,4-aminoalcohols are included in a single section. Difunctional compounds that have an oxide as the second group are found in the monofunctional sections for the nonoxide functional group. Therefore, the nitroketone product of oxidation of a nitroalcohol is found in Section 168 (ketones from alcohols and thiols). Conversion of an oxide to another functional group is generally found in the "Miscellaneous" section, so conversion of a nitroalkane to an amine is found in Section 105 (amines from miscellaneous compounds). The following examples illustrate the application of this classification system:

Difunctional Product	*Section Title*
$RC{\equiv}C-C{\equiv}CR$	Acetylene–acetylene
$RCH(OH)COOH$	Carboxylic acid–alcohol
$RCH{=}CHOMe$	Ether–olefin
$RCHF_2$	Halide–halide
$RCH(Br)CH_2F$	Halide–halide
$RCH(OAc)CH_2OH$	Alcohol–ester
$RCH(OH)CO_2Me$	Alcohol–ester
$RCH{=}CHCH_2CO_2Me$	Ester–olefin
$RCH{=}CHOAc$	Ester–olefin
$RCH(OMe)CH_2SO_2CH_2CH_2OH$	Alcohol–ether
$RSO_2CH_2CH_2OH$	Oxides–alcohol

How to Use the Book to Locate Examples of the Preparation of Difunctional Compounds. The difunctional index on p. xiv gives the section and page corresponding to each difunctional product. Thus Section 327 (alcohol, thiol-ester) contains examples of the preparation of hydroxyesters; Section 323 (alcohol, thiol–alcohol, thiol) contains examples of the preparation of diols.

Some preparations of olefinic and acetylenic compounds from olefinic and acetylenic starting materials can, in principle, be classified in either the monofunctional or difunctional sections; for example, $RCH{=}CHBr \rightarrow RCH{=}CHCOOH$, carboxylic acids from halides (Section 25, monofunctional compounds) or carboxylic acid-olefin (Section 322, difunctional compounds). In such cases both sections should be consulted.

Reactions applicable to both aldehyde and ketone starting materials are in many cases illustrated by an example that uses only one of them.

Many literature preparations of difunctional compounds are extensions of the methods applicable to monofunctional compounds. Thus the reaction RCl → ROH can be extended to the preparation of diols by using the corresponding dichloro compound as a starting material. Such methods are not fully covered in the difunctional sections.

The user should bear in mind that the pairs of functional groups alcohol, ester; carboxylic acids, ester; amine, amide; and carboxylic acid, amide can be interconverted by simple reactions. Compounds of the type $RCH(OAc)CH_2OAc$ (ester–ester) would thus be of interest to anyone preparing the diol $RCH(OH)CH_2OH$ (alcohol–alcohol).

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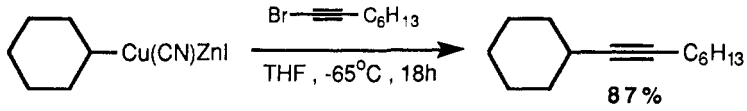
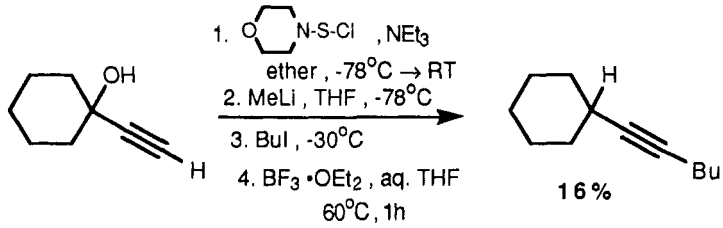
CHAPTER 1
PREPARATION OF ALKYNES

SECTION 1: ALKYNES FROM ALKYNES



Yeh, M.C.P.; Knochel, P. *Tetrahedron Lett.*, ***1989***, *30*, 4799.



Baudin, J.-B.; Julia, S.A.; Wang, Y. *Tetrahedron Lett.*, ***1989***, *30*, 4965.

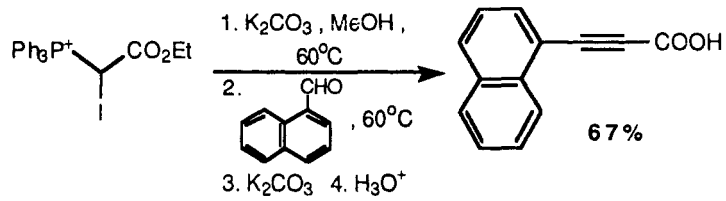
SECTION 2: ALKYNES FROM ACID DERIVATIVES

NO ADDITIONAL EXAMPLES

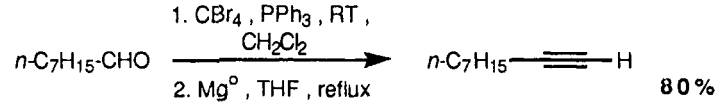
SECTION 3: ALKYNES FROM ALCOHOLS AND THIOLS

NO ADDITIONAL EXAMPLES

SECTION 4: ALKYNES FROM ALDEHYDES



Chenault, J.; Dupin, J.-F.E. *Synthesis,* ***1987***, 498.



van Hijfte, L.; Kolb, M.; Witz, P. *Tetrahedron Lett.,* ***1989***, *30*, 3655.

SECTION 5: ALKYNES FROM ALKYLS, METHYLENES AND ARYLS

NO ADDITIONAL EXAMPLES

SECTION 6: ALKYNES FROM AMIDES

NO ADDITIONAL EXAMPLES

SECTION 7: ALKYNES FROM AMINES

NO ADDITIONAL EXAMPLES

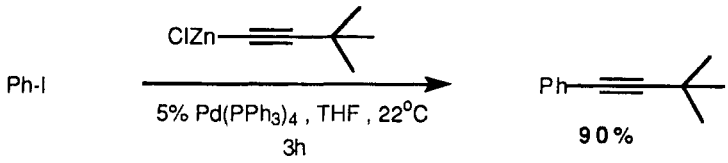
SECTION 8: ALKYNES FROM ESTERS

NO ADDITIONAL EXAMPLES

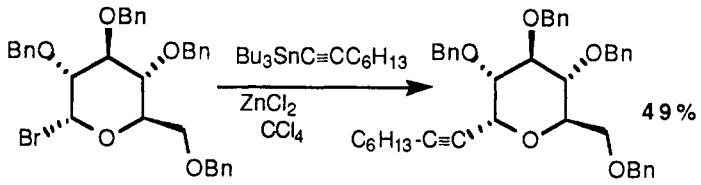
SECTION 9: ALKYNES FROM ETHERS, EPOXIDES AND THIOETHERS

NO ADDITIONAL EXAMPLES

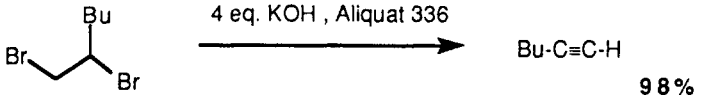
SECTION 10: ALKYNES FROM HALIDES AND SULFONATES



Negishi, E.; Akiyoshi, K.; Takahashi, T. *J. Chem. Soc., Chem. Commun.*, ***1987***, 477.



Zhai, D.; Zhai, W.; Williams, R.M. *J. Am. Chem. Soc.*, ***1988***, *110*, 2501.



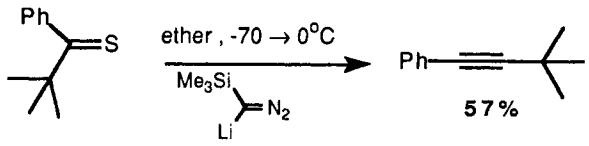
Vinczer, P.; Kovacs, T.; Novak, L.; Szantay, C. *Org. Prep. Proceed. Int.*, ***1989***, *21*, 232.

SECTION 11: ALKYNES FROM HYDRIDES

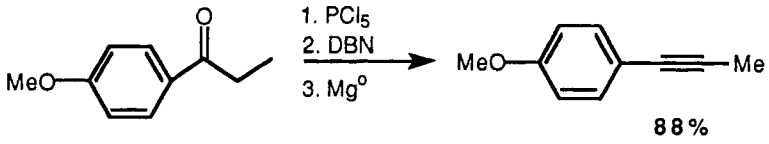
For examples of the reaction RC≡CH → RC≡C-C≡CR^1, see section 300 (Alkyne-Alkyne).

NO ADDITIONAL EXAMPLES

SECTION 12: ALKYNES FROM KETONES



Shioiri, T.; Iwamoto, Y.; Aoyama, T. *Heterocycles, **1987**, 25*, 1467.

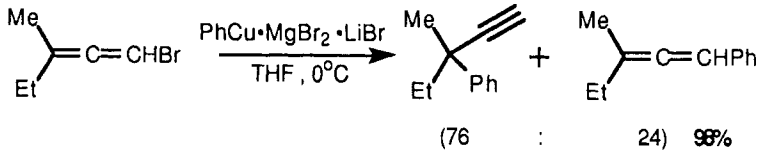


Engler, T.A.; Combrink, K.D.; Ray, J.E. *Synth. Commun., **1989**, 19*, 1735.

SECTION 13: ALKYNES FROM NITRILES

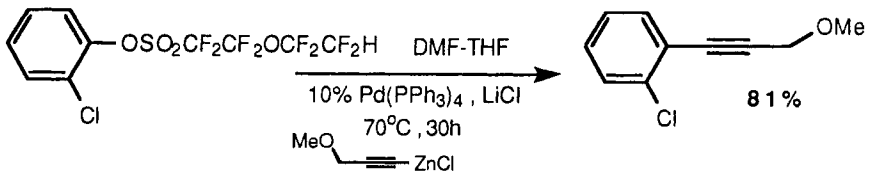
NO ADDITIONAL EXAMPLES

SECTION 14: ALKYNES FROM ALKENES



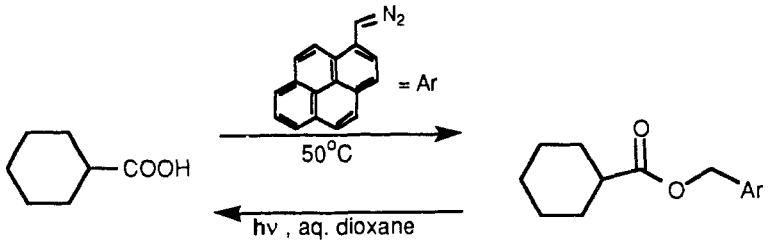
Caporusso, A.M.; Polizzi, C.; Lardicci, R. *J. Org. Chem., **1987**, 52*, 3920

SECTION 15: ALKYNES FROM MISCELLANEOUS COMPOUNDS



Chen, Q.-Y.; He, Y.-B. *Tetrahedron Lett., **1987**, 28*, 2387.

SECTION 15A: PROTECTION OF ALKYNES



90%

Iwamura, M.; Ishikawa, T.; Koyama, Y.; Sakuma, K.; Iwamura, H. *Tetrahedron Lett.*, ***1987***, *28*, 679.

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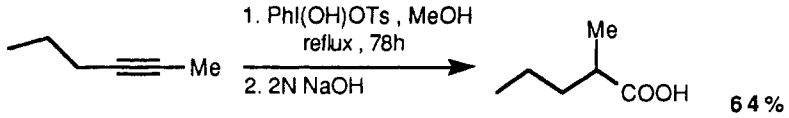
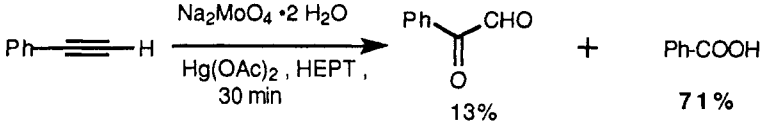
CHAPTER 2
PREPARATION OF ACID DERIVATIVES

SECTION 16: ACID DERIVATIVES FROM ALKYNES

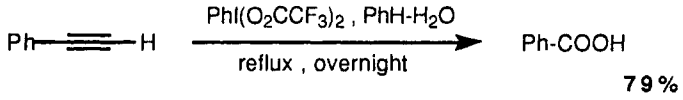


Moriarty, R.M.; Vaid, R.K.; Duncan, M.P.; Vaid, B.K. *Tetrahedron Lett.*, ***1987, 28***, 2845.



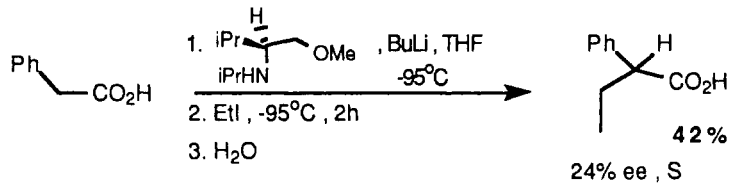
HEPT = hexaethyl phosphoric triamide

Ballistreri, F.P.; Failla, S.; Tomaselli, G.A. *J. Org. Chem.*, ***1988, 53***, 830.



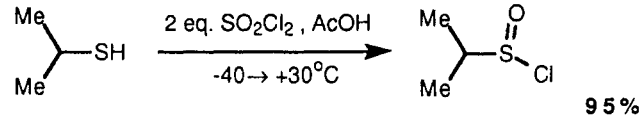
Moiriarty, R.M.; Penmasta, R.; Awasthi, A.K. *J. Org. Chem.*, ***1988, 53***, 6124.

SECTION 17: ACID DERIVATIVES FROM ACID DERIVATIVES

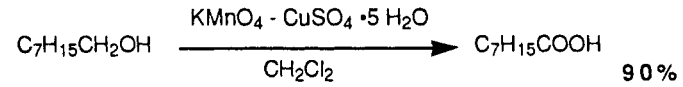


Ando, A.; Shiqiri, T. *J. Chem. Soc., Chem. Commun.*, ***1987***, 656.

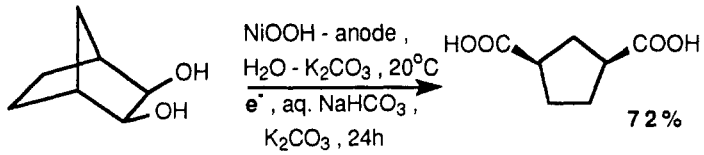
SECTION 18: ACID DERIVATIVES FROM ALCOHOLS AND THIOLS



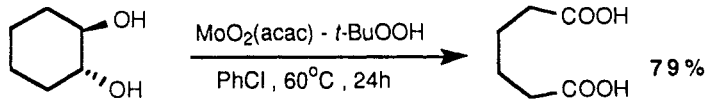
Youn, J.-H.; Herrmann, R. *Synthesis*, ***1987***, 72.



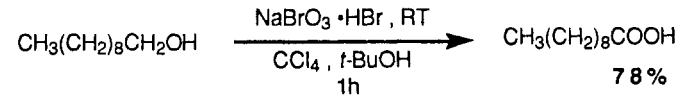
Jefford, C.W.; Wang, Y. *J. Chem. Soc., Chem. Commun.*, ***1988***, 634.



Ruholl, H.; Schäfer, H.-J. *Synthesis*, ***1988***, 54.

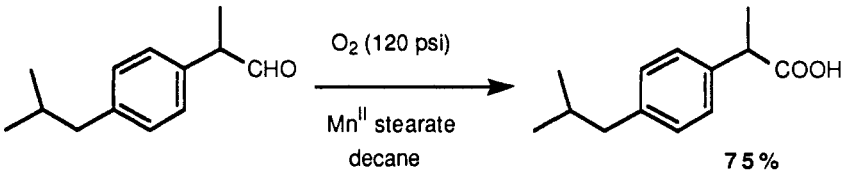


Kameda, K.; Morimoto, K.; Imanaka, T. *Chem. Lett.*, ***1988***, 1295.



Veeraiah, T.; Periasamy, M. *Synth. Commun.*, ***1989***, *19*, 2151.

SECTION 19: ACID DERIVATIVES FROM ALDEHYDES



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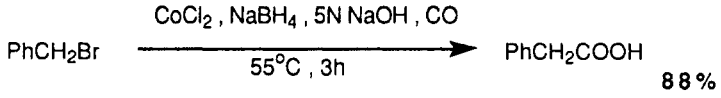
Riley, D.P.; Gelman, D.P.;Beck, G.R.; Heintz, R.M. *J. Org. Chem.*, ***1987***, *52*, 287.



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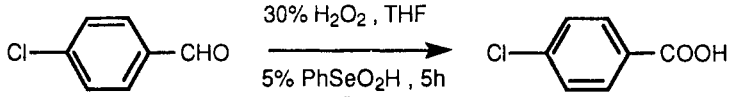
Satayanarayana, N.; Perisamy, M. *Tetrahedron Lett.*, ***1987***, *28*, 2633.



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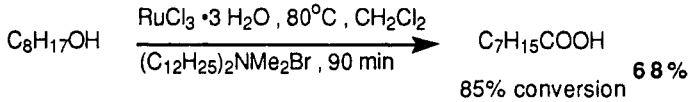
Choi, J.-K.; Chang, Y.-K.; Hong, S.Y. *Tetrahedron Lett.*, ***1988***, *29*, 1967.



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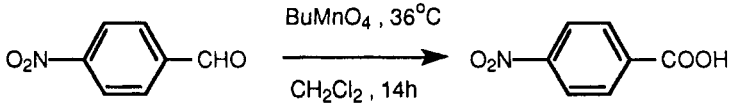
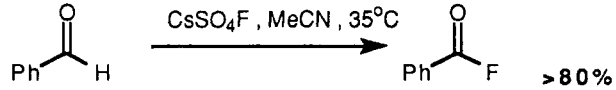
Barak, G.; Dakka, J.; Sasson, Y. *J. Org. Chem.*, ***1988***, *53*, 3553.



results are poor with aliphatic aldehydes

Srivastava, R.G.; Venkataramani, P.S. *Synth. Commun.*, ***1988***, *18*, 2193.



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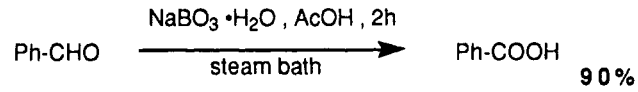
Stavber, S.; Planinšek, Z.; Zupan, M. *Tetrahedron Lett.*, ***1989***, *30*, 6095.

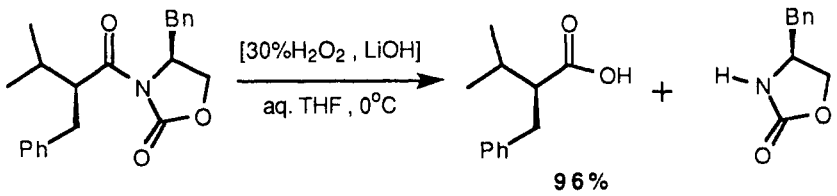


Bannerjee, A.; Hazra, B.; Bhattacharya, A.; Bannerjee, S.; Bannerjee, G.C.; Sengupta, S. *Synthesis*, ***1989***, 765.

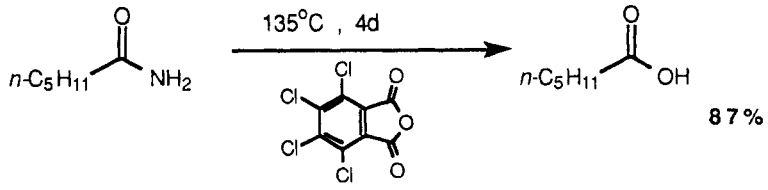
SECTION 20: ACID DERIVATIVES FROM ALKYLS, METHYLENES AND ARYLS

NO ADDITIONAL EXAMPLES

SECTION 21: ACID DERIVATIVES FROM AMIDES



Evans, D.A.; Britton, T.C.; Ellman, J.A. *Tetrahedron Lett.*, ***1987***, *28*, 6141.

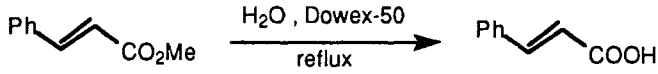


Eaton, J.T.; Rounds, W.D.; Urbanowicz, J.H.; Gribble, G.W. *Tetrahedron Lett.*, ***1988***, *29*, 6553.

SECTION 22: ACID DERIVATIVES FROM AMINES

NO ADDITIONAL EXAMPLES

SECTION 23: ACID DERIVATIVES FROM ESTERS



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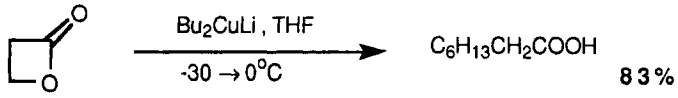
Basu, M.K.; Sarkar, D.C.; Ranu, B.C. *Synth. Commun.*, ***1989***, *19*, 627.



83%

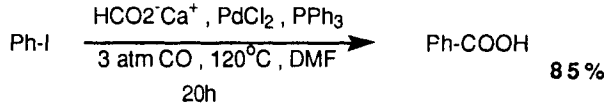
Kawashima, M.; Sato, T.; Fujisawa, T. *Tetrahedron*, ***1989***, *45*, 403.

Other reactions useful for the hydrolysis of esters may be found in Section 30A (Protection of Carboxylic Acids).

SECTION 24: ACID DERIVATIVES FROM ETHERS, EPOXIDES AND THIOETHERS

NO ADDITIONAL EXAMPLES

SECTION 25: ACID DERIVATIVES FROM HALIDES AND SULFONATES



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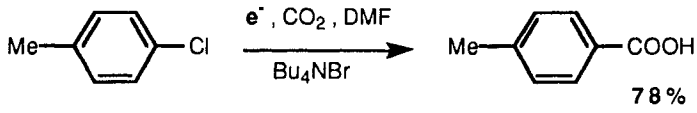
Pri-Bar, I.; Buchman, O. *J. Org. Chem.*, ***1988***, *53*, 624.



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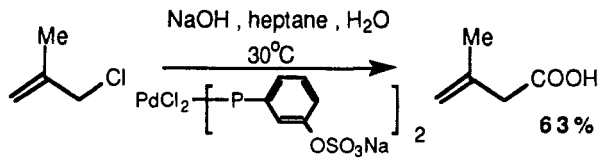
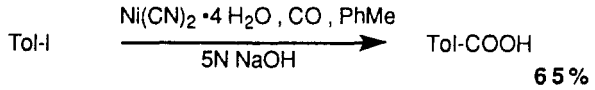
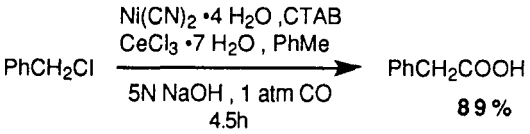
Heintz, M.; Sock, O.; Saboureau, C.; Périchon, J. *Tetrahedron*, ***1988***, *44*, 1631.



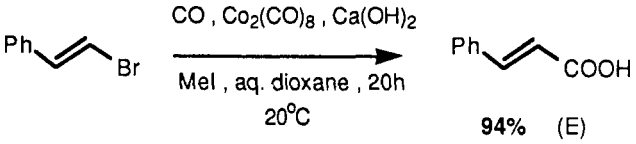
Kiji, J.; Okano, T.; Nishiumi, W.; Konishi, H. *Chem. Lett.*, ***1988***, 957.



Amer, I.; Alper, H. *J. Org. Chem.*, ***1988***, *53*, 5147.

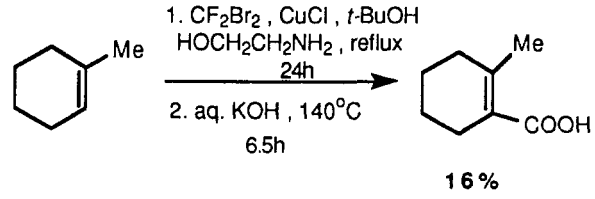


Amer, I.; Alper, H. *J. Am. Chem. Soc.*, ***1989***, *111*, 927.
Alper, H.; Amer, I.; Vasapollo, G. *Tetrahedron Lett.*, ***1989***, *30*, 2617.



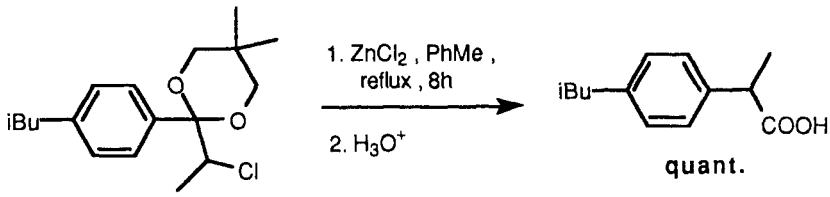
Miura, M.; Okura, K.; Hattori, A.; Nomura, M. *J. Chem. Soc., Perkin Trans. I*, ***1989***, 73.

SECTION 26: ACID DERIVATIVES FROM HYDRIDES



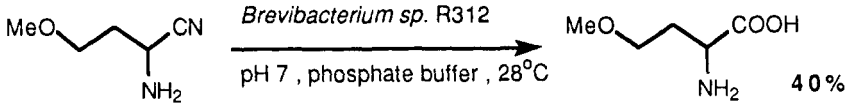
Elsheimer, S.; Slattery, D.K.; Michael, M.; Weeks, J.; Topoleski, K. *J. Org. Chem.*, ***1989***, *54*, 3992.

SECTION 27: ACID DERIVATIVES FROM KETONES

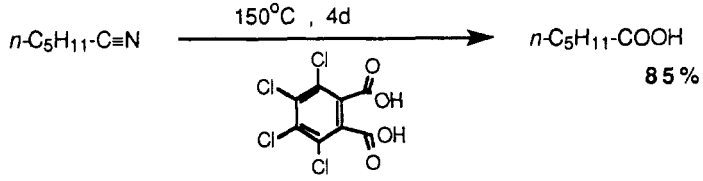


Piccolo, O.; Spreafico, F.; Visentii, G. *J. Org. Chem.*, ***1987***, *52*, 10.

SECTION 28: ACID DERIVATIVES FROM NITRILES

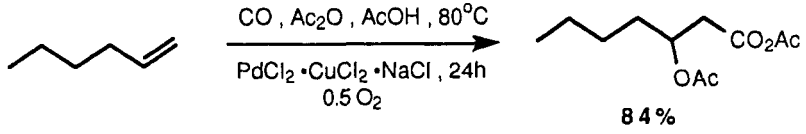


Vo-Quang, Y.; Marais, D.; Vo-Quang, L.; LeGoffic, F.; Thiéry, A.; Maestracci, M.; Arnaud, A.; Galzy, P. *Tetrahedron Lett.*, ***1987***, *28*, 4057.

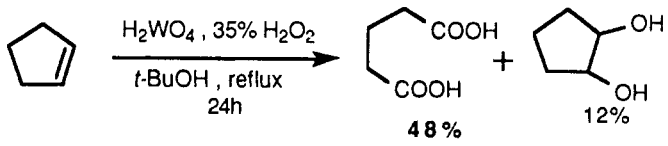


Rounds,W.D.; Eaton, J.T.; Urbanowicz, J.H.; Gribble, G.W. *Tetrahedron Lett.*, ***1988***, *29*, 6557.

SECTION 29: ACID DERIVATIVES FROM ALKENES

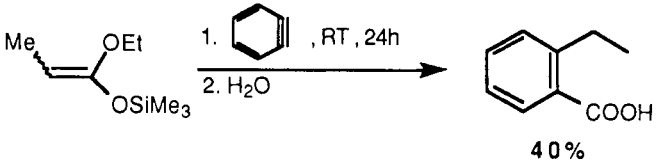


Urata, H.; Fujita, A.; Fuchikami, T. *Tetrahedron Lett.*, ***1988***, *29*, 4435.



Oguchi, T.; Ura, T.; Ishii, Y.; Ogawa, M. *Chem. Lett.*, ***1989***, 857.

SECTION 30: ACID DERIVATIVES FROM MISCELLANEOUS COMPOUNDS



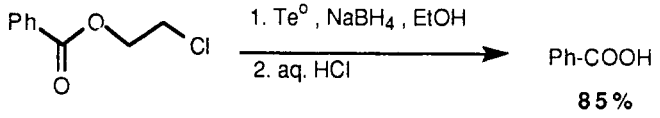
Ali, S.M.; Tanimoto, S. *J. Chem. Soc., Chem. Commun.*, ***1988***, 1465.

REVIEW:

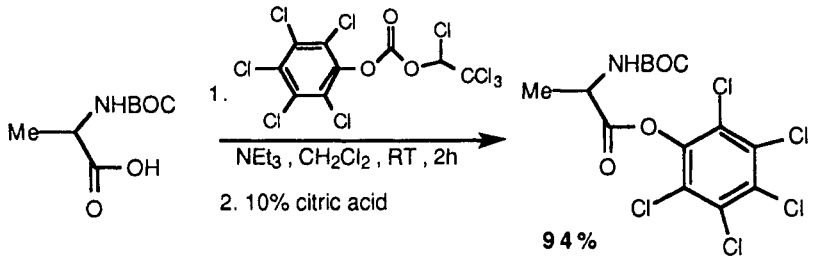
"Selenium and Tellurium Isologues of Carboxylic Acid Derivatives"

Kato, S.; Murai, T.; Ishida, M. *Org. Prep. Proceed. Int.*, ***1986***, *18*, 369.

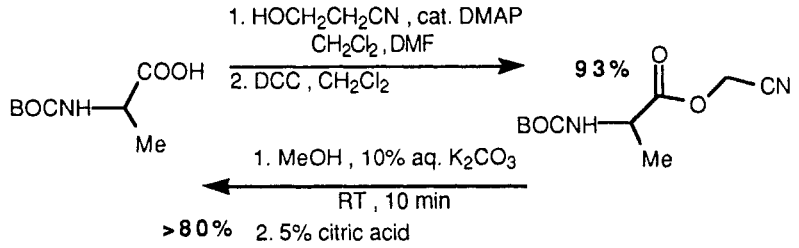
SECTION 30A: PROTECTION OF CARBOXYLIC ACID DERIVATIVES



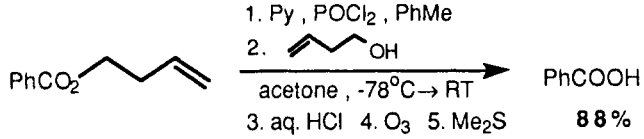
Chen, J.; Zhou, X.-J. *Synth. Commun.*, ***1987***, *17*, 161.



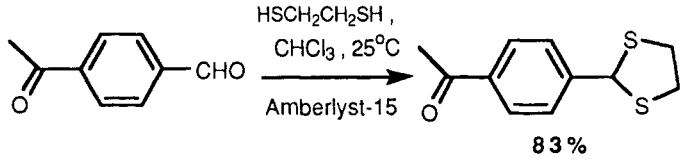
Jaouadi, M.; Martinez, J.; Castro, B.; Barcelo, G.; Sennyey, G.; Senet, J.-P. *J. Org. Chem.*, ***1987***, *52*, 2364.



Misra, P.K.; Hashmi, S.A.N.; Haq, W.; Katti, S.B. *Tetrahedron Lett.*, ***1989***, *30*, 3569.



Barrett, A.G.M.; Lebold, S.A.; Zhang, X. *Tetrahedron Lett.*, ***1989***, *30*, 7317.



Perni, R.B. *Synth. Commun.*, ***1989***, *19*, 2883.

Other reactions useful for the protection of carboxylic acids are included in Section 107 (Esters from Carboxylic Acids and Acid Halides) and Section 23 (Carboxylic Acids from Esters).

Compendium of Organic Synthetic Methods, Volume 7
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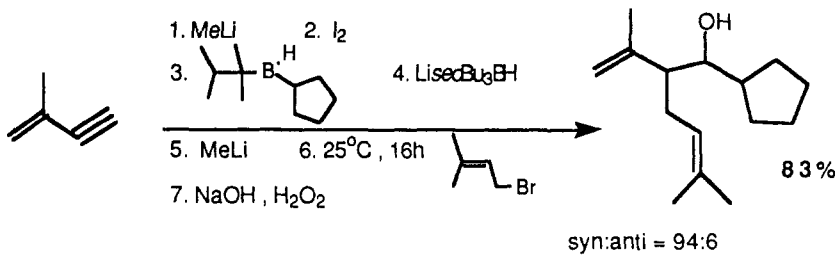
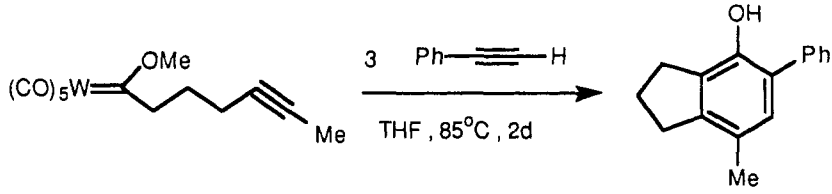
CHAPTER 3
PREPARATION OF ALCOHOLS

SECTION 31: ALCOHOLS AND THIOLS FROM ALKYNES



Zweifel, G.; Hahn, G.R.; Shoup, T.M. *J. Org. Chem.*, ***1987***, *52*, 5484.

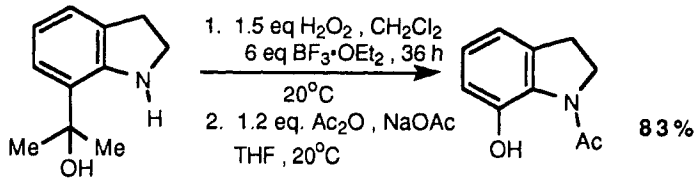


Wulff, W.D.; Xu, Y.-C. *Tetrahedron Lett.*, ***1988***, *29*, 415.

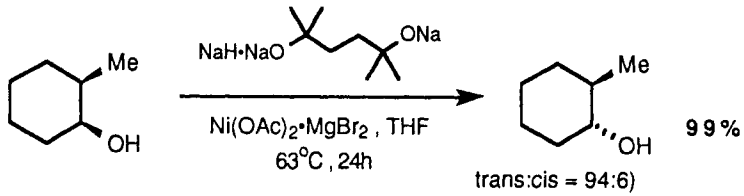
SECTION 32: ALCOHOLS AND THIOLS FROM ACID DERIVATIVES

NO ADDITIONAL EXAMPLES

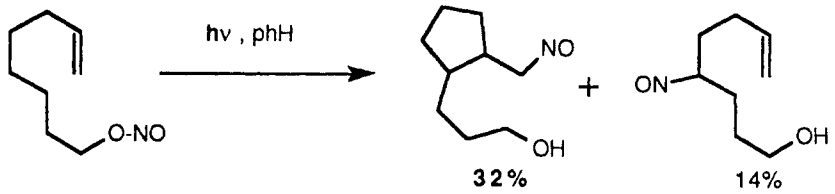
SECTION 33: ALCOHOLS AND THIOLS FROM ALCOHOL AND THIOLS



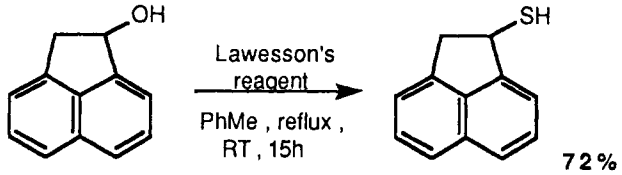
Boger, D.L.; Coleman, R.S. *Tetrahedron Lett.*, ***1987***, *28*, 1027.



Feghouli, G.; Vanderesse, R.; Fort, Y.; Caubere, P. *Tetrahedron Lett.*, ***1988***, *29*, 1383.



Ceković, Ž.; Ilijiv, D. *Tetrahedron Lett.*, ***1988***, *29*, 1441.

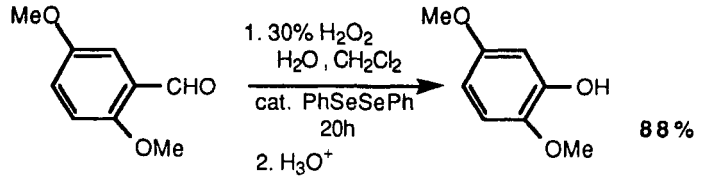


Nishio, T. *J. Chem. Soc., Chem. Commun.*, ***1989***, 205.

SECTION 34: ALCOHOLS AND THIOLS FROM ALDEHYDES

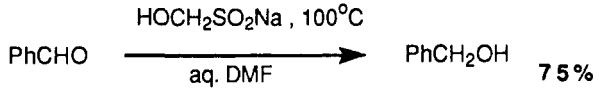
The following reaction types are included in this section:
A. Reductions of Aldehydes to Alcohols
B. Alkylation of Aldehydes, forming Alcohols.

Coupling of Aldehydes to form Diols is found in Section 323 (Alcohol-Alcohol).

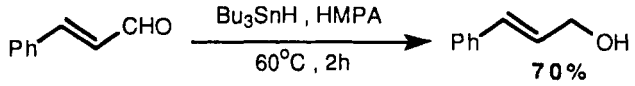


Syper, L. *Synthesis*, ***1989***, 167.

SECTION 34A: REDUCTIONS OF ALDEHYDES TO ALCOHOLS



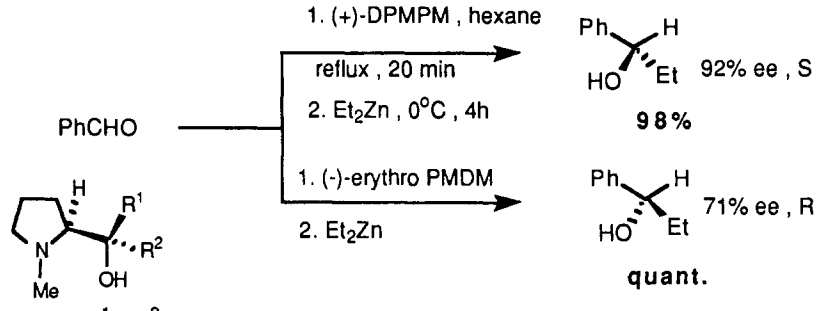
Harris, A.R.; Mason, T.J. *Synth. Commun.*, ***1989***, *19*, 529.



Shibata, I.; Yoshida, T.; Baba, A.; Matsuda, H. *Chem. Lett.*, ***1989***, 619.

SECTION 34B: ALKYLATION OF ALDEHYDES, FORMING ALCOHOLS

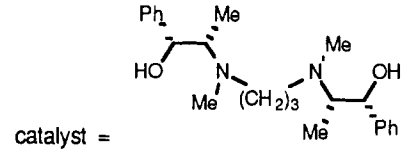
ASYMMETRIC ALKYLATIONS



$R^1 = R^2 = Ph$ = (+)-DPMDM

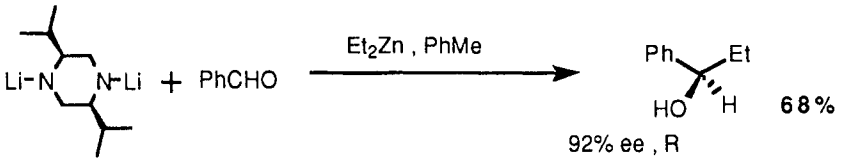
$R^1 = Ph$, $R^2 = H$ = (-)-erytho PMDM

Soai, K.; Ookawa, A.; Ogawa, K.; Kaba, T. *J. Chem. Soc., Chem. Commun.*, ***1987***, 467.

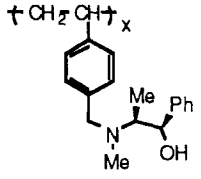


catalyst = 59% , 85% ee , R

Soai, K.; Nishi, M.; Ito, Y. *Chem. Lett.*, ***1987***, 2405.



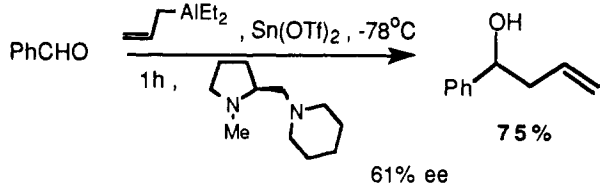
Soai, K.; Niwa, S.; Yamada, Y.; Inoue, H. *Tetrahedron Lett.*, ***1987***, *28*, 4841.



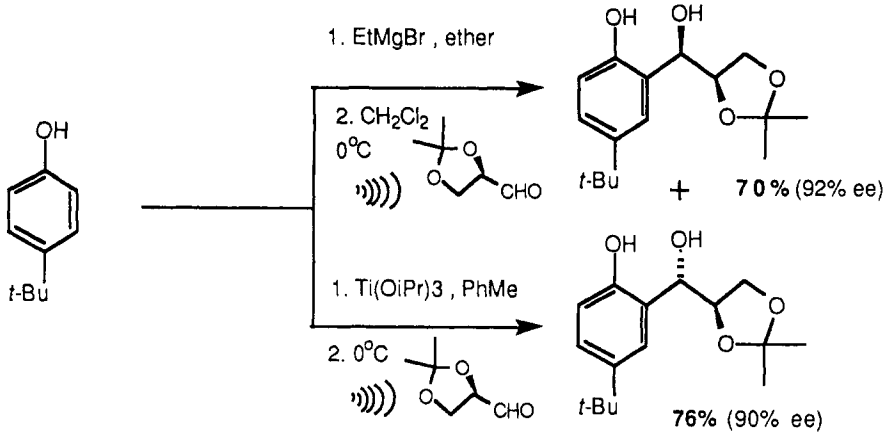
catalyst = 67% (61% ee , S)

Soai, K.; Niwa, S.; Watanabe, M. *J. Org. Chem.*, ***1988***, *53*, 927.

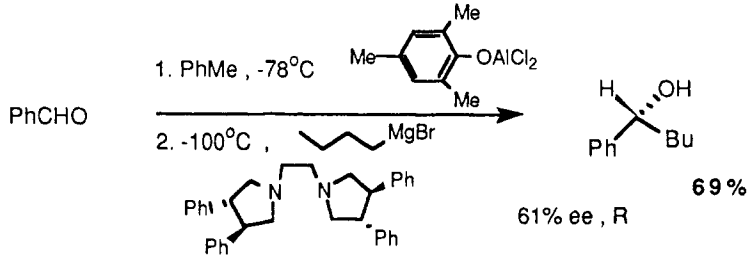
Soai, K.;; Ookawa, A.; Kaba, T.; Ogawa, K. *J. Am. Chem. Soc.*, ***1987***, *109*, 7111.



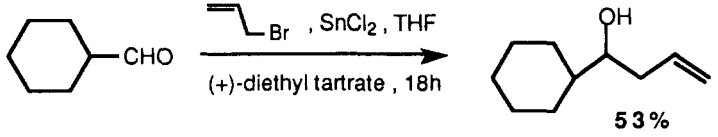
Minowa, N.; Mukaiyama, T. *Bull. Chem. Soc., Jpn.*, ***1987***, *60*, 6397.



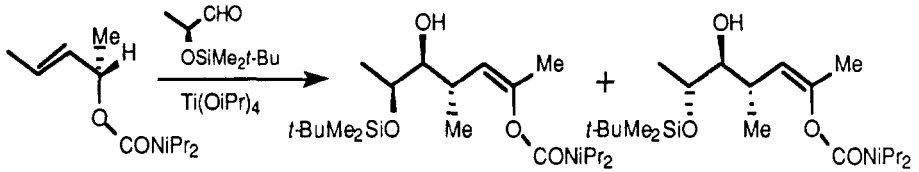
Casiraghi, G.; Cornia, M.; Casnati, G.; Fava, G.G.; Belicchi, M.F.; Zetta, L. *J. Chem. Soc., Chem. Commun.*, ***1987***, 794.



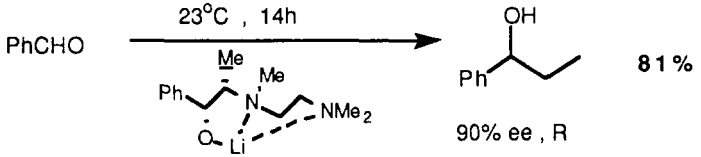
Tomioka, K.; Nakajima, M.; Koga, K. *Tetrahedron Lett.*, ***1987***, *28*, 1291.



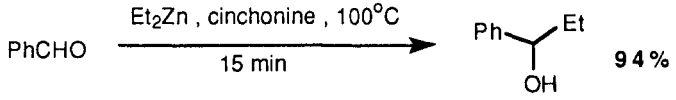
Boldrini, G.P.; Lodi, L.; Tagliavini, E.; Tavasco, C.; Trombini, C.; Umani-Ronchi, A. *J. Org. Chem.*, ***1987***, *52*, 5447.



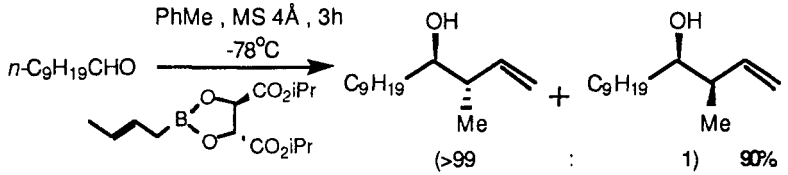
Krämer, T.; Hoppe, D. *Tetrahedron Lett.*, ***1987***, *28*, 5149.



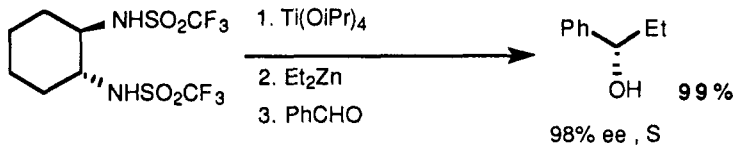
Corey, E.J.; Hannon, F.J. *Tetrahedron Lett.*, ***1987***, *28*, 5233.



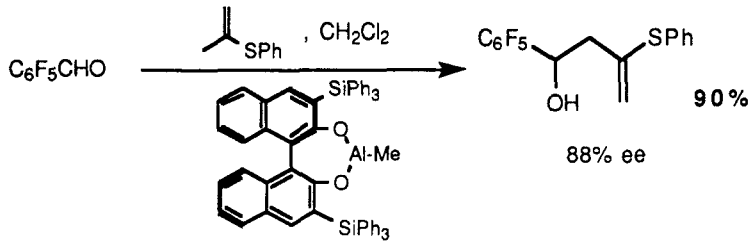
Muchow, G.; Vannoorenberghe, Y.; Buono, G. *Tetrahedron Lett.*, ***1987***, *28*, 6163.



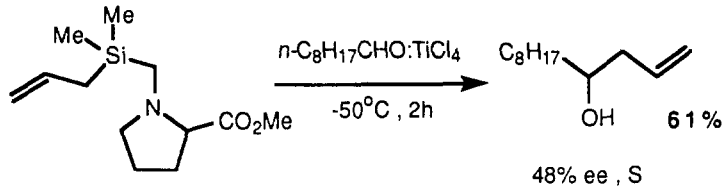
Roush, W.R.; Ando, K.; Powers,.D.B.; Halterman, R.L.; Palkowitz, A.D. *Tetrahedron Lett.*, ***1988***, *29*, 5579.



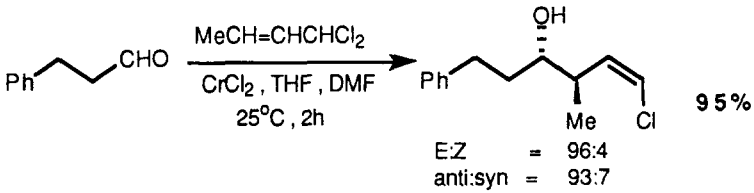
Yoshioka, M.; Kawakita, T.; Ohno, M. *Tetrahedron Lett.*, ***1989***, *30*, 1657.
Takahashi, H.; Kawakita, T.; Yoshioka, M.; Kobayashi, S.; Ohno, M. *Tetrahedron Lett.*, ***1989***, *30*, 7095.



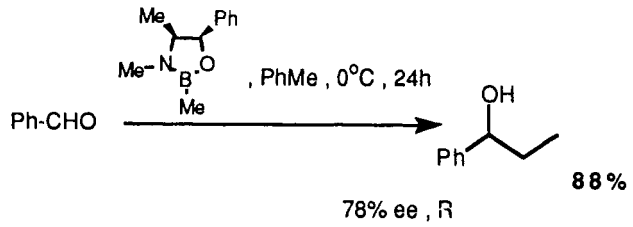
Maruoka, K.; Hoshino, Y.; Shirasaka, T.; Yamamoto, H. *Tetrahedron Lett.*, ***1989***, *30*, 3967.



Chan, T.H.; Wang, D. *Tetrahedron Lett.*, ***1989***, *30*, 3041.



Takai, K.; Kataoka, Y.; Utimoto, K. *Tetrahedron Lett.*, ***1989***, *30*, 4389.



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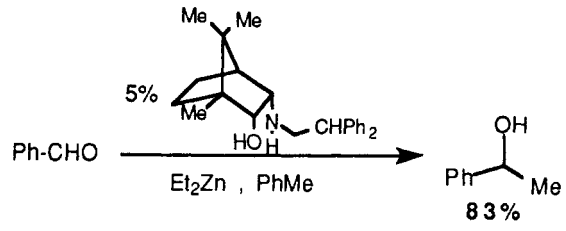

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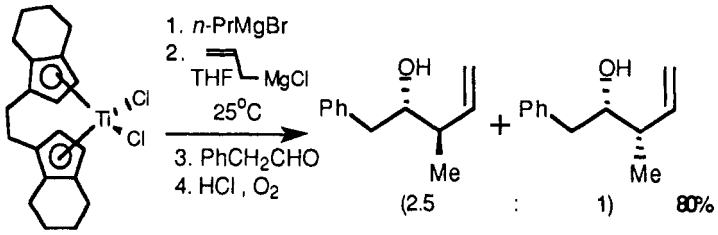
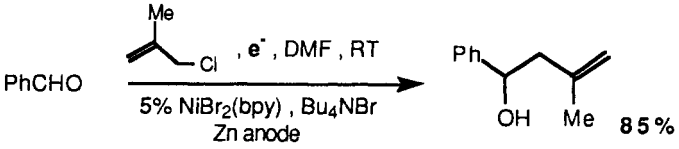


Collins, S.; Kuntz, B.A.; Hong, Y. *J. Org. Chem.*, ***1989***, *54*, 4154.



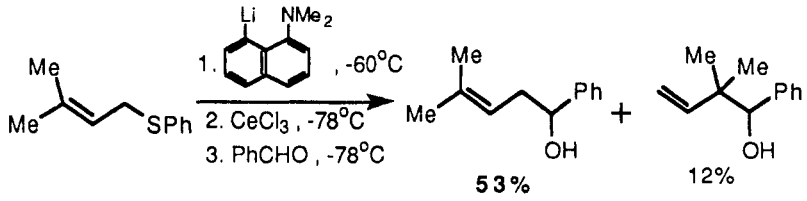
Durandetti, S.; Sibille, S.; Périchon, J. *J. Org. Chem.*, ***1989***, *54*, 2198.

REVIEW:

"Asymmetric Reductions with Organoborane Reagents"

Midland, M.M. *Chem. Rev.*, ***1989***, *89*, 1553.

NON-ASYMMETRIC ALKYLATIONS



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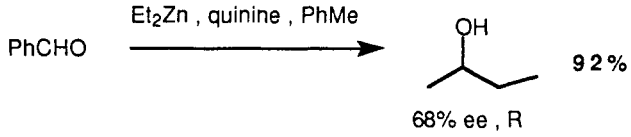

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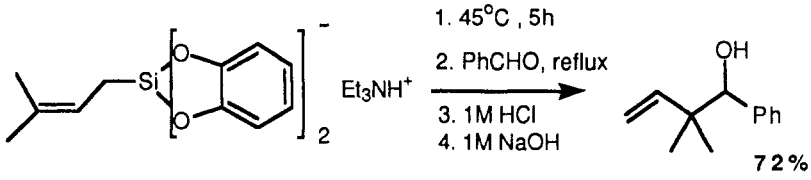

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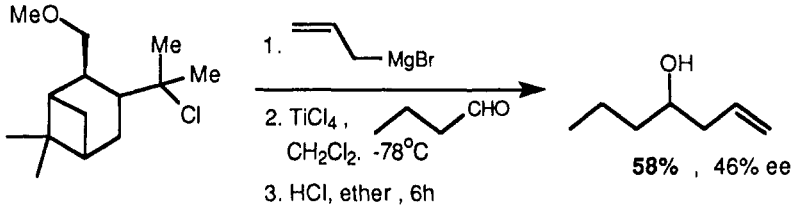
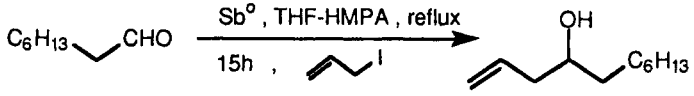


Coppi, L.; Mordini, A.; Taddei, M. *Tetrahedron Lett.*, ***1987***, *28*, 965.



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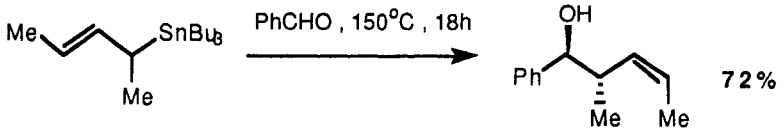

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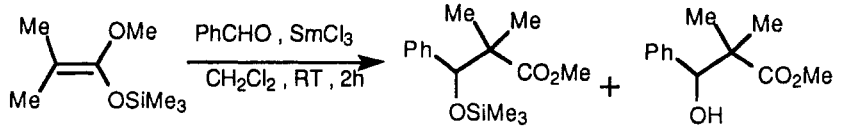

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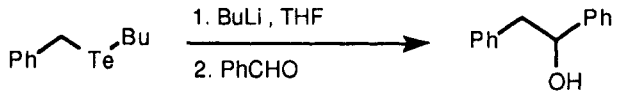
Vougioukas, A.E.; Kagan, H.B. *Tetrahedron Lett.*, ***1987***, *28*, 5513.



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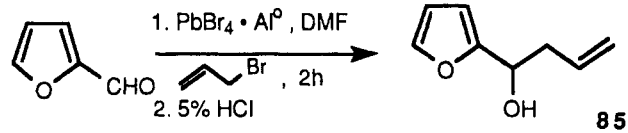

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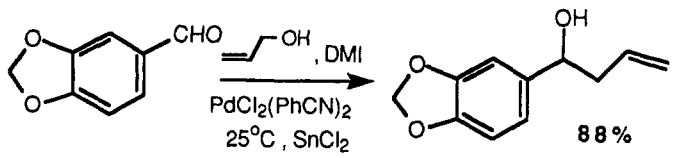
Tanaka, H.; Yamashita, S.; Hamatani, T.; Ikemoto, Y.; Torii, S. *Synth. Commun.*, ***1987***, *17*, 789.



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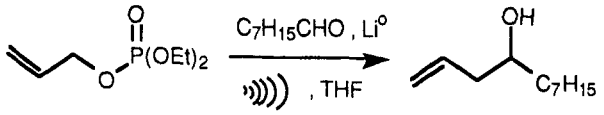

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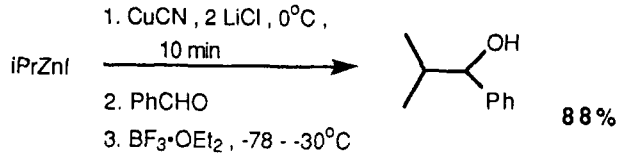
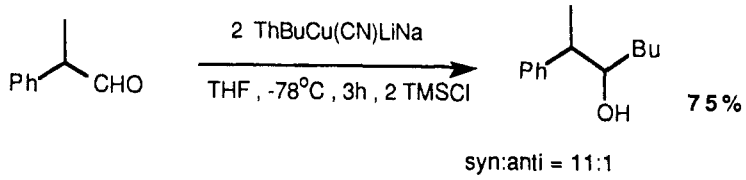


Yeh, M.C.P.; Knochel, P.; Santa, L.E. *Tetrahedron Lett.*, ***1988***, *29*, 3887.



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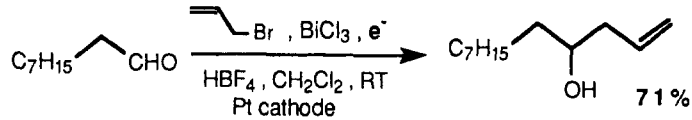

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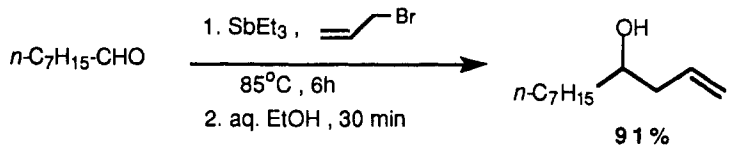

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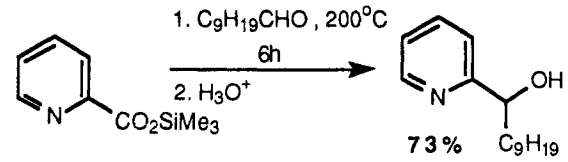
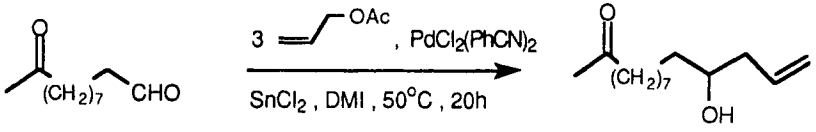


Effenberger, F.; König, J. *Tetrahedron*, ***1988***, *44*, 3281.



1,3-dimethylimidazolidin-2-one

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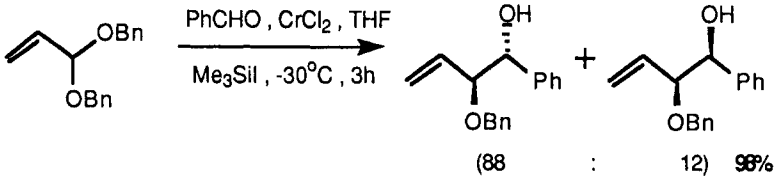

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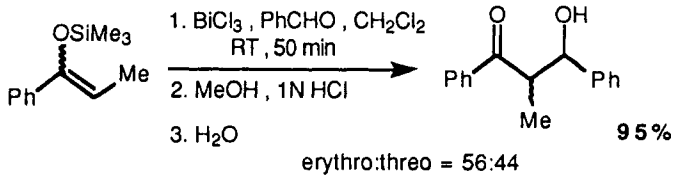

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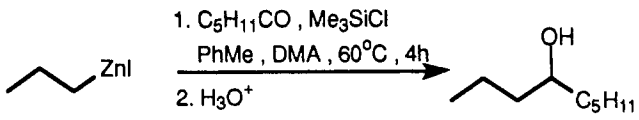

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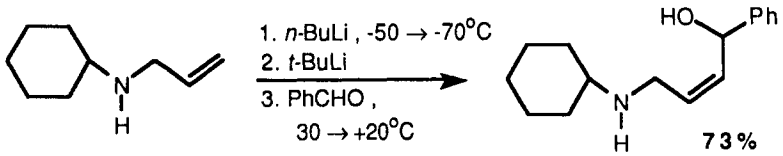

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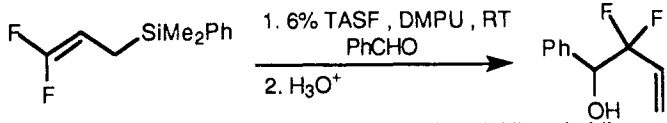
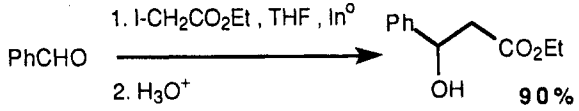


93%

DMPU = 1,3-dimethyl-3,4,5,6-tetrahydro-2(1H)-pyrimidinone

Fujita, M.; Obayashi, M.; Hiyama, T. *Tetrahedron*, ***1988***, *44*, 4135.



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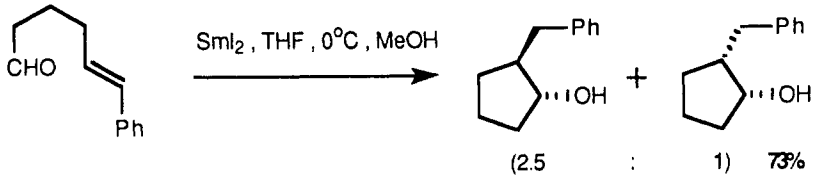

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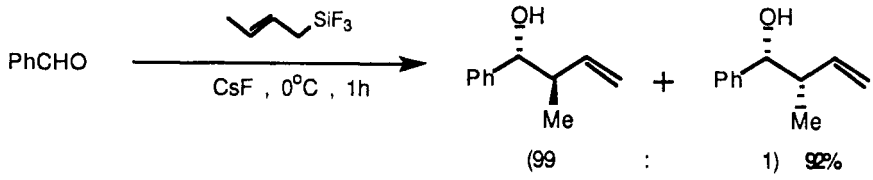
Enholm, E.J.; Trivellas, A. *Tetrahedron Lett.*, ***1989***, *30*, 1063.



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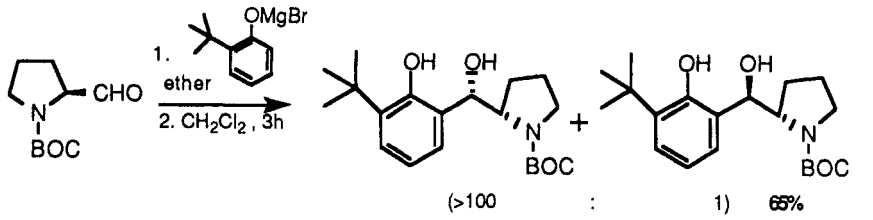

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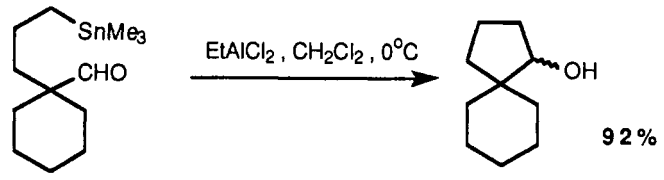

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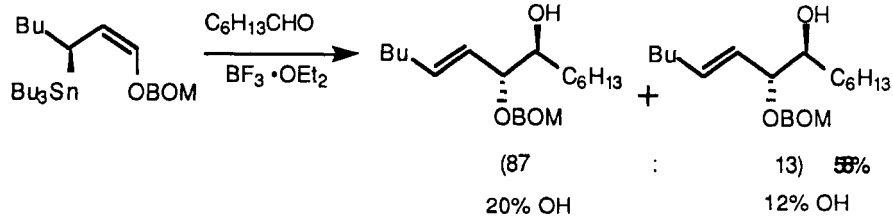

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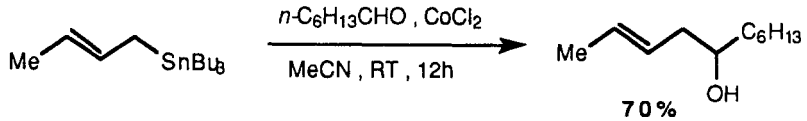

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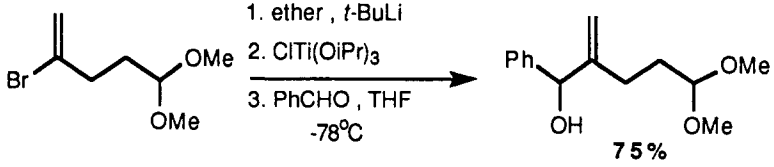

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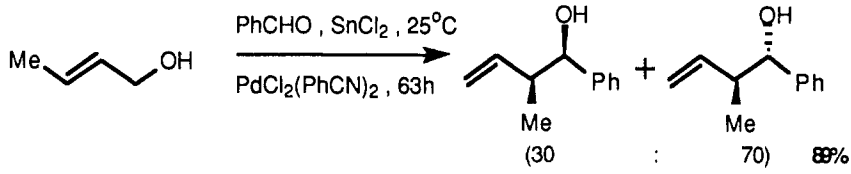

Masuyama, Y.; Takahara, J.P.; Kurusu, Y. *Tetrahedron Lett.*, ***1989***, *30*, 3437.
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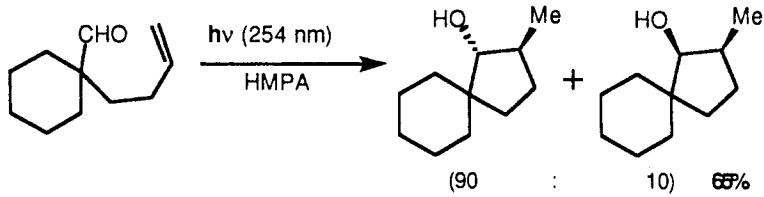

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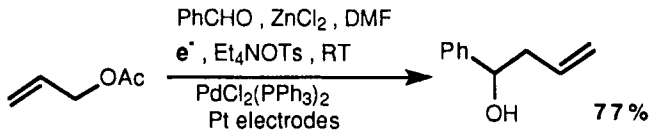
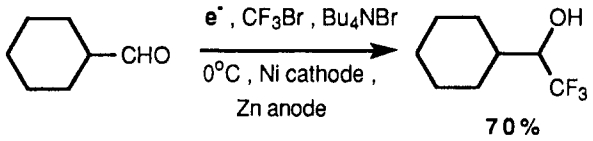


Qiu, W.; Wang, Z. *J. Chem. Soc., Chem. Commun.*, ***1989***, 356.



Sibille, S.; Mcharek, S.; Perichon, J. *Tetrahedron*, ***1989***, *45*, 1423.

REVIEWS:

"Organoaluminums in Organic Synthesis"

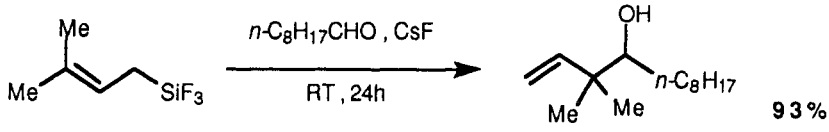
Maruoka, K.; Yamamoto, H. *Tetrahedron, **1988**, 44*, 5001.

"Acyclic Stereocontrol via Allylic Organometallic Compounds"

Yamamoto, Y. *Acc. Chem. Res., **1987**, 20*, 243.

SECTION 35: ALCOHOLS AND THIOLS FROM ALKYLS, METHYLENES AND ARYLS

No examples of the reaction $RR^1 \rightarrow ROH$ (R^1 = alkyl, aryl, etc.) occur in the literature. For reactions of the type $RH \rightarrow ROH$ (R = alkyl or aryl) see Section 41 (Alcohols and Phenols from Hydrides).



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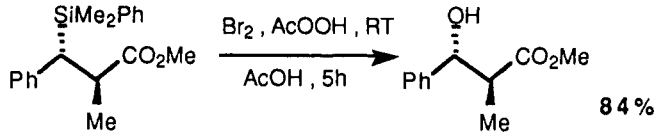

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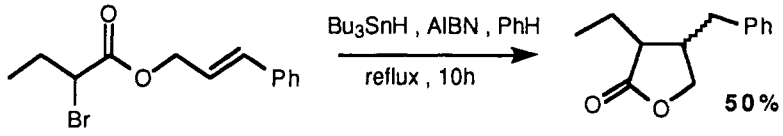

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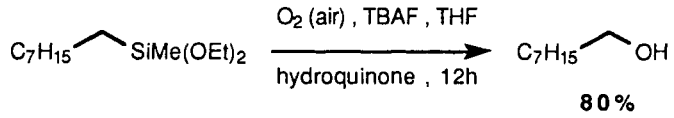

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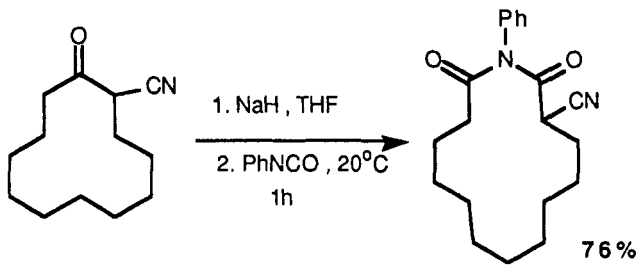
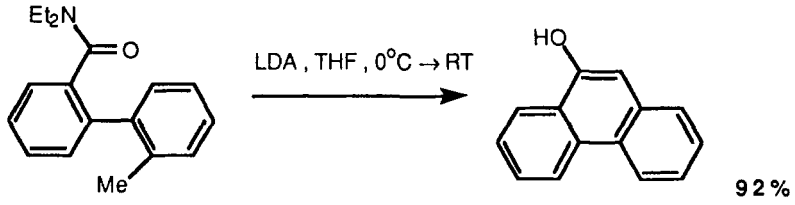


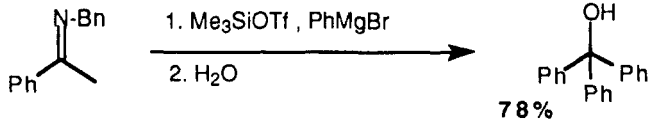
Lohray, B.B.; Enders, D. *Helv. Chim. Acta*, ***1989***, *72*, 980.

SECTION 36: ALCOHOLS AND THIOLS FROM AMIDES



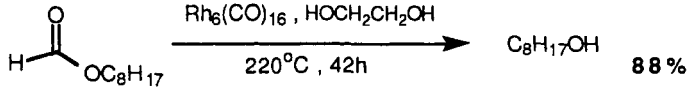
Fu, J.-M.; Sharp, M.J.; Snieckus, V. *Tetrahedron Lett.*, ***1988***, *29*, 5459.

SECTION 37: ALCOHOLS AND THIOLS FROM AMINES

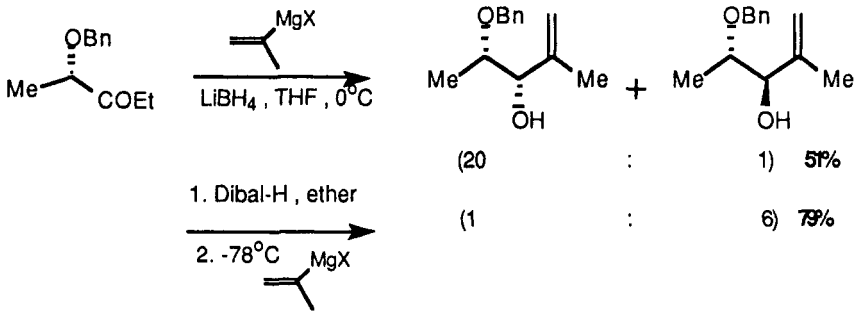


Brook, M.A.; Jahangir *Synth. Commun.*, ***1988***, *18*, 893.

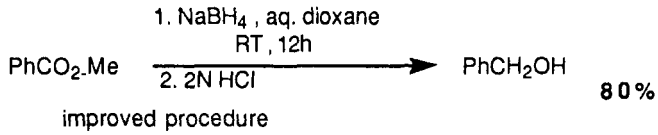
SECTION 38: ALCOHOLS AND THIOLS FROM ESTERS



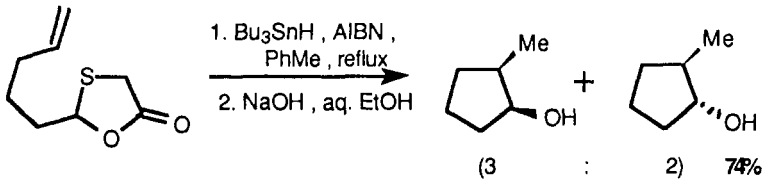
Zahalka, H.A.; Alper, H. *Tetrahedron Lett.*, ***1987***, *28*, 2215.



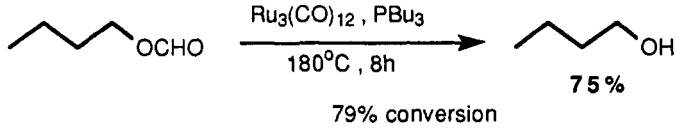
Burke, S.D.; Deaton, D.N.; Olsen, R.J.; Armistead, D.M.A.; Blough, B.E. *Tetrahedron Lett.*, ***1987***, *28*, 3905.



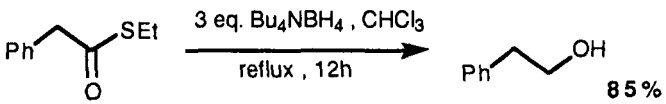
Bianco, A.; Passacantilli, P.; Righi, G. *Synth. Commun.*, ***1988***, *18*, 1765.



Yadav, V.; Fallis, A.G. *Tetrahedron Lett.*, ***1989***, *30*, 3283.

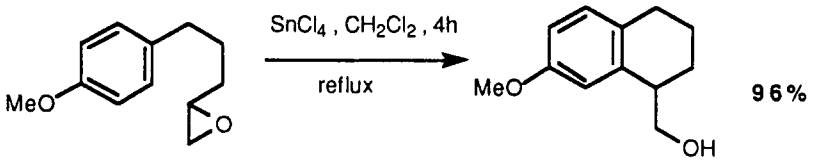


Jenner, G.; Nahmed, E.M.; Leismann, H. *Tetrahedron Lett.*, ***1989***, *30*, 6501.

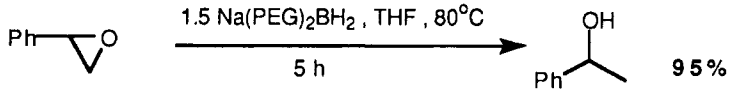


Liu, H.-J.; Luo, W. *Synth. Commun.*, ***1989***, *19*, 387.

SECTION 39: ALCOHOLS AND THIOLS FROM ETHERS, EPOXIDES AND THIOETHERS

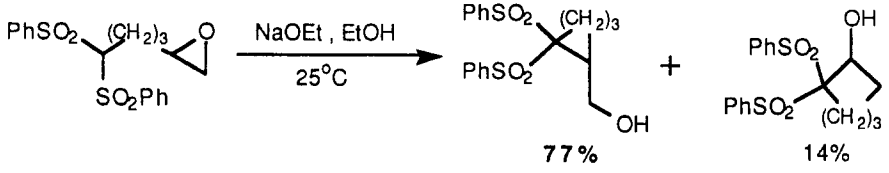


Taylor, S.K.; Davisson, M.E.; Hissom Jr., B.R.; Brown, S.L.; Pristach, H.A.; Schramm, S.B.; Harvey, S.M. *J. Org. Chem.*, ***1987***, *52*, 425.

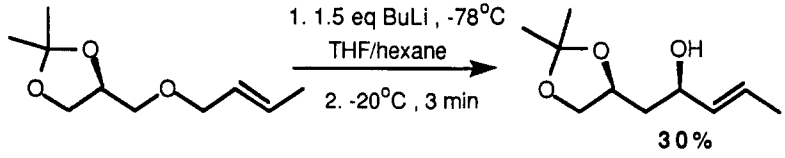


PEG 400 = polyethylene glycol

Santaniello, E.; Ferraboschi, P.; Fiecchi, A.; Grisenti, P.; Manzocchi, A. *J. Org. Chem.*, ***1987***, *52*, 671.

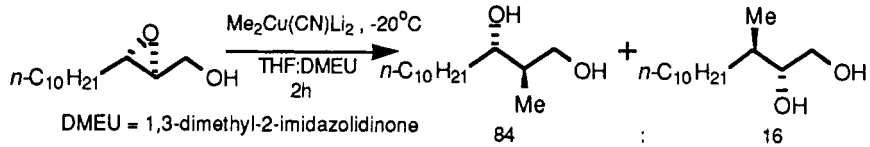


Benedetti, F.; Fabrissin, S.; Gianferrara, T.; Risaliti, A. *J. Chem. Soc., Chem. Commun.*, ***1987***, 406.



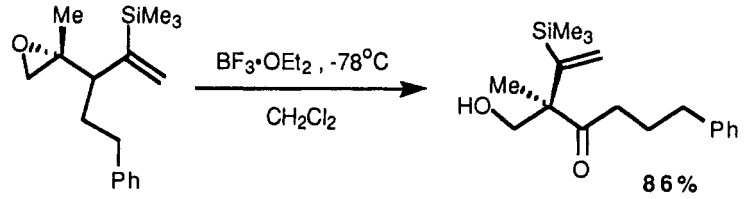
syn:anti = 10:1

Schreiber, S.L.; Goulet, M.T. *Tetrahedron Lett.*, ***1987***, *28*, 1043.

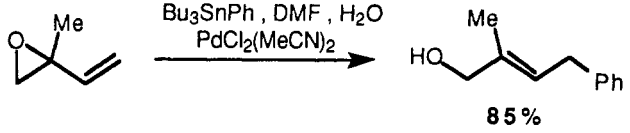


DMEU = 1,3-dimethyl-2-imidazolidinone

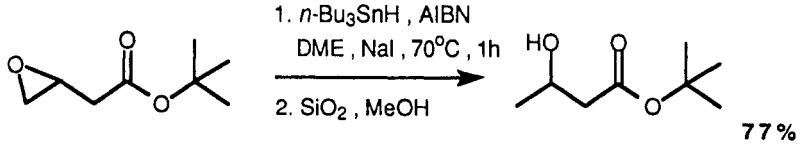
Chong, J.M.; Cyr, D.R.; Mar, E.K. *Tetrahedron Lett.*, ***1987***, *28*, 5009.



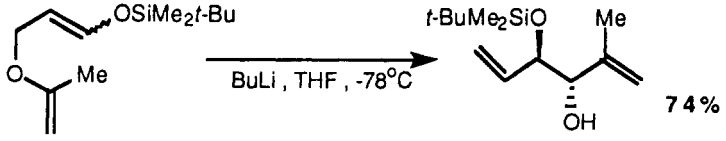
Shimazaki, M.; Hara, H.; Suzuki, K.; Tsuchihashi, G. *Tetrahedron Lett.*, ***1987***, *28*, 5891.



Echavarren, A.M.; Tueting, D.R.; Stille, J.K. *J. Am. Chem. Soc.*, ***1988***, *110*, 4039.



Bonini, C.; DiFabio, R. *Tetrahedron Lett.*, ***1988***, *29*, 819.



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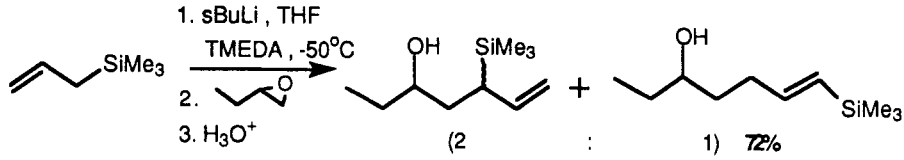
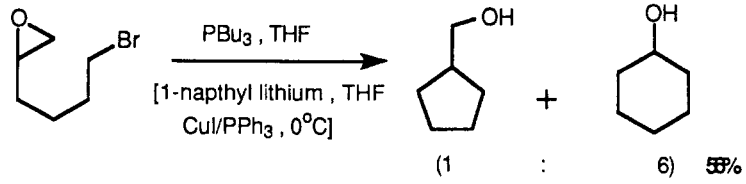
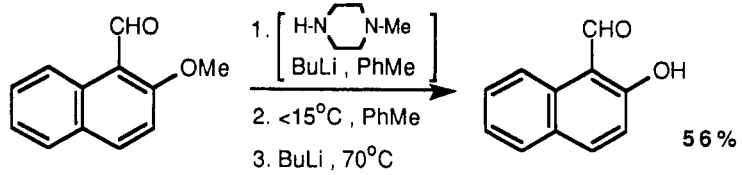
Nakai, E.; Nakai, T. *Tetrahedron Lett.*, ***1988***, *29*, 5409.



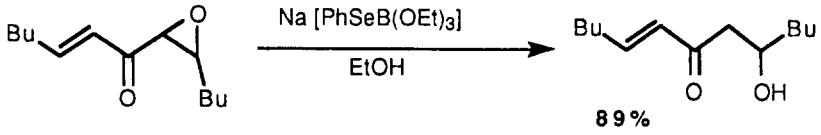
Schaumann, E.; Kirschning, A. *Tetrahedron Lett.*, ***1988***, *29*, 4281.



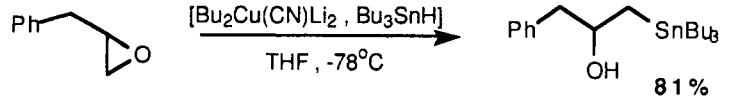
Wu, T.-C.; Rieke, R.D. *Tetrahedron Lett.*, ***1988***, *29*, 6753.



Gilles, B.; Loft, M.S. *Synth. Commun.*, ***1988***, *18*, 191.



Miyashita, M.; Suzuki, T.; Yoshikoshi, A. *Tetrahedron Lett.*, ***1989***, *30*, 1819.
Miyashita, M.; Hoshino, M.; Suzuki, T.; Yoshikoshi, A. *Chem. Lett.*, ***1988***, 507.



Lipshutz, B.H.; Ellsworth, E.L.; Dimock, S.H.; Reuter, D.C. *Tetrahedron Lett.*, ***1989***, *30*, 2065.

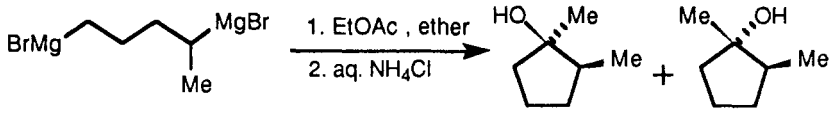
REVIEW:

"S_N2' Additions of Organocopper Reagents to Vinyloxiranes"

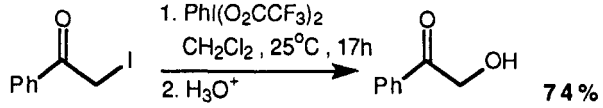
Marshall, J.A. *Chem. Rev.*, ***1989***, *89*, 1503.

Additional examples of ether cleavages may be found in Section 45A (Protection of Alcohols and Thiols).

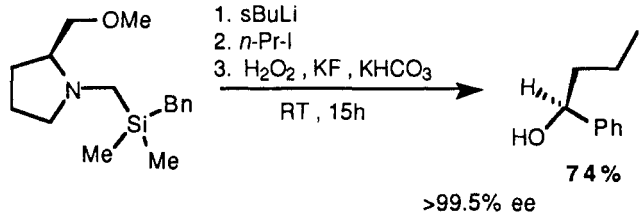
SECTION 40: ALCOHOLS AND THIOLS FROM HALIDES AND SULFONATES



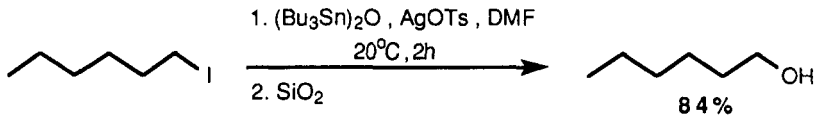
Canonne, P.; Bernatchez, M. *J. Org. Chem.*, ***1987***, *52*, 4025.



Boyer, J.H.; Natesh, A. *Synthesis*, ***1988***, 980.

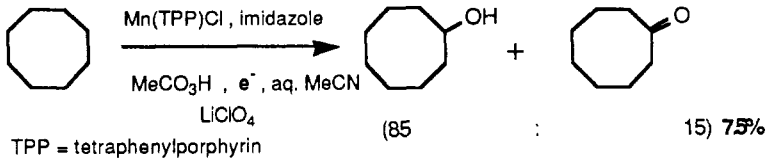


Chan, T.H.; Pellon, P. *J. Am. Chem. Soc.*, ***1989***, *111*, 8737.

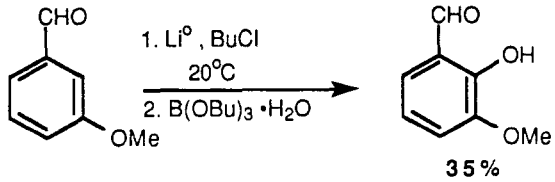


Gingras, M.; Chan, T.H. *Tetrahedron Lett.*, ***1989***, *30*, 279.

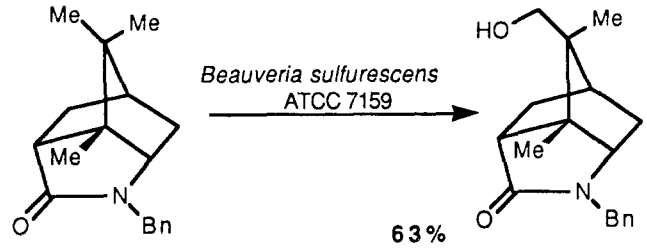
SECTION 41: ALCOHOLS AND THIOLS FROM HYDRIDES



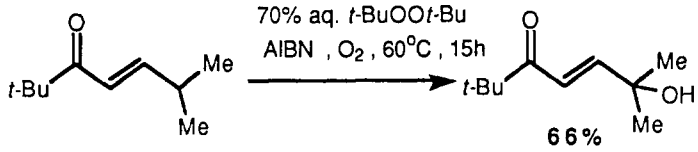
Leduc, P.; Battioni, P.; Bartoli, J.F.; Mansuy, D. *Tetrahedron Lett.*, ***1988***, *29*, 205.



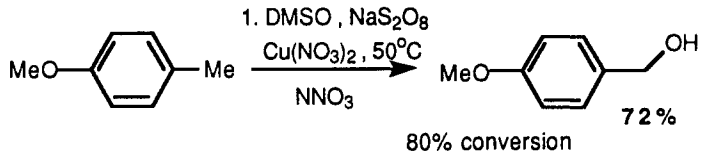
Einhorn, J.; Luche, J.-L.; Demerseman, P. *J. Chem. Soc., Chem. Commun.*, ***1988***, 1350.



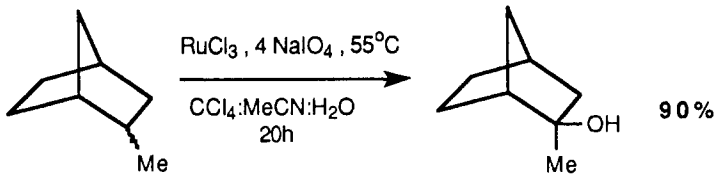
Archelas, A.; Fourneron, J.-D.; Furstoss, R. *J. Org. Chem.*, ***1988***, *53*, 1797.



Sabol, M.R.; Wiglesworth, C.; Watt, D.S. *Synth. Commun.*, ***1988***, *18*, 1.



Cort, A.D.; Mandolini, L.; Panaioli, S. *Synth. Commun.*, ***1988***, *18*, 613.



Tenaglia, A.; Terranova, E.; Waegell, B. *Tetrahedron Lett.*, ***1989***, *30*, 5271, 5275.

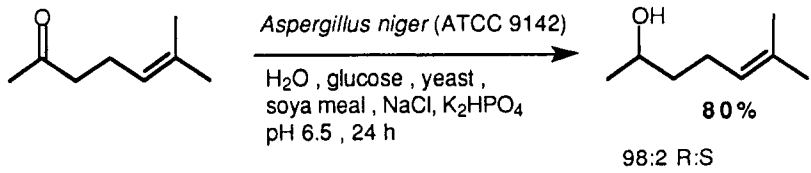
SECTION 42: ALCOHOLS AND THIOLS FROM KETONES

The following reaction types are included in this section:
A. Reductions of Ketones to Alcohols
B. Alkylations of Ketones, forming Alcohols

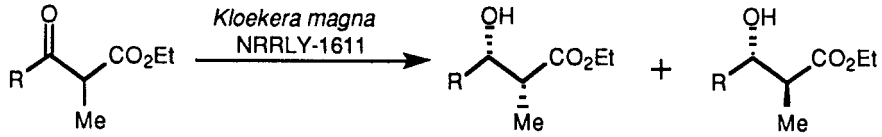
Coupling of ketones to give diols is found in Section 323 (Alcohol → Alcohol).

SECTION 42A: REDUCTION OF KETONES TO ALCOHOLS

ASYMMETRIC REDUCTION

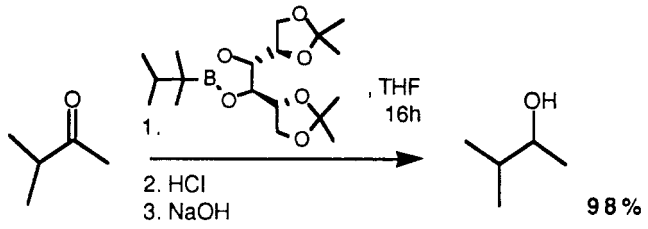


Belan, A.; Bolte, J.; Fauve, A.; Gourcy, J.G.; Veschambre, H. *J. Org. Chem.*, ***1987***, *52*, 256.



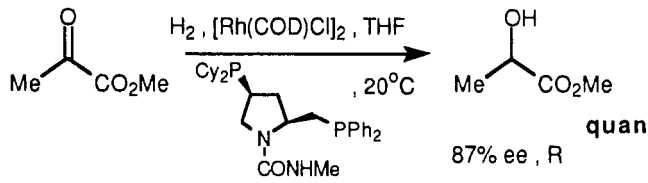
R = Me	50 >95%ee	:	50 >95%ee
R = Et	5 >95%ee	:	95 90%ee

Buisson, D.; Sanner, C.; Larcheveque, M.; Azerad, R. *Tetrahedron Lett.*, ***1987***, *28*, 3939.



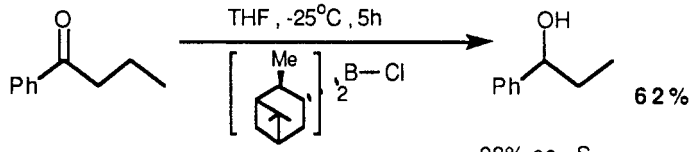
44% ee , R

Brown, H.C.; Cho, B.T.; Park, W.S. *J. Org. Chem.*, ***1987***, *52*, 4020.



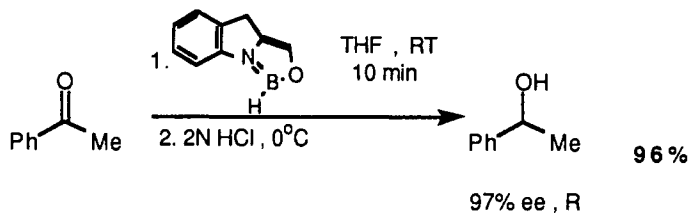
87% ee , R

Takahashi, H.; Morimoto, T.; Achiwa, K. *Chem. Lett.*, ***1987***, 855.

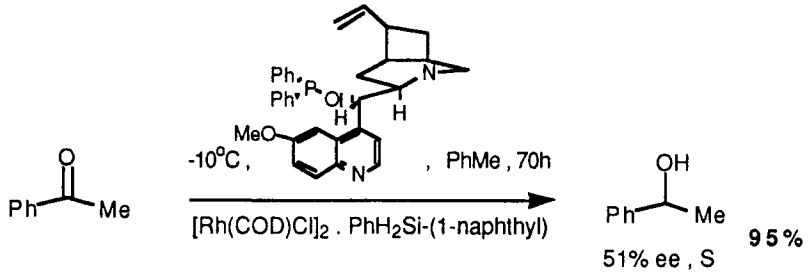


98% ee , S

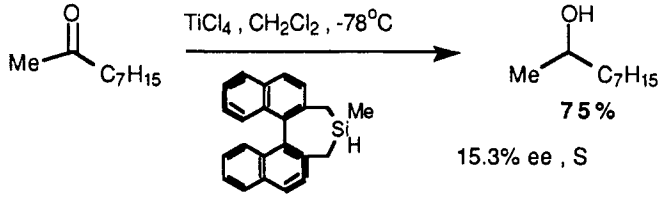
Brown, H.C.; Chandrasekharan, J.; Ramachandran, P.V. *J. Am. Chem. Soc.*, ***1988***, *110*, 1539.



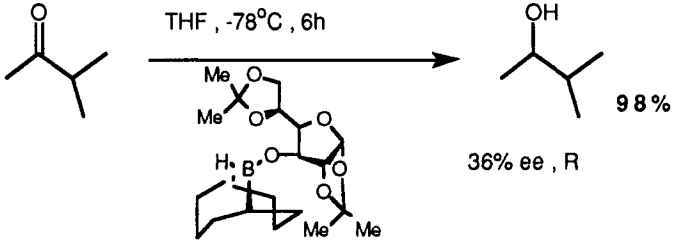
Youn, I.K.; Lee, S.W.; Pak, C.S. *Tetrahedron Lett.*, ***1988***, *29*, 4453.



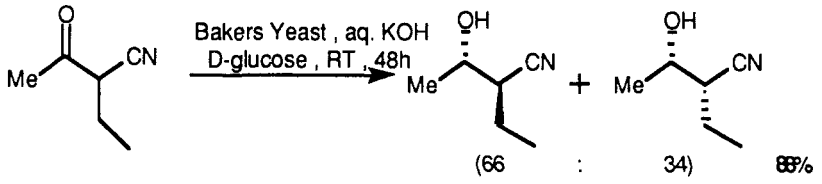
Vannoorenberghe, Y.; Buono, G. *Tetrahedron Lett.*, ***1988***, *29*, 3235.



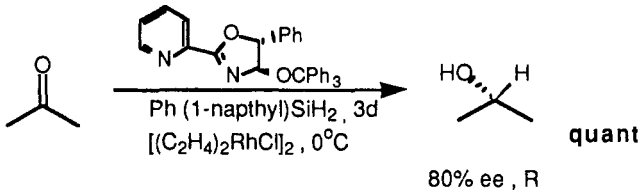
Jung, M.E.; Hogan, K.T. *Tetrahedron Lett.*, ***1988***, *29*, 6199.



Brown, H.C.; Cho, B.T.; Park, W.S. *J. Org. Chem.*, ***1988***, *53*, 1231.



Itoh, T.; Takagi, Y.; Fujisawa, T. *Tetrahedron Lett.*, ***1989***, *30*, 3811.



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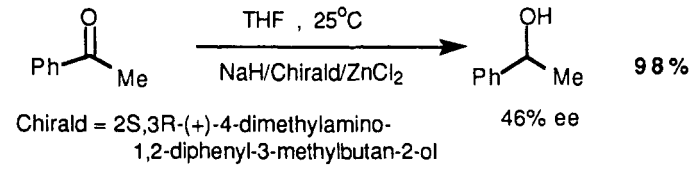

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REVIEW:

"Asymmetric Reductions with Organoborane Reagents"

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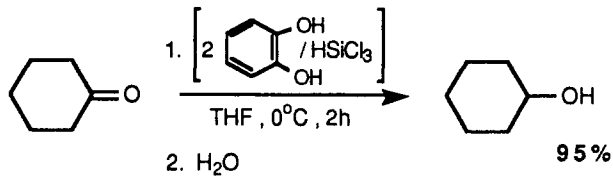
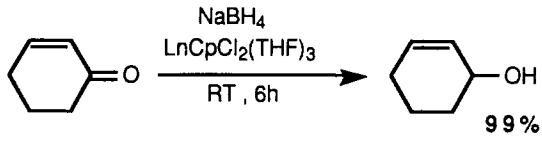
NON-ASYMMETRIC REDUCTION



Kira, M.; Sato, K.; Sakurai, H. *J. Org. Chem.*, ***1987***, *52*, 948.



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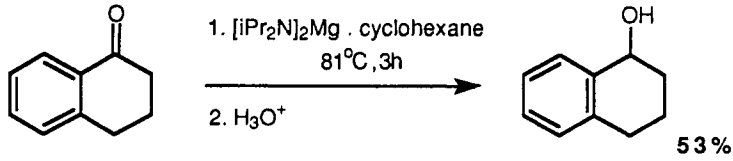
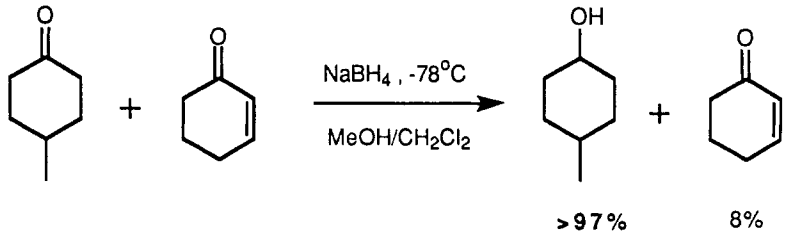
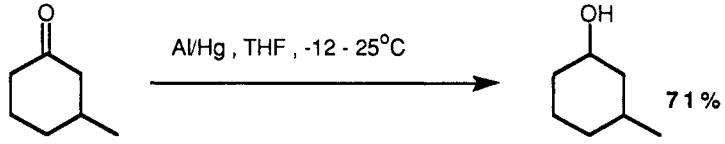


also obtained 47% of condensation products

Sanchez, R.; Scott, W. *Tetrahedron Lett.*, ***1988***, *29*, 139.

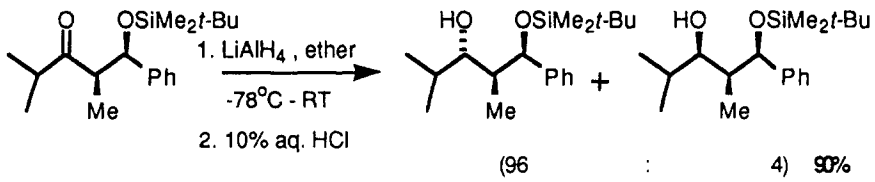


Ward, D.E.; Rhee, C.K.; Zoghaib, W.M. *Tetrahedron Lett.*, ***1988***, *29*, 517.

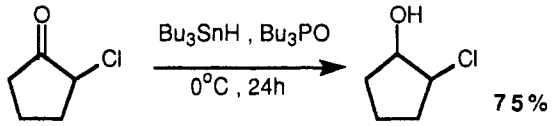


aliphatic ketones give no reaction; reduces only cyclic ketones

Hulce, M.; LaVaute, T. *Tetrahedron Lett.*, ***1988***, *29*, 525.

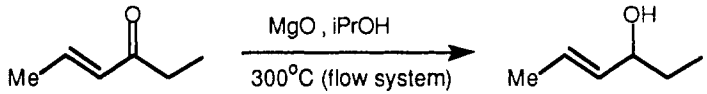


Bloch, R.; Gilbert, L.; Virard, C. *Tetrahedron Lett.*, ***1988***, *29*, 1021.

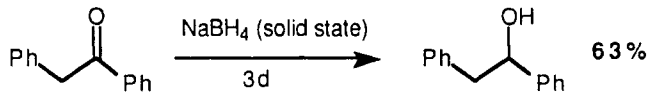


erythro:threo = 54:46

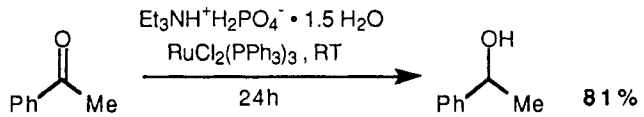
Shibata, I.; Suzuki, T.; Baba, A.; Matsuda, H. *J. Chem. Soc., Chem. Commun.*, ***1988***, 882.



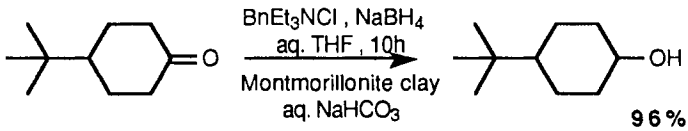
Kaspar, J.; Trovarelli, A.; Lenarda, M.; Graziani, M. *Tetrahedron Lett.*, ***1989***, *30*, 2705.



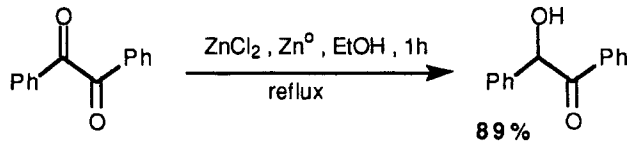
Toda, F.; Kiyoshige, K.; Yagi, M. *Angew. Chem. Int. Ed., Engl.*, ***1989***, *28*, 320.



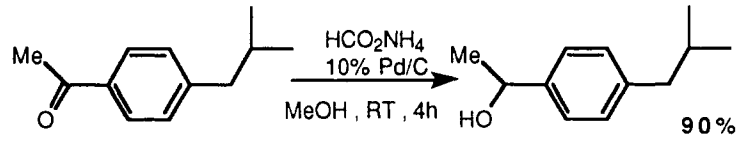
Khai, B.T.; Arcelli, A. *J. Org. Chem.*, ***1989***, *54*, 949.



Sarkar, A.; Rao, B.R.; Konar, M.M. *Synth. Commun.*, ***1989***, *19*, 2313.



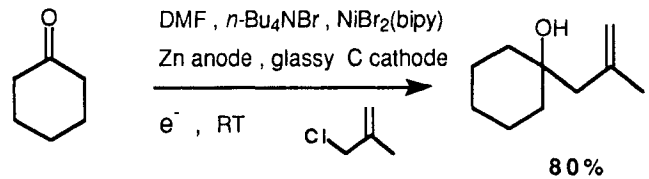
Toda, F.; Tanaka, K.; Tange, H. *J. Chem. Soc., Perkin Trans. I,* ***1989***, 1555.



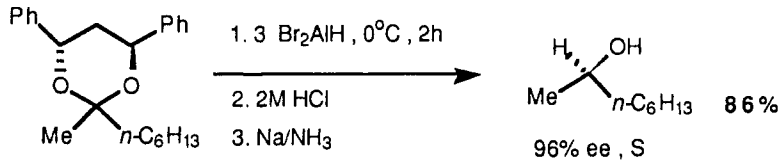
Radhakrishna, A.S.; Prasad Rao, K.R.K.; Nigam, S.C.; Bakthavatchalam, R.; Singh, B.B. *Org. Prep. Proceed. Int.,* ***1989, 21***, 373.

SECTION 42B: ALKYLATION OF KETONES, FORMING ALCOHOLS

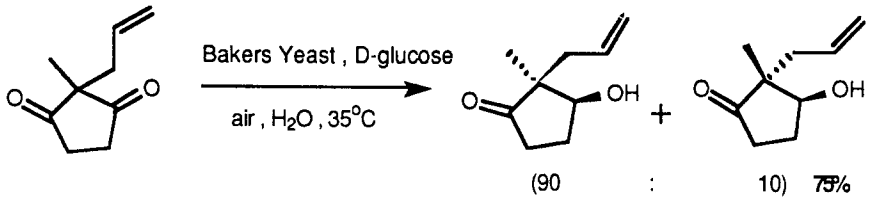
Aldol reactions are listed in Section 330 (Ketone-Alcohol)



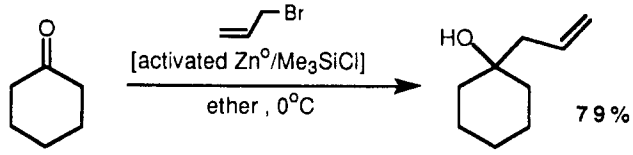
Sibille, S.; d'Incon, E.; Leport, L.; Massebiau, M.-C.; Perichon, J. *Tetrahedron Lett.,* ***1987***, *28*, 55.



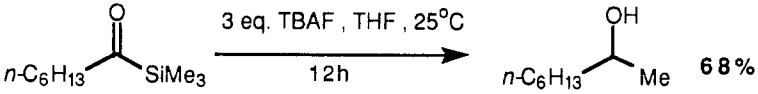
Yamamoto, K.; Ando, H.; Chikamatsu, H. *J. Chem. Soc., Chem. Commun.,* ***1987***, 334.



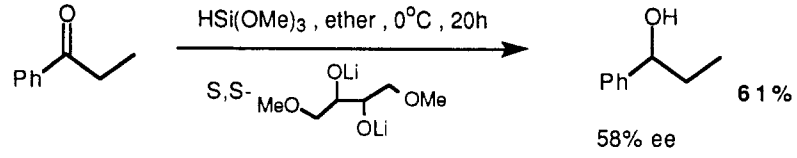
Brooks, D.W.; Mazdiyasni, H.; Grothaus, P.G. *J. Org. Chem.*, ***1987***, *52*, 3233.



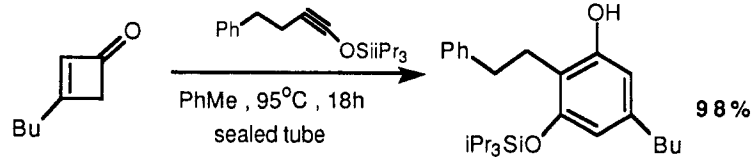
Picotin, G.; Miginiac, Ph. *Tetrahedron Lett.*, ***1987***, *28*, 4551.



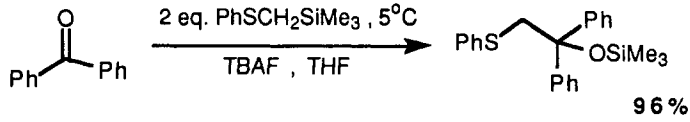
Bulman Page, P.C.; Rosenthal, S.; Williams, R.V. *Tetrahedron Lett.*, ***1987***, *28*, 4455.



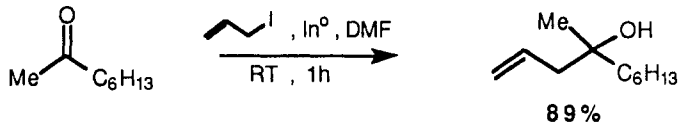
Kohra, S.; Hayashida, H.; Tominaga, Y.; Hosomi, A. *Tetrahedron Lett.*, ***1988***, *29*, 89.



Danheiser, R.L.; Nishida, A.; Savariar, S.; Trova, M.P. *Tetrahedron Lett.*, ***1988***, *29*, 4917.

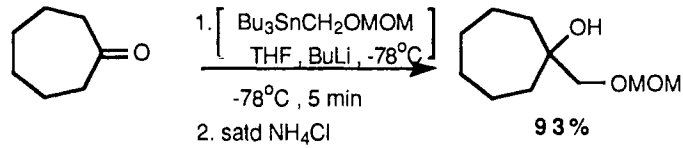


Kitteringham, J.; Michell, M.B. *Tetrahedron Lett.*, ***1988***, *29*, 3319.

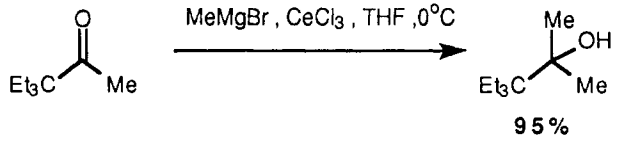


Araki, S.; Ito, H.; Butsugan, Y. *J. Org. Chem.*, ***1988***, *53*, 1831.

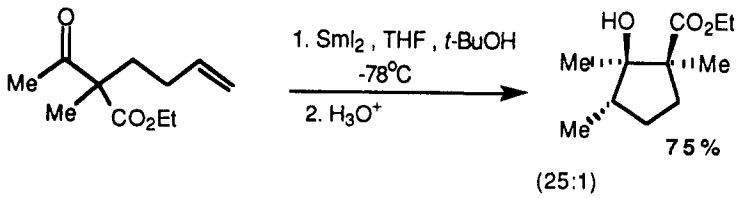
Sasaki, M.; Collin, J.; Kagan, H.B. *Tetrahedron Lett.*, ***1988***, *29*, 4847.



Johnson, C.R.; Medich, J.R. *J. Org. Chem.*, ***1988***, *53*, 4131.



Imamoto, T.; Takiyama, N.; Nakamura, K.; Hatajima, T.; Kamiya, Y. *J. Am. Chem. Soc.*, ***1989***, *111*, 4392.



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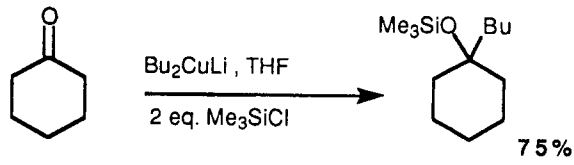
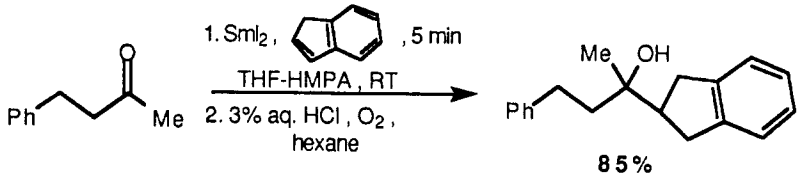
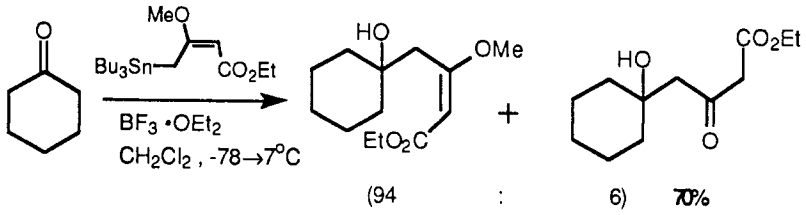
Molander, G.A.; Kenny, C. *Tetrahedron Lett.*, ***1987***, *28*, 4367.



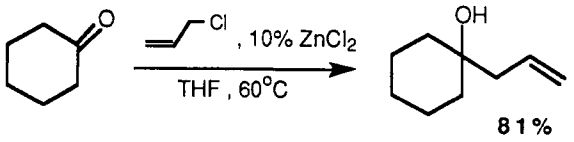
Matsuzawa, S.; Isaka, M.; Makamura, E.; Kuwajima, I. *Tetrahedron Lett.*, ***1989***, *30*, 1975.



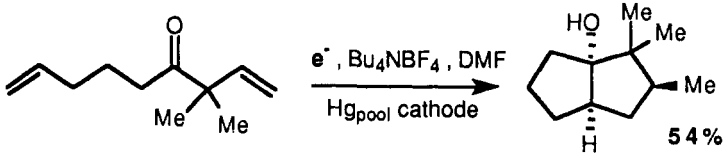
Ujikawa, O.; Inanage, J.; Yamaguchi, M. *Tetrahedron Lett.*, ***1989***, *30*, 2837.



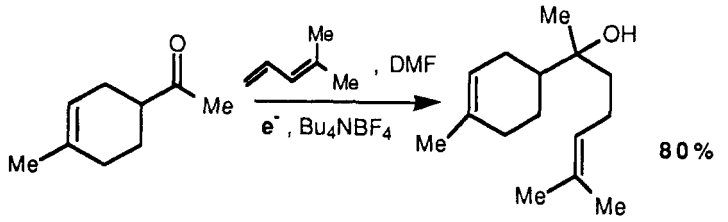
Fan, R.; Hudlicky, T. *Tetrahedron Lett.*, ***1989***, *30*, 5533.



Cahiez, G.; Chavant, P.-Y. *Tetrahedron Lett.*, ***1989***, *30*, 7373.



Kariv-Miller, E.; Maeda, H.; Lombardo, F. *J. Org. Chem.*, ***1989***, *54*, 4022.



Shono, T.; Kashimura, S.; Mori, Y.; Hayashi, T.; Soejima, T.; Yanaguchi,.Y. *J. Org. Chem.*, ***1989***, *54*, 6001.

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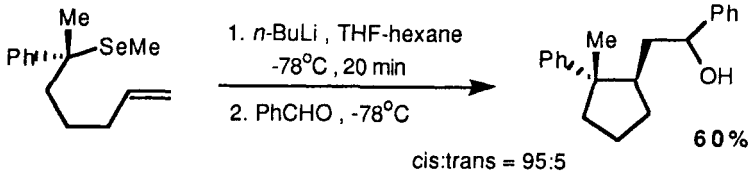
"Use of Activation Methods for Organo-Zinc Reagents"

Erdik, E. *Tetrahedron*, ***1987***, *43*, 2203.

SECTION 43: ALCOHOLS AND THIOLS FROM NITRILES

NO ADDITIONAL EXAMPLES

SECTION 44: ALCOHOLS AND THIOLS FROM ALKENES



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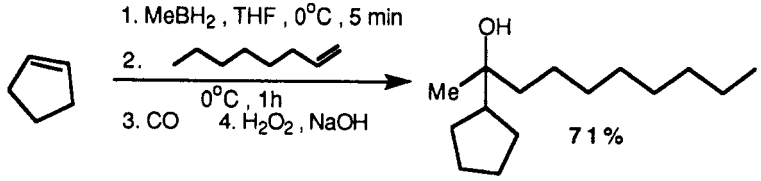
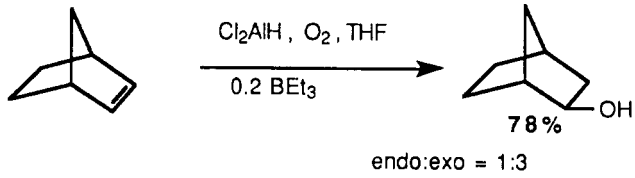
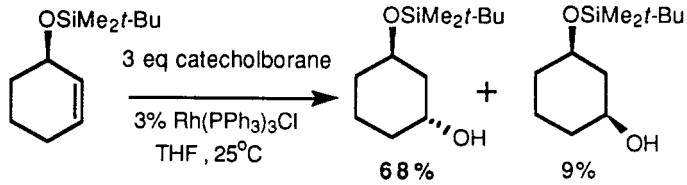


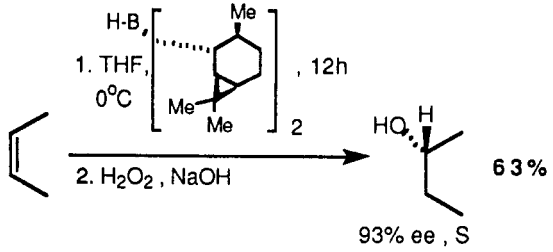
Srebnik, M.; Cole, T.E.; Brown, H.C. *Tetrahedron Lett.*, ***1987***, *28*, 3771.



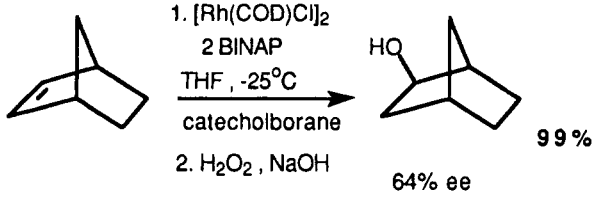
Maruoka, K.; Sano, H.; Shinoda, K.; Yamamoto, H. *Chem. Lett.*, ***1987***, 73.



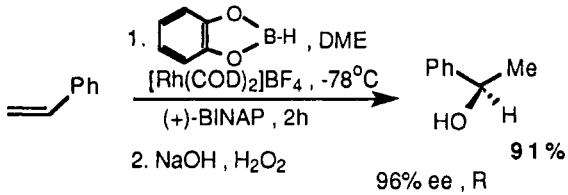
Evans, D.A.; Fu, G.C.; Hoveyda, A.H. *J. Am. Chem. Soc.*, ***1988***, *110*, 6917.



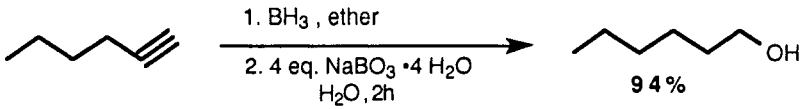
Brown, H.C.; Vara Prasad, J.V.N.; Zaidlewicz, M. *J. Org. Chem.*, ***1988***, *53*, 2911.



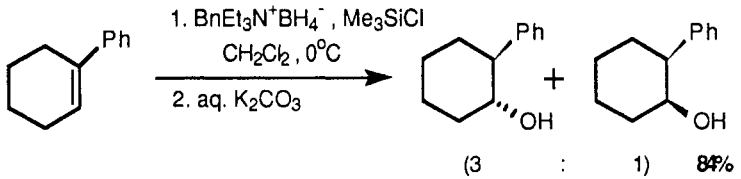
Burgess, K.; Ohlmeyer, M.J. *J. Org. Chem.*, ***1988***, *53*, 5178.



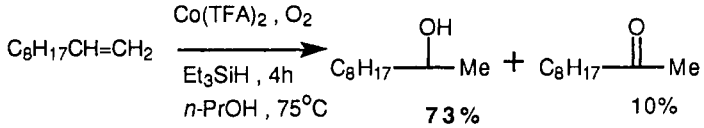
Hayashi, T.; Matsumoto, Y.; Ito, Y. *J. Am. Chem. Soc.*, ***1989***, *111*, 3426.



Kabalka, G.W.; Shoup, T.M.; Goudgaon, N.M. *Tetrahedron Lett.*, ***1989***, *30*, 1483.

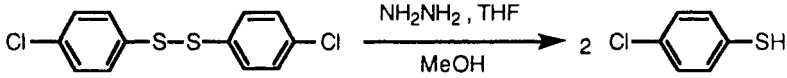


Baskaran, S.; Gupta, V.; Chidambaram, N.; Chandrasekaran, S. *J. Chem. Soc., Chem. Commun.*, ***1989***, 903.



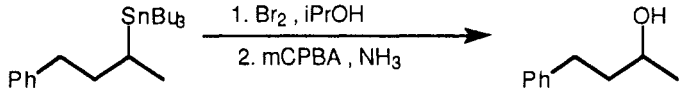
Isayama, S.; Mukaiyama, T. *Chem. Lett.*, ***1989***, 569.

SECTION 45: ALCOHOLS AND THIOLS FROM MISCELLANEOUSCOMPOUNDS



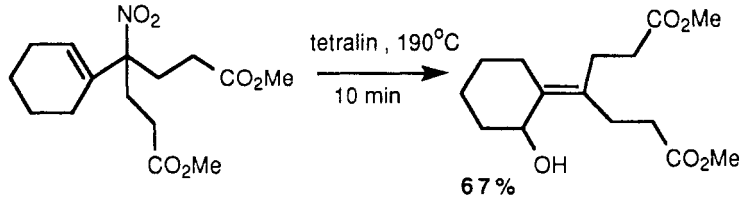
89 %

Maiti, S.N.; Spevak, P.; Singh, M.P.; Micetich, R.G.; Reddy, A.V.N. *Synth. Commun.*, ***1988***, *18*, 575.



86 %

Herndon, J.W.; Wu, C. *Tetrahedron Lett.*, ***1989***, *30*, 6461.



67 %

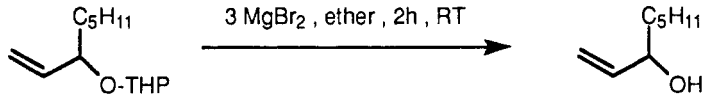
Boivin, J.; El Kaim, L.; Kervagoret, J.; Zard, S.Z. *J. Chem. Soc., Chem. Commun.*, ***1989***, 1006.

REVIEW:

"Boronic Esters in Stereodirected Synthesis"

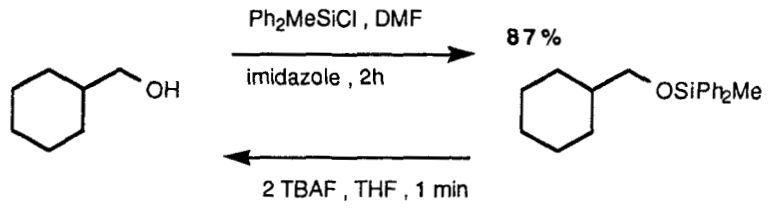
Matteson, D.S. *Tetrahedron*, ***1989***, *45*, 1859.

SECTION 45A: PROTECTION OF ALCOHOLS AND THIOLS

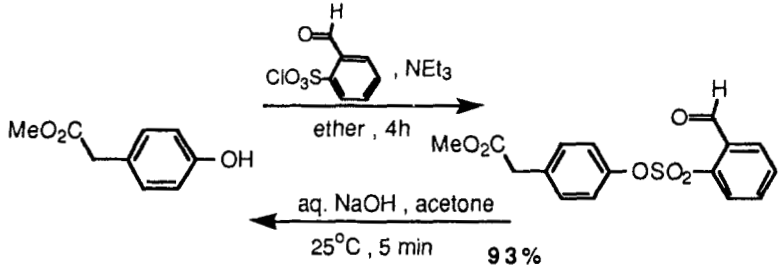


72 %

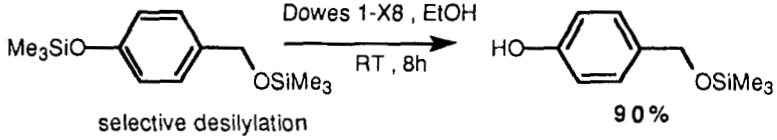
Kim, S.; Park, J.H. *Tetrahedron Lett.*, ***1987***, *28*, 439.



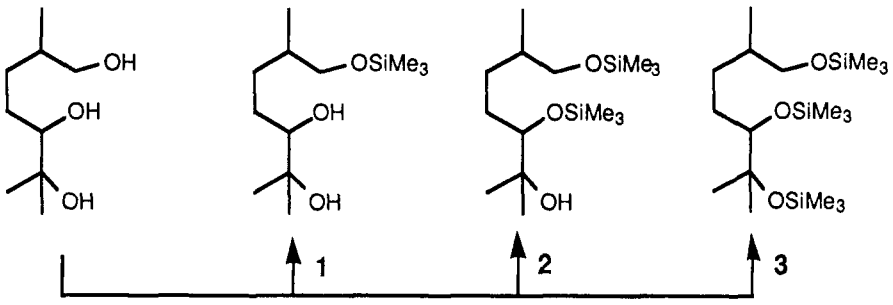
Denmark, S.E.; Hammer, R.P.; Weber, E.J.; Habermas, K.L. *J. Org. Chem.*, ***1987***, *52*, 165.



Shashidhar, M.S.; Bhatt, M.V. *J. Chem. Soc., Chem. Commun.*, ***1987***, 654.

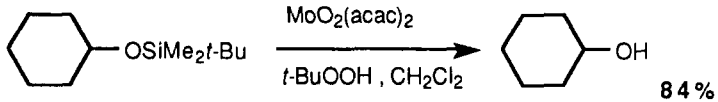


Kawazoe, Y.; Nomura, M.; Kondo, Y.; Kohda, K *Tetrahedron Lett.*, ***1987***, *28*, 4307.

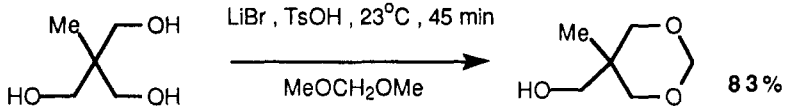


1. 1.2 eq. $(Me_3Si)_2NH$; 0.1 eq. Me_3SiCl
2. 1.3 eq. $(Me_3Si)_2NH$; 1.2 eq. Me_3SiCl
3. 2.5 eq. $(Me_3Si)_2NH$; 2.5 eq. Me_3SiCl ; cat. DMAP

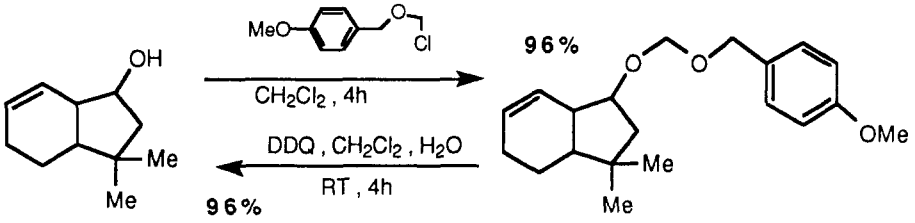
Cossy, J.; Pole, P. *Tetrahedron Lett.*, ***1987***, *28*, 6039.



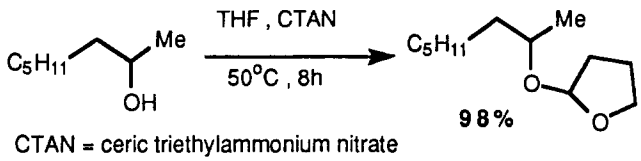
Hanamoto, T.; Hayama, T.; Katsuki, T.; Yamaguchi, M. *Tetrahedron Lett.*, ***1987***, *28*, 6329.



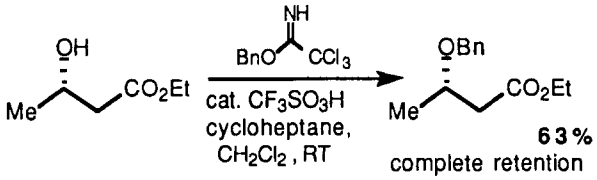
Gras, J.-L.; Nouguier, R.; Mchich, M. *Tetrahedron Lett.*, ***1987***, *28*, 6601.



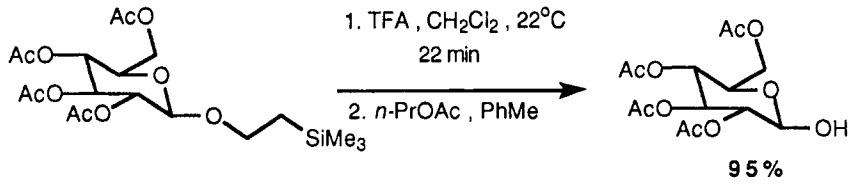
Kozikowski, A.P.; Wu, J.-P. *Tetrahedron Lett.*, ***1987***, *28*, 5125.



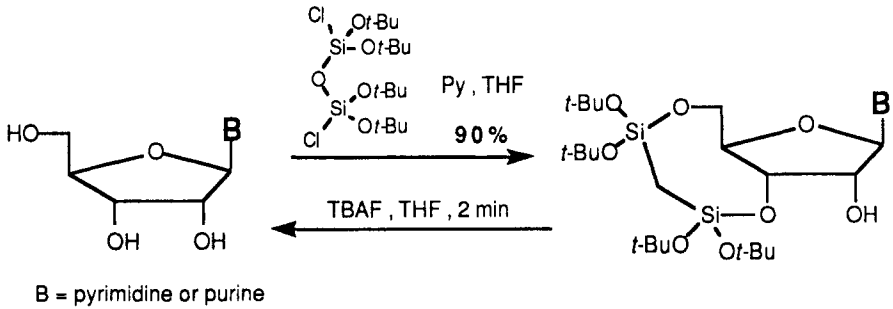
Maione, A.M.; Romeo, A. *Synthesis,* ***1987***, 250.



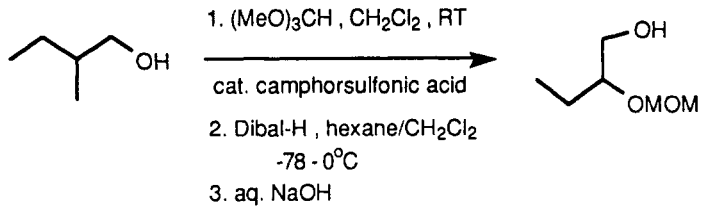
Widmer, U. *Synthesis,* ***1987***, 568.



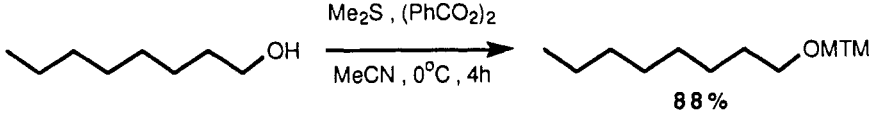
Jansson, K.; Frejid, T.; Kihlberg, J.; Magnusson, G. *Tetrahedron Lett., **1988**, 29*, 361.



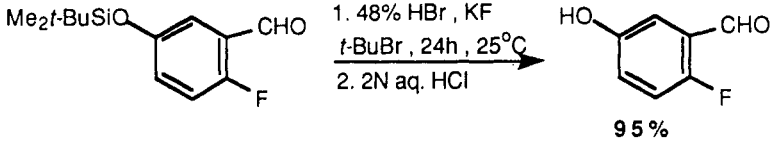
Markiewicz, W.T.; Nowakowska, B.; Adrych, K. *Tetrahedron Lett., **1988**, 29*, 1561.



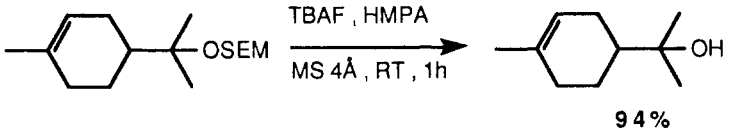
Takasu, M.; Naruse, Y.; Yamamoto, H. *Tetrahedron Lett.*, ***1988***, *29*, 1947.



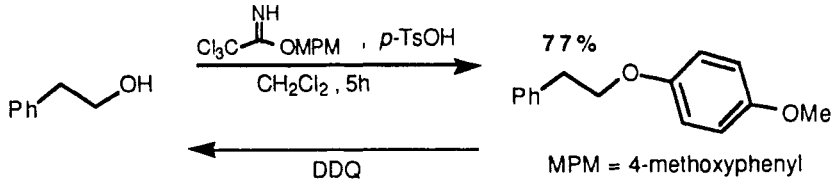
Medina, J.C.; Salomon, M.; Kyler, K.S. *Tetrahedron Lett.*, ***1988***, *29*, 3773.



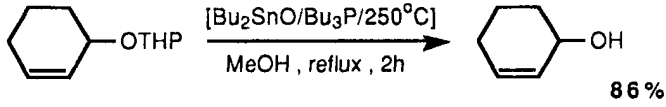
Sinhababu, A.K.; Kawase, M.; Borchardt, R. *Synthesis*, ***1988***, 710.



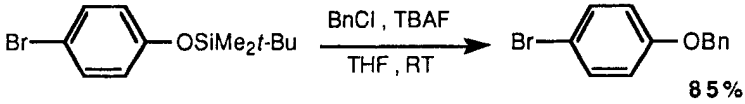
Kan, T.; Hashimoto, M.; Yanagiya, M.; Shirahama, H. *Tetrahedron Lett.*, ***1988***, *29*, 5417.



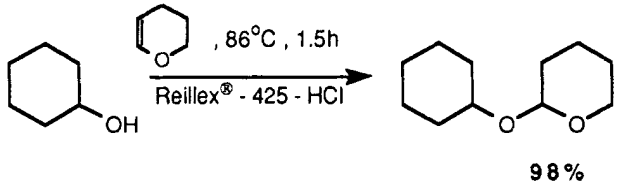
Nakajima, N.; Horita, K.; Abe, R.; Yonemitsu, O. *Tetrahedron Lett.*, ***1988***, *29*, 4139.



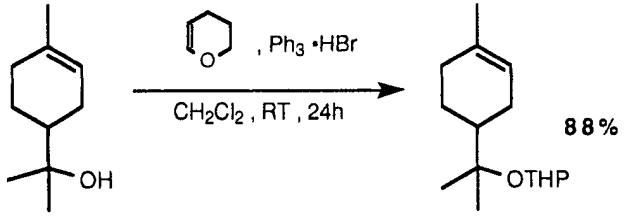
Otera, J.; Niibo, Y.; Chikada, S.; Nozaki, H. *Synthesis,* ***1988***, 328.



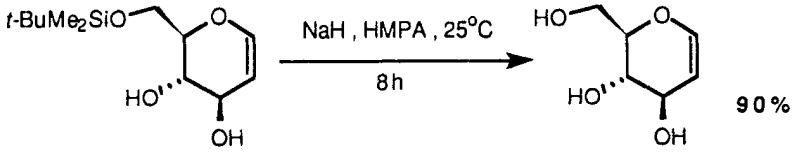
Saunders, D.G. *Synthesis,* ***1988***, 377.



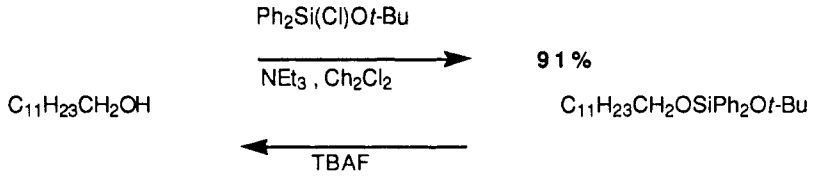
Johnston, R.D.; Marston, C.R.; Krieger, P.E.; Goe, G.L. *Synthesis,* ***1988***, 393.



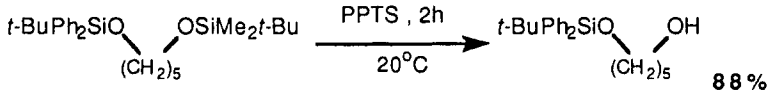
Bolitt, V.; Mioskowski, C.; Shin, D.-S.; Falck, J.R. *Tetrahedron Lett.,* ***1988, 29***, 4583.



Shekhani, M.S.; Khan, K.M.; Mahmood, K. *Tetrahedron Lett.,* ***1988, 29***, 6161.

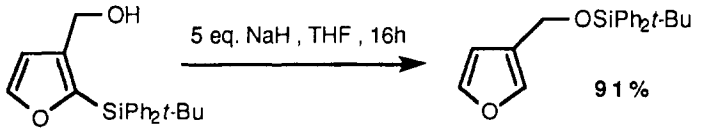


Gillard, J.W.; Fortin, R.; Morton, H.E.; Yoakim, C.; Quesnelle, C.A.; Daignault, S.; Guindon, Y. *J. Org. Chem.*, ***1988***, *53*, 2602.

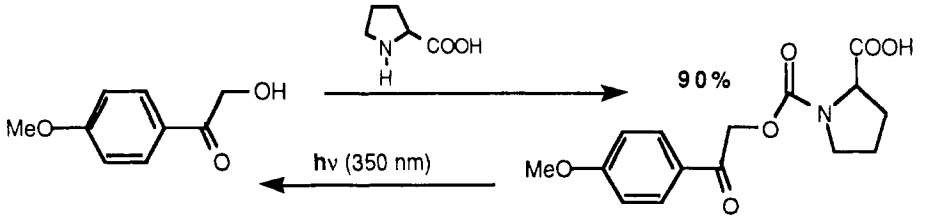


PPTS = pyridinium *p*-toluenesulfonate

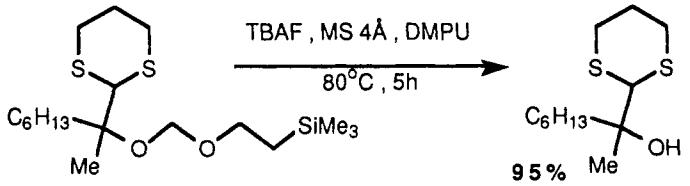
Prakash, C.; Saleh, S.; Blair, I.A. *Tetrahedron Lett.*, ***1989***, *30*, 19.



Spinazzé, P.G.; Keay, B.A. *Tetrahedron Lett.*, ***1989***, *30*, 1765.

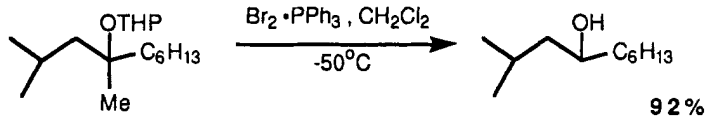


Church, G.; Ferland, J.-M.; Gauthier, J. *Tetrahedron Lett.*, ***1989***, *30*, 1901.

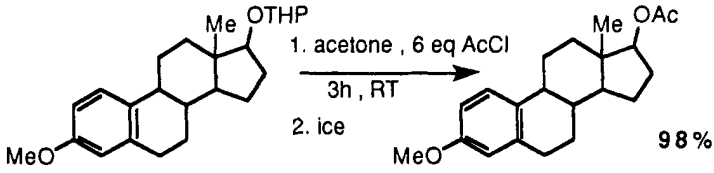


DMPU = N,N'-dimethylpropylene urea

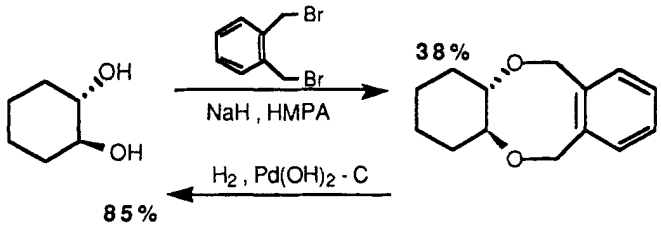
Lipshutz, B.H.; Miller, T.A. *Tetrahedron Lett.*, ***1989***, *30*, 7149.



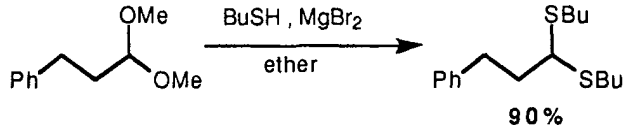
Wagner, A.; Heitz, M.-P.; Mioskowski, C. *J. Chem. Soc., Chem. Commun.*, ***1989***, 1619.



Bakos, T.; Vincze, I. *Synth. Commun.*, ***1989***, *19*, 523.



Poss, A.J.; Smyth, M.S. *Synth. Commun.*, ***1989***, *19*, 3363.



Park, J.H.; Kim, S. *Chem. Lett.*, ***1989***, 629.

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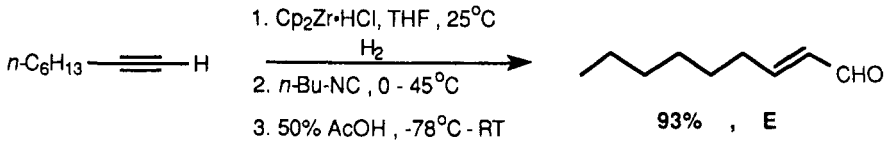
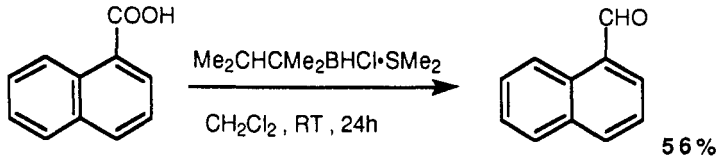
CHAPTER 4
PREPARATION OF ALDEHYDES

SECTION 46: ALDEHYDES FROM ALKYNES

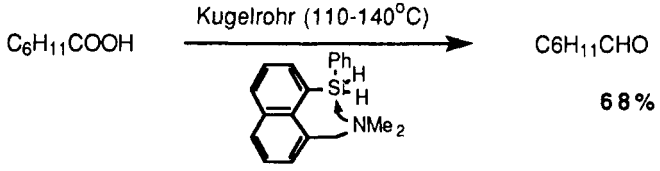


Negishi, E.; Swanson, D.R.; Miller, S.R. *Tetrahedron Lett.*, ***1988***, *29*, 1631.

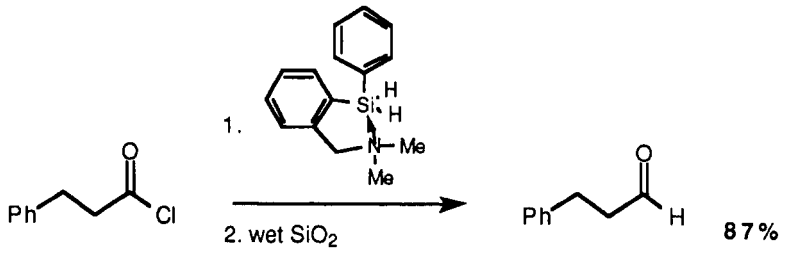
SECTION 47: ALDEHYDES FROM ACID DERIVATIVES



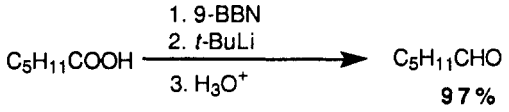
Brown, H.C.; Cha, J.S.; Yoon, N.M.; Nazer, B. *J. Org. Chem.*, ***1987***, *52*, 5400.



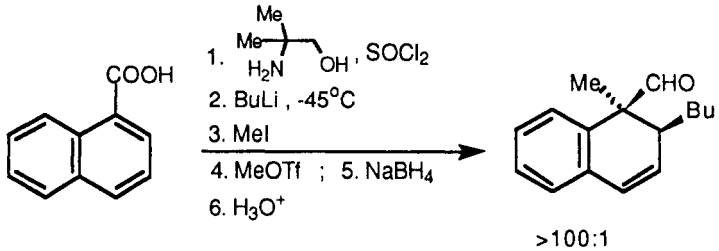
Corriu, R.J.P.; Lanneau, G.F.; Perrot, M. *Tetrahedron Lett.*, ***1987***, *28*, 3941.



Corriu, R.J.P.; Lanneau, G.F.; Perrot, M. *Tetrahedron Lett.*, ***1988***, *29*, 1271.



Cha, J.S.; Oh, S.Y.; Lee, K.W.; Yoon, M.S.; Lee, J.C. *Heterocycles*, ***1988***, *27*, 595.
Cha, J.S.; Kim, J.E.; Oh, S.Y.; Kim, J.D. *Tetrahedron Lett.*, ***1987***, *28*, 4575.
Cha, J.S.; Kim, J.E.; Yoon, M.S.; Kim, Y.S. *Tetrahedron Lett.*, ***1987***, *28*, 6231.



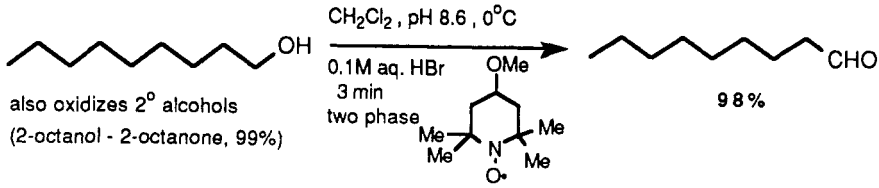
Meyers, A.I.; Lutomski, K.A.; Laucher, D. *Tetrahedron*, ***1988***, *44*, 3107.

REVIEW:

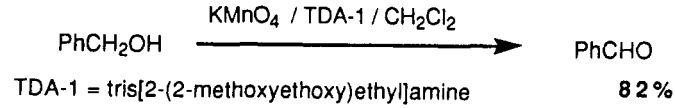
"Recent Developments in the Synthesis of Aldehydes by Reduction of Carboxylic Acids and Their Derivatives with Metal Hydrides. A Review."

Cha, J.S. *Org. Prep. Proceed. Int.*, ***1989***, *21*, 451.

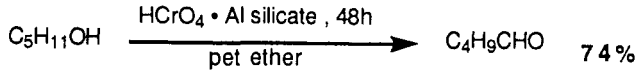
SECTION 48: ALDEHYDES FROM ALCOHOLS AND THIOLS



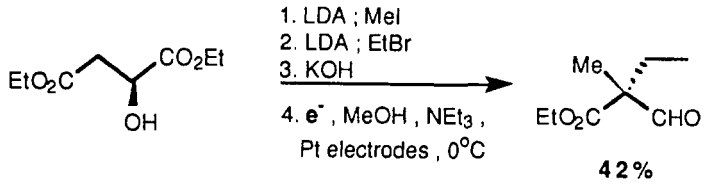
Anelli, P.L.; Biffi, C.; Montanari, F.; Quici, S. *J. Org. Chem.*, ***1987***, *52*, 2559.



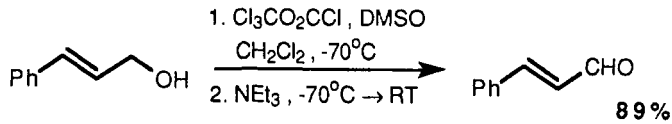
McKillop, A.; Mills, L.S. *Synth. Commun.*, ***1987***, *17*, 647.



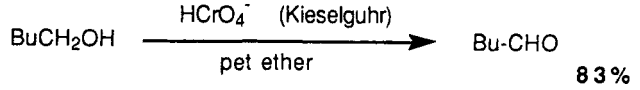
Lou, J.-D.; Wu, Y.-Y. *Synth. Commun.*, ***1987***, *17*, 1717.



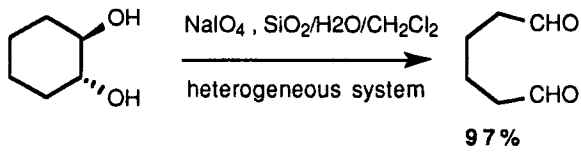
Renaud, P.; Hürzeler, M.; Seebach, D. *Helv. Chim. Acta*, ***1987***, *70*, 292.



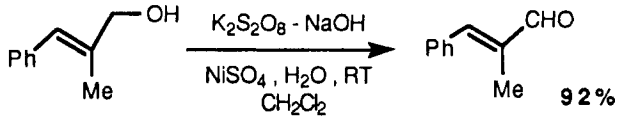
Takano, S.; Inomata, K.; Tomita, S. *Tetrahedron Lett.*, ***1988***, *29*, 6619.



Lou, J.-D. *Synth. Commun.*, ***1989***, *19*, 1841.



Daumas, M.; Vo-Quang, Y.; Vo-Quang, L.; LeGoffic, F. *Synthesis, **1989**, 64.*

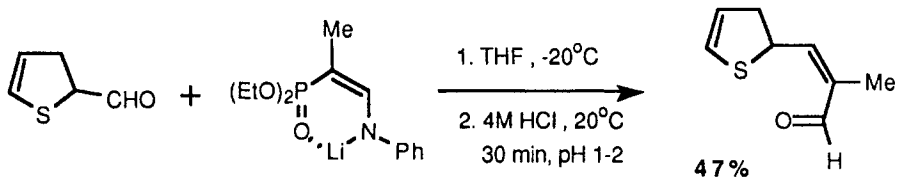


Yamazaki, S.; Yamazaki, Y. *Chem. Lett., **1989**, 1361.*

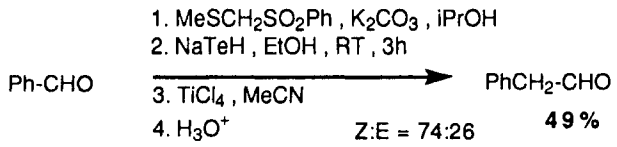
Related Methods: Ketones from Alcohols and Phenols (Section 168)

SECTION 49: ALDEHYDES FROM ALKYNES

Conjugate reductions and Michael Alkylations of conjugated aldehydes are listed in Section 74 (Alkyls from Alkenes).



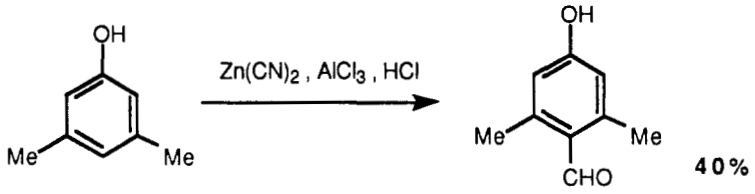
Tay, M.K.; Aboryaoude, E.E.; Collingnon, N.; Savignac, Ph. *Tetrahedron Lett., **1987**, 28*, 1263.



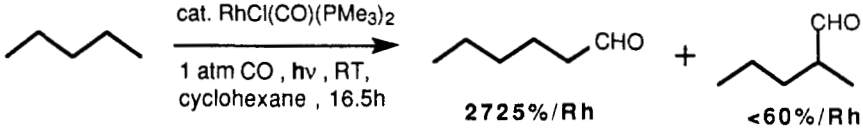
Huang, X.; Zhang, H.-Z. *Synthesis, **1989**, 42.*

Related Methods: Aldehydes from Ketones (Section 57)
Ketones from Ketones (Section 177)
Also via: Alkenyl aldehydes (Section 341)

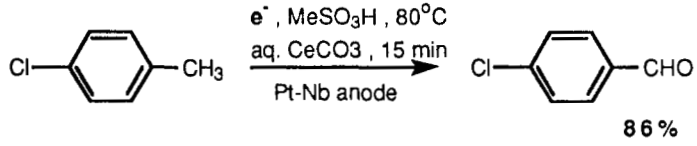
SECTION 50: ALDEHYDES FROM ALKYLS, METHYLENES AND ARYLS



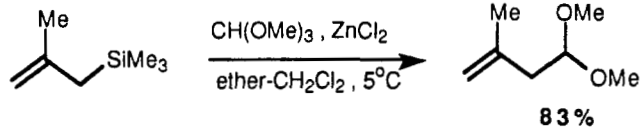
Marx, J.N.; Bih, Q.-R. *J. Org. Chem.*, ***1987***, *52*, 336.



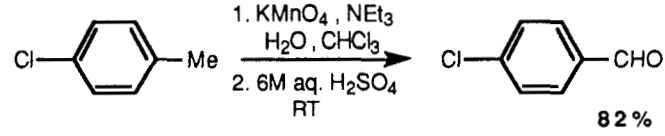
Sakakura, T.; Tanaka, M. *J. Chem. Soc., Chem. Commun.*, ***1987***, 758.



Kreh, R.P.; Spotnitz, R.M.; Lundquist, J.T. *Tetrahedron Lett.*, ***1987***, *28*, 1067.

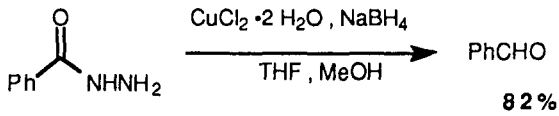


Cambanis, A.; Bäuml, E.; Mayr, H. *Synthesis*, ***1989***, 128.



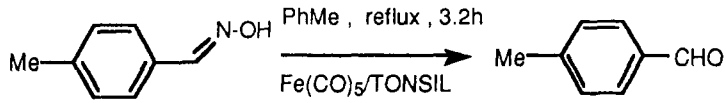
Li, W.-S.; Liu, L.K. *Synthesis*, ***1989***, 293.

SECTION 51: ALDEHYDES FROM AMIDES



Attanasi, O.A.; Serra-Zanetti, F.; Tosi, G. *Org. Prep. Proceed. Int.*, ***1988***, *20*, 405.

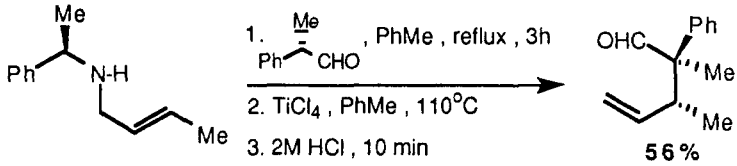
SECTION 52: ALDEHYDES FROM AMINES



TONSIL = bentonitic earth

96%

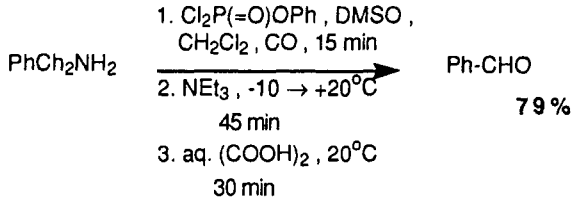
Alvarez, C.; Cano, A.C.; Rivera, V.; Márquez, C. *Synth. Commun.*, ***1987***, *17*, 279.



56%

72% de (81% ee)

Bailey, P.D.; Harrison, M.J. *Tetrahedron Lett.*, ***1989***, *30*, 5341.

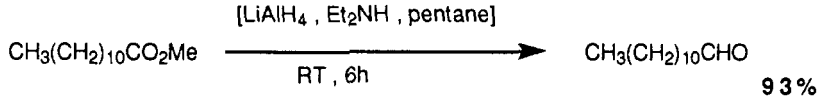


79%

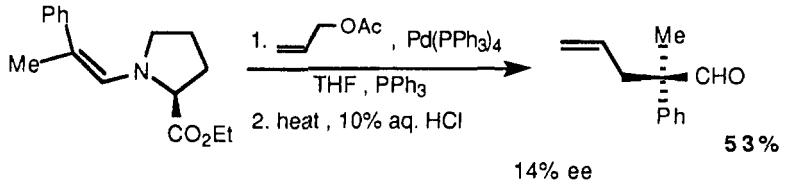
Liu, H.-J.; Nyangullu, J.M. *Synth. Commun.*, ***1989***, *19*, 3407.

Related Methods: Ketones from Amines (Section 172)

SECTION 53: ALDEHYDES FROM ESTERS

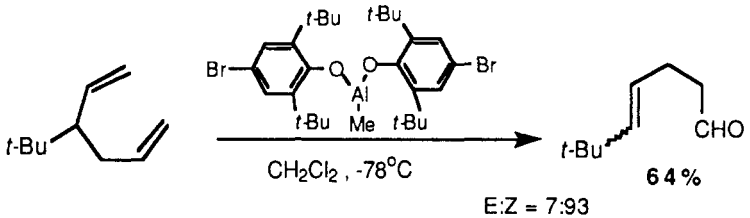


Cha, J.S.; Kwon, S.S. *J. Org. Chem.*, ***1987***, *52*, 5486.

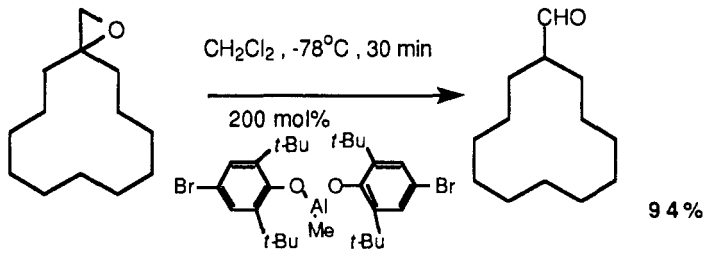


Hiroi, K.; Abe, J.; Suya, K.; Sato, S. *Tetrahedron Lett.*, ***1989***, *30*, 1543.

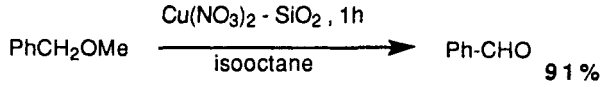
SECTION 54: ALDEHYDES FROM ETHERS, EPOXIDES AND THIOETHERS



Maruoka, K.; Nonoshita, K.; Banno, H.; Yamamoto, H. *J. Am. Chem. Soc.*, ***1988***, *110*, 8922.



Maruoka, K.; Nagahara, S.; Ooi, T.; Yamamoto, H. *Tetrahedron Lett.*, ***1989***, *30*, 5607.



Nishiguchi, T.; Bougauchi, M. *J. Org. Chem.*, ***1989***, *54*, 3001.

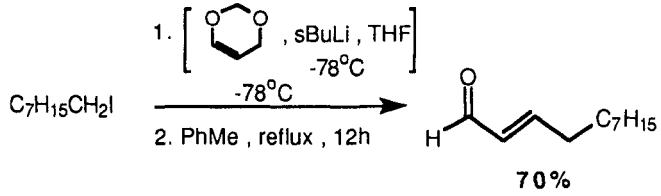
REVIEW:

"The Thermal Aliphatic Claisen Rearrangement"

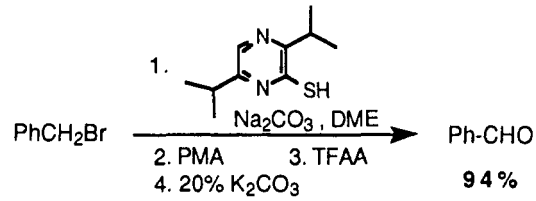
Ziegler, F.E. *Chem. Rev.*, ***1988***, *88*, 1423.

Related Methods: Ketones from Ethers and Epoxides (Section 174)

SECTION 55: ALDEHYDES FROM HALIDES AND SULFONATES

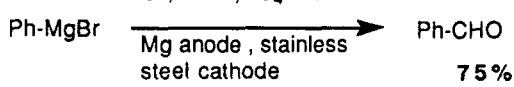


Funk, R.L.; Bolton, G.L. *J. Am. Chem. Soc.*, ***1988***, *110*, 1290.



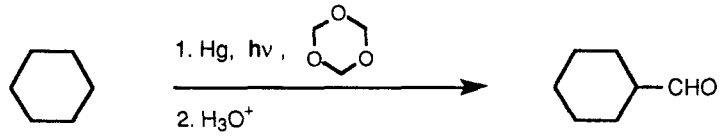
PMA = permalic acid

Shimazaki, M.; Nakanishi, T.; Mochizuki, M.; Ohta, A. *Heterocycles*, ***1988***, *27*, 1643.



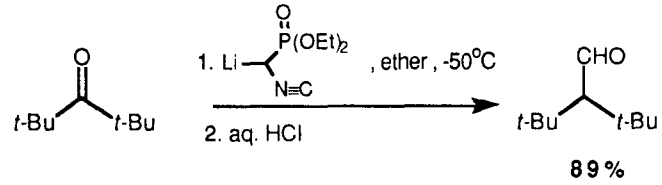
Saboureua, C.; Troupel, M.; Sibille, S.; d'Incan, E.; Périchon, J. *J. Chem. Soc., Chem. Commun.*, ***1989***, 895.

SECTION 56: ALDEHYDES FROM HYDRIDES

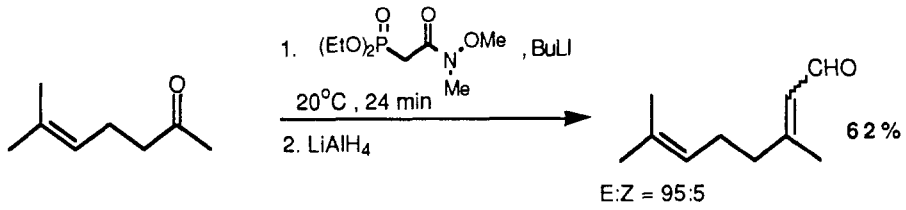


Brown, S.H.; Crabtree, R.H. *J. Chem. Soc., Chem. Commun.*, ***1987***, 970.

SECTION 57: ALDEHYDES FROM KETONES

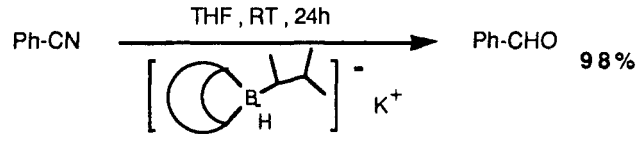


Moskal, J.; van Leusen, A.M. *Recl. Trav. Chim., Pays-Bas*, ***1987***, *106*, 137.



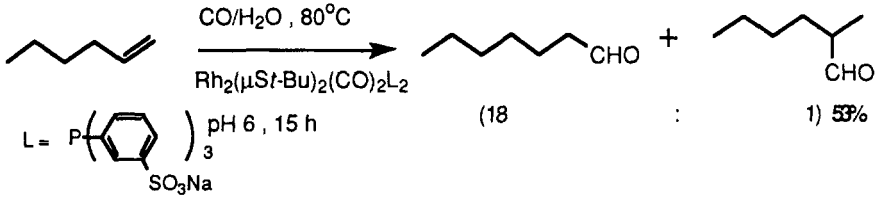
Nuzillard, J.-M.; Boumendjel, A.; Massiot, G. *Tetrahedron Lett.*, ***1989***, *30*, 3779.

SECTION 58: ALDEHYDES FROM NITRILES

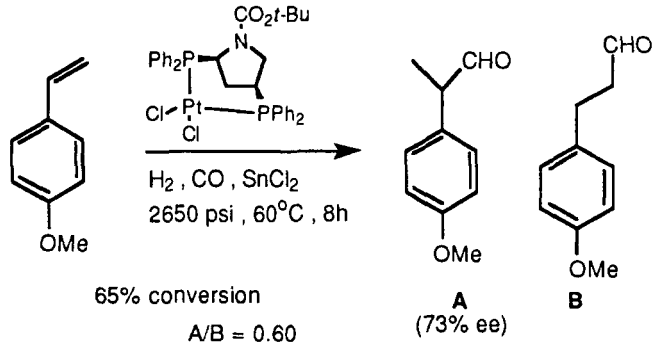


Cha, J.S.; Yoon, M.S. *Tetrahedron Lett.*, ***1989***, *30*, 3677.

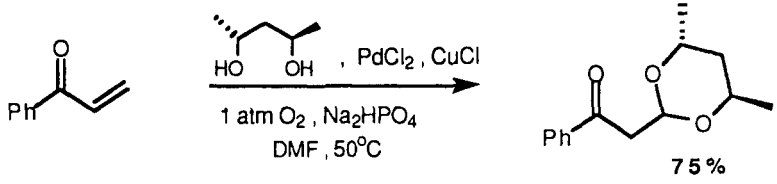
SECTION 59: ALDEHYDES FROM ALKENES



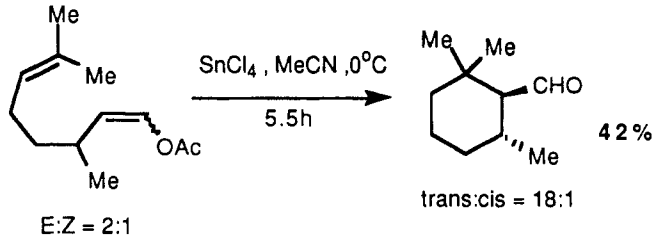
Escaffre, P.; Thorez, A.; Kalck, P. *J. Chem. Soc., Chem. Commun.*, ***1987***, 146.



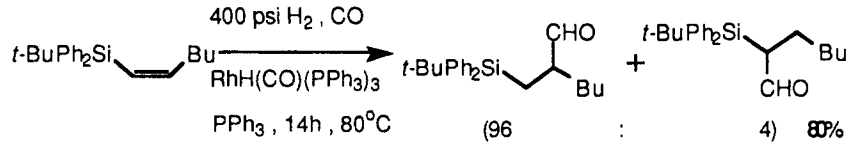
Parrinello, G.; Stille, J.K. *J. Am. Chem. Soc.*, ***1987***, *109*, 7122.



Hosokawa , T.; Ohta, T.; Kanayama, S.; Murahashi, S. *J. Org. Chem.*, ***1987***, *52*, 1758.



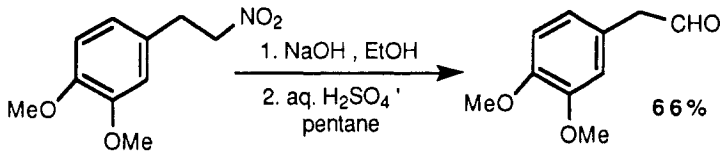
Simmons, D.P.; Reichlin, D.; Skuy, D. *Helv. Chim. Acta, **1988**, 71*, 1000.



Doyle, M.M.; Jackson, W.R.; Perlmutter, P. *Tetrahedron Lett., **1989**, 30*, 233.

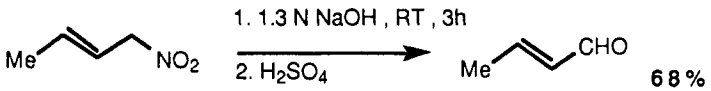
Related Methods: Ketones from Alkenes (Section 179)

SECTION 60: ALDEHYDES FROM MISCELLANEOUS COMPOUNDS



can also generate ketones

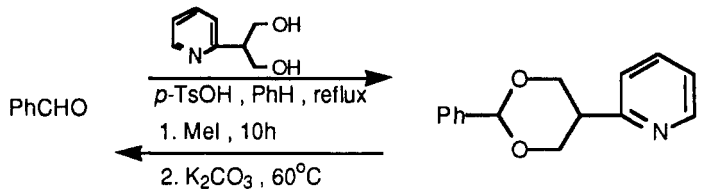
Chikashita, H.; Morita, Y.; Itoh, K. *Synth. Commun., **1987**, 17*, 677.



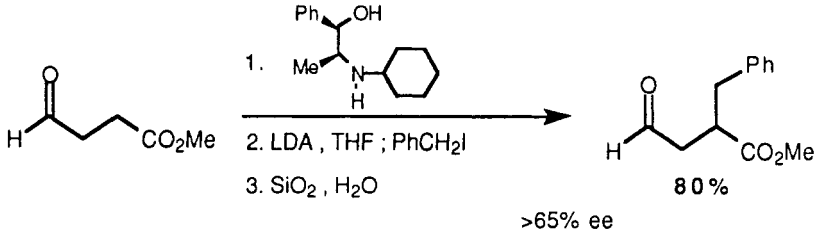
extension of the Nef reaction

Lou, J.-D.; Lou, W.-X. *Synthesis, **1987***, 179.

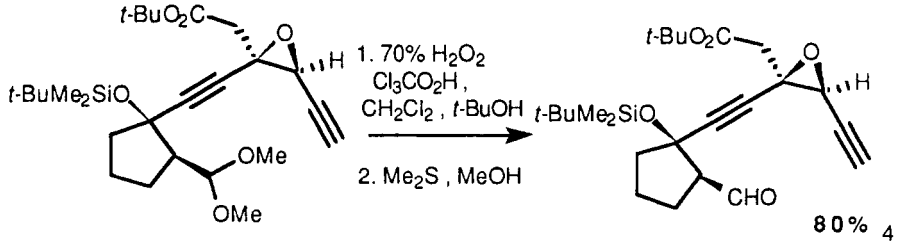
SECTION 60A: PROTECTION OF ALDEHYDES



Katritzky, A.R.; Fan, W.-Q.; Li, Q.-L. *Tetrahedron Lett.*, ***1987***, *28*, 1195.

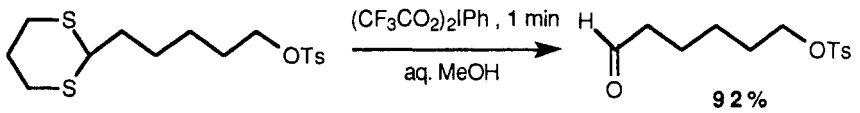


Agami, C.; Couty, F. *Tetrahedron Lett.*, ***1987***, *28*, 5659.

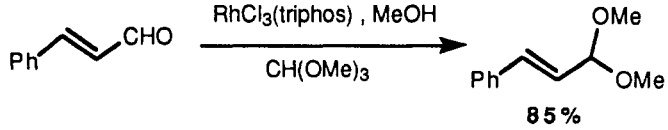


4

Myers, A.G.; Fundy, M.A.M.; Lindstrom Jr., P.A. *Tetrahedron Lett.*, ***1988***, *29*, 5609.



Stork, G.; Zhao, K. *Tetrahedron Lett.*, ***1989***, *30*, 287.



85%

Ott, J.; Ramos Tombo, G.M.; Schmid, B.; Venanzi, L.M.; Wang, G.; Ward, T.R. *Tetrahedron Lett.*, ***1989***, *30*, 6151.

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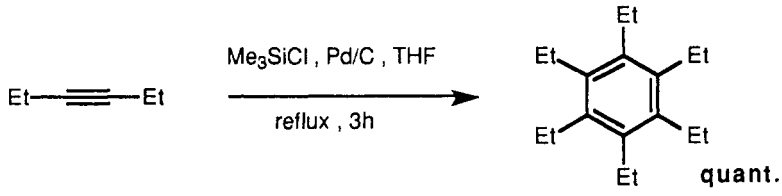
CHAPTER 5

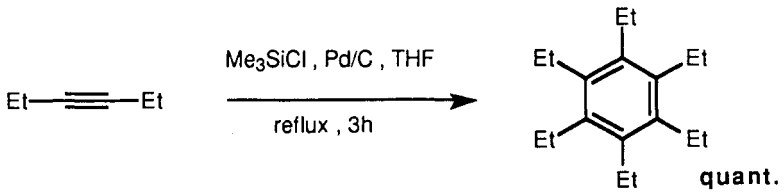
PREPARATION OF ALKYLS, METHYLENES AND ARYLS

This chapter lists the conversion of functional groups into methyl, ethyl, propyl, etc. as well as methylene (CH_2), phenyl, etc.

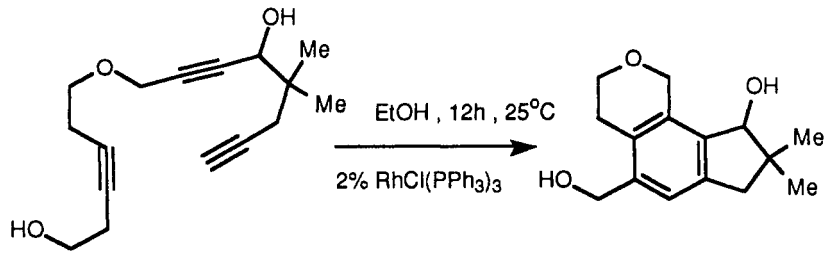
SECTION 61: ALKYLS, METHYLENES AND ARYLS FROM ALKYNES



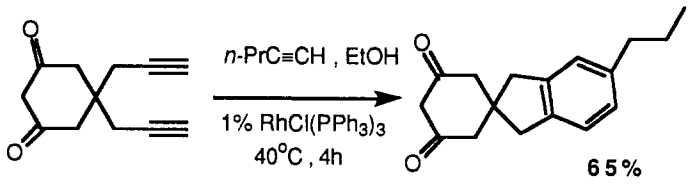
Morris Jr., P.E.; Kiely, D.E. *J. Org. Chem.*, ***1987***, *52*, 1149.



Jhingan, A.K.; Maier, W.F. *J. Org. Chem.*, ***1987***, *52*, 1161.

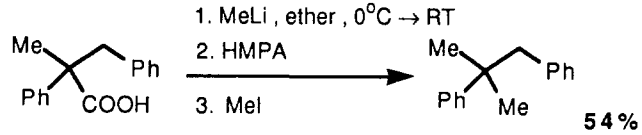


Neeson, S.J.; Stevenson, P.J. *Tetrahedron Lett.*, ***1988***, *29*, 813.

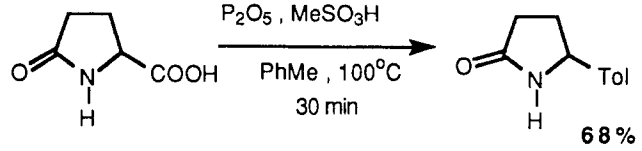


Grigg, R.; Scott, R.; Stevenson, P. *J. Chem. Soc., Perkin Trans. I*, ***1988***, 1357.

SECTION 62: ALKYLS, METHYLENES AND ARYLS FROM ACID DERIVATIVES

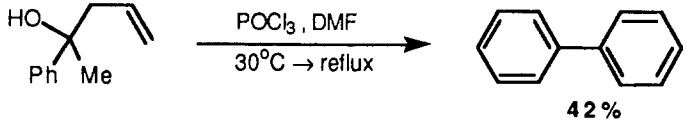


Gilday, J.P.; Paquette, L.A. *Tetrahedron Lett.*, ***1988***, *29*, 4505.

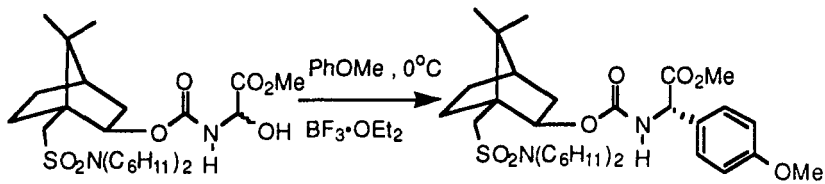


Rigo, B.; Fasseur, D.; Cherepy, N.; Couturier, D. *Tetrahedron Lett.*, ***1989***, *30*, 7057.

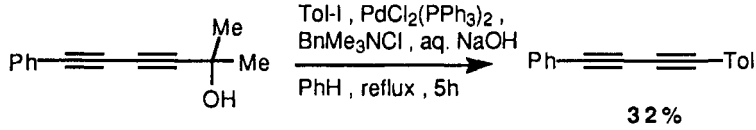
SECTION 63: ALKYLS, METHYLENES AND ARYLS FROM ALCOHOLS AND THIOLS



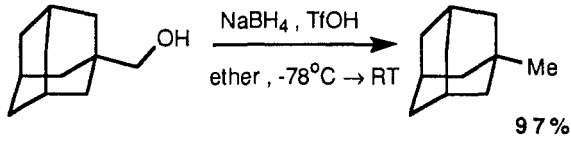
Rao, M.S.C.; Rao, G.S.K. *Synthesis*, ***1987***, 231.



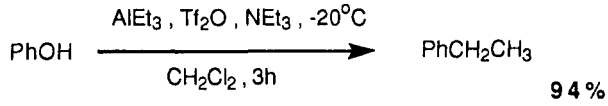
Harding, K.E.; Davis, C.S. *Tetrahedron Lett.*, ***1988***, *29*, 1891.



Nye, S.A.; Potts, K.T. *Synthesis*, ***1988***, 375.

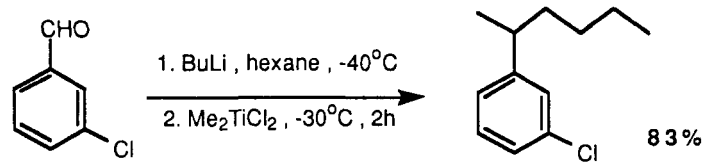


Olah, G.A.; Wu, A.-h.; Farooq, O. *J. Org. Chem.*, ***1989***, *54*, 1452.

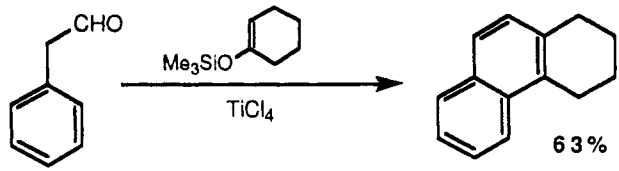


Hirotaq, K.; Isobe, Y.; Maki, Y. *J. Chem. Soc., Perkin Trans. I*, ***1989***, 2513.

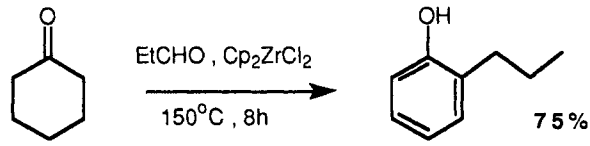
SECTION 64: ALKYLS, METHYLENES AND ARYLS FROM ALDEHYDES



Reetz, M.T.; Kyung, S.-H. *Chem. Ber.*, ***1987***, *120*, 123.



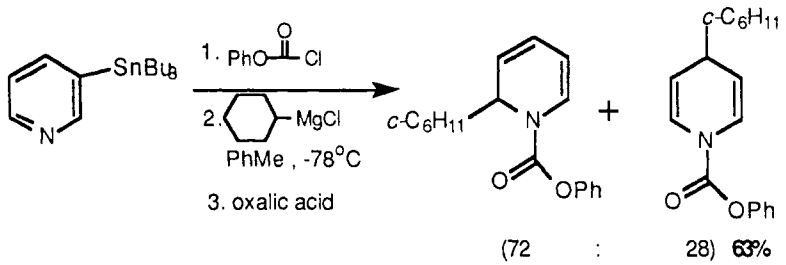
DiRaddo, P.; Harvey, R.G. *Tetrahedron Lett.*, ***1988***, *29*, 3885.



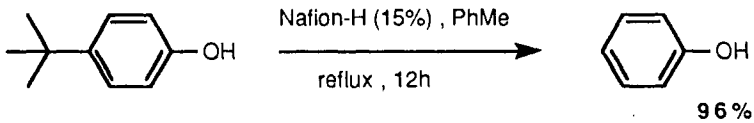
Nakano, T.; Shirai, H.; Tamagawa,H.; Ishii, Y.; Ogawa,M. *J. Org. Chem.*, ***1988***, *53*, 5181.

Related Methods: Alkyls, Methylenes and Aryls from Ketones (Section 72)

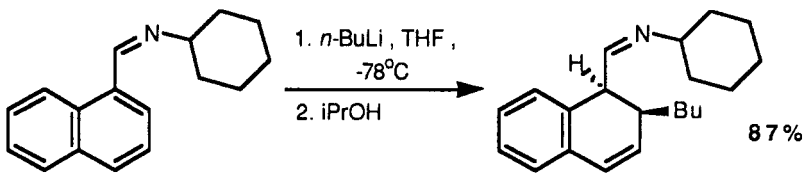
SECTION 65: ALKYLS, METHYLENES AND ARYLS FROM ALKYLS, METHYLENES AND ARYLS



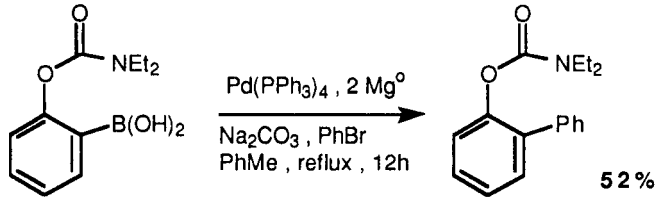
Comins, D.L.; Mantlo, N.B. *Tetrahedron Lett.*, ***1987***, *28*, 759.



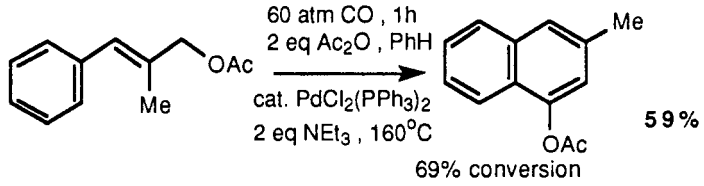
Olah, G.A.; Surya Prakash, G.K.; Iyer, P.S.; Tashiro, M.; Yamamoto, T. *J. Org. Chem.*, ***1987***, *52*, 1881.



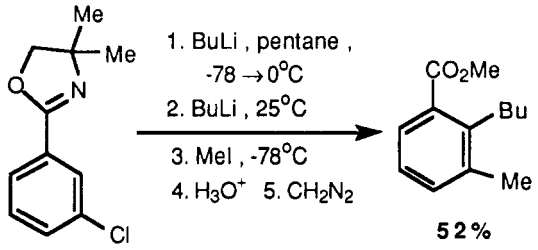
Meyers, A.I.; Brown, J.D.; Laucher, D. *Tetrahedron Lett.*, ***1987***, *28*, 5279, 5283.



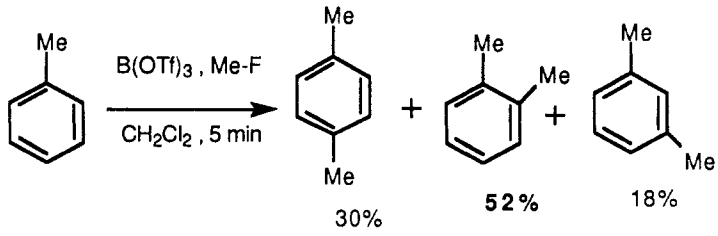
Sharp, M.J.; Cheng, W.; Snieckus, V. *Tetrahedron Lett.*, ***1987***, *28*, 5093, 5097.



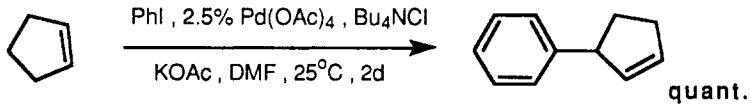
Matsuzaka, H.; Hiroe, Y.; Iwasaki, M.; Ishii, Y.; Koyasu, Y.; Hidai, M. *J. Org. Chem.*, ***1988***, *53*, 3832.



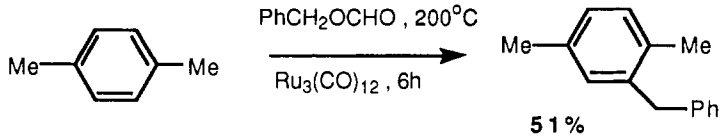
Pansegrau, P.D.; Rieker, W.F.; Meyers, A.I. *J. Am. Chem. Soc.*, ***1988***, *110*, 7178.



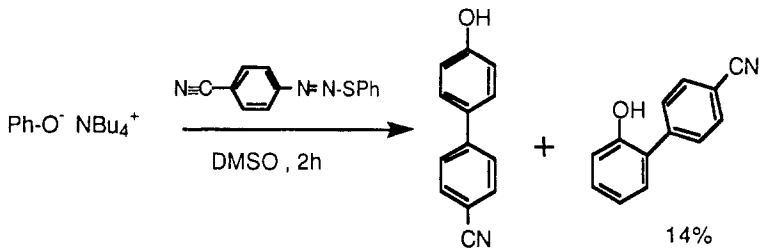
Olah, G.A.; Farooq, O.; Farina, S.M.F.; Olah, J.A. *J. Am. Chem. Soc.*, ***1988***, *110*, 2560.



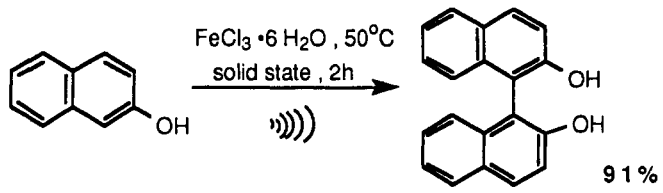
Larock, R.C.; Baker, B.E. *Tetrahedron Lett.*, ***1988***, *29*, 905.



Kondo, T.; Tantayanon, S.; Tsuji, Y.; Watanabe, Y. *Tetrahedron Lett.*, ***1989***, *30*, 4137.



Petrillo, G.; Novi, M.; Oell;Erba,C. *Tetrahedron Lett.*, ***1989***, *30*, 6911.

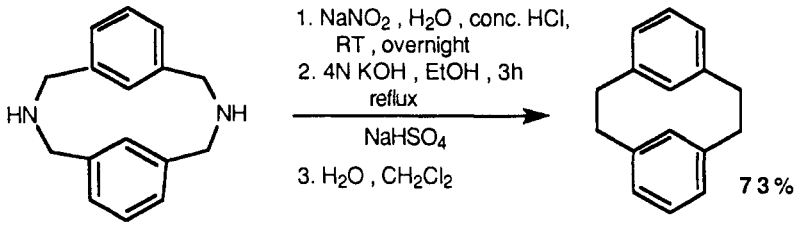


Toda, F.; Tanaka, K.; Iwata, S. *J. Org. Chem.*, ***1989, 54***, 3007.

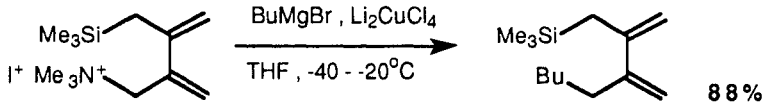
SECTION 66: ALKYLS, METHYLENES AND ARYLS FROM AMIDES

NO ADDITIONAL EXAMPLES

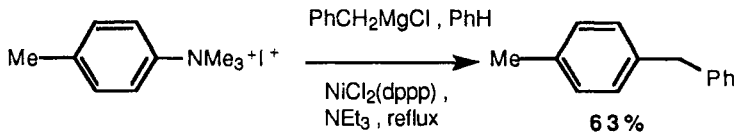
SECTION 67: ALKYLS, METHYLENES AND ARYLS FROM AMINES



Takemura, H.; Shinmyozu, T.; Inazu, T. *Tetrahedron Lett.*, ***1988, 29***, 1031.

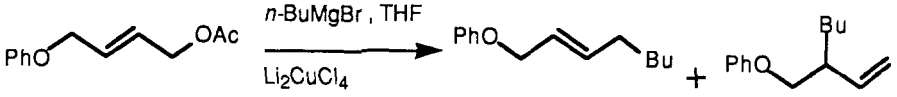


Hosomi, A.; Hoashi, K.; Tominaga, Y.; Otaka, K.; Sakurai, H. *J. Org. Chem.*, ***1987, 52***, 2947.

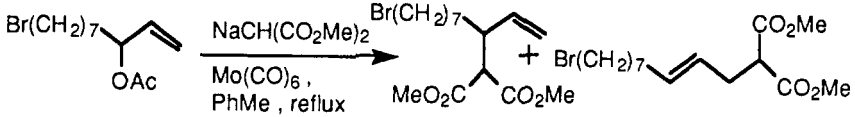


Wenkert, E.; Han, A.-L.; Jenny, C.-J. *J. Chem. Soc., Chem. Commun.*, ***1988***, 975.

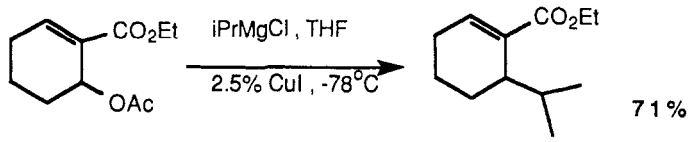
SECTION 68: ALKYLS, METHYLENES AND ARYLS FROM ESTERS



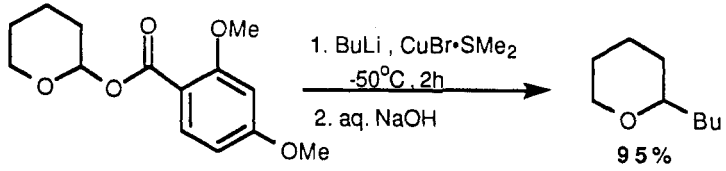
Bäckvall, J.-E.; Sellén, M. *J. Chem. Soc., Chem. Commun.*, ***1987***, 827.



Trost, B.M.; Lautens, M. *J. Am. Chem. Soc.*, ***1987***, *109*, 1469.



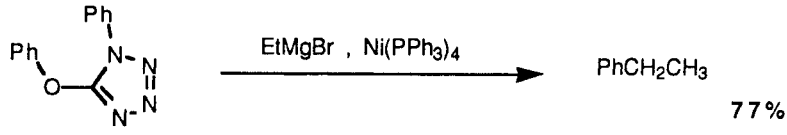
Amri, H.; Villieras, J. *Tetrahedron Lett.*, ***1987***, *28*, 5521.



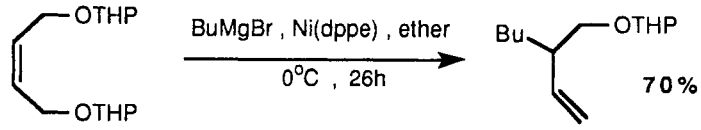
Bolitt, V.; Mioskowski, C.; Falck, J.R. *Tetrahedron Lett.*, ***1989***, *30*, 6027.

SECTION 69: ALKYLS, METHYLENES AND ARYLS FROM ETHERS, EPOXIDES AND THIOETHERS

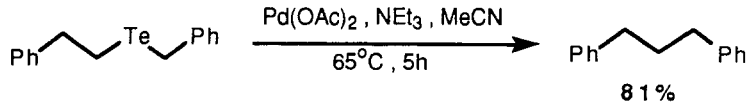
The conversion ROR → RR' (R' = alkyl, aryl) is included in this section.



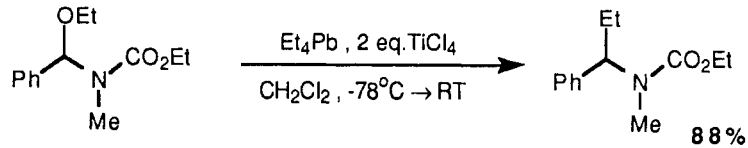
Johnstone, R.A.W.; McLean, W.N. *Tetrahedron Lett.*, ***1988***, *29*, 5553.



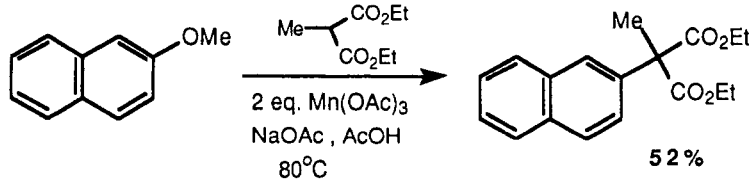
Menicagli, R.; Malanga, C.; Finato, B.; Lardicci, L. *Tetrahedron Lett.*, ***1988***, *29*, 3373.



Barton, D.H.R.; Ozbalik, N.; Ramesh, M. *Tetrahedron Lett.*, ***1988***, *29*, 3533.



Yamada, J.; Satô, H.; Yamamoto, Y. *Tetrahedron Lett.*, ***1989***, *30*, 5611.



Citterio, A.; Santi, R.; Fiorani, T.; Strologo, S. *J. Org. Chem.*, ***1989***, *54*, 2703.

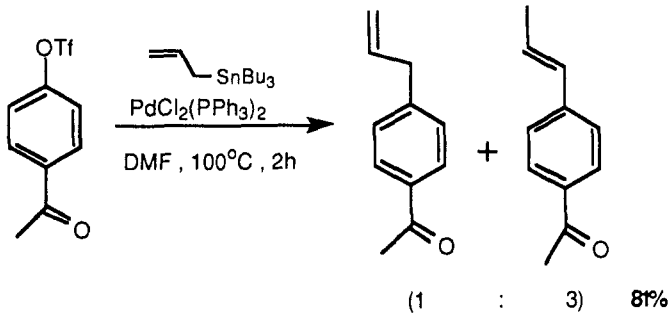
REVIEW:

"Synthesis of Novel Benzenoid Molecules by Low-Valent-Titanium Deoxygenation"

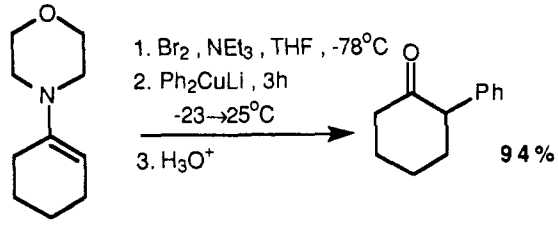
Wong, H.N.C. *Acc. Chem. Res.*, ***1989***, *22*, 145

SECTION 70: ALKYLS, METHYLENES AND ARYLS FROM HALIDES AND SULFONATES

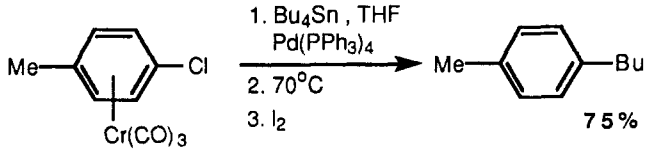
The replacement of halogen by alkyl or aryl groups is included in this section. For the conversion of RX → RH (X = halogen) see Section 160 (Hydrides from Halides and Sulfonates).



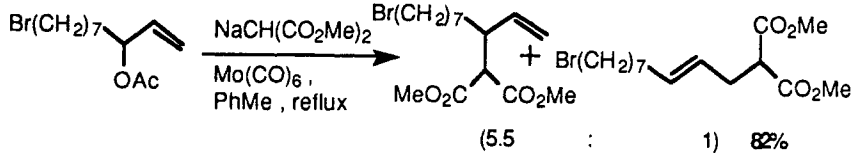
Echavarren, A.M.; Stille, J.K. *J. Am. Chem. Soc.*, ***1987***, *109*, 5478.



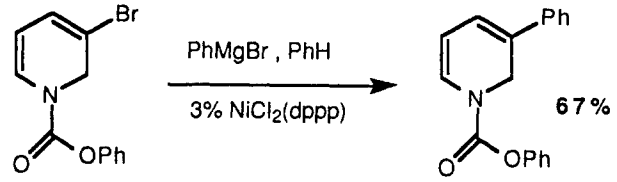
Rathke, M.W.; Vogiazoglou, D. *J. Org. Chem.*, ***1987***, *52*, 3697.



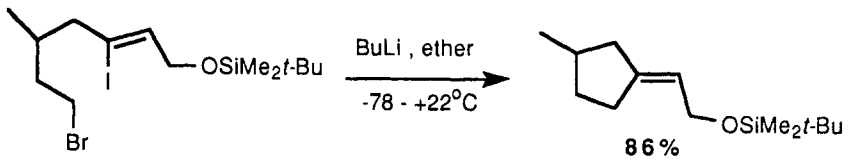
Scott, W.J. *J. Chem. Soc., Chem. Commun.*, ***1987***, 1755.



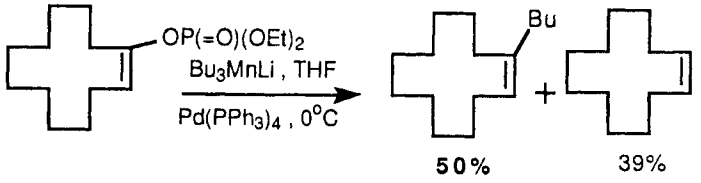
Minato, A.; Suzuki, K.; Tamao, K. *J. Am. Chem. Soc.*, ***1987***, *109*, 1257.



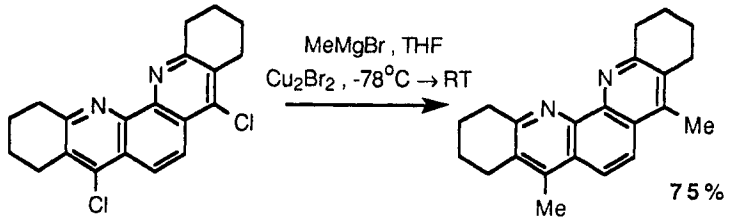
Comins, D.L.; Herrick, J.J. *Heterocycles*, ***1987***, *26*, 2159.



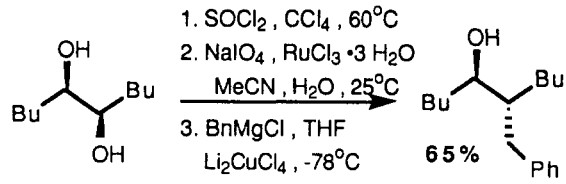
Negishi, E.; Zhang, Y.; Bagheri, V. *Tetrahedron Lett.*, ***1987***, *28*, 5793.



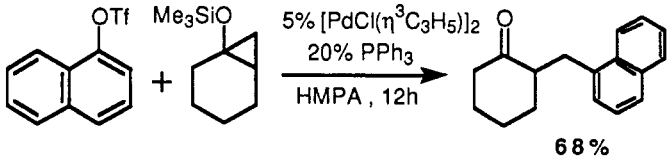
Fugami, K.; Oshima, K.; Utimoto, K. *Chem. Lett.*, ***1987***, 2203.



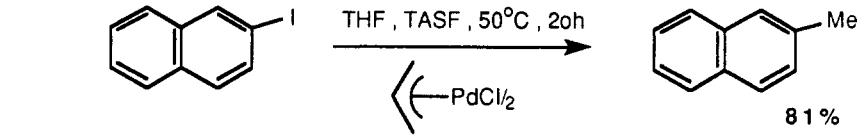
Bell, T.W.; Hu, L.-Y.; Patel, S.V. *J. Org. Chem.*, ***1987***, *52*, 3847.



Gao, Y.; Sharpless, K.B. *J. Am. Chem. Soc.*, ***1988***, *110*, 7538.

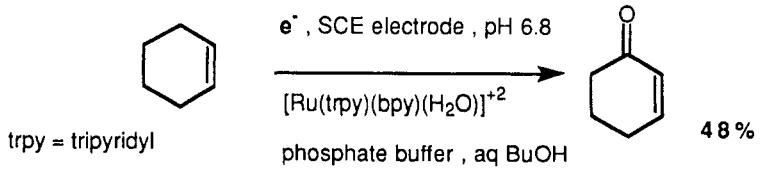


Aoki, S.; Fujimura, T.; Nakamura, E.; Kuwajima, I. *J. Am. Chem. Soc.*, ***1988***, *110*, 3296.



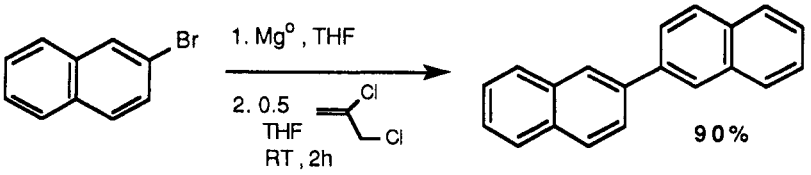
TASF = tris-(diethylamino)sulfonium difluorotrimethyl silicate

Hatanaka, Y.; Hiyama, T. *Tetrahedron Lett.*, ***1988***, *29*, 97.

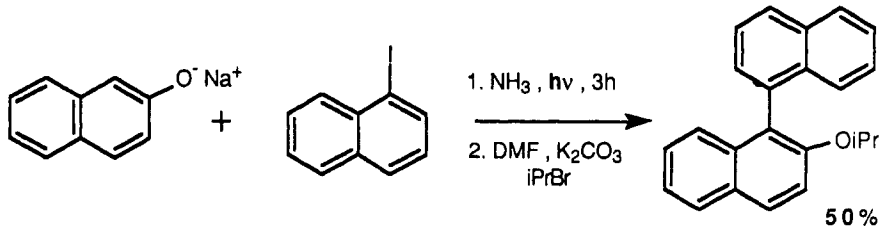


trpy = tripyridyl

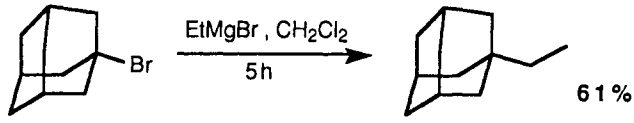
Mudurro, J.M.; Chiericato Jr., G.; DeGiovani, W.F.; Romero, J.R. *Tetrahedron Lett.*, ***1988***, *29*, 765.



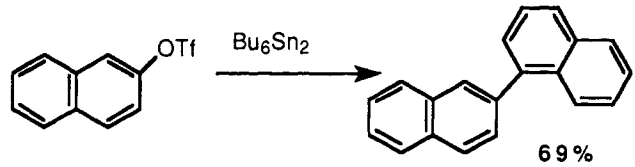
Cheng, J.-W.; Luo, F.-T. *Tetrahedron Lett.*, ***1988***, *29*, 1293.



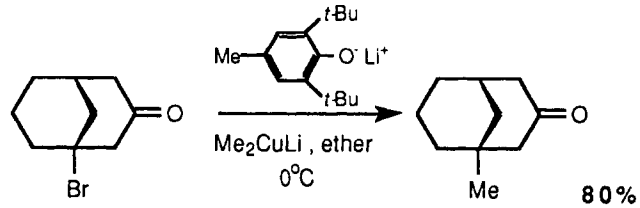
Beugelmans, R.; Bois-Choussy, M.; Tang, Q. *Tetrahedron Lett.*, ***1988***, *29*, 1705.



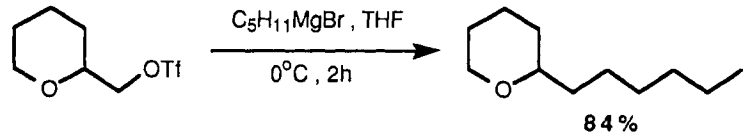
Ohno, M.; Shimizu, K.; Ishizaki, K.; Sasaki, T.; Eguchi, S. *J. Org. Chem.*, ***1988***, *53*, 729.



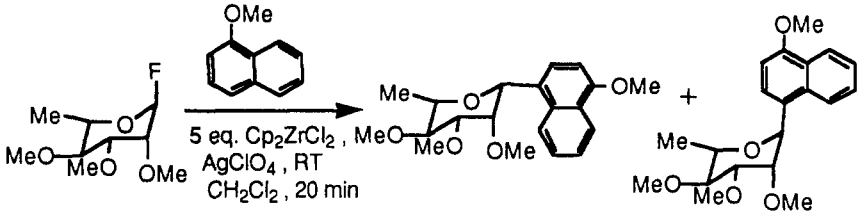
Crisp, G.T.; Papadopoulos, S. *Aust. J. Chem.*, ***1988***, *41*, 1711.



Kraus, G.A.; Yi, P. *Synth. Commun.*, ***1988***, *18*, 473.

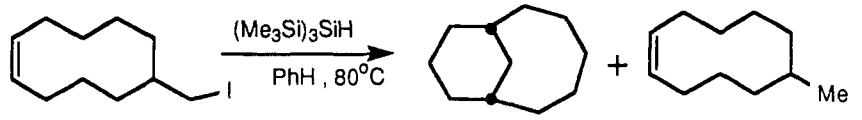


Kotsuki, H.; Kadota, I.; Ochi, M. *Tetrahedron Lett.*, ***1989***, *30*, 1281.



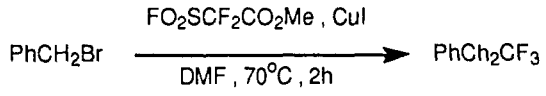
	(100	:	0)	98%
2 eq., 45 min	(12	:	1)	91%
0.3 eq., 2h	(1	:	2)	79%

Matsumoto, T.; Katsuki, M.; Suzuki, K. *Tetrahedron Lett.*, ***1989***, *30*, 833.



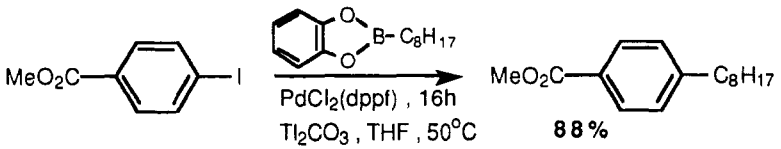
(4 : 1) **quant**

Winkler, J.D.; Sridar, V.; Siegel, M.G. *Tetrahedron Lett.*, ***1989***, *30*, 4943.



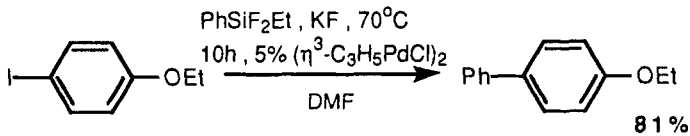
81%

Chen, Q.-Y.; Wu, S.-W. *J. Chem. Soc., Chem. Commun.*, ***1989***, 705.



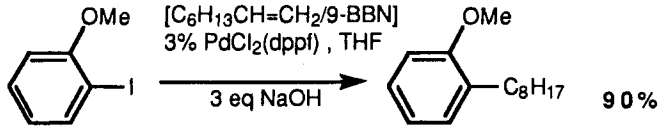
88%

Sato, M.; Miyaura, N.; Suzuki, A. *Chem. Lett.*, ***1989***, 1405.



81%

Hatyanaka, Y.; Fukushima, S.; Hiyama, T. *Chem. Lett.*, ***1989***, 1711.



Miyura, N.; Ishiyama, T.; Sasaki,H.; Ishikawa, M.; Satoh, M.; Suzuki, A. *J. Am. Chem. Soc.*, ***1989***, *111*, 314.

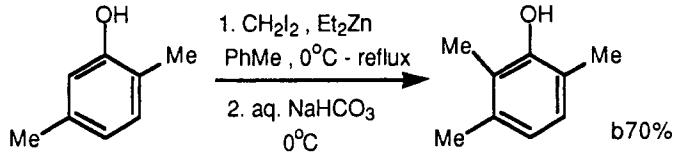
REVIEW:

"Applications of Higher Order Mixed Organocuprates to Organic Synthesis"

Lipshutz, B.H. *Synthesis*, ***1987***, 325.

SECTION 71: ALKYLS, METHYLENES AND ARYLS FROM HYDRIDES

This section lists examples of the reaction of RH → RR' (R,R' = alkyl or aryl). For the reaction C=CH → C=C-R (R = alkyl or aryl), see Section 209 (Alkenes from Alkenes). For alkylations of ketones and esters, see Section 177 (Ketones from Ketones) and Section 113 (Esters from Esters).



Lehnert, E.K.; Sawyer, J.S.; Macdonald, T.L. *Tetrahedron Lett.*, ***1989***, *30*, 5215.

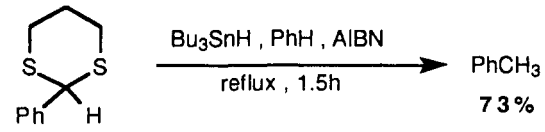
REVIEW:

"Arylation Reactions of Organobismuth Reagents"

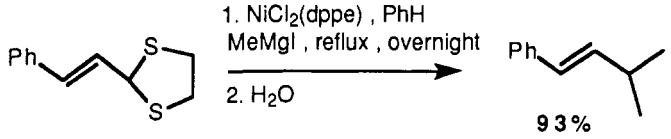
Finet, J.-P. *Chem. Rev.*, ***1989***, *89*, 1487.

SECTION 72: ALKYLS, METHYLENES AND ARYLS FROM KETONES

The conversions $R_2C=O \rightarrow R\text{-}R$, R_2CH_2, R_2CHR', etc. are listed in this section.



Schmidt, K.; O'Neal, S.; Chan, T.C.; Alexis, C.P.; Uribe, J.M.; Lossener, K.; Gutierrez, C.G. *Tetrahedron Lett.*, ***1989***, *30*, 7301.



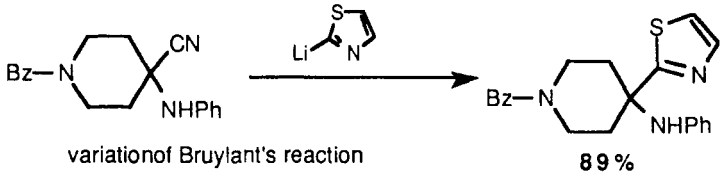
Yang, P.-F.; Ni, Z.-J.; Luh, T.-Y. *J. Org. Chem.*, ***1989***, *54*, 2261.

REVIEW:

"Formation of Six-Membered Aromatic Rings by Cyclialkylation of Some Aldehydes and Ketones"

Bradsher, C.K. *Chem. Rev.*, ***1987***, *87*, 1277.;

SECTION 73 ALKYLS, METHYLENES AND ARYLS FROM NITRILES



variationof Bruylant's reaction

Kudzma, L.V.; Spencer, H.K.; Severnak, S.A. *Tetrahedron Lett.*, ***1988***, *29*, 6827.

SECTION 74: ALKYLS, METHYLENES AND ARYLS FROM ALKENES

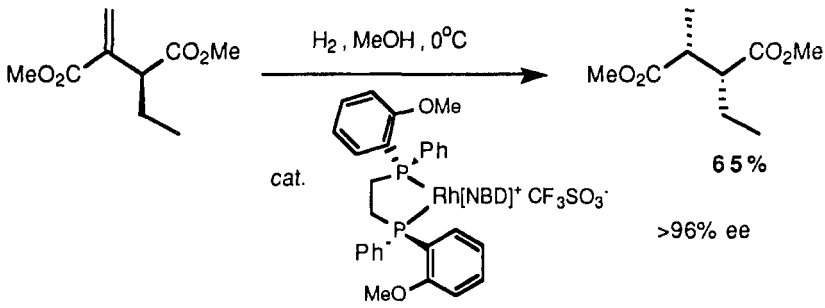
The following reaction types are included in this section:

A. Hydrogenation of Alkenes (and Aryls)
B. Formation of Aryls

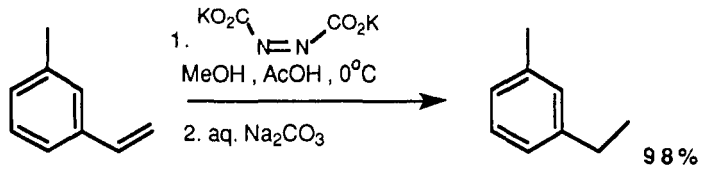
C. Alkylations and Arylations of Alkenes
D. Conjugate Reduction of Conjugated Aldehydes, Ketones, Acids, Esters and Nitriles
E. Conjugate Alkylations
F. Cyclopropanations, including halocyclopropanations

SECTION 74A: Hydrogenation of Alkenes (and Aryls)

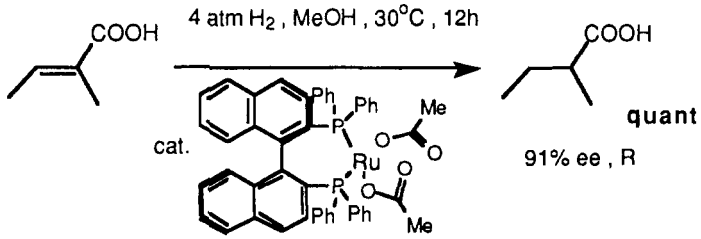
Reduction of aryls to dienes are listed in Section 377 (Alkene-Alkene).



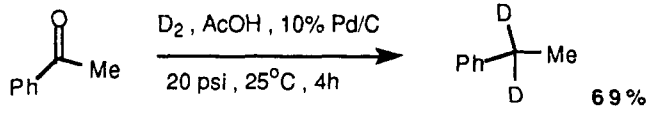
Brown, J.M.; James, A.P. *J. Chem. Soc., Chem. Commun.*, ***1987***, 181.



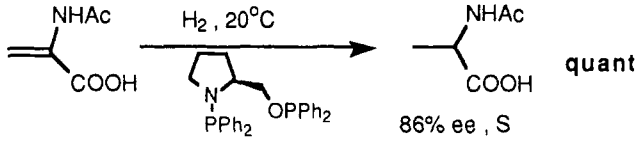
Negoro, T.; Ikeda, Y. *Org. Prep. Proceed. Int.*, ***1987***, *19*, 71.



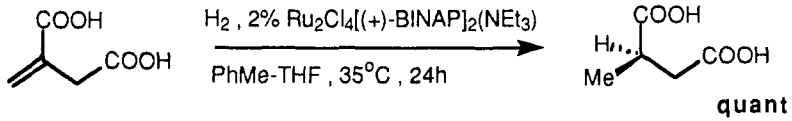
Ohta, T.; Takaya, H.; Kitamura, M.; Nagai, K.; Noyori, R. *J. Org. Chem.*, ***1987***, *52*, 3176.
Takaya, H.; Ohta, T.; Sago, N.; Kimobayashi, H.; Akutagawa, S.; Inoue, S.; Kasahara, I.; Noyori, R. *J. Am. Chem. Soc.*, ***1987***, *109*, 1596.



Ofosu-Asante, K.; Stock, L.M. *J. Org. Chem.*, ***1987***, *52*, 2939.

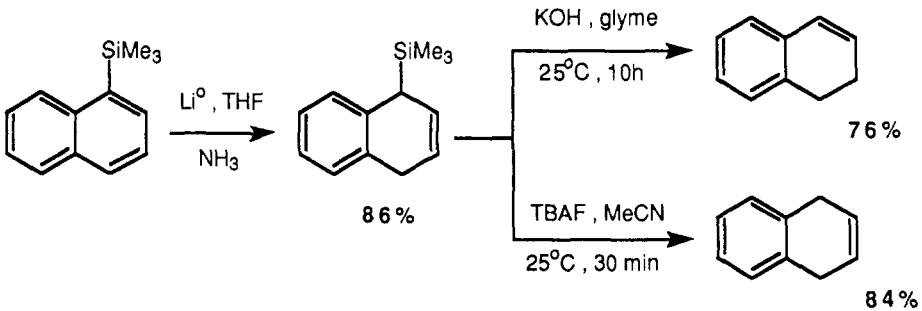


Cesarotti, E.; Chiesa, A.; Prati, L. *Gazz. Chim. Ital.*, ***1987***, *117*, 129.

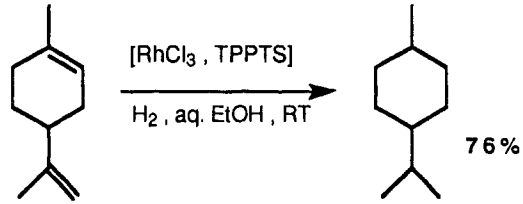


BINAP = R-(+)-2,2'-bis-(diphenylphosphno) 1,1'-binapthyl

Kawano, H.; Ishii, Y.; Ikariya, T.; Saburi, M.; Yoshikawa, S.; Ucida, Y.; Kumobayashi, H. *Tetrahedron Lett.*, ***1987***, *28*, 1905.

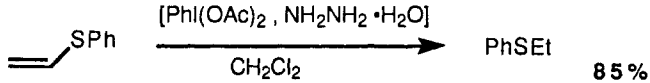


Rabideau, P.W.; Karrick, G.L. *Tetrahedron Lett.*, ***1987***, *28*, 2481



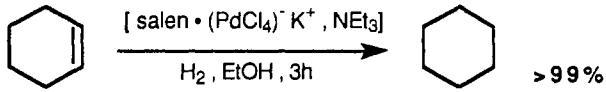
TPPTS = triphenylphosphine meta trisulfonate

Larpent, C.; Dabard, R.; Patin, H. *Tetrahedron Lett.*, ***1987***, *28*, 2507.

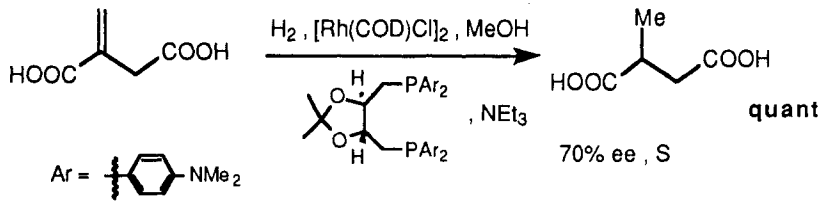


new method to generate diimide

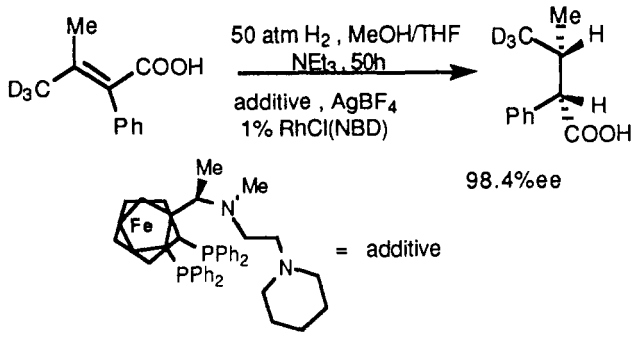
Moriarty, R.M.; Vaid, R.K.; Duncan, M.P. *Synth. Commun.*, ***1987***, *17*, 703.



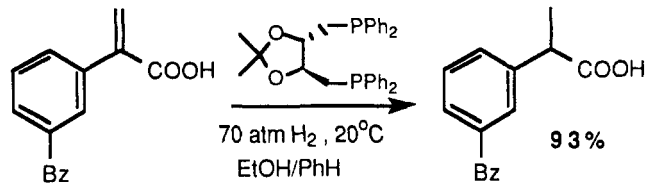
Kerr, J.M.; Suckling, C.J. *Tetrahedron Lett.*, ***1988***, *29*, 5545.



Morimoto, T.; Chiba, M.; Achiwa, K. *Tetrahedron Lett.*, ***1988***, *29*, 4755.



Hayashi, T.; Kawamura, N.; Ito, Y. *Tetrahedron Lett.*, ***1988***, *29*, 5969.



Sunjić, V.; Habuš, I.; Comisso, G.; Moimas, F. *Gazz. Chim. Ital.*, ***1989***, *119*, 229.

REVIEWS:

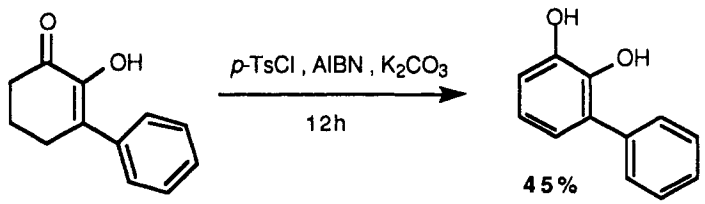
"Recent Advances in Catalytic Asymmetric Reactions Promoted by Transition Metal Complexes"

Ojima, I.; Clos, N.; Bastos, C. *Tetrahedron*, ***1989***, *45*, 6901.

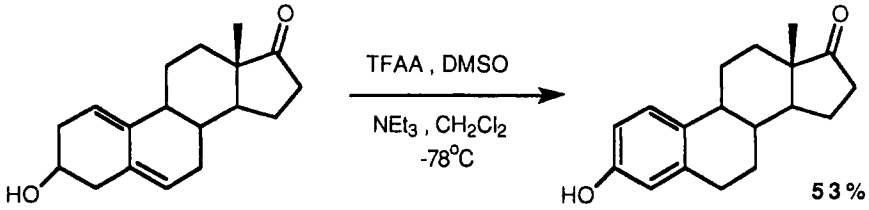
"Ammonium Formate in Organic Synthesis: A Versatile Agent in Catalytic Hydrogen Transfer Reductions"

Ram, S.; Ehrenkaufer, R.E. *Synthesis*, ***1988***, 91.

SECTION 74B: Formation of Aryls

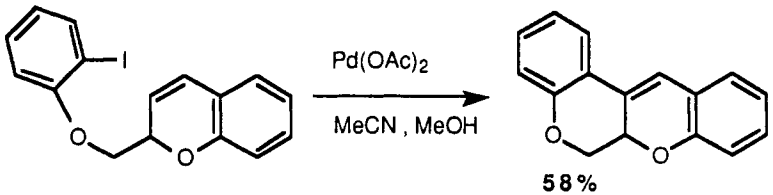


Feigenbaum, A.; Pete, J.-P.; Poquet-Dhimane, A. *Tetrahedron Lett.*, ***1988***, *29*, 73.

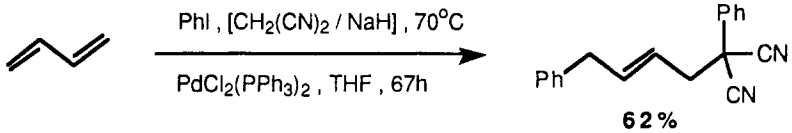


Suginone, H.; Senboku, H.; Yamada, S. *Tetrahedron Lett.*, ***1988***, *29*, 79.

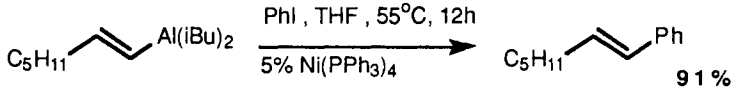
SECTION 74C: Alkylations and Arylations of Alkenes



Amos, P.C.; Whiting, D.A. *J. Chem. Soc., Chem. Commun.*, ***1987***, 510.



Uno, M.; Takahashi, T.; Takahashi, S. *J. Chem. Soc., Chem. Commun.*, ***1987***, 785.



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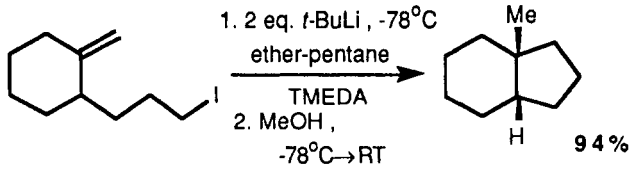

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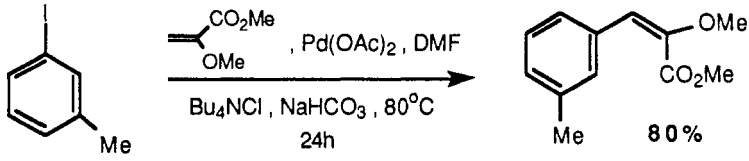

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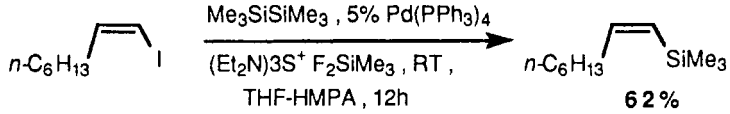

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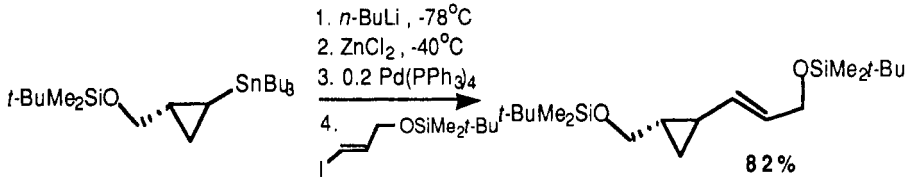

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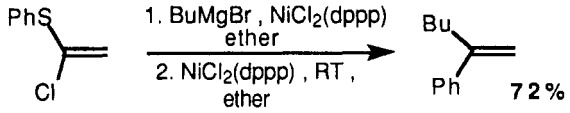

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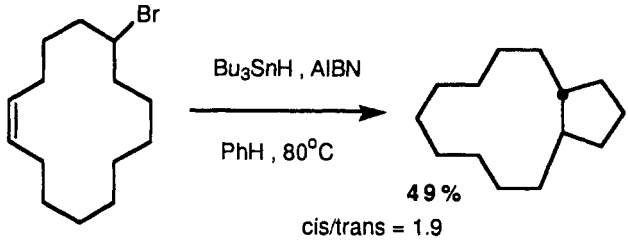

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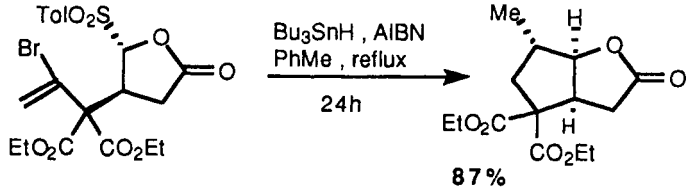

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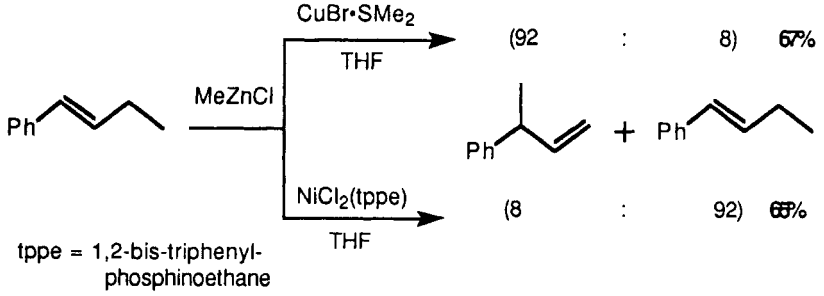

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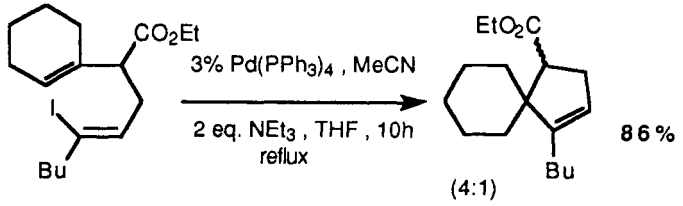

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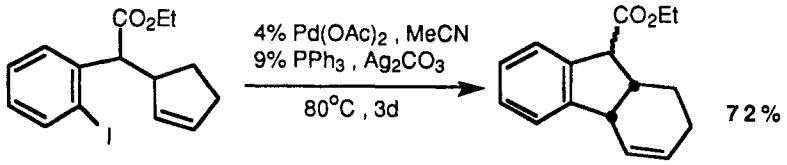

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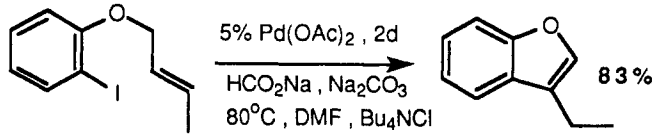

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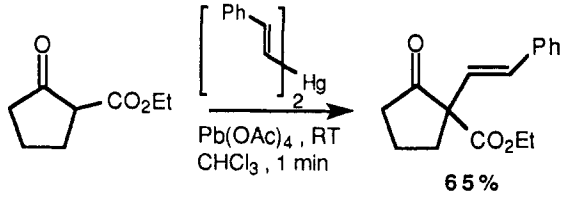

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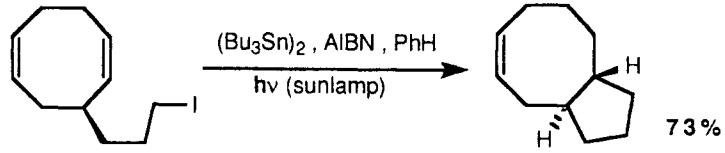

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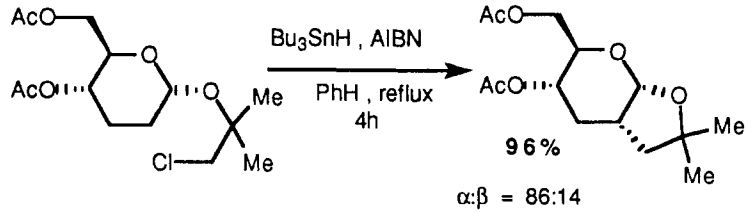

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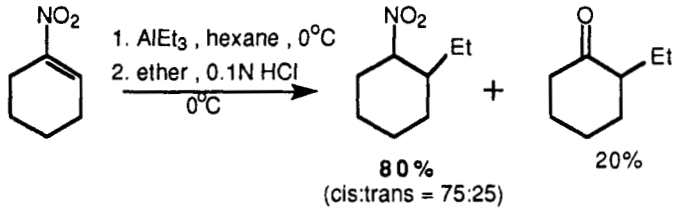

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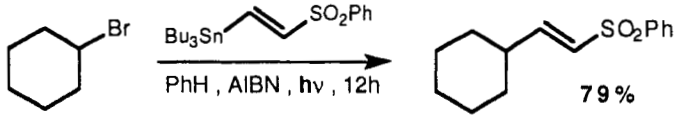

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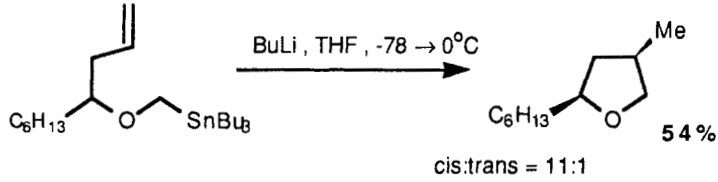

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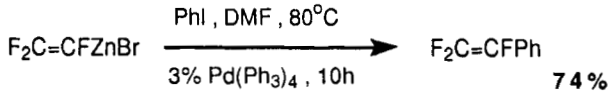

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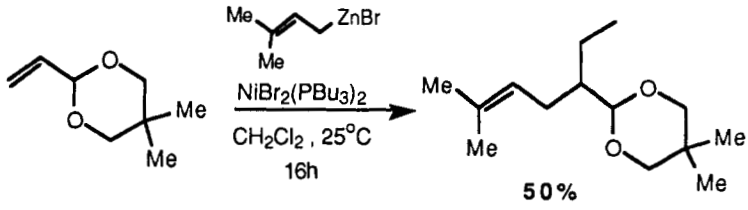

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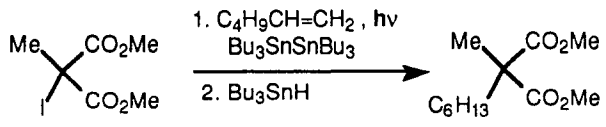

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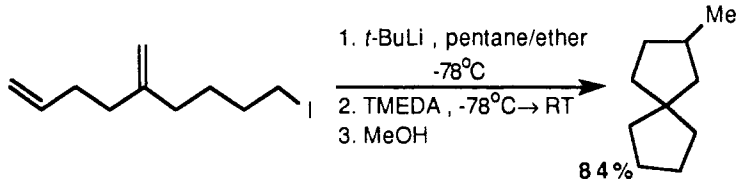

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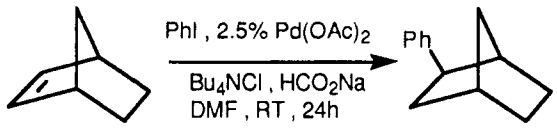

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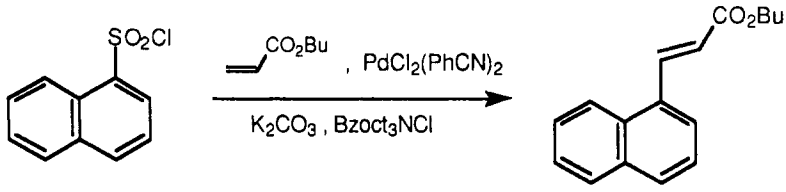

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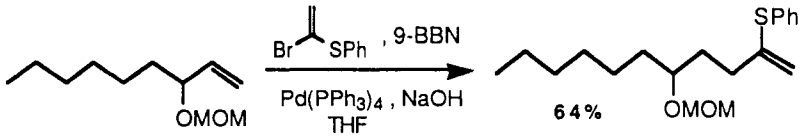

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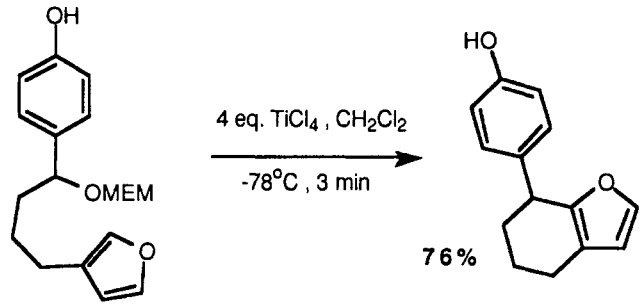

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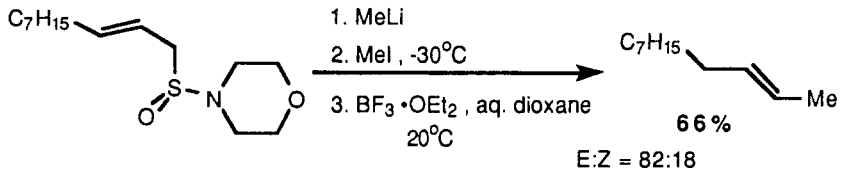

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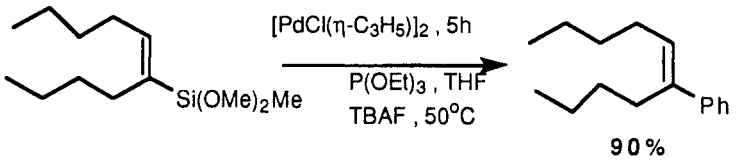

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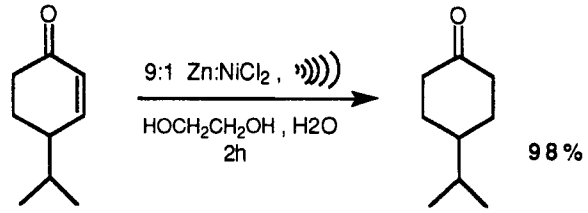
SECTION 74D: Conjugate Reduction of α,β-Unsaturated Aldehydes, Ketones, Acids, Esters and Nitriles



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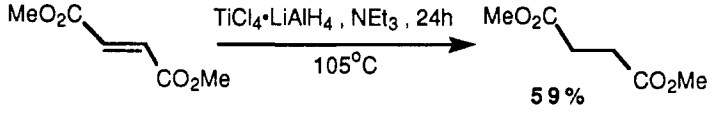

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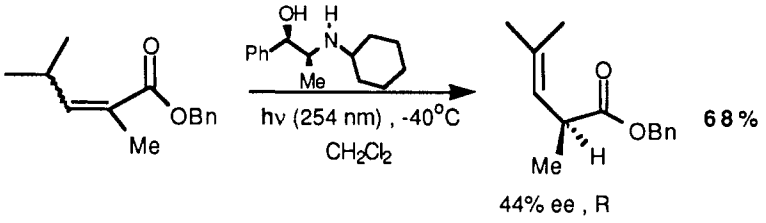

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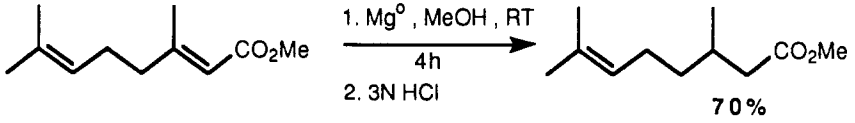

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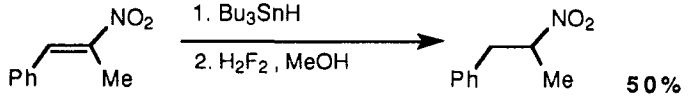

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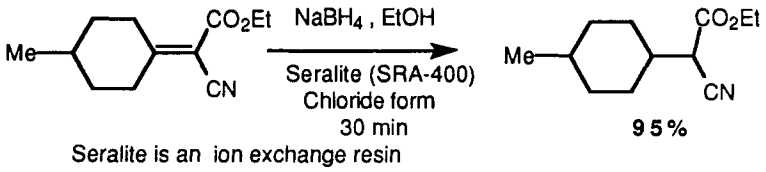

Seralite is an ion exchange resin

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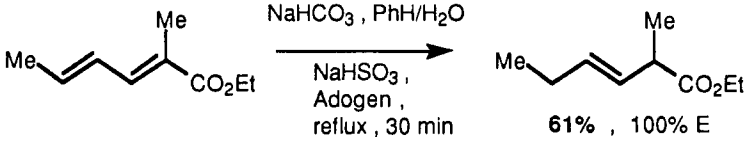

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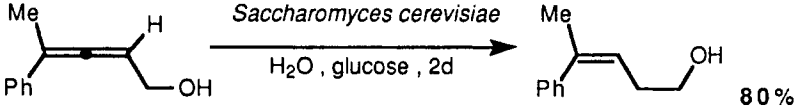

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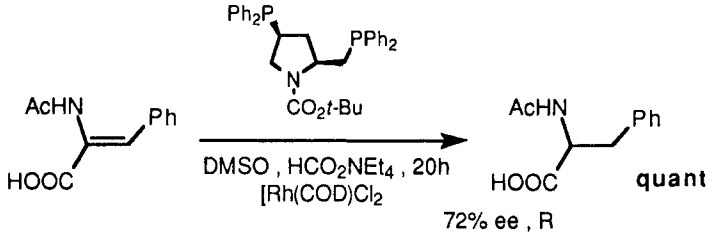

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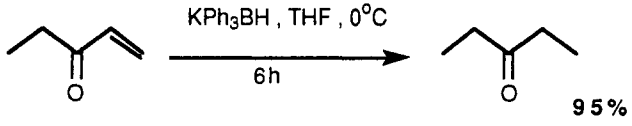

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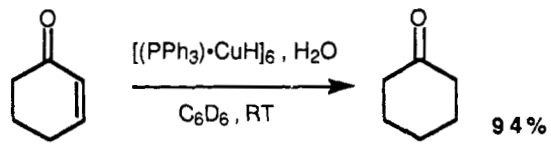

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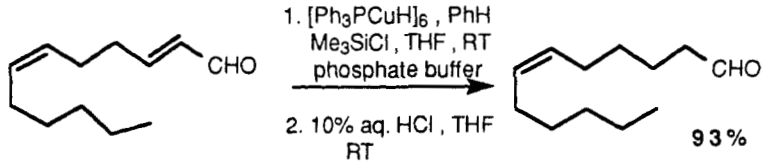

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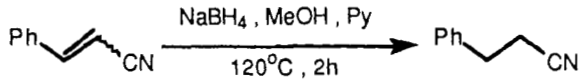

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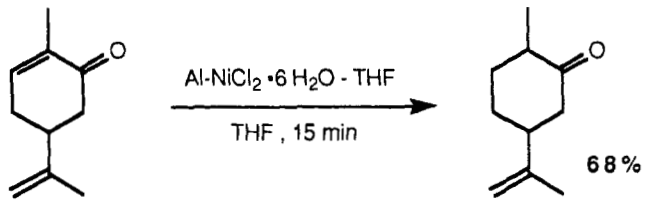

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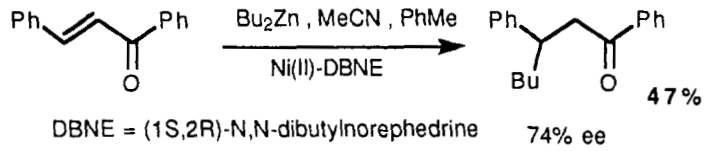

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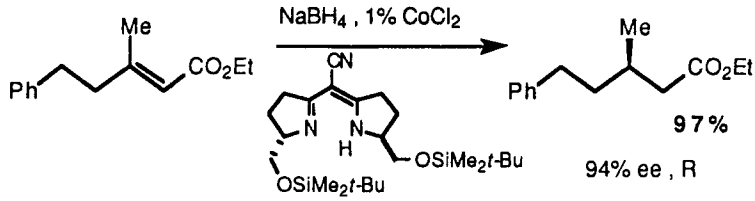

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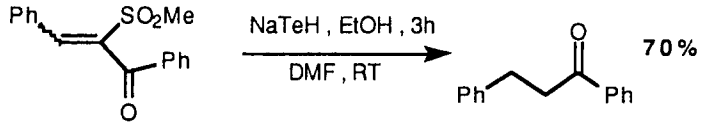

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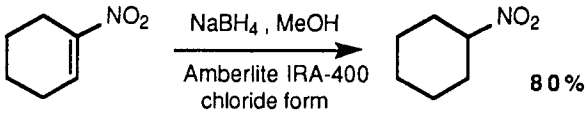

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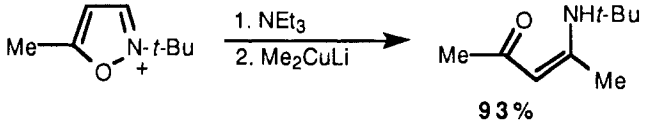

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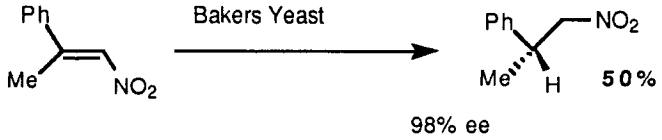

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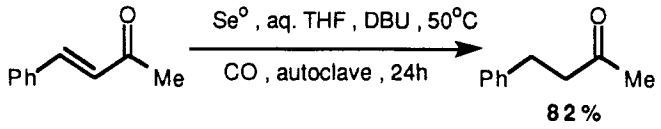

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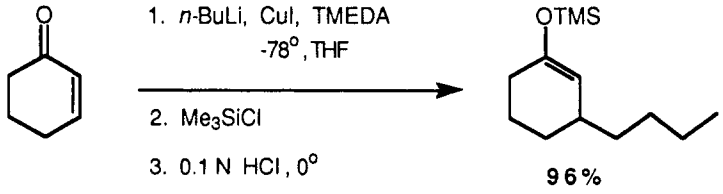
SECTION 74E: Conjugate Alkylations



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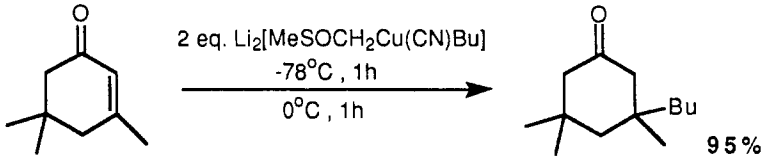

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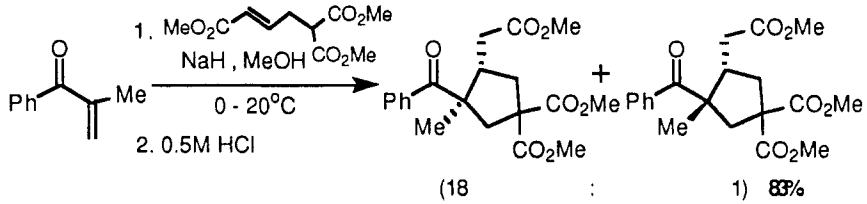

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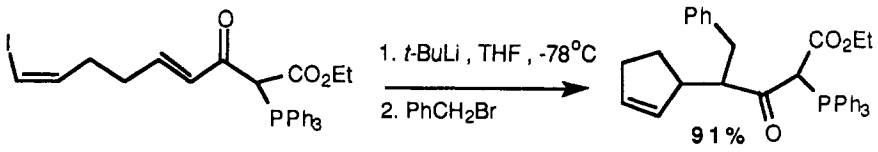

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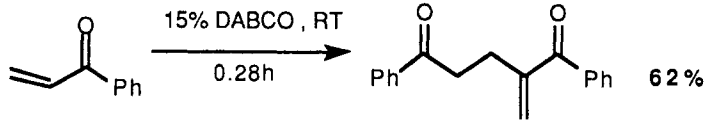

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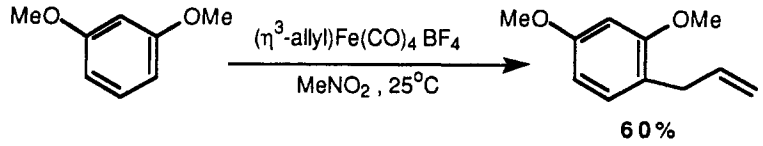

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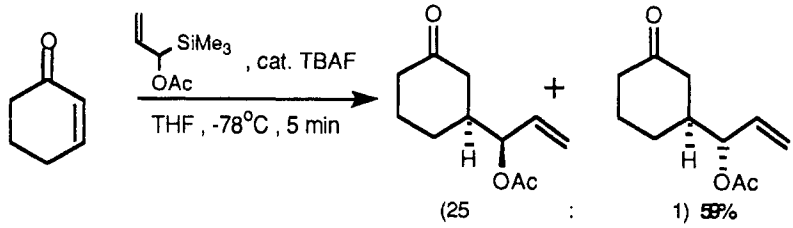

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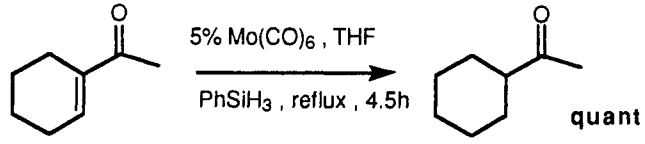

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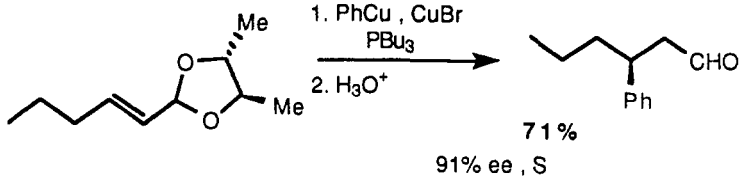

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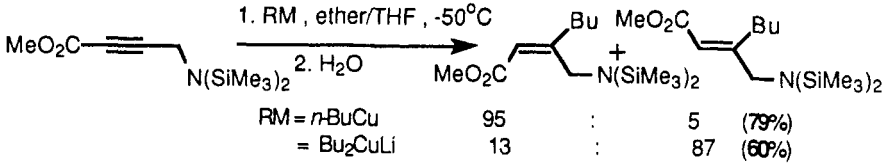

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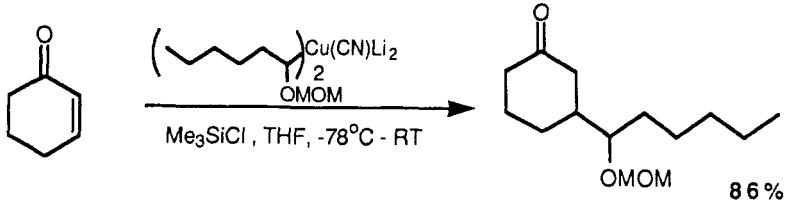

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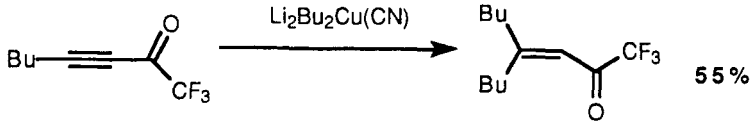

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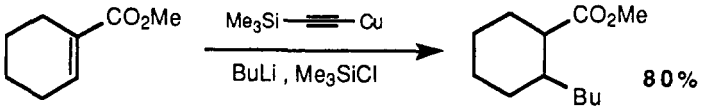

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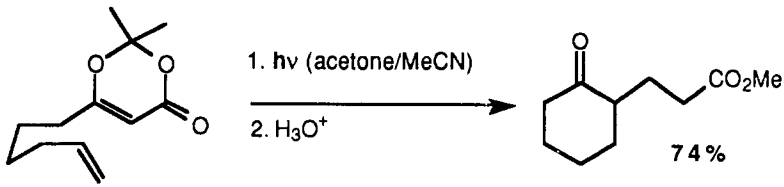

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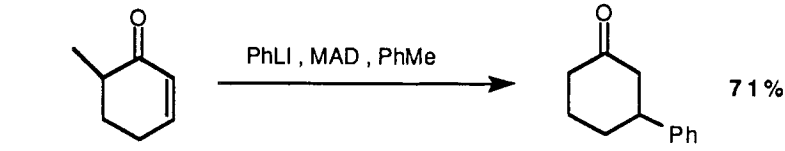

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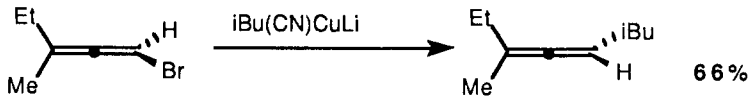

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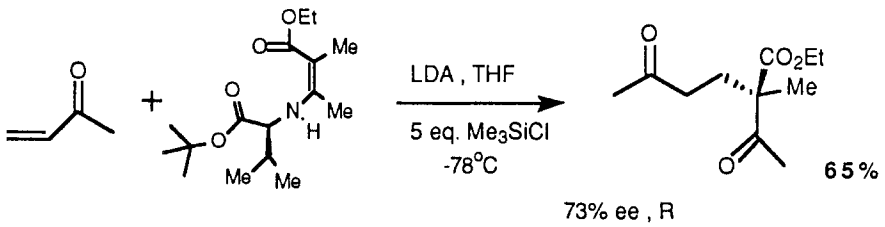

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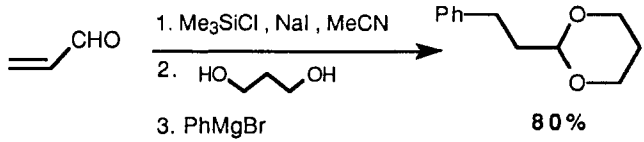

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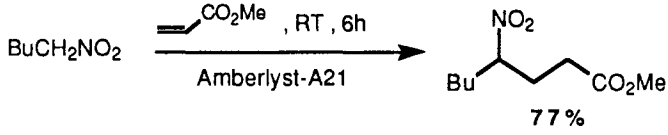

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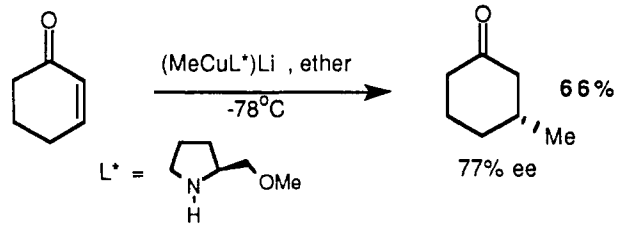

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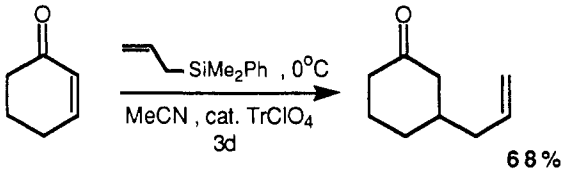

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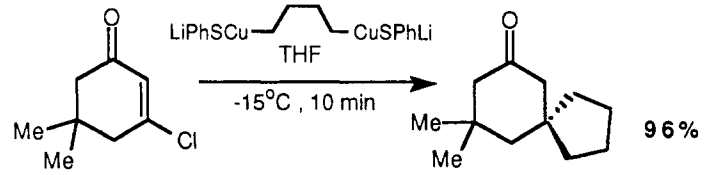

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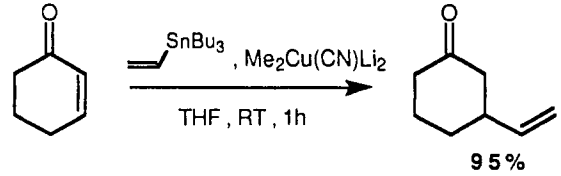

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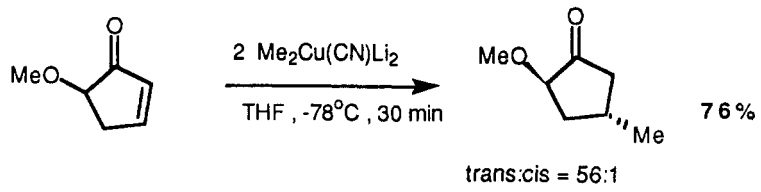

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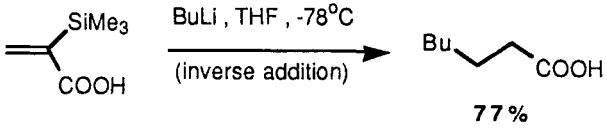

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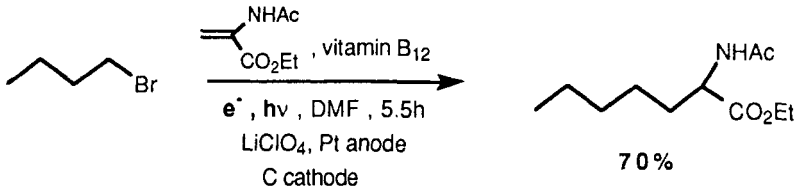

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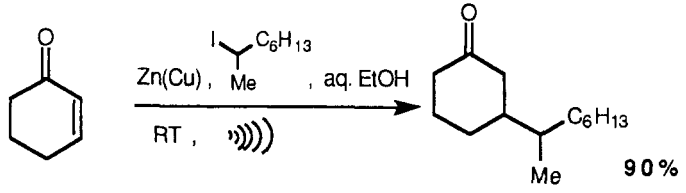

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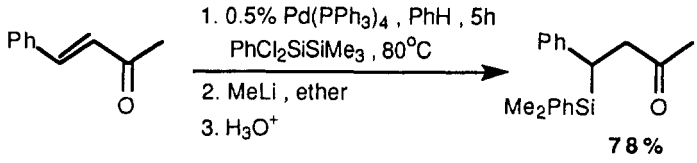

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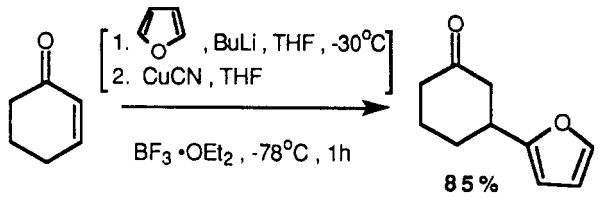

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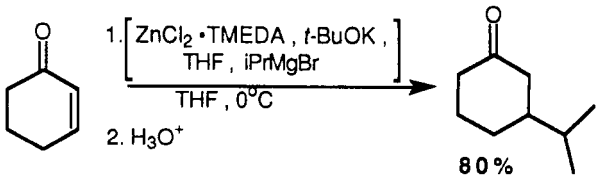

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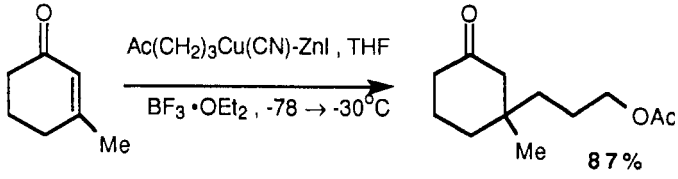

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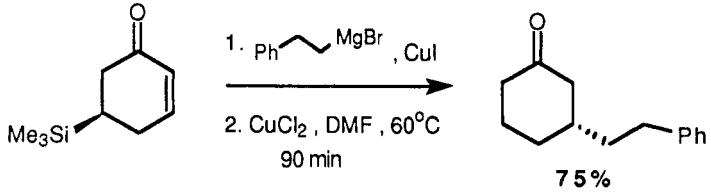

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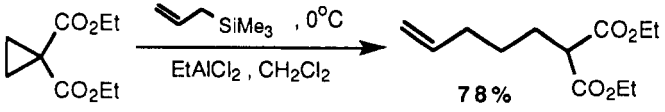

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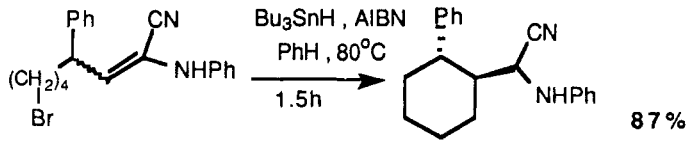

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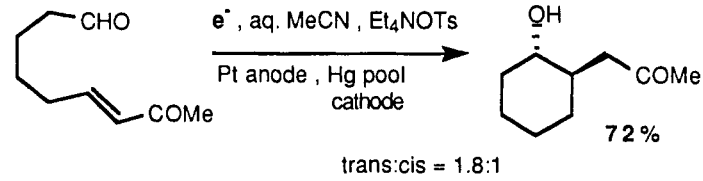
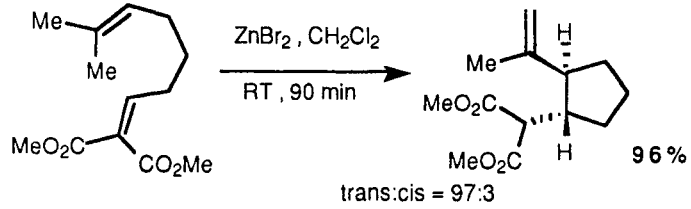


Little, R.D.; Fox, D.P.; Van Hijfte, L.; Dannecker, R.; Sowell, G.; Wolin, R.L.; Moëns, L.; Baizer, M.M. *J. Org. Chem.*, ***1988***, *53*, 2287.



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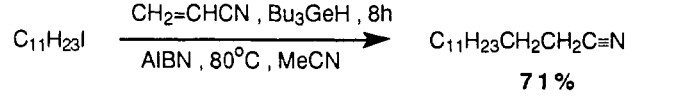

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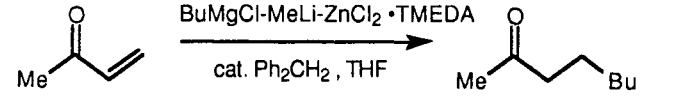

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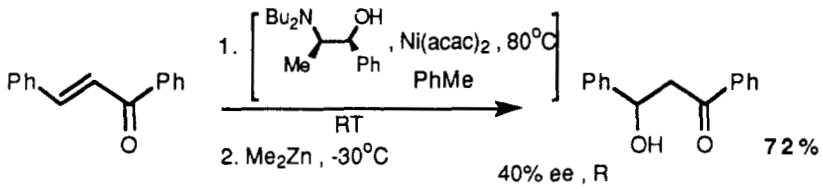

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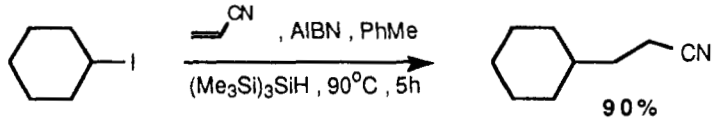

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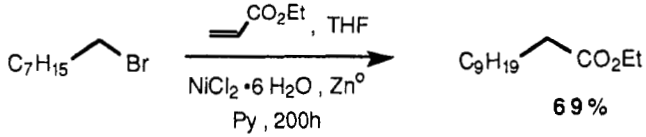

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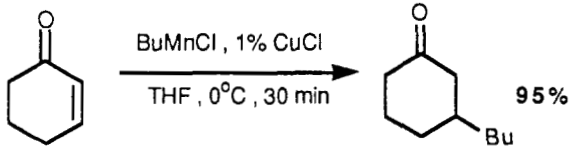

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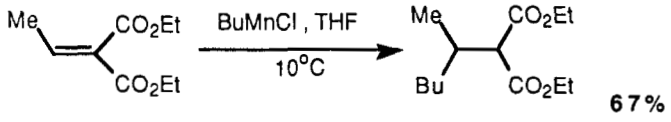

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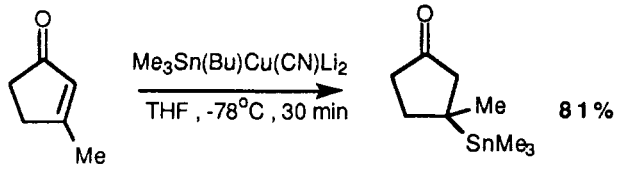

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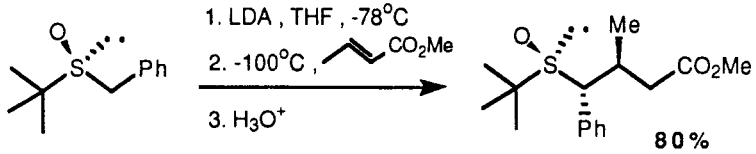

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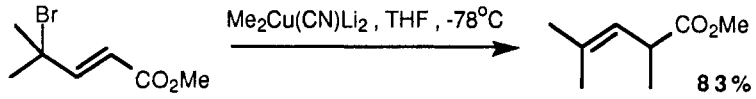

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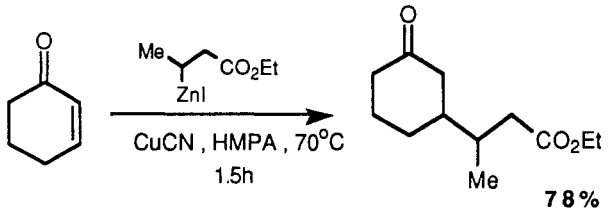

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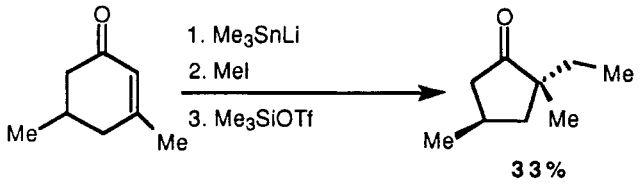

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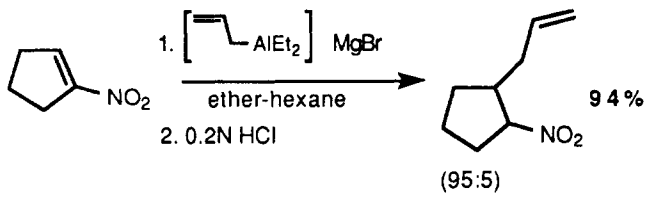

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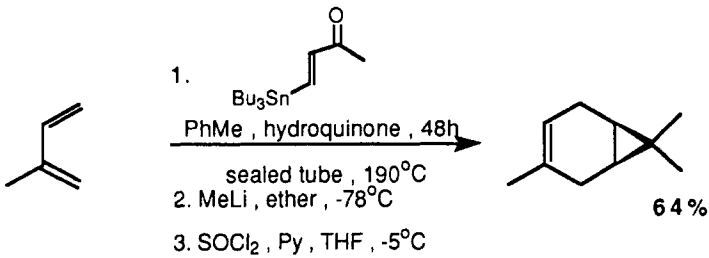
SECTION 74F: Cyclopropanations, including Halocyclopropanations



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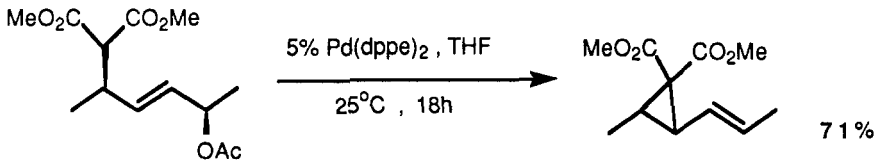

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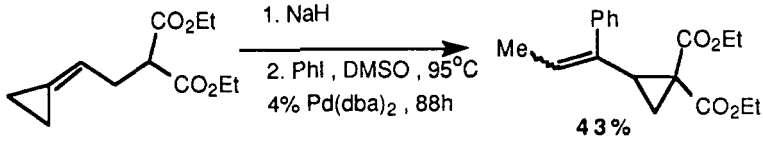

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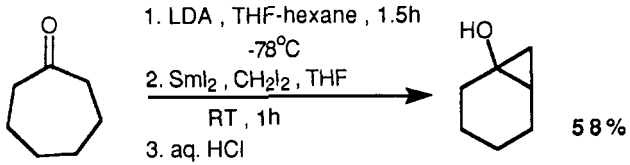

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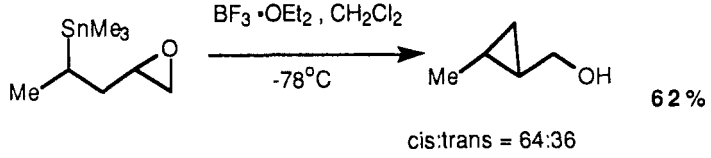

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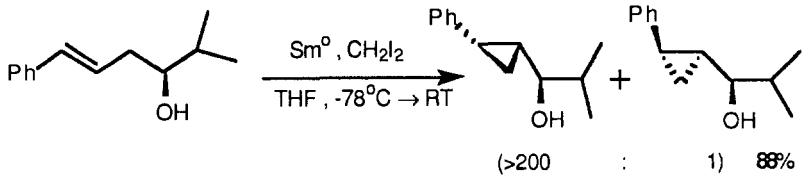

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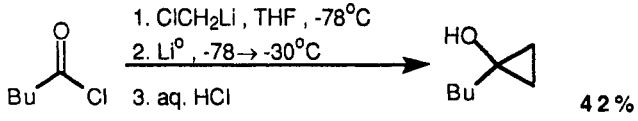

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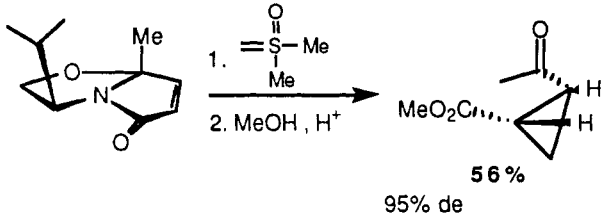

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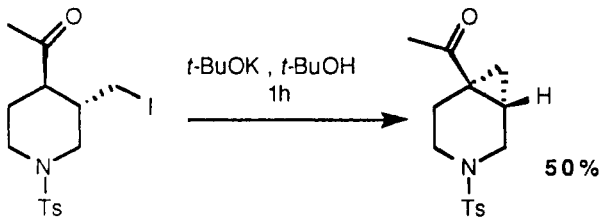

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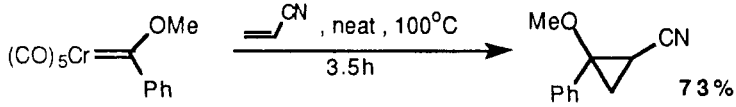

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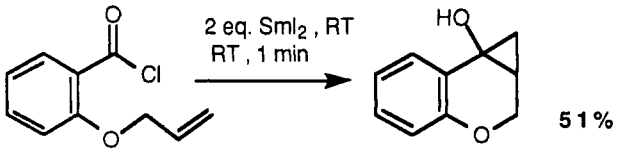

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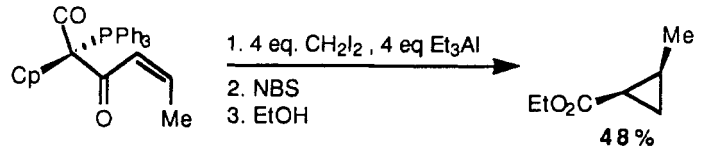

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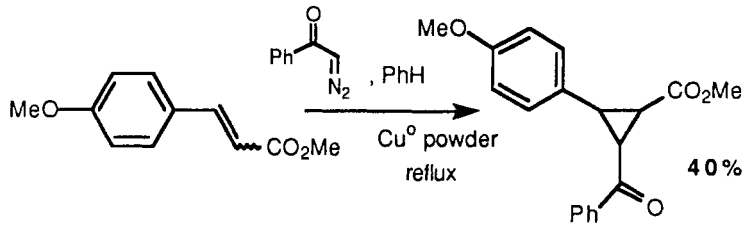

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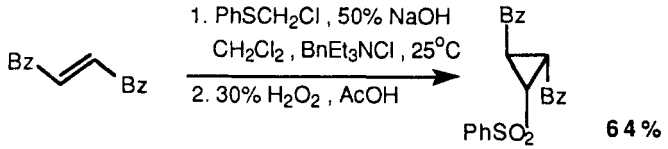

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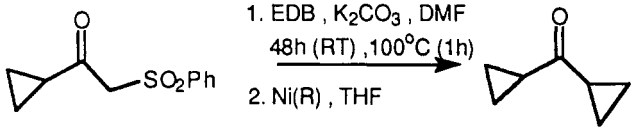

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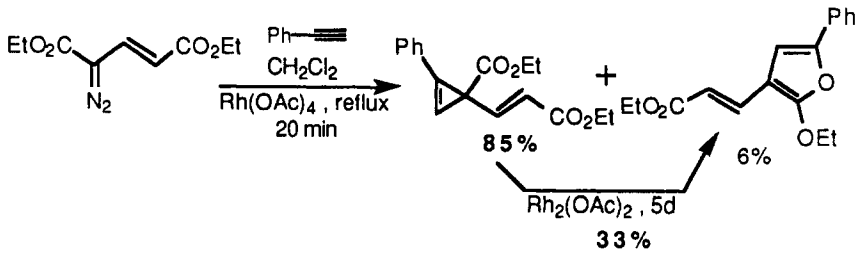

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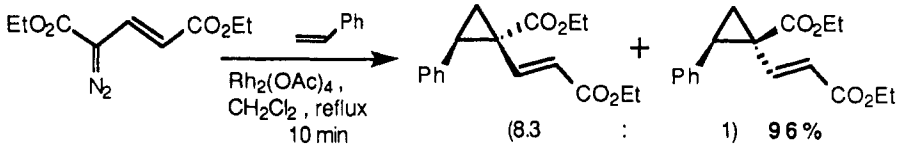

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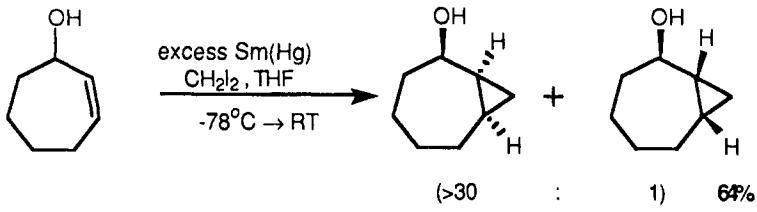

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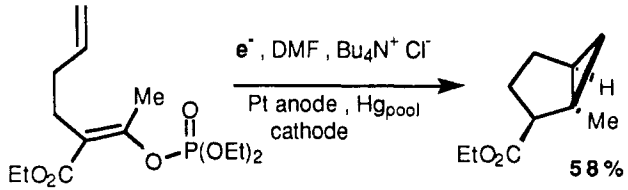

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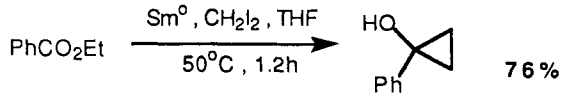

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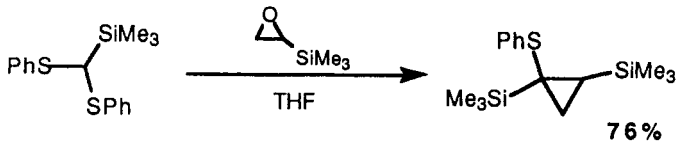

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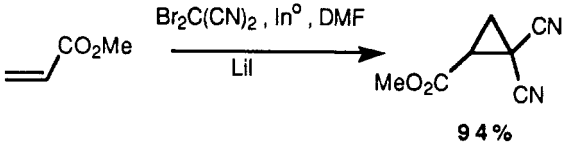

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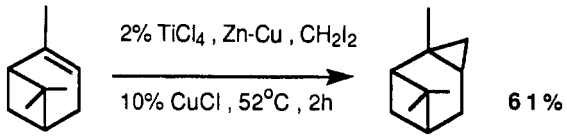

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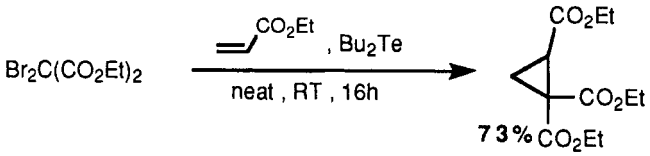

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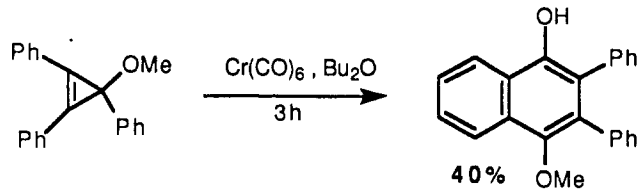
SECTION 75: ALKYLS, METHYLENES AND ARYLS FROM MISCELLANEOUS COMPOUNDS



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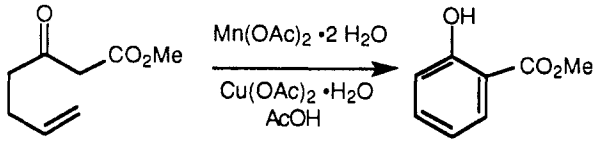

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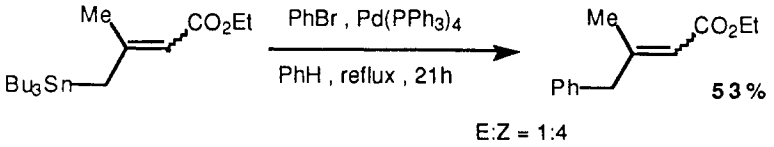

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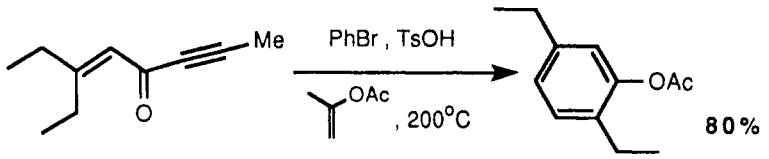

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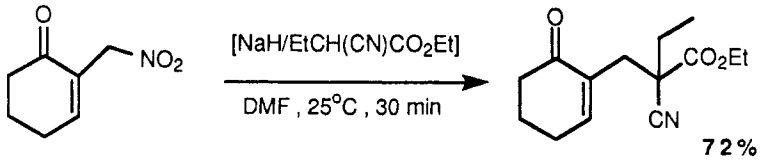

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"Anionic Approaches to the Construction of Cyclopentanoids"

Hudlicky, T.; Price, J.D. *Chem. Rev.,* ***1989,*** *89*, 1467.

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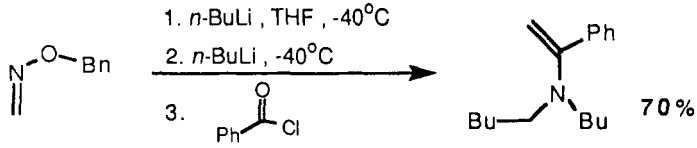
CHAPTER 6
PREPARATION OF AMIDES

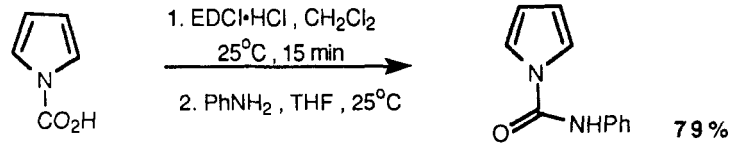
SECTION 76: AMIDES FROM ALKYNES

NO ADDITIONAL EXAMPLES

SECTION 77: AMIDES FROM ACID DERIVATIVES

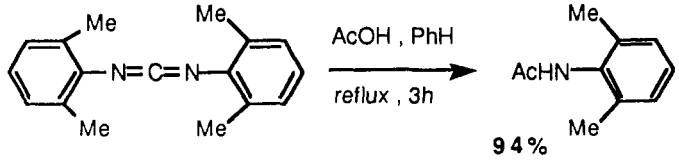


Basha, A.; Brooks, D.W. *J. Chem. Soc., Chem. Commun.*, ***1987***, 305.

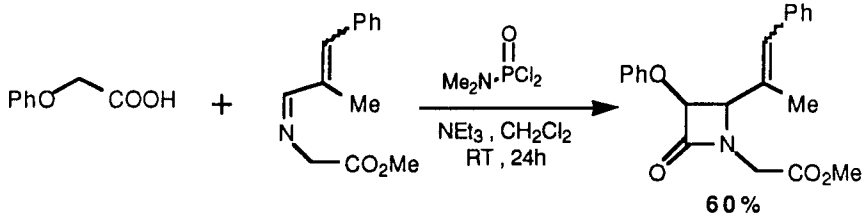


EDCI = 1-[3-(dimethylamino)propyl]-3-ethyl carbodiimide

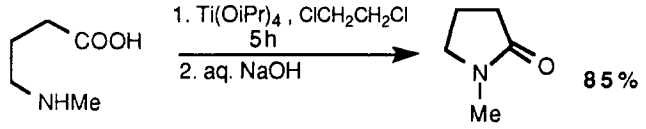
Boger, D.L.; Patel, M. *J. Org. Chem.*, ***1987***, *52*, 2319.



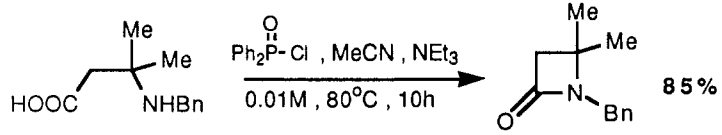
Vovk, M.V.; Dorohkov, V.I.; Samarai, L.I. *J. Org. Chem., U.S.S.R.*, ***1987***, *23*, 1212.



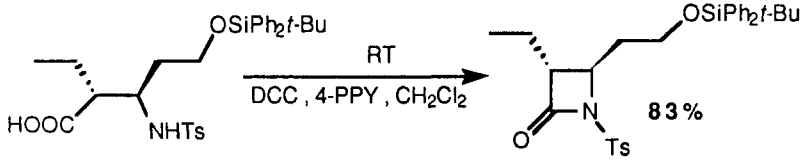
Cossío, F.P.; Ganbua, I.; García, J.M.; Lecea, B.; Palomo, C. *Tetrahedron Lett.*, ***1987***, *28*, 1945.



Mader, M.; Helquist, P. *Tetrahedron Lett.*, ***1988***, *29*, 3049.

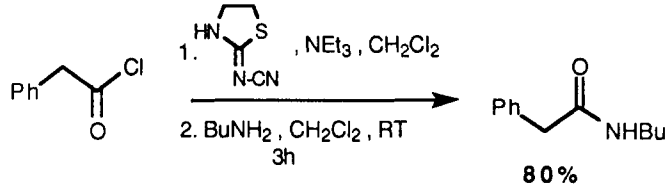


Kim, S.; Lee, P.H.; Lee, T.A. *J. Chem. Soc., Chem. Commun.*, ***1988***, 1242.
Kim, S.; Lee, P.H.; Lee, T.A. *Synth. Commun.*, ***1988***, *18*, 247.

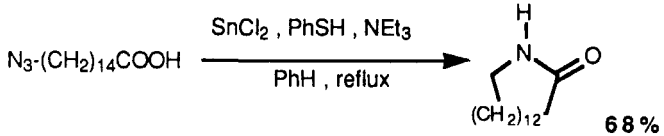


4-PPY = 4-pyrrolidino pyridine

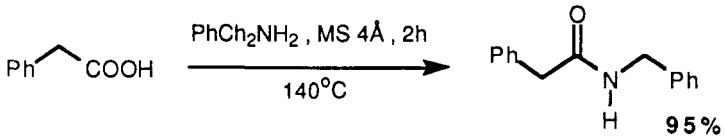
Tanner, D.; Somfai, P. *Tetrahedron*, ***1988***, *44*, 613.



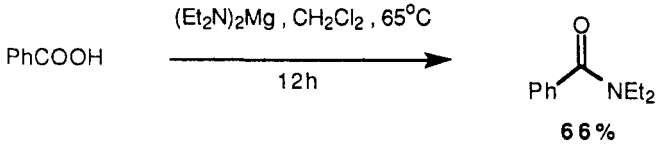
Iwata, C.; Watanabe, M.; Okamoto, S.; Fujimoto, M.; Sakae, M.; Katsurada, M.; Imanishi, T. *Heterocycles, **1988**, 27*, 323.



Barta, M.; Bou, V.; Garcia, J.; Urpi, F.; Vilarrasa, J. *J. Chem. Soc., Chem. Commun., **1988**,* 270.

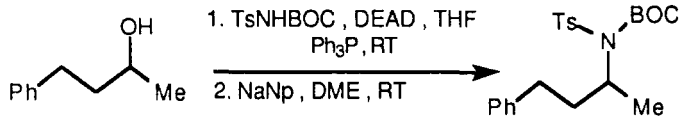


Cossy, J.; Pale-Grosdemange, C. *Tetrahedron Lett., **1989**, 30*, 2771.

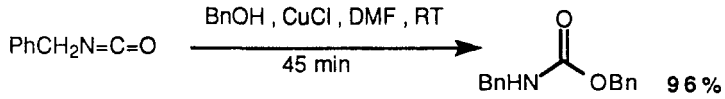


Sanchez, R.; Vest, G.; Despres, L. *Synth. Commun., **1989**, 19*, 2909.

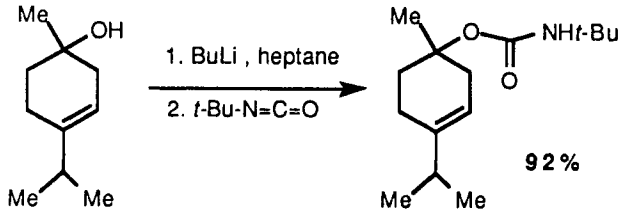
SECTION 78: AMIDES FROM ALCOHOLS AND THIOLS



Henry, J.R.; Marcin, L.R.; McIntosh, M.C.; Scola, P.M.; Harris Jr., G.D.; Weinreb, S.M. *Tetrahedron Lett., **1989**, 30*, 5709.

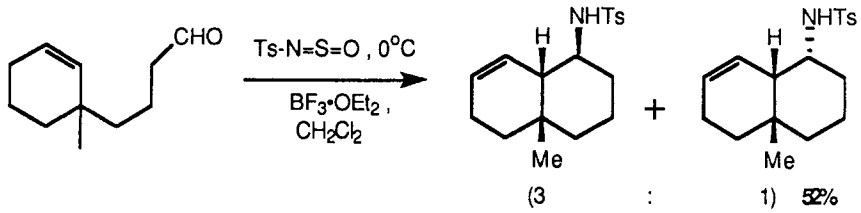


Duggan, M.E.; Imagire, J.S. *Synthesis, **1989**,* 131.

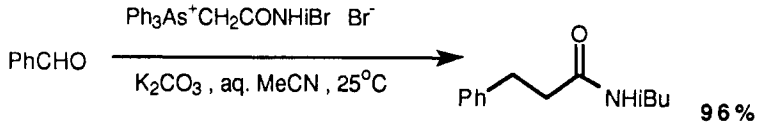


Nikifurov, A.; Jirovetz, L.; Buchbauer, G. *Liebigs Ann. Chem.*, ***1989***, 489.

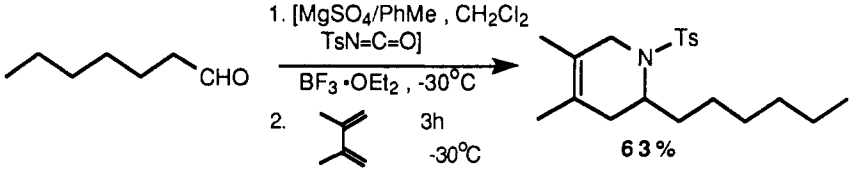
SECTION 79: AMIDES FROM ALDEHYDES



Melnick, M.J.; Freyer, A.J.; Weinreb, S.M. *Tetrahedron Lett.*, ***1988***, *29*, 3891.



Shi, L.; Yang, J.; Wen, X.; Huang, Y.-Z. *Tetrahedron Lett.*, ***1989***, *30*, 3949.



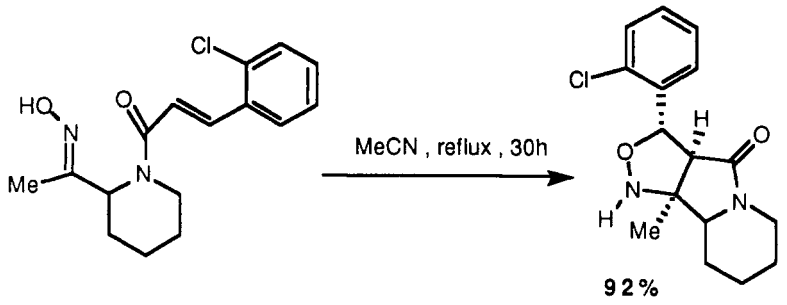
Sisko, J.; Weinreb, S.M. *Tetrahedron Lett.*, ***1989***, *30*, 3037.

SECTION 80: AMIDES FROM ALKYLS, METHYLENES AND ARYLS

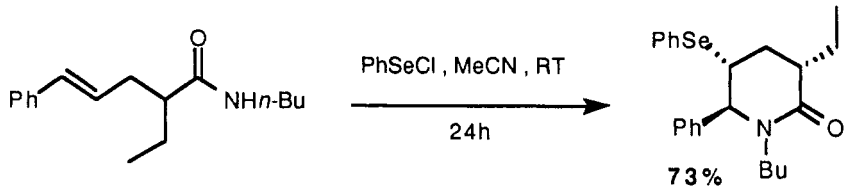
NO ADDITIONAL EXAMPLES

SECTION 81: AMIDES FROM AMIDES

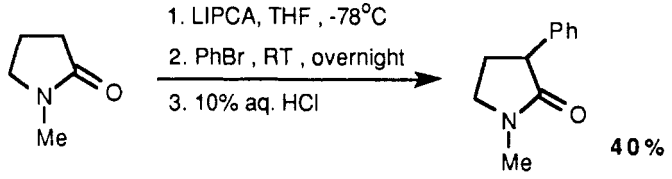
Conjugate reductions of unsaturated amides are listed in Section 74D (Alkyls from Alkenes).



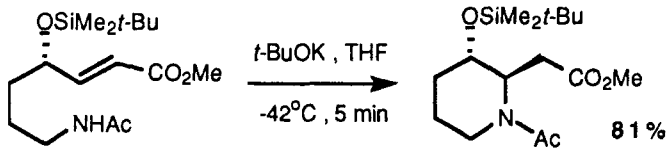
Norman, M.H.; Heathcock, C.H. *J. Org. Chem.*, ***1987***, *52*, 226.



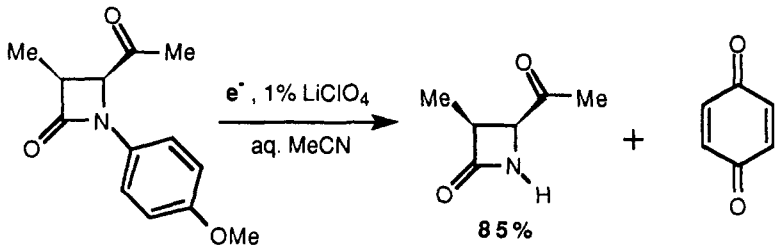
Toshimitsu, A.; Terao, K.; Uemura, S. *J. Org. Chem.*, ***1987***, *52*, 2018.



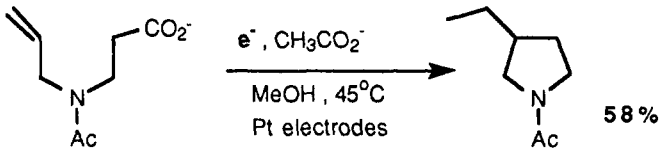
Stewart, J.D.; Fields, S.C.; Kochhar, K.S.; Pinnick, H.W. *J. Org. Chem.*, ***1987***, *52*, 2110.



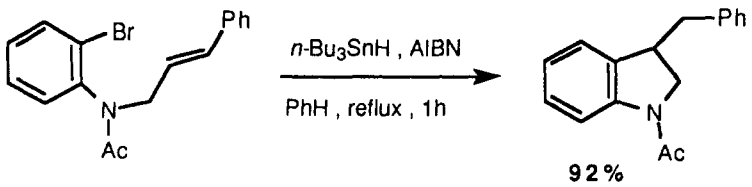
Hirama, M.; Iwakuma, T.; Itô, S. *J. Chem. Soc., Chem. Commun.*, ***1987***, 1523.



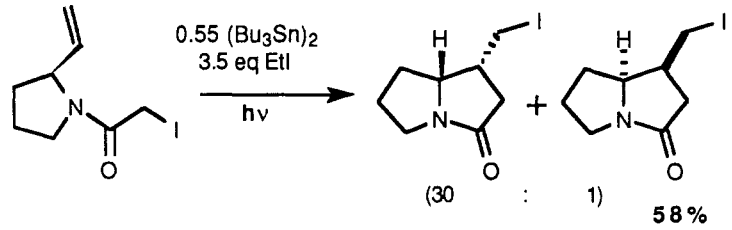
Corley, E.G.; Karady, S.; Abramson *Tetrahedron Lett.*, ***1988***, *29*, 1497.



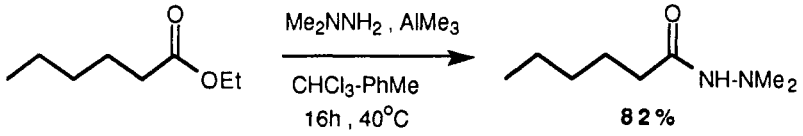
Becking, L.; Schäfer, H.J. *Tetrahedron Lett.*, ***1988***, *29*, 2797.



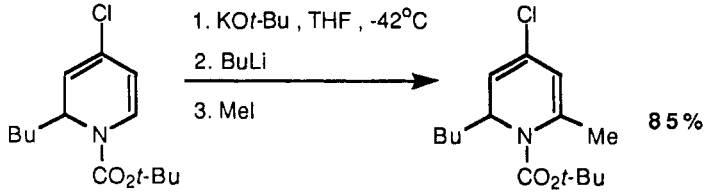
Dittami, J.P.; Ramanathan, H. *Tetrahedron Lett.*, ***1988***, *29*, 45.



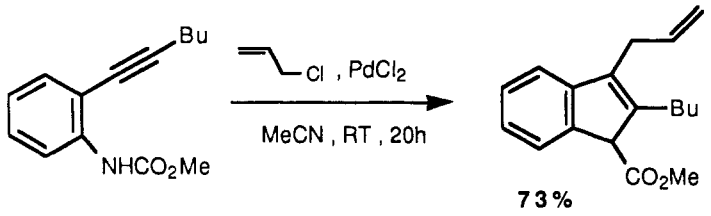
Jolly , R.S.; Livinghouse, T. *J. Am. Chem. Soc.*, ***1988***, *110*, 7536.



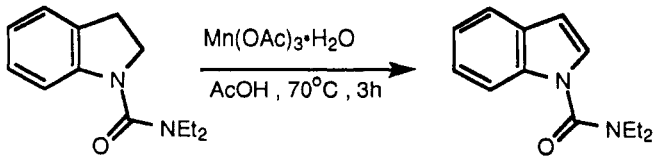
Benderly, A.; Stabchansky, S. *Tetrahedron Lett.*, ***1988***, *29*, 739.



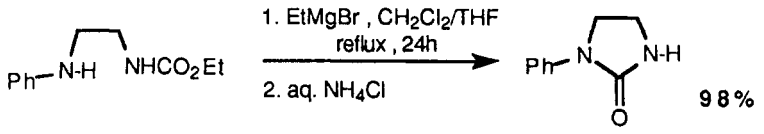
Comins, D.L.; Weglarz, M.A.; O'Connor, S. *Tetrahedron Lett.*, ***1988***, *29*, 1751.



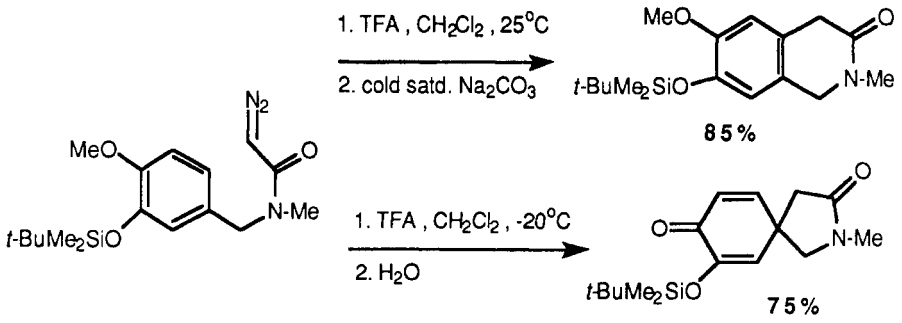
Iritani, K.; Matsubara, S.; Utimoto, K. *Tetrahedron Lett.*, ***1988***, *29*, 1799.



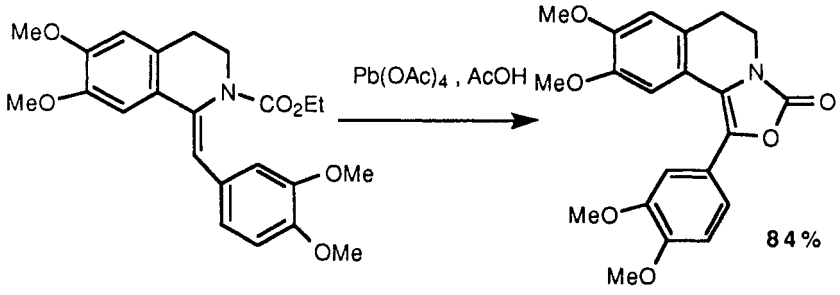
Ketcha, D.M. *Tetrahedron Lett.*, ***1988***, *29*, 2151.



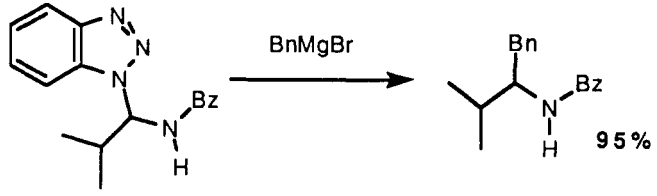
Basha, A. *Tetrahedron Lett.*, ***1988***, *29*, 2525.



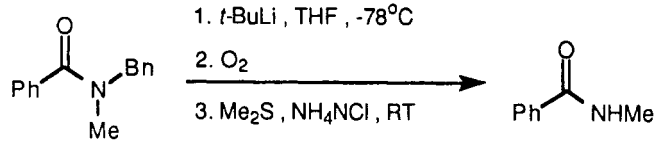
Rishton, G.M.; Schwartz, M.A. *Tetrahedron Lett.*, ***1988***, *29*, 2643.



Lenz, G.R.; Costanza, C. *J. Org. Chem.*, ***1988***, *53*, 1176.



Katritzky, A.R.; Drewniaki, M.; Lue, P. *J. Org. Chem.*, ***1988***, *53*, 5854.



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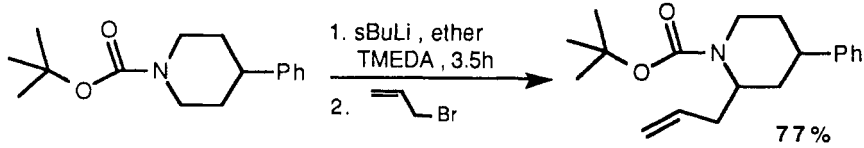
Williams, R.M.; Kwast, E. *Tetrahedron Lett.*, ***1989***, *30*, 451.



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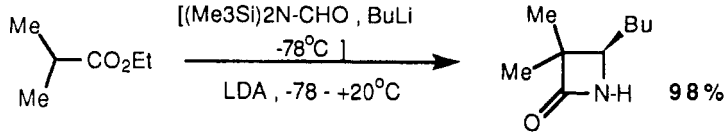
Beak, P.; Lee, W.-K. *Tetrahedron Lett.*, ***1989***, *30*, 1197.



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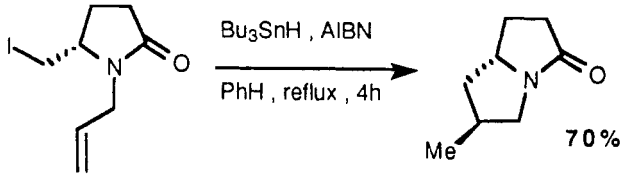
Uyehara, T.; Suzuki, I.; Yamamoto, Y. *Tetrahedron Lett.*, ***1989***, *30*, 4275.



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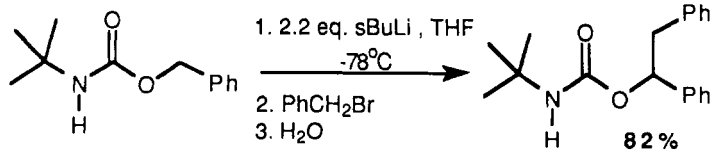
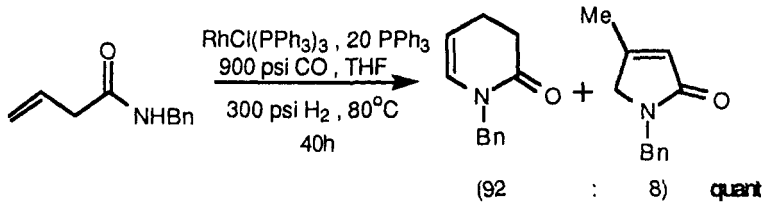
Keusenkothen, P.F.; Smith, M.B. *Tetrahedron Lett.*, ***1989***, *30*, 3369.

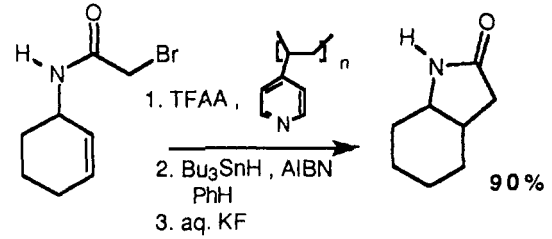


82%

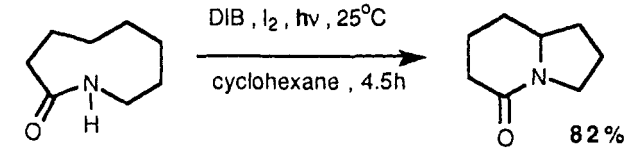
Barner, B.A.; Mani, R.S. *Tetrahedron Lett.*, ***1989***, *30*, 5413.



Ojima, I.; Korda, A. *Tetrahedron Lett.*, ***1989***, *30*, 6283.

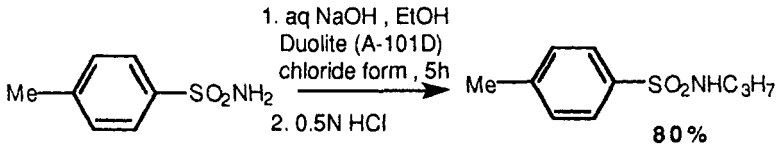


Stork, G.; Mah, R. *Heterocycles*, ***1989***, *28*, 723.



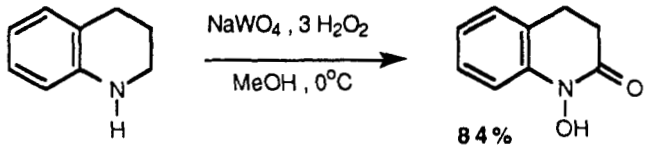
DIB = (diacetoxyiodo) benzene

Dorta, R.L.; Francisco, C.G.; Suárez, E. *J. Chem. Soc., Chem. Commun.*, ***1989***, 1168.

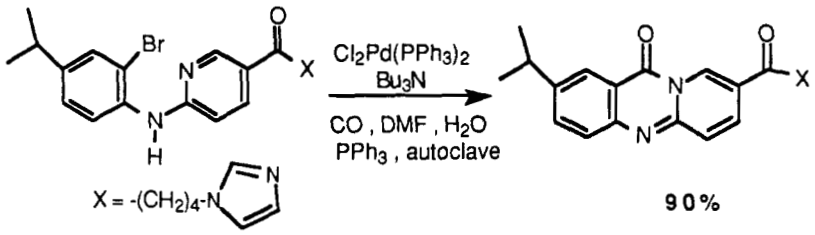


Sanghavi, N.M.; Parab, V.L.; Patravale, B.S.; Patel, M.N. *Synth. Commun.*, ***1989***, *19*, 1499.

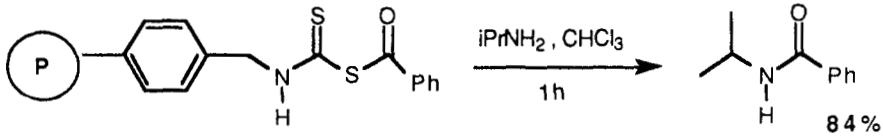
SECTION 82: AMIDES FROM AMINES



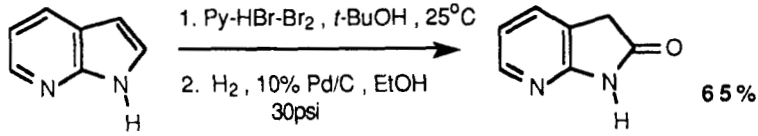
Murahashi, S.I.; Oda, T.; Sugahara, T.; Masui, Y. *J. Chem. Soc., Chem. Commun.*, ***1987***, 1471.



Tilley, J.W.; Coffen, D.L.; Schaer, B.H.; Lind, J. *J. Org. Chem.*, ***1987***, *52*, 2469.



Haridasan, V.K.; Ajayaghosh, A.; Pillai, V.N.R. *J. Org. Chem.*, ***1987***, *52*, 2662.



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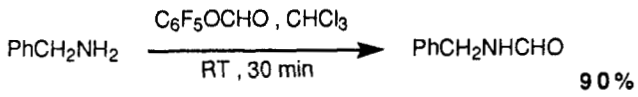
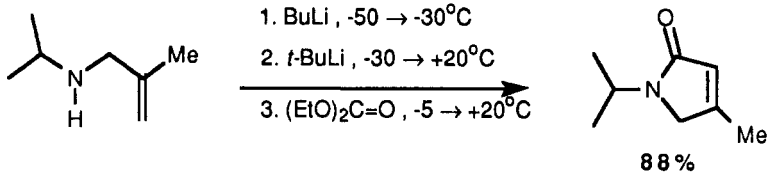
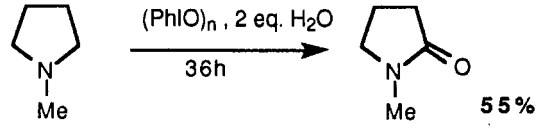


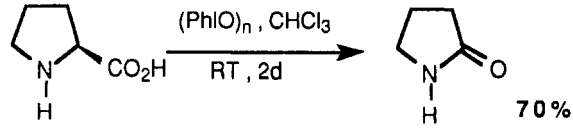
Kisfaludy, L.; Ötvös Jr., L. *Synthesis*, ***1987***, 510.



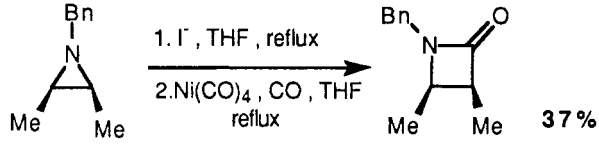
Barluenga, J.; Fañanás, F.J.; Foubelo, F.; Yus, M. *Tetrahedron Lett.*, ***1988***, *29*, 4859.



Moriarty, R.M.; Vaid, R.K.; Duncan, M.P.; Ochiai, M.; Inenaga, M.; Nagao, Y. *Tetrahedron Lett.*, ***1988***, *29*, 6913.



Ochiai, M.; Inenaga, M.; Nagao, Y.; Moriarty, R.M.; Vaid, R.K.; Duncan, M.P. *Tetrahedron Lett.*, ***1988***, *29*, 6917.



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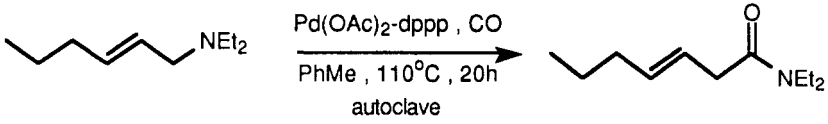

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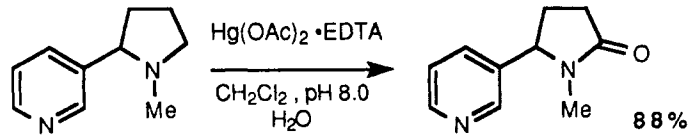

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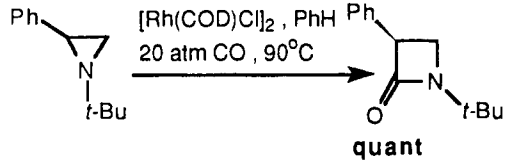
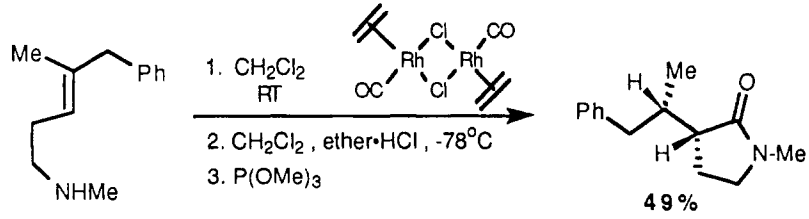
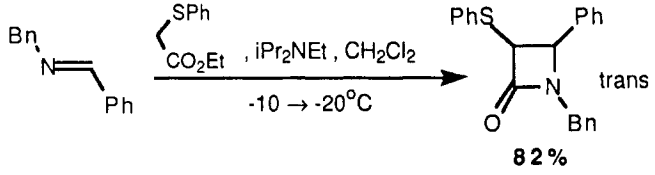


Calet, S.; Urso, F., Alper, H. *J. Am. Chem. Soc.*, ***1989***, *111*, 931.



Krafft, M.E. *Tetrahedron Lett.*, ***1989***, *30*, 539.



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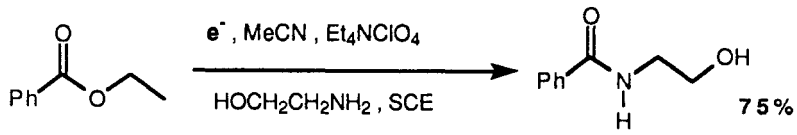
REVIEW:

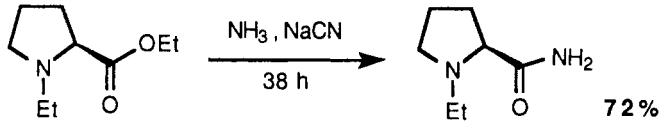
"Amine Dealkylations with Acyl Chlorides"

Cooley, J.H.; Evain, E.J. *Synthesis*, ***1989***, 1.

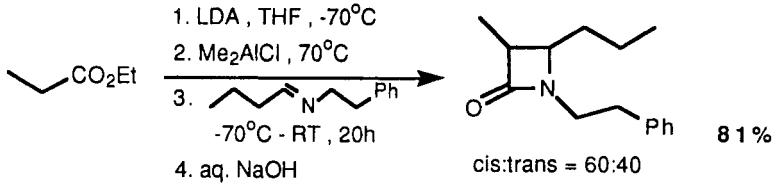
SECTION 83: AMIDES FROM ESTERS



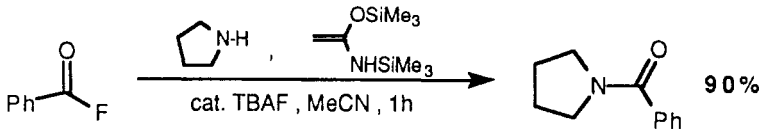
Arai, K.; Shaw, C.; Nozawa, K.; Kawai, K.; Nakajima, S. *Tetrahedron Lett.*, ***1987***, *28*, 441.



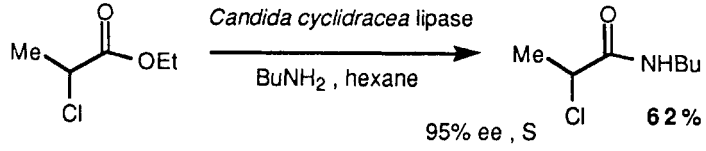
Högberg, T.; Ström, P.; Ebner, M.; Rämsby, S. *J. Org. Chem.*, ***1987***, *52*, 2033.



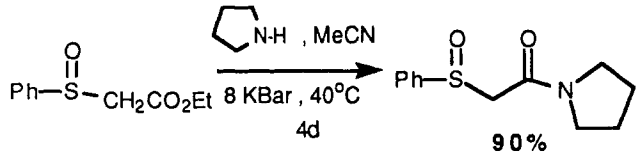
Wada, M.; Aiura, H.; Akiba, K. *Tetrahedron Lett.*, ***1987***, *28*, 3377.



Rajeeswari, S.; Jones, R.J.; Cava, M.P. *Tetrahedron Lett.*, ***1987***, *28*, 5099.

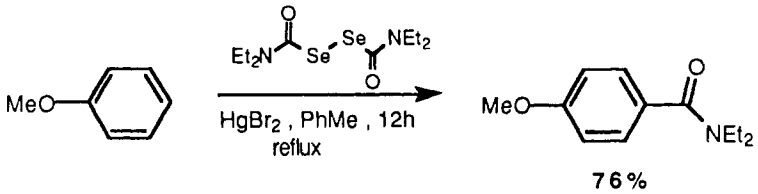


Gotor, V.; Brieva, R.; Rebelledo, F. *Tetrahedron Lett.*, ***1988***, *29*, 6973.

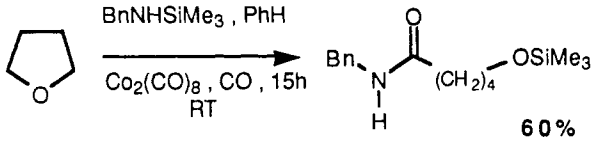


Matsumoto, K.; Hashimoto, S.; Okamoto, T.; Tanikaga, R.; Uryu, T.; Munakata, M. *Chemistry Express, **1988**, 3*, 615.

SECTION 84: AMIDES FROM ETHERS, EPOXIDES AND THIOETHERS

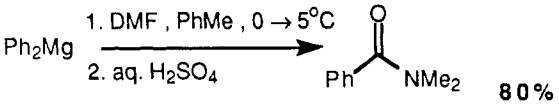


Fujiwara, S.; Ogawa, A.; Kambe, N.; Ryu, I.; Sonoda, N. *Tetrahedron Lett., **1988**, 29*, 6121.



Tsuji, Y.; Kobayashi, M.; Okuda, F.; Watanabe, Y. *J. Chem. Soc., Chem. Commun., **1989***, 1253.

SECTION 85: AMIDES FROM HALIDES AND SULFONATES



Screttas, C.G.; Steele, B.R. *J. Org. Chem., **1988**, 53*, 5151.

SECTION 86: AMIDES FROM HYDRIDES

NO ADDITIONAL EXAMPLES

SECTION 87: AMIDES FROM KETONES

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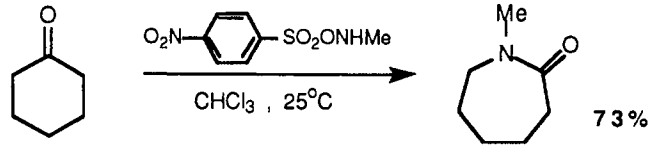
Georg, G.I.; Guan, X.; Kant, J. *Tetrahedron Lett.*, ***1988***, *29*, 403.



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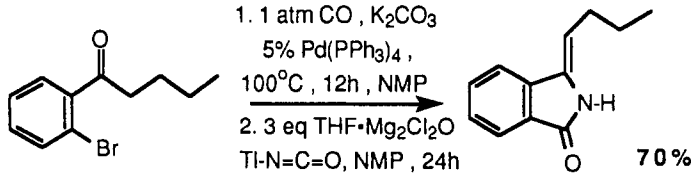

NMP = N-methyl-2-pyrrolidinone

Uozumi, Y.; Kawasaki, N.; Mori, E.; Mori, M.; Shibasaki, M. *J. Am. Chem. Soc.*, ***1989***, *111*, 3725.

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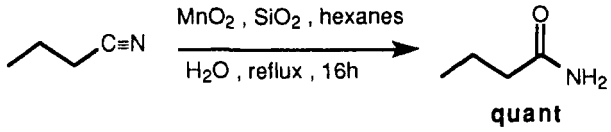
"Syntheses of Macrocyclic Compounds by Ring Enlargement"

Stauch, H.; Hesse, M. *Tetrahedron*, ***1988***, *44*, 1573.

SECTION 88: AMIDES FROM NITRILES



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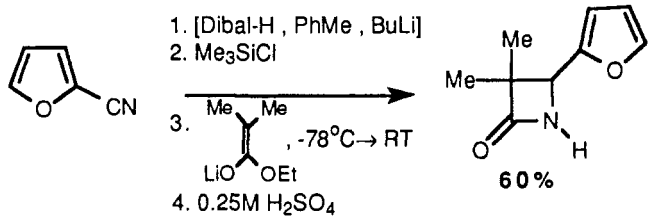
Liu, K.-T.; Shih, M.-H.; Huang, H.-W.; Hu, C.-J. *Synthesis, **1988**,* 715.



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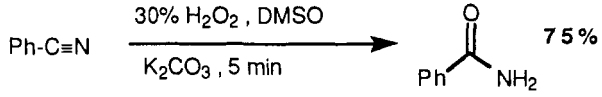
Andreoli, P.; Cainelli, G.; Contento, M.; Giacomini, D.; Martelli, G.; Panunzio, M. *J. Chem. Soc., Perkin Trans. I, **1988**,* 945.



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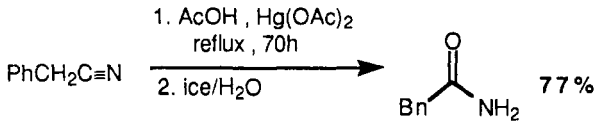
Katritzky, A.R.; Pilarski, B.; Urogdi, L. *Synthesis, **1989**,* 949.



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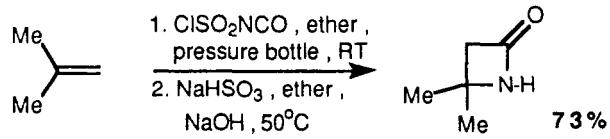
Plummer, B.F.; Menendez, M.; Songster, M. *J. Org. Chem., **1989**, 54,* 718.

SECTION 89: AMIDES FROM ALKENES



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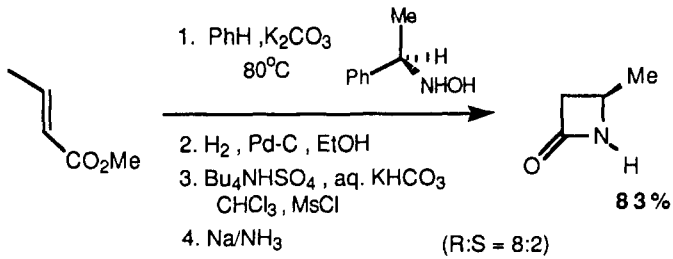
REVIEW:

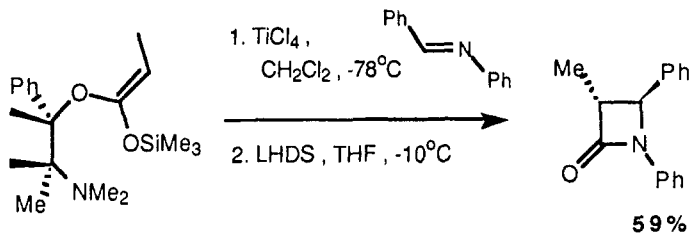
"The Ester Iminium Condensation Route to β-Lactams"

Hart, D.J.; Ha, D.-C. *Chem. Rev.*, ***1989***, *89*, 1447.

SECTION 90: AMIDES FROM MISCELLANEOUS COMPOUNDS



Baldwin, S.W.; Aubé, J. *Tetrahedron Lett.*, ***1987***,*.28*, 179.



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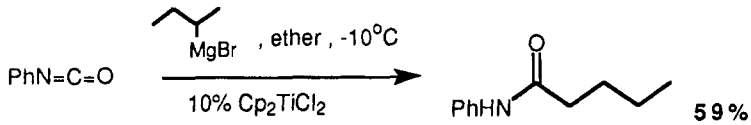
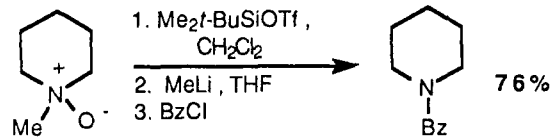
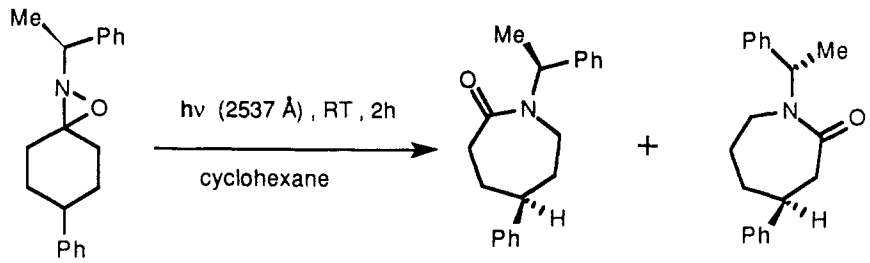


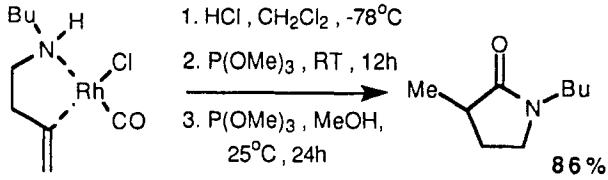
Zhang, Y.; Jiang, J.; Chen, Y. *Tetrahedron Lett.*, ***1987***, *28*, 3815.



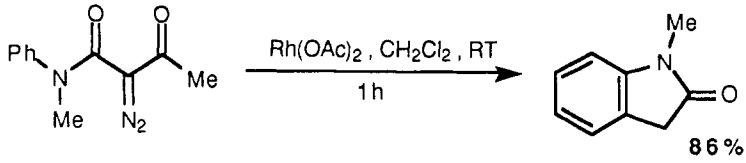
Tokitoh, N.; Okazaki, R. *Bull. Chem. Soc., Jpn.*, ***1987***, *60*, 3291.
Tokitoh, N.; Okazaki, R. *Bull. Chem. Soc., Jpn.*, ***1988***, *61*, 735.



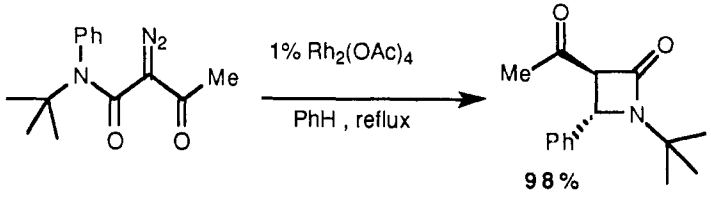
Aubé, J.; Burgett, P.M.; Wang, Y. *Tetrahedron Lett.*, ***1988***, *29*, 151.



Krafft, M.E.; Wilson, L.J.; Onan, K.D. *Tetrahedron Lett.*, ***1988***, *29*, 6421.



Doyle, M.P.; Shanklin, M.S.; Pho, H.Q.; Mahapatro, S.N. *J. Org. Chem.*, ***1988***, *53*, 1017.



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"Synthesis and Reactions of β-Sultams: A Review"

Chanet-Ray, J.; Vessiere, R. *Org. Prep. Proceed. Int.*, ***1986***, *18*, 157.

"Amides from N-Acyl Imines and Related Heterodienes in [4+2]-Cycloaddition Reactions"

Weinreb, S.M.; Scola, P.M. *Chem. Rev.*, ***1989***, *89*, 1525.

Compendium of Organic Synthetic Methods, Volume 7
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CHAPTER 7
PREPARATION OF AMINES

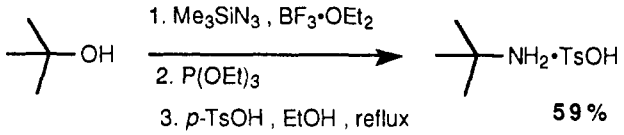
SECTION 91: AMINES FROM ALKYNES

NO ADDITIONAL EXAMPLES

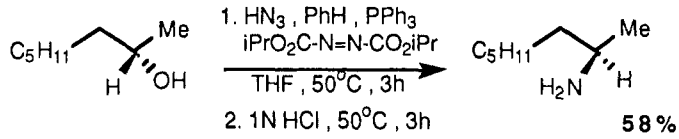
SECTION 92: AMINES FROM ACID DERIVATIVES

NO ADDITIONAL EXAMPLES

SECTION 93: AMINES FROM ALCOHOLS AND THIOLS

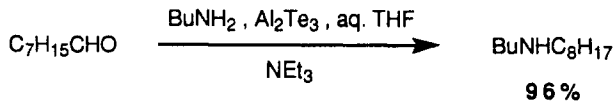


Koziara, A.; Zwierzak, A. *Tetrahedron Lett.*, ***1987***, *28*, 6513.

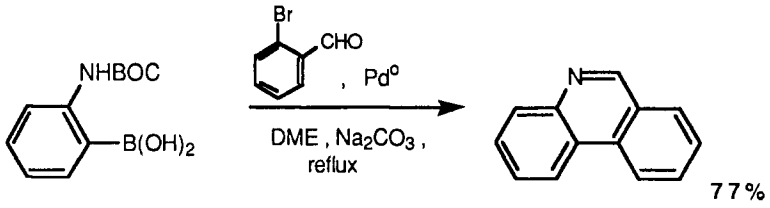


Fabiano, E.; Golding, B.T.; Sadeghi, M.M. *Synthesis,* ***1987***, 190.

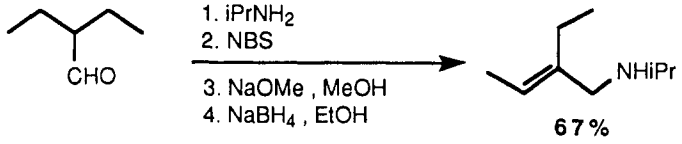
SECTION 94: AMINES FROM ALDEHYDES



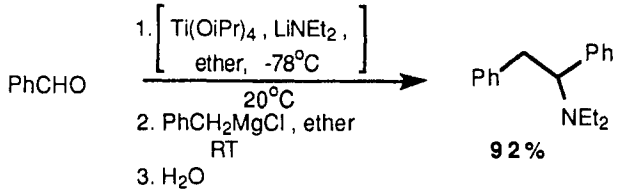
Kambe, N.; Inagaki, T.; Miyoshi, N.; Ogawa, A.; Sonoda, N. *Chem. Lett.*, ***1987***, 1275.



Siddiqui, M.A.; Snieckus, V. *Tetrahedron Lett.*, ***1988***, *29*, 5463.



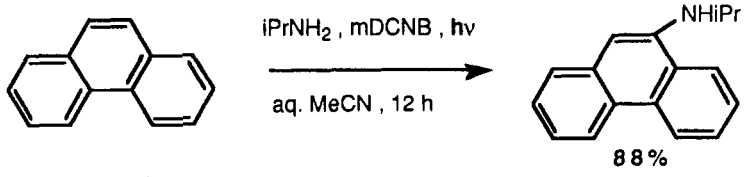
DeKimpe, N.; Stanceva, E.; Verhé, R.; Schamp, N. *Synthesis*, ***1988***, 587.



Takahashi, H.; Tsubuki, T.; Higashiyama, K. *Synthesis*, ***1988***, 238.

Related Methods: Section 102 (Amines from Ketones)

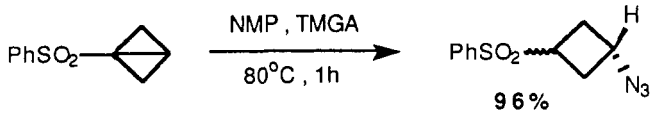
SECTION 95: AMINES FROM ALKYLS, METHYLENES AND ARYLS



mDCNB = *m*-dicyanobenzene

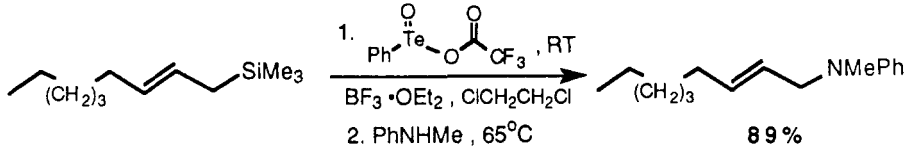
74% conversion

Yasuda, M.; Yamashita, T.; Shima, K.; Pac, C. *J. Org. Chem.*, ***1987***, *52*, 753.



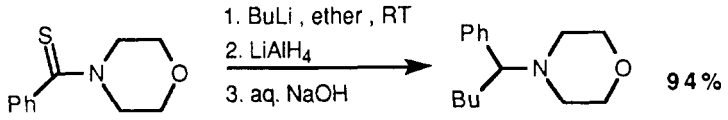
NMP = N-methyl-2-pyrrolidinone
TMGA = N,N,N',N'-tetramethylguanidinium azide

Gaoni, Y. *Tetrahedron Lett.*, ***1988***, *29*, 1591.

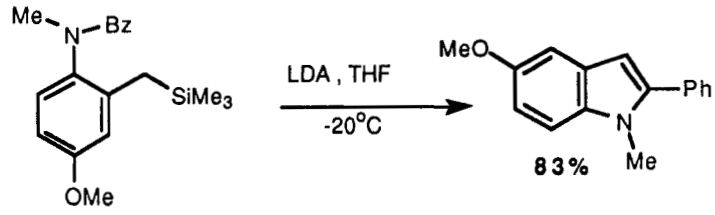


Hu, N.X.; Aso, Y.; Otsubo, T.; Ogura, F. *Tetrahedron Lett.*, ***1988***, *29*, 4949.

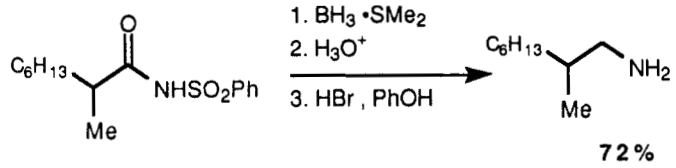
SECTION 96: AMINES FROM AMIDES



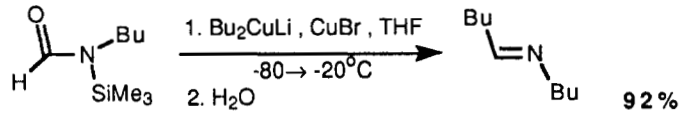
Tominaga, Y.; Kohra, S.; Hosomi, A. *Tetrahedron Lett.*, ***1987***, *28*, 1529.



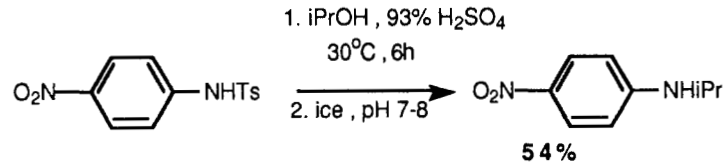
Bartoli, G.; Bosco, M.; Dalpozzo, R.; Todesco, P.E. *J. Chem. Soc., Chem. Commun.*, ***1988***, 807.



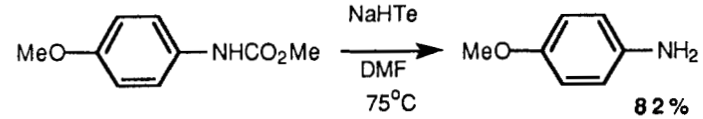
Belletire, J.L.; Fry, D.F. *Synth. Commun.*, ***1988***, *18*, 29.



Ferringa, B.L.; Jansen, J.F.G.A. *Synthesis*, ***1988***, 184.



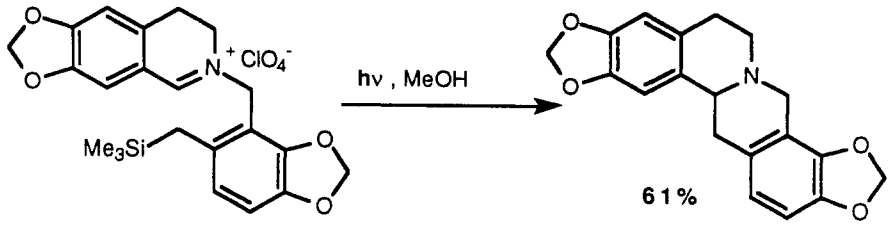
Markov, V.I.; Dmitrikova, L.V.; Dubina, V.L.; Burmistrov, K.S. *J. Org. Chem., U.S.S.R.*, ***1988***, *24*, 2222.



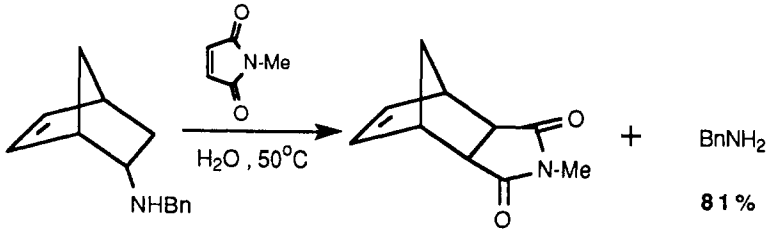
Zhou, X.-J.; Huang, Z.-Z. *Synth. Commun.*, ***1989***, *19*, 1347.

Related Methods: Section 105A (Protection of Amines)

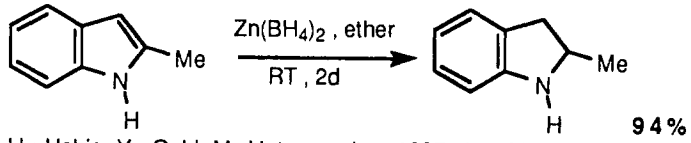
SECTION 97: AMINES FROM AMINES



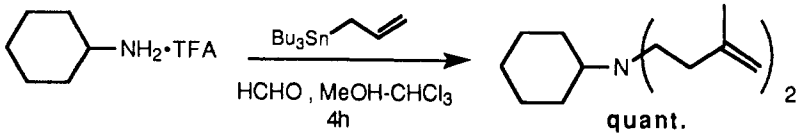
Dai-Ho, G.; Mariano, P.S. *J. Org. Chem.*, ***1987***, *52*, 704.



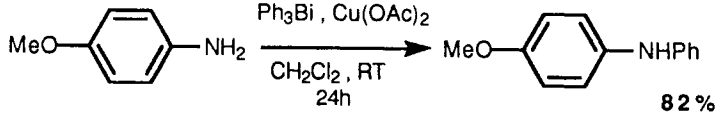
Grieco, P.A.; Parker, D.T.; Fobare, W.F.; Ruckle, R. *J. Am. Chem. Soc.*, ***1987***, *109*, 5859.



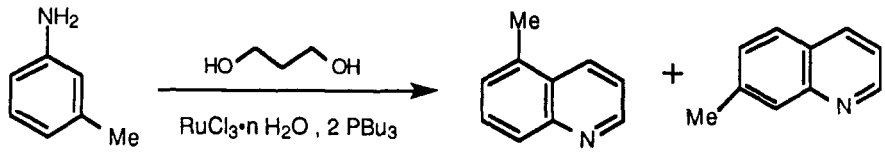
Kotlsuki, H.; Ushio, Y.; Ochi, M. *Heterocycles*, ***1987***, *26*, 1771.



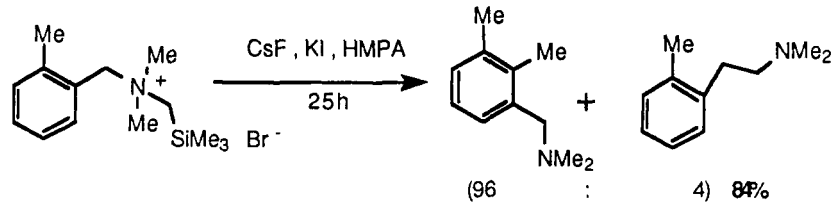
Grieco, P.A.; Bahsas, A. *J. Org. Chem.*, ***1987***, *52*, 1378.



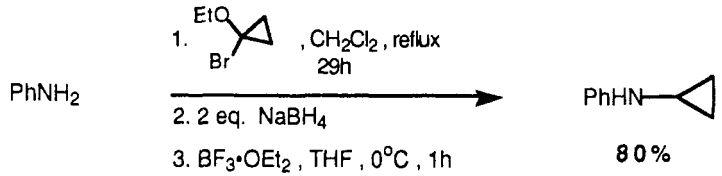
Barton, D.H.R.; Finet, J.-P.; Khamsi, J. *Tetrahedron Lett.*, ***1987***, *28*, 887.
Barton, D.H.R.; Finet, J.-P.; Khamsi, J. *Tetrahedron Lett.*, ***1989***, *30*, 937.



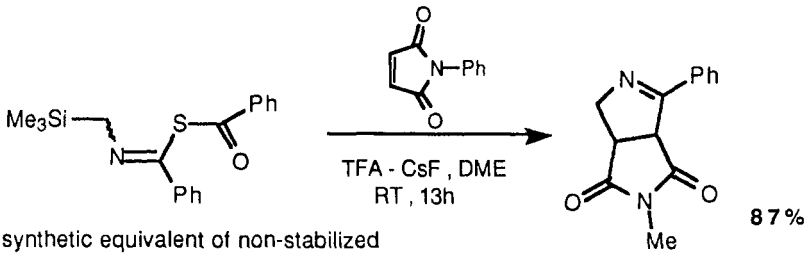
Tsuji, Y.; Huh, K.-T.; Watanabe, Y. *J. Org. Chem.*, ***1987***, *52*, 1673.



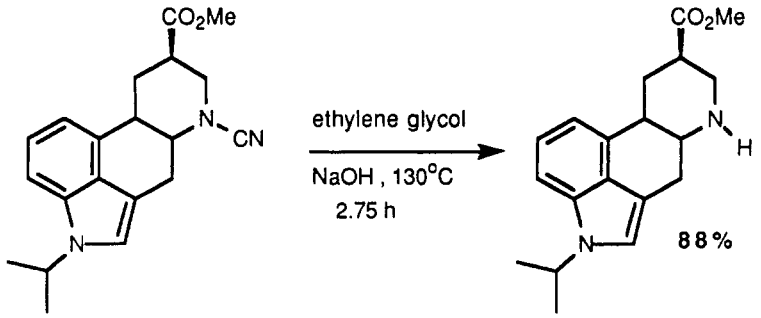
Nakano, M.; Sato, Y. *J. Org. Chem.*, ***1987***, *52*, 1844.



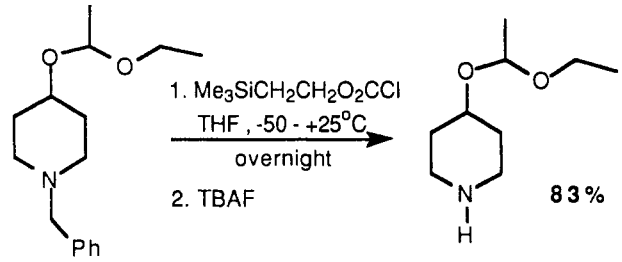
Kang, J.; Kim, K.S. *J. Chem. Soc., Chem. Commun.*, ***1987***, 897.



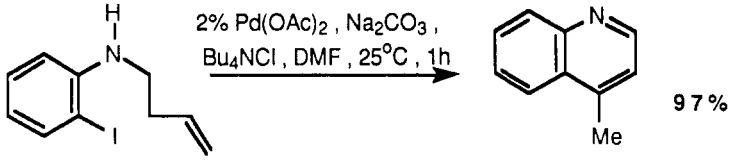
Tsuge, O.; Kanemasa, S.; Yamada, T.; Matsuda, K. *J. Org. Chem.*, ***1987***, *52*, 2523.



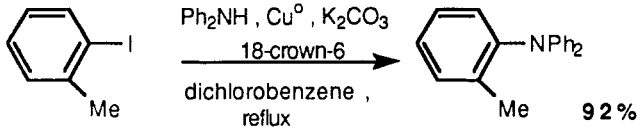
Misner, J.W. *J. Org. Chem.*, ***1987***, *52*, 3166.



Campbell, A.L.; Pilipauskas, D.R.; Khanna, I.K.; Rhodes, R.A. *Tetrahedron Lett.*, ***1987***, *28*, 2331.

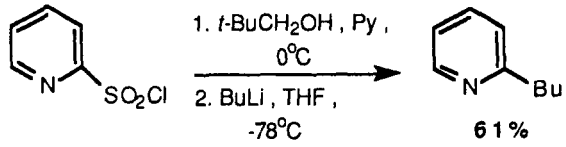


Larock, R.C.; Babu, S. *Tetrahedron Lett.*, ***1987***, *28*, 5291.

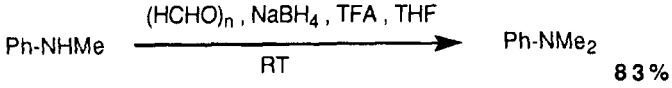


modified Ullman Synthesis

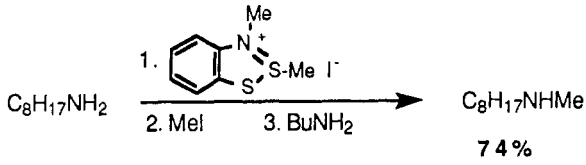
Gauthier, S.; Fréchet, J.M.J. *Synthesis*, ***1987***, 383.



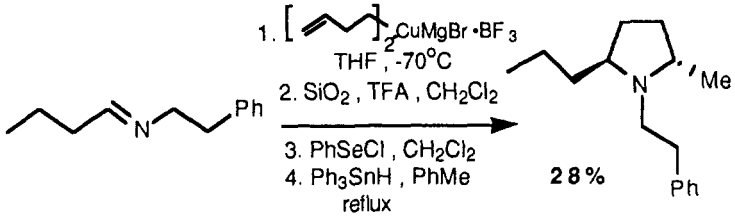
Hanessian, S.; Kagotani, M. *Synthesis,* ***1987***, 409.



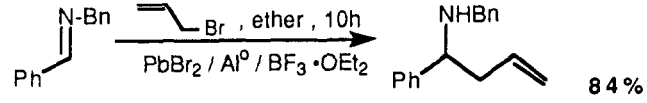
Gribble, G.W.; Nutaitis, C.F. *Synthesis,* ***1987***, 709.



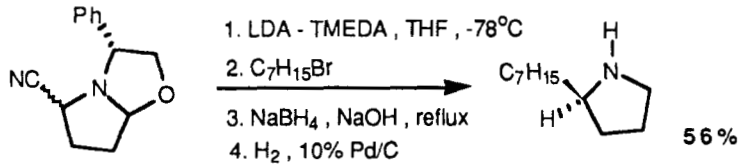
Katritzky, A.R.; Drewniak, M.; Aurrecoechea, J.M. *J. Chem. Soc., Perkin Trans. I,* ***1987***, 2539.



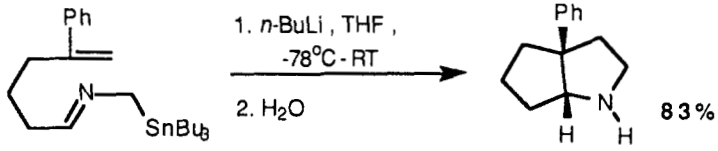
Wada, M.; Aiura, H.; Akiba, K. *Heterocycles,* ***1987***, *25*, 929.



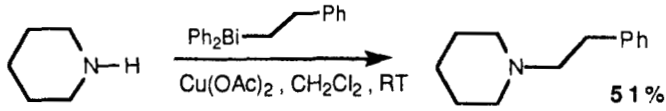
Tanaka, H.; Yamashita, S.; Ikemoto, Y.; Torii, S. *Chem. Lett.,* ***1987***, 673.



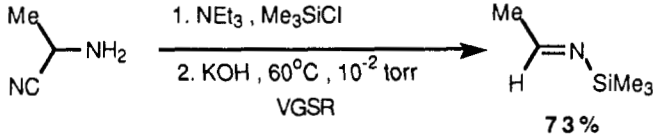
Arseniyadis, S.; Huang, P.Q.; Husson, H-P. *Tetrahedron Lett.*, ***1988***, *29*, 631.



Pearson, W.H.; Szura, D.P.; Harter, W.G. *Tetrahedron Lett.*, ***1988***, *29*, 761.

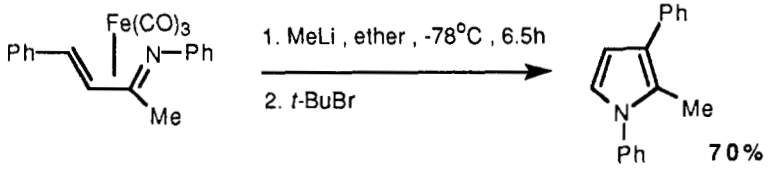


Barton, D.H.R.; Ozbalik, N.; Ramesh, M. *Tetrahedron Lett.*, ***1988***, *29*, 857.

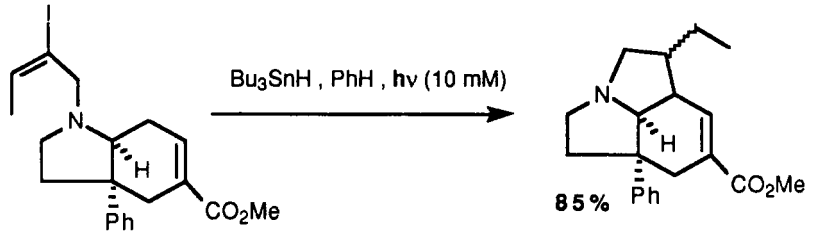


VBSR = vacuum gas-solid reactions

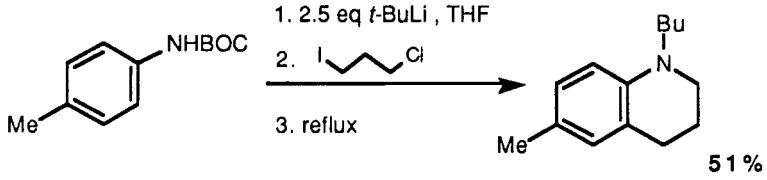
Guillemin, J.-C.; Ammi, L.; Denis, J.-M. *Tetrahedron Lett.*, ***1988***, *29*, 1287.



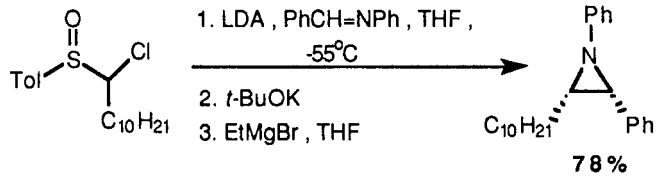
Danks, T.N.; Thomas, S.E. *Tetrahedron Lett.*, ***1988***, *29*, 1425.



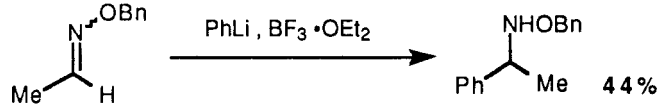
Lathbury, D.C.; Parsons, P.J.; Pinto, I. *J. Chem. Soc., Chem. Commun.*, ***1988***, 81.



Reed, J.N.; Rotchford, J.; Strickland, D. *Tetrahedron Lett.*, ***1988***, *29*, 5725.

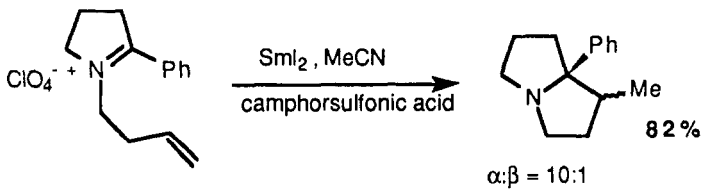


Satoh, T.; Oohara, T.; Yamakawa, K. *Tetrahedron Lett.*, ***1988***, *29*, 4093.

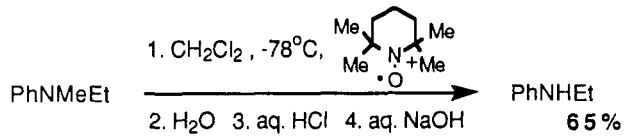


(Z:E = 47:53)

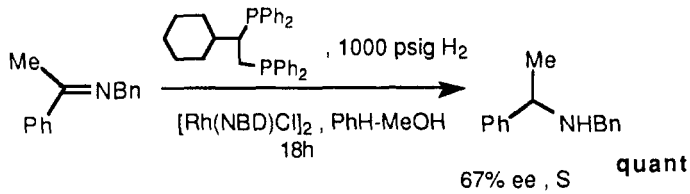
Rodrigues, K.E.; Basha, A.; Summers, J.B.; Brooks, D.W. *Tetrahedron Lett.*, ***1988***, *29*, 3455.



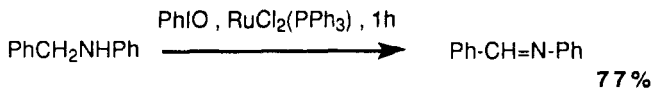
Martin, S.F.; Yang, C.-P.; Laswell, W.L.; Rüeger, H. *Tetrahedron Lett.*, ***1988***, *29*, 6685.



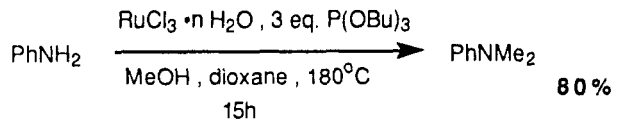
Hunter, D.H.; Racok, J.S.; Rey, A.W.; Ponce, Y.Z. *J. Org. Chem.*, ***1988***, *53*, 1278.



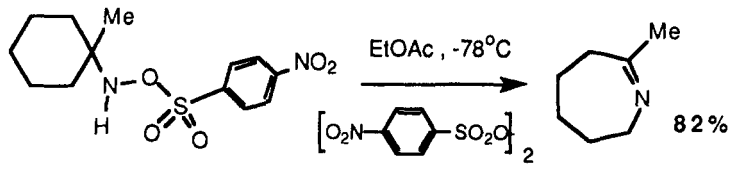
Kang, G.-J.; Cullen, W.R.; Fryzuk, M.D.; James, B.R.; Kutney, J.P. *J. Chem. Soc., Chem. Commun.*, ***1988***, 1466.



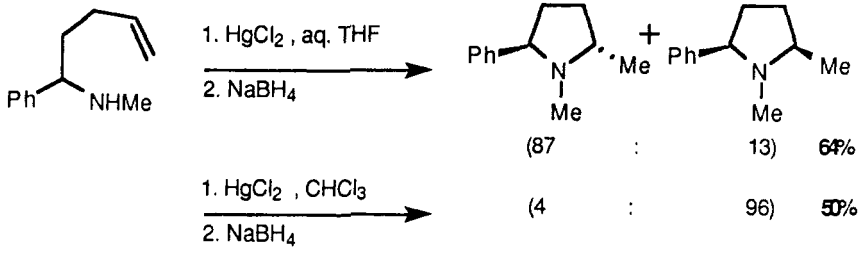
Müller, P.; Gilabert, D.M. *Tetrahedron*, ***1988***, *44*, 7171.



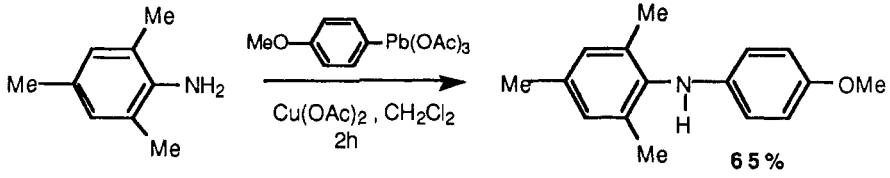
Huh, K.-T.; Tsuji, Y.; Kobayashi, M.; Okuda, F.; Watanabe, Y. *Chem. Lett.*, ***1988***, 449.



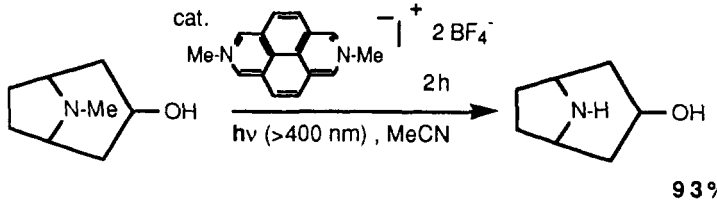
Hoffman, R.V.; Buntain, G.A. *J. Org. Chem.*, ***1988***, *53*, 3316.



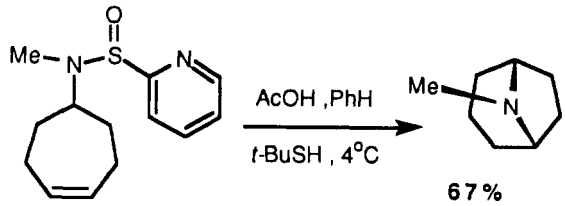
Tokuda, M.; Yamada, Y.; Sugiyonme, H. *Chem. Lett.*, ***1988***, 1289.



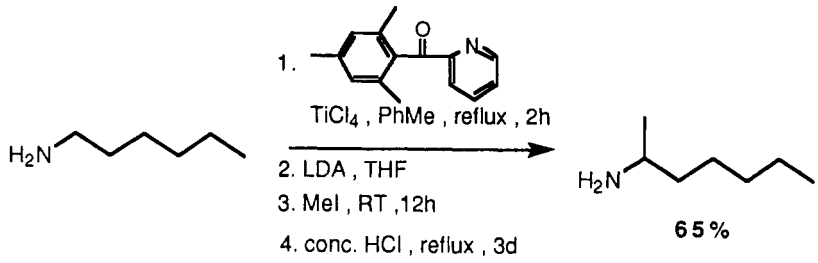
Barton, D.H.R.; Donnelly, D.M.X.; Finet, J.-P.; Guiry, P.J. *Tetrahedron Lett.*, ***1989***, *30*, 1377.
Barton, D.H.R.; Yadav-Bhatnagar, N.; Finet, J.-P.; Khamsi, J. *Tetrahedron Lett.*, ***1987***, *28*, 3111.



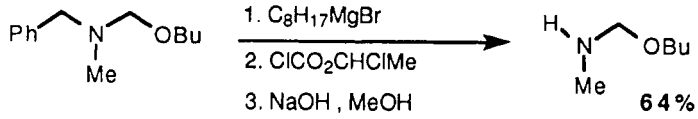
Santamaria, J.; Ouchabane, R.; Rigaudy, J. *Tetrahedron Lett.*, ***1989***, *30*, 2927.



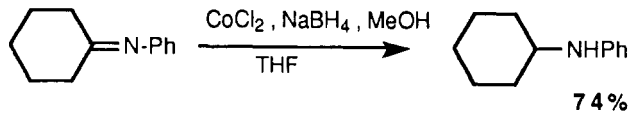
Newcomb, M.; Marquardt, D.J. *Heterocycles, **1989**, 28*, 129.



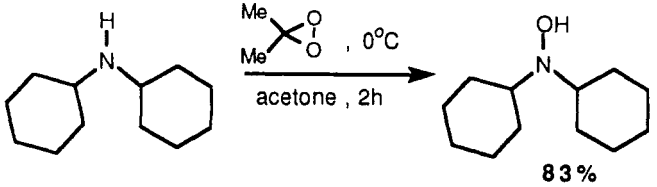
Hornback, J.M.; Murugaverl, B. *Tetrahedron Lett., **1989**, 30*, 5853.



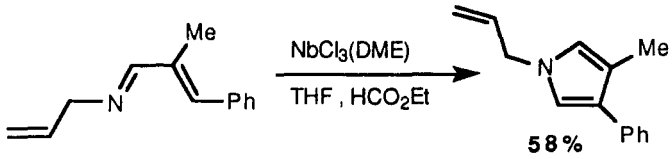
Yankep, E.; Kapnang, H.; Charles, G. *Tetrahedron Lett., **1989**, 30*, 7383.



Periasamy, M.; Devasagayaraj, A.; Satyanarayana, N.; Narayana, C. *Synth. Commun., **1989**, 19*, 565.



Murray, R.W.; Singh, M. *Synth. Commun., **1989**, 19*, 3509.



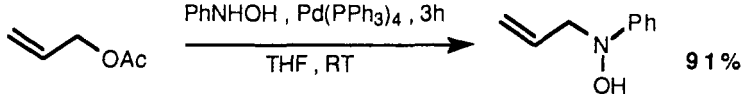
Roskamp, E.J.; Dragovich, P.S.; Hartung Jr., J.B.; Pedersen, S.F. *J. Org. Chem.*, ***1989***, *54*, 4736.

REVIEW:

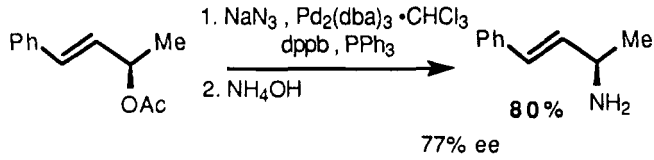
"Transition Metals in the Synthesis and Functionalization of Indoles"

Hegedus, L.S. *Angew. Chem. Int. Ed., Engl*, ***1988***, *27*, 1113.

SECTION 98: AMINES FROM ESTERS



Murahashi, S.; Imada, Y.; Tankguchi, Y. *Tetrahedron Lett.*, ***1988***, *29*, 2973.

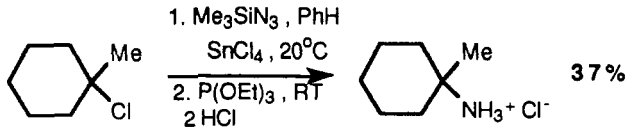


Murahashi, S.; Taniguchi, Y.; Imada, Y.; Tanigawa, Y. *J. Org. Chem.*, ***1989***, *54*, 3292.

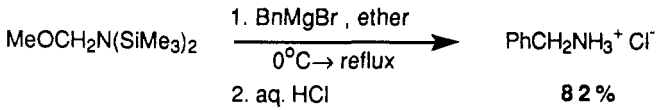
SECTION 99: AMINES FROM ETHERS, EPOXIDES AND THIOETHERS

NO ADDITIONAL EXAMPLES

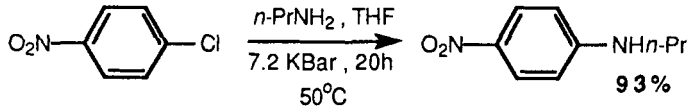
SECTION 100: AMINES FROM HALIDES AND SULFONATES



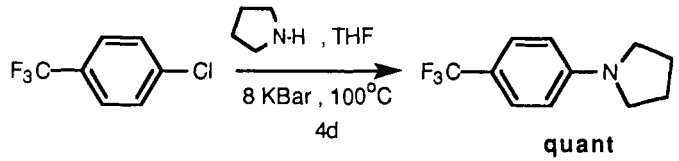
Koziara, A.; Osowska-Pacewicka, K.; Zawadzki, S.; Zwierzak, A. *Synthesis, **1987**,* 487.



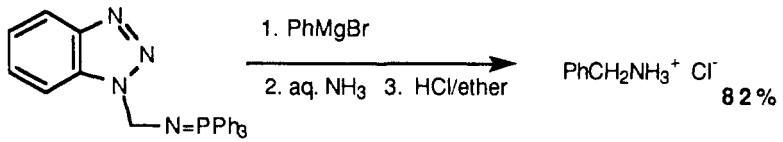
Bestmann, H.J.; Wölfel, G.; Mederer, K. *Synthesis, **1987**,* 848.



Ibata, T.; Isogami, Y.; Toyoda, J. *Chem. Lett., **1987**,* 1187.



Matsumoto, K.; Uchida, T.; Okamoto, T.; Halshimoto, S. *Chemistry Express, **1987**, 2,* 551.



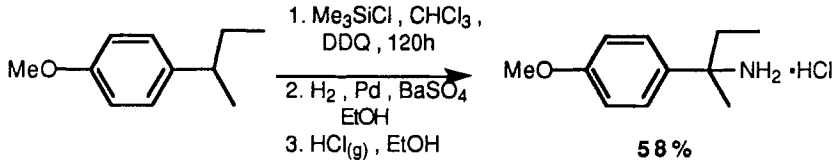
Katritzky, A.R.; Jiang, J.; Urogdi, L. *Tetrahedron Lett., **1989**, 30,* 3303.

REVIEW:

"Electrophilic Amination of Carbanions"

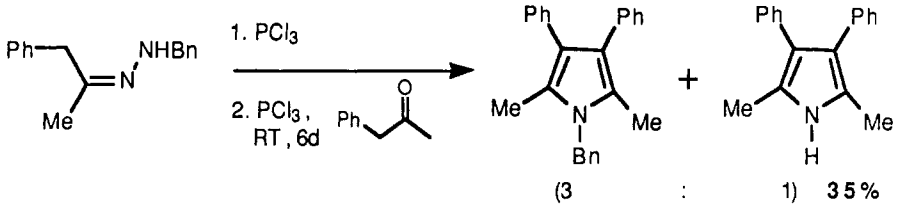
Erdik, E.; Ay, M. *Chem. Rev., **1989**, 89,* 1947.

SECTION 101: AMINES FROM HYDRIDES

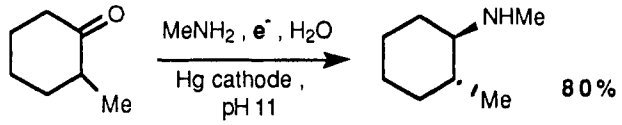


Guy, A.; Lemor, A.; Doussot, J.; Lemaire, M. *Synthesis, **1988**,* 900.

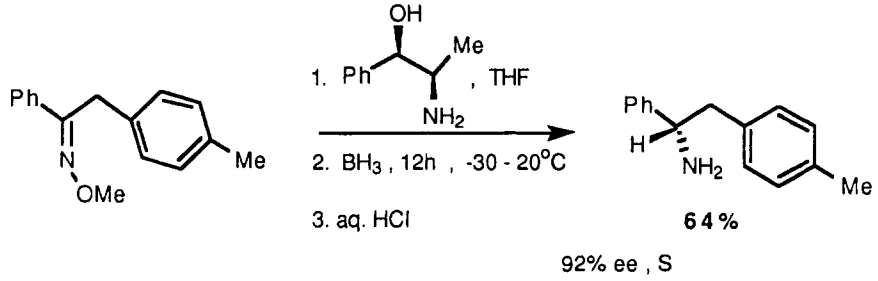
SECTION 102: AMINES FROM KETONES



Baccolini, G.; Sandali, C. *J. Chem. Soc., Chem. Commun., **1987**,* 788.



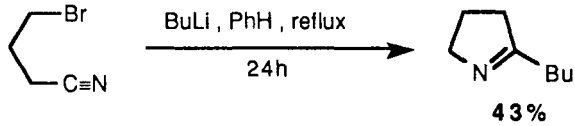
Pienemann, T.; Schäfer, H.-J. *Synthesis, **1987**,* 1005.



Sakito, Y.; Yoneyoshi, Y.; Suzukamo, G. *Tetrahedron Lett., **1988**, 29,* 223.

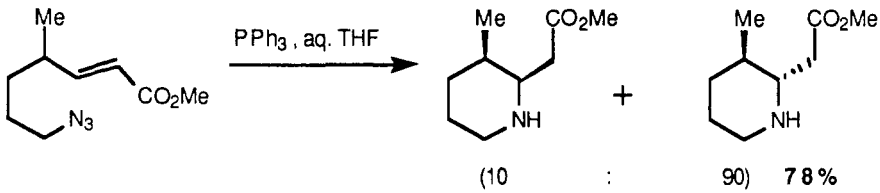
Related Methods: Section 94 (Amines from Aldehydes)

SECTION 103: AMINES FROM NITRILES

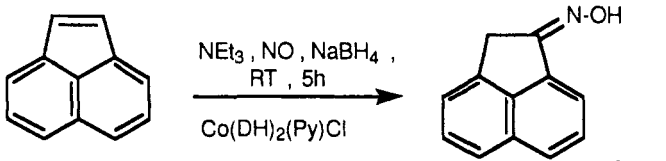


Gallulo, V.; Dimas, L.; Zezza, C.A.; Smith, M.B. *Org. Prep. Proceed. Int.*, ***1989***, *21*, 297.

SECTION 104: AMINES FROM ALKENES

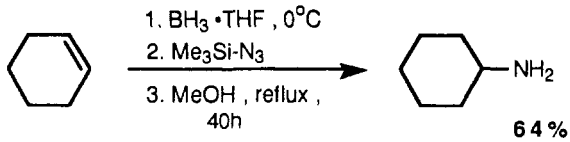


Knouzi, N.; Vaultier, M.; Toupet, L.; Carrie, R. *Tetrahedron Lett.*, ***1987***, *28*, 1757.

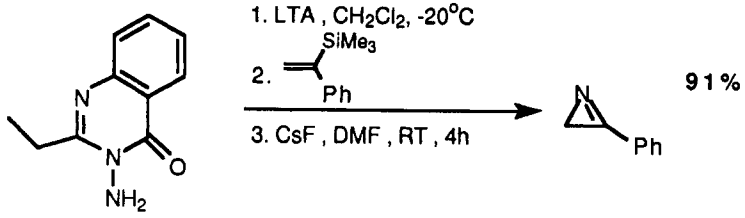


DH = dimethyl glyoxime

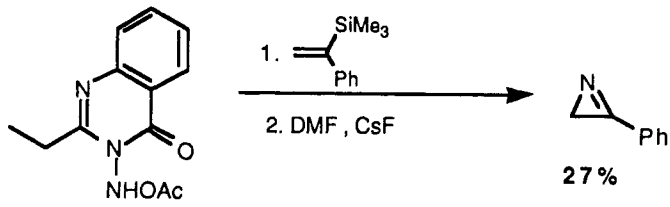
Okamoto, T.; Kobayashi, K.; Oka, S.; Tanimoto, S. *J. Org. Chem.*, ***1987***, *52*, 5089.



Kabalka, G.W.; Goudgaon, N.M.; Liang, Y. *Synth. Commun.*, ***1988***, *18*, 1363.

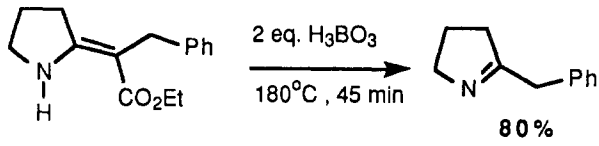


Atkinson, R.S.; Kelly, B.J. *Tetrahedron Lett.*, ***1989***, *30*, 2703.

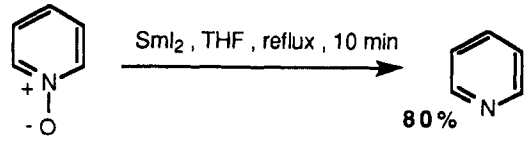


Atkinson, R.S.; Kelly, B.J. *J. Chem. Soc., Chem. Commun.*, ***1989***, 836.

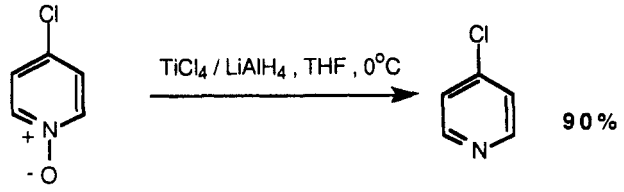
SECTION 105: AMINES FROM MISCELLANEOUS COMPOUNDS



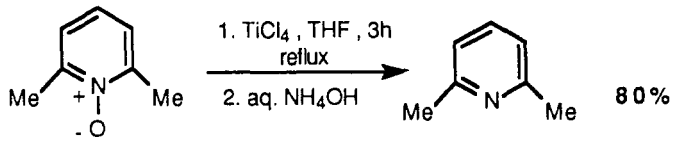
Bacos, D.; Celerier, J.-P.; Lhommet, G. *Tetrahedron Lett.*, ***1987***, *28*, 2353.



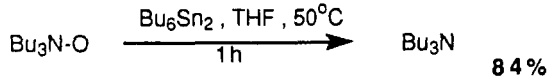
Zhang, Y.; Lin, R. *Synth. Commun.*, ***1987***, *17*, 329.



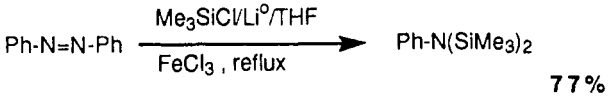
Malinowski, M.; Kaczmarek, L. *Synthesis, **1987***, 1013.



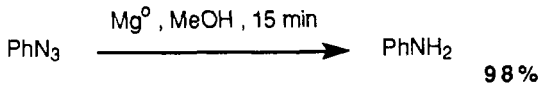
Malinowski, M. *Synthesis, **1987***, 732.



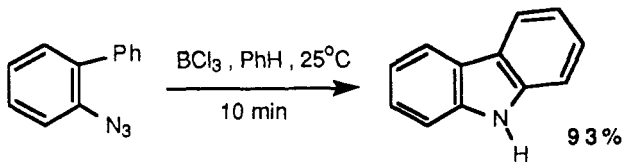
Jousseaume, B.; Chanson, E. *Synthesis, **1987***, 55.



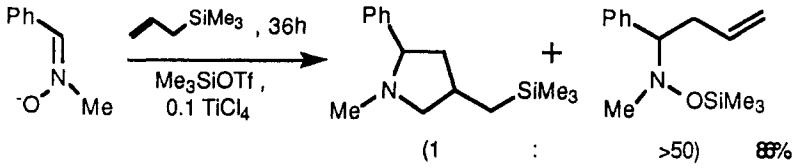
Kira, M.; Naga, S.; Nishimura, M.; Sakurai, H. *Chem. Lett., **1987***, 153.



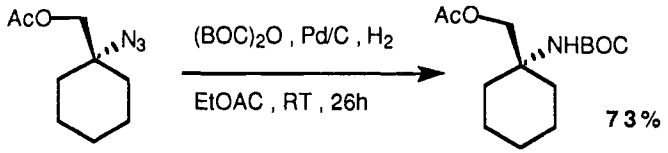
Maiti, S.N.; Spevak, P.; Reddy, A.V.N. *Synth. Commun., **1988**, 18*, 1201.



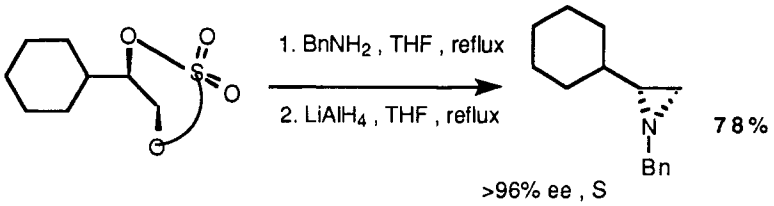
Spagnolo, P.; Zanirato, P. *J. Chem. Soc., Perkin Trans. I, **1988***, 2615.



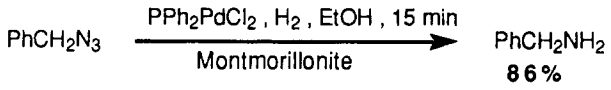
Wuts, P.G.M.; Jung, Y.-W. *J. Org. Chem.*, ***1988***, *53*, 1957.



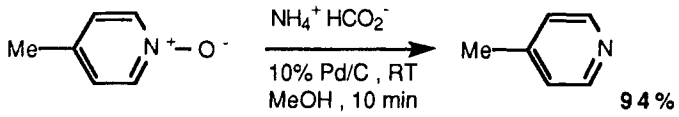
Saito, S.; Nakajima, H.; Inaba, M.; Moriwake, T. *Tetrahedron Lett.*, ***1989***, *30*, 837.



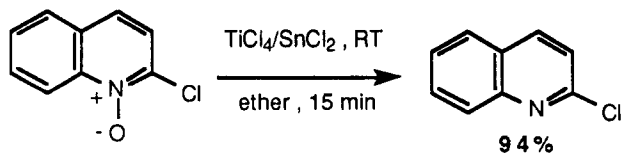
Lohray, B.B.; Gao, Y. Sharpless, K.B. *Tetrahedron Lett.*, ***1989***, *30*, 2623



Sharma, G.V.M.; Chandrasekhar, S. *Synth. Commun.*, ***1989***, *19*, 3289.

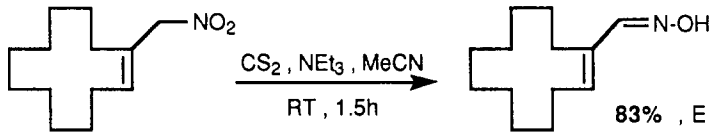


Balicki, R. *Synthesis*, ***1989***, 645.

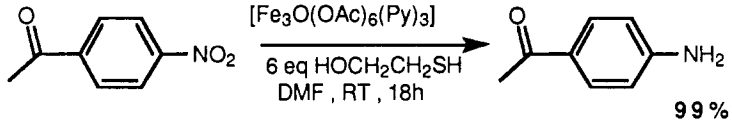


Balicki, R.; Kaczmarek, L.; Malinowski, M. *Synth. Commun.*, ***1989***, *19*, 897.

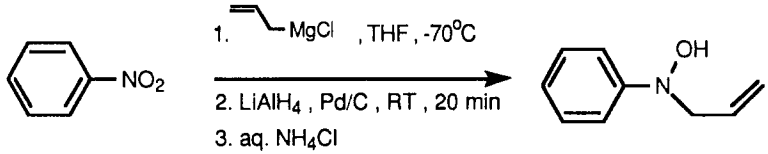
AMINES FROM NITRO COMPOUNDS



Barton, D.H.R.; Fernandez, I.; Richard, C.S.; Zard, S.Z. *Tetrahedron*, ***1987***, *43*, 551.



Murata, S.; Miura, M.; Nomura, M. *Chem. Lett.*, ***1988***, 361.



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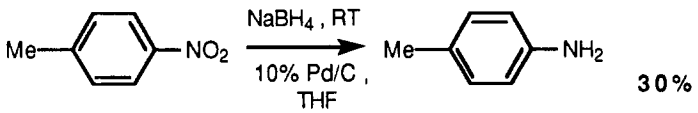

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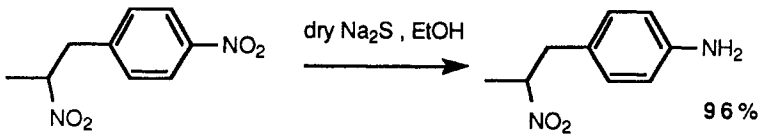
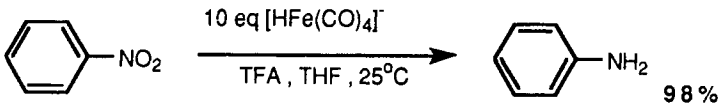
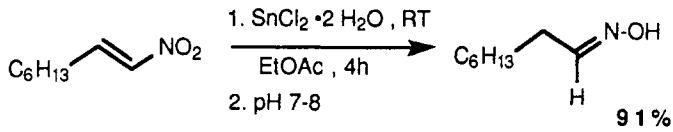


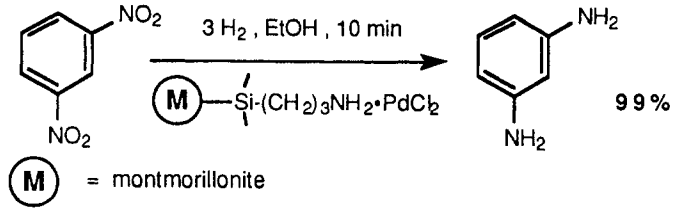
Huber, D.; Andermann, G.; Leclerc, G. *Tetrahedron Lett.*, ***1988***, *29*, 635.



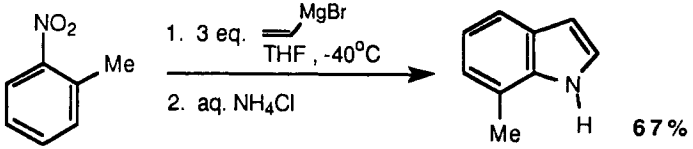
Gaus, P.L.; Gerritz, S.W.; Jeffries, P.M. *Tetrahedron Lett.*, ***1988***, *29*, 5083.



Kabalka, G.W.; Gondgaon, N.M. *Synth. Commun.*, ***1988***, *18*, 693.



Mukkanti, K.; Subba Rao, Y.V.; Choudary, B.M. *Tetrahedron Lett.*, ***1989***, *30*, 251.



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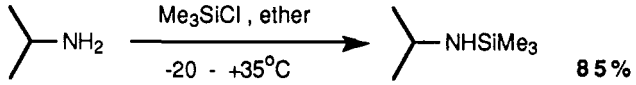
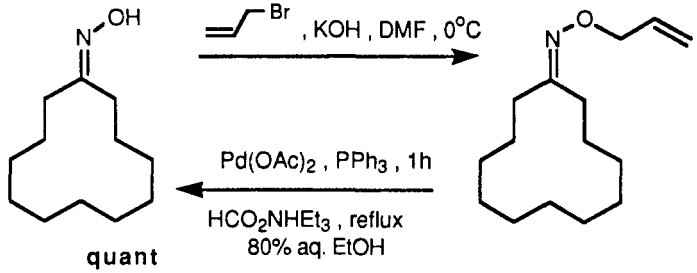
Scriven , E.F.V.; Turnbull , K. *Chem. Rev.*, ***1988***, *88*, 297.

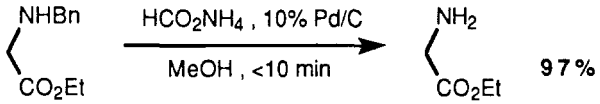
SECTION 105A: PROTECTION OF AMINES



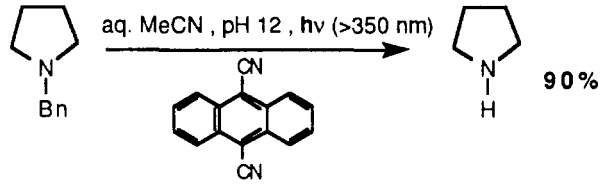
Courtois, G.; Miginiac, L. *Tetrahedron Lett.*, ***1987***, *28*, 1659.



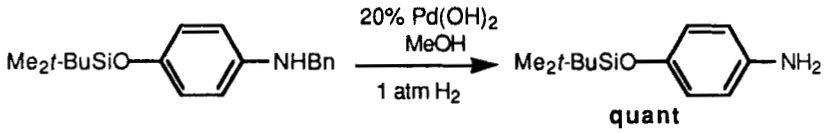
Yamada, T.; Goto, K.; Mitsuda, Y.; Tsuji, J. *Tetrahedron Lett.*, ***1987***, *28*, 4557.



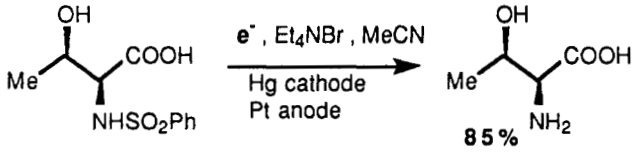
Ram, S.; Spicer, L.D. *Tetrahedron Lett.*, ***1987***, *28*, 515.
Ram, S.; Spicer, L.D. *Synth. Commun.*, ***1987***, *17*, 415.



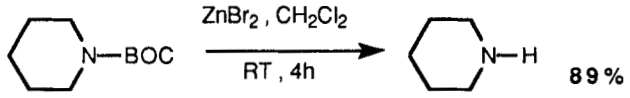
Pandey, G.; Sudha Rani, K. *Tetrahedron Lett.*, ***1988***, *29*, 4157.



Yoshida, K.; Nakajima, S.; Wakamatsu, T.; Ban, Y.; Shibasaki, M. *Heterocycles*, ***1988***, *27*, 1167.



Roemmele, R.C.; Rapoport, H. *J. Org. Chem.*, ***1988***, *53*, 2367.



Nigam, S.C.; Mann, A.; Taddei, M.; Wermuth, C.-G. *Synth. Commun.*, ***1989***, *19*, 3139.

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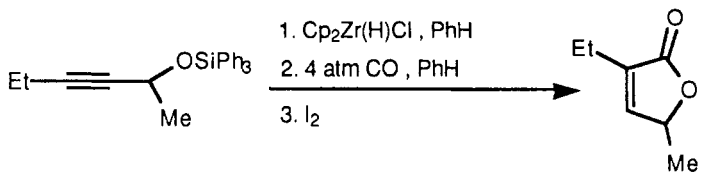
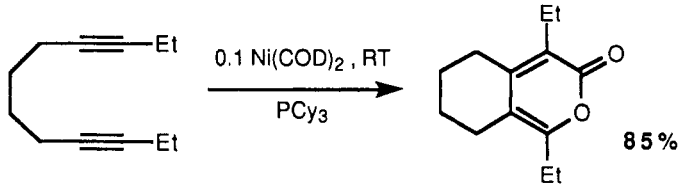
CHAPTER 8
PREPARATION OF ESTERS

SECTION 106: ESTERS FROM ALKYNES



Buchwald, S.L.; Fang, Q.; King, S.M. *Tetrahedron Lett.*, ***1988***, *29*, 3445.

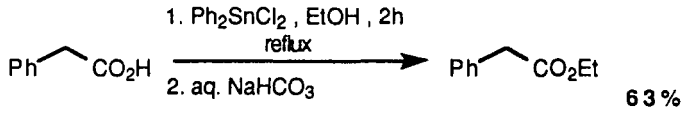


Tsuda, T.; Morikawa, S.; Sumiya, R.; Saegusa, T. *J. Org. Chem.*, ***1988***, *53*, 3140.
Tsuda, T.; Sumiya, R.; Saegusa, T. *Synth. Commun.*, ***1987***, *17*, 147.

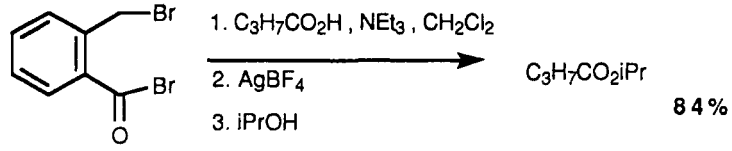
SECTION 107: ESTERS FROM ACID DERIVATIVES

The following types of reactions are found in this section:

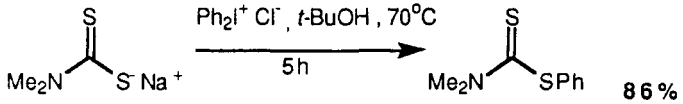
1. Esters from the reaction of alcohols with carboxylic acids, acid halides and anhydrides.
2. Lactones from hydroxy acids
3. Esters from carboxylic acids and halides, sulfoxides and miscellaneous compounds



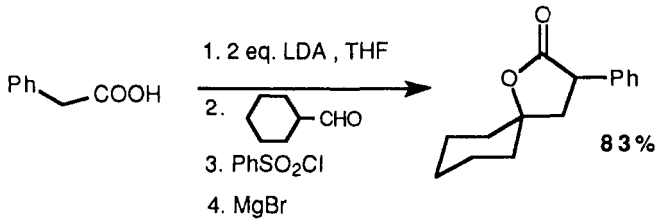
Kumar, A.K.; Chattopadhyay, T.K. *Tetrahedron Lett.*, ***1987***, *28*, 3713.



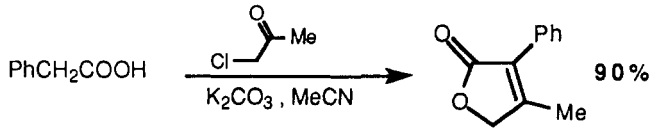
Fukuota, S.; Takimoto, S.; Katsuki, T.; Yamaguchi, M. *Tetrahedron Lett.*, ***1987***, *28*, 4711.



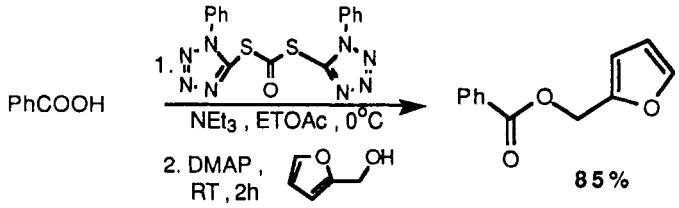
Chen, Z.-C.; Jin, Y.-Y.; Stang, P.J. *J. Org. Chem.*, ***1987***, *52*, 4117.



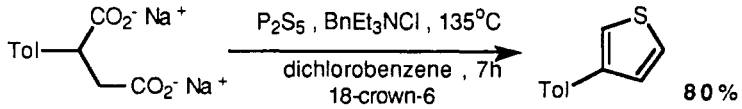
Black, T.H.; DuBay III, W.J. *Tetrahedron Lett.*, ***1987***, *28*, 4787.



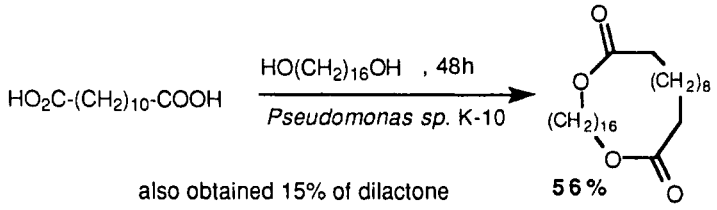
Wakharkar, R.D.; Deshpande, V.H.; Landge, A.B.; Upadhye, B.K. *Synth. Commun.*, ***1987***, *17*, 1513.



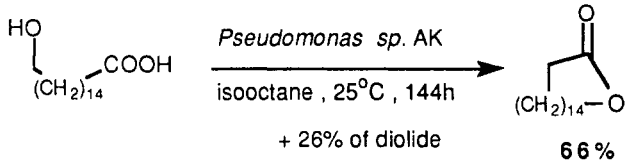
Takeda, K.; Tsuboyama, K.; Takayanagi, H.; Ogura, H. *Synthesis, **1987**,* 560.



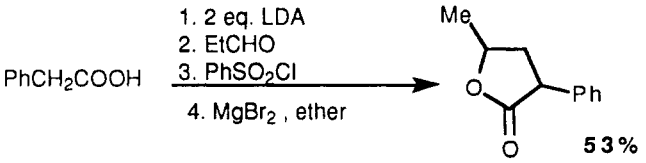
Sastry, C.V.R.; Marwah, A.K.; Marwah, P.; Rao, G.S.; Shridhar, D.R. *Synthesis, **1987**,* 1024.



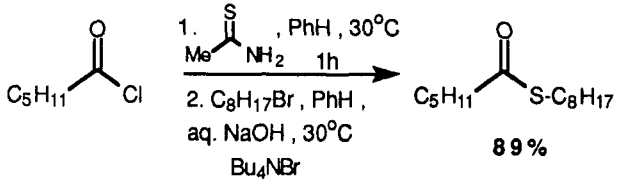
Guo, Z.-W.; Sih, C.J. *J. Am. Chem. Soc., **1988**, 110,* 1999.



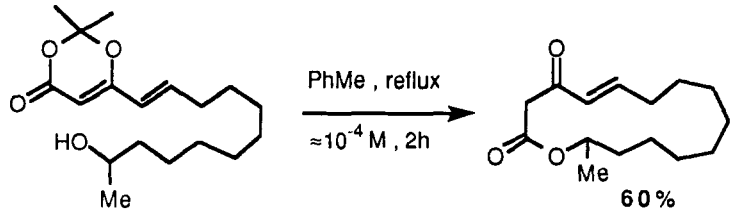
Guo, Z.; Ngooi, T.K.; Scilimati, A.; Fülling, G.; Sih, C.J. *Tetrahedron Lett., **1988**, 29,* 5583.



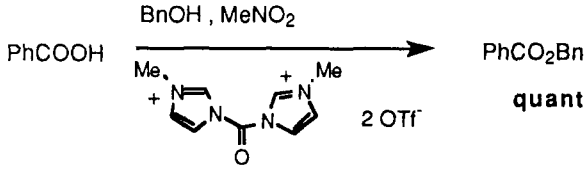
Black, T.H.; Fields, J.D. *Synth. Commun., **1988**, 18,* 125.



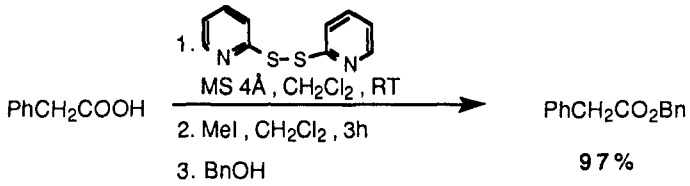
Takido, T.; Toriyama, M.; Itabashi, K. *Synthesis, **1988**,* 404.



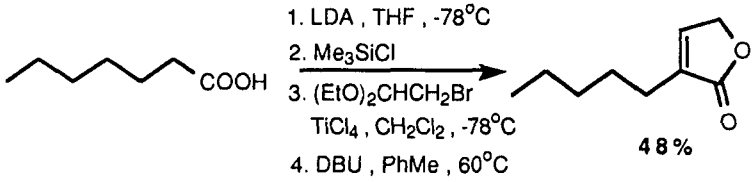
Boeckman Jr., R.K.; Pruitt, J.R. *J. Am. Chem. Soc., **1989**, 111,* 8286.



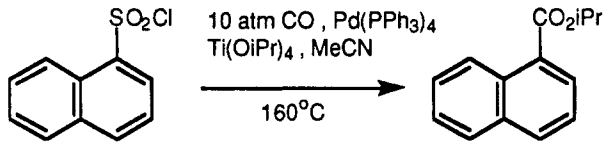
Saha, A.K.; Schultz, P.; Rapoport, H. *J. Am. Chem. Soc., **1989**, 111,* 4856.



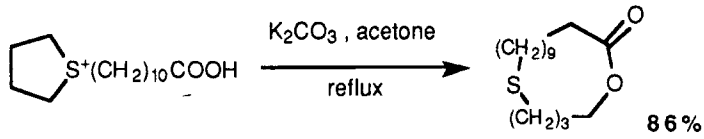
Ravi, D.; Mereyala, H.B. *Tetrahedron Lett., **1989**, 30,* 6089.



Demnitz, F.W.J. *Tetrahedron Lett., **1989**, 30,* 6109.



Miura, M.; Itoh, K.; Nomura, M. *Chem. Lett.*, ***1989***, 77.



Matsuyama, H.; Nakamura, T.; Kamigata, N. *J. Org. Chem.*, ***1989***, *54*, 5218.

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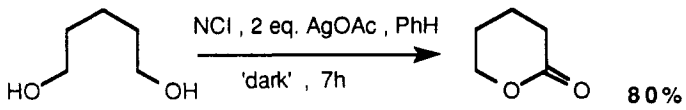
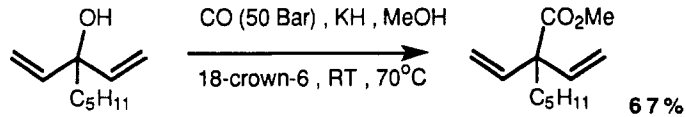
Further examples of the reaction $RCO_2H + R'OH \rightarrow RCO_2R'$ are included in Section 108 (Esters from Alcohols and Phenols) and in Section 30A (Protection of Carboxylic Acids).

SECTION 108: ESTERS FROM ALCOHOLS AND THIOLS



Beebe, T.R.; Adkins, R.; Baldridge, R.; Hensley, V.; McMillen, D.; Morris, D.; Noe, R.; Ng, F.W.; Powell, G.; Spielberger, C.; Stolte, M. *J. Org. Chem.*, ***1987***, *52*, 5472.
McDonald, C.E.; Beebe, T.R.; Beard, M.; McMillen, D.; Selski, D. *Tetrahedron Lett.*, ***1989***, *30*, 4791.



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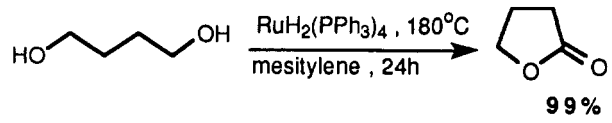
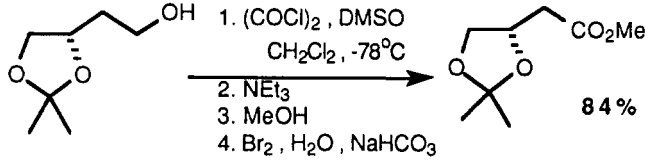
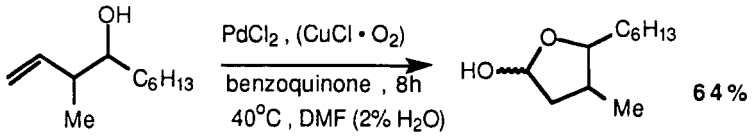


Murahashi, S.; Naota, T.; Ito, K.; Maeda, Y.; Taki, H. *J. Org. Chem.*, ***1987***, *52*, 4319.

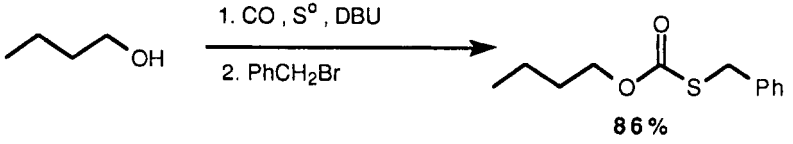
Perron, F.; Gahman, T.C.; Albizati, K.F. *Tetrahedron Lett.*, ***1988***, *29*, 2023.



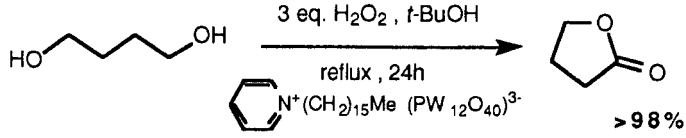
Lichtenthaler, F.W.; Jarglis, P.; Lorenz, K. *Synthesis*, ***1988***, 790.



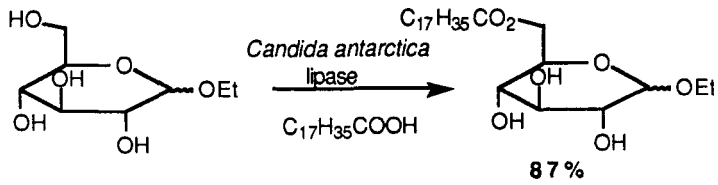
Nokami, J.; Ogawa, H.; Miyamoto, S.; Mandai, T.; Wakabayashi, S.; Tsuji, J. *Tetrahedron Lett.*, ***1988***, *29*, 5181.



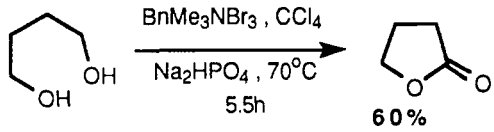
Mizuno, T.; Nishiguchi, I.; Hirashima, T. *Tetrahedron Lett.*, ***1988***, *29*, 4767.



Ishii, Y.; Yoshida, T.; Yamawaki, K.; Ogawa, M. *J. Org. Chem.*, ***1988***, *53*, 5549.



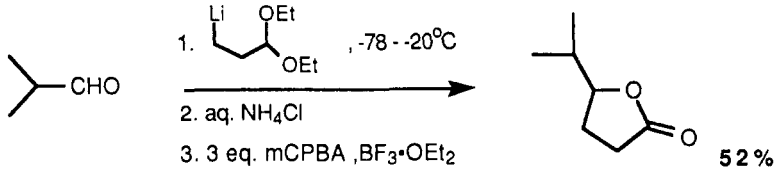
Björkling, F.; Godtfredsen, S.E.; Kirki, O. *J. Chem. Soc., Chem. Commun.*, ***1989***, 934.



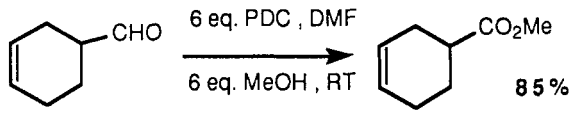
Kajigaeshi, S.; Kawamukai, H.; Fujisaki, S. *Bull. Chem. Soc., Jpn.*, ***1989***, *62*, 2585.

Further examples of the reaction ROH → RCO_2R' are included in Section 107 (Esters from Acid Derivatives) and in Section 45A (Protection of Alcohols and Phenols).

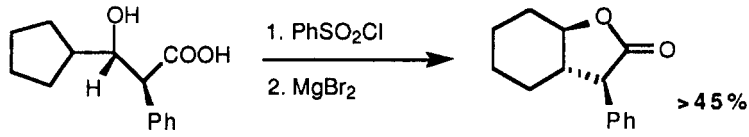
SECTION 109: ESTERS FROM ALDEHYDES



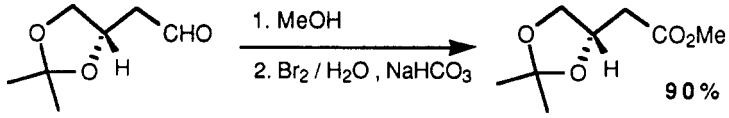
Barluenga, J.; Fernández, J.R.; Yus, M. *J. Chem. Soc., Chem. Commun.*, ***1987***, 1534.



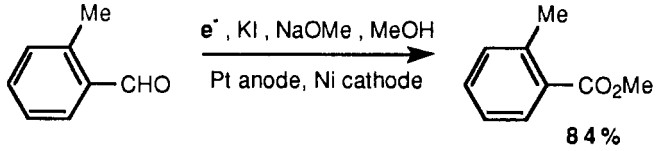
O'Connor, B.; Just, G. *Tetrahedron Lett.*, ***1987***, *28*, 3235.



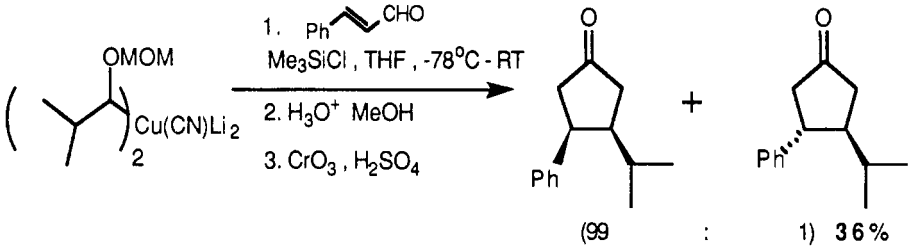
Black, T.H.; DuBay III, W.J. *Tetrahedron Lett.*, ***1988***, *29*, 1747.



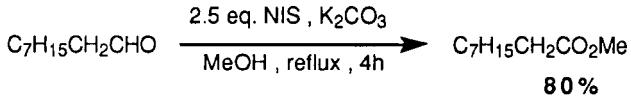
Williams, D.R.; Klingler, F.D.; Allen, E.E.; Lichtenthaler, F.W. *Tetrahedron Lett.*, ***1988***, *29*, 5087.



Okimoto, M.; Chiba, T. *J. Org. Chem.*, ***1988***, *53*, 218.



Linderman, R.J.; McKenzie, J.R. *Tetrahedron Lett.*, ***1989***, *30*, 3911.



McDonald, C.; Holcomb, H.; Kennedy, K.; Kirkpatrick, E.; Leathers, T.; Vanemon, P. *J. Org. Chem.*, ***1989***, *54*, 1213.

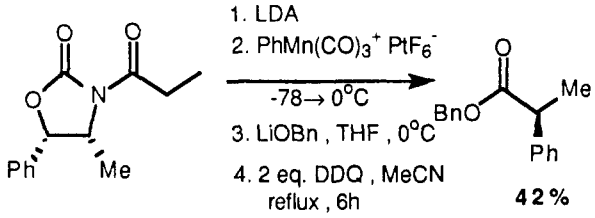
Related Methods: Section 117 (Esters from Ketones)

SECTION 110: ESTERS FROM ALKYLS, METHYLENES AND ARYLS

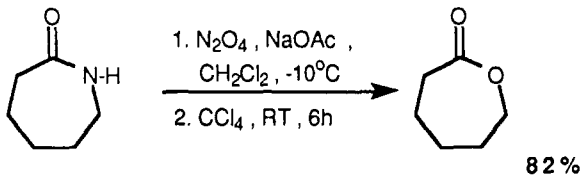
No examples of the reaction R-R → RCO_2R' or $R'CO_2R$ (R,R' = alkyl, aryl, etc.) occur in the literature. For the reaction R-H → RCO_2R' or $R'CO_2R$, see Section 116 (Esters from Hydrides).

NO ADDITIONAL EXAMPLES

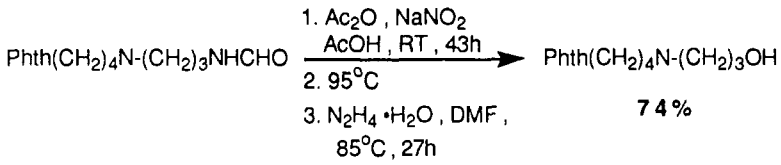
SECTION 111: ESTERS FROM AMIDES



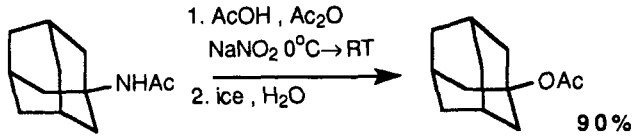
Miles, W.H.; Smiley, P.M.; Brinkman, H.R. *J. Chem. Soc., Chem. Commun.*, ***1989***, 1897.



Torra, N.; Urpí, F.; Vilarrasa, J. *Tetrahedron*, ***1989***, ***45***, 863.



Iwata, M.; Kuzuhara, H. *Chem. Lett.*, ***1989***, 1195.



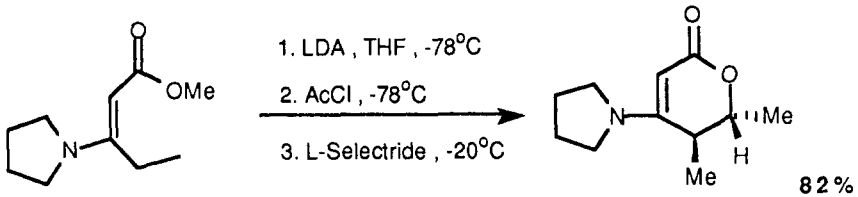
Nikolaides, N.; Ganem, B. *J. Org. Chem.*, ***1989***, *54*, 5996.

SECTION 112: ESTERS FROM AMINES

NO ADDITIONAL EXAMPLES

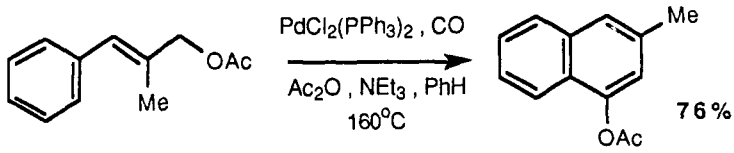
SECTION 113: ESTERS FROM ESTERS

Conjugate reductions and conjugate alkylations of unsaturated esters are found in Section 74 (Alkyls from Alkenes).

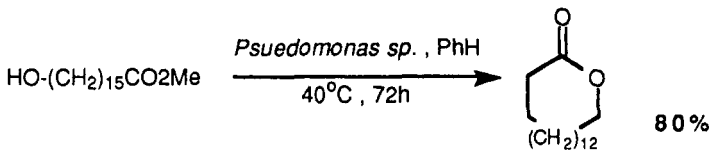


threo:erythro = 99:1

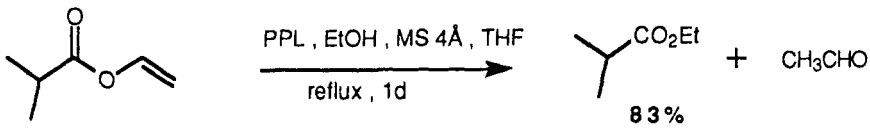
Schlessinger, R.; Tata, J.R.; Springer, J.P. *J. Org. Chem.*, ***1987***, *52*, 708.



Koyasu, Y.; Matsuzaka, H.; Hiroe, Y.; Uchida, Y.; Hidai, M. *J. Chem. Soc., Chem. Commun.*, ***1987***, 575.

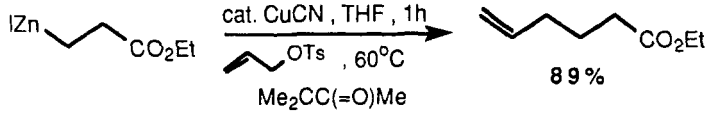


Makita, A.; Nihira, T.; Yamada, Y. *Tetrahedron Lett.*, ***1987***, *28*, 805.

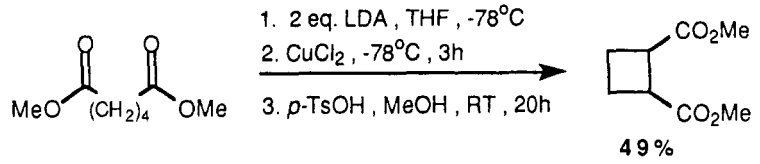


PPL = pig pancreatic lipase

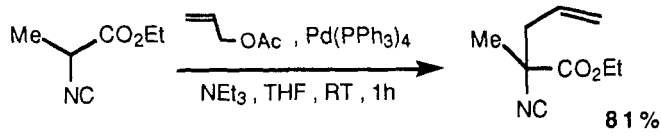
Degueil-Castaing, M.; DeJeso, B. *Tetrahedron Lett.*, ***1987***, *28*, 953.



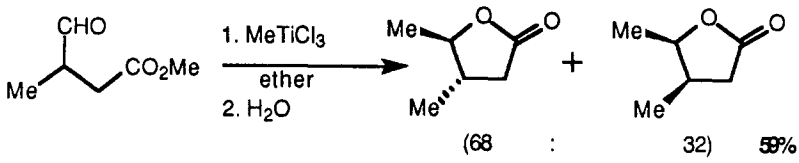
Ochiai, H.; Tamaru, Y.; Tsubaki, K.; Yoshida, Z. *J. Org. Chem.*, ***1987***, *52*, 4418.



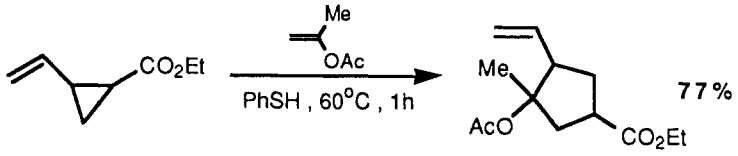
Babler, J.H.; Sarussi, S.J. *J. Org. Chem.*, ***1987***, *52*, 3462.



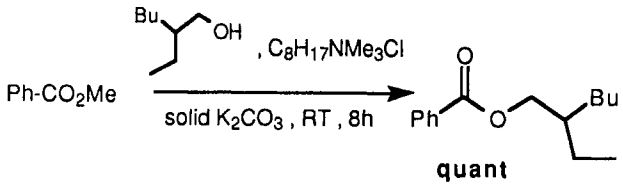
Ito, Y.; Sawamura, M.; Matsuoka, M.; Matsumoto, Y.; Hayashi, T. *Tetrahedron Lett.*, ***1987***, *28*, 4849.



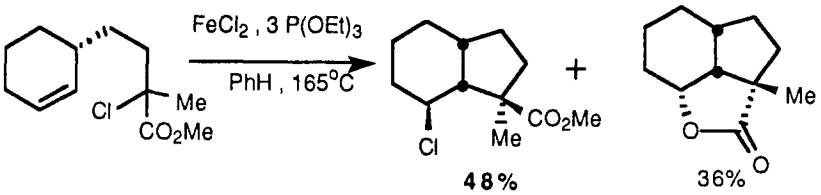
Kunz, T.; Reissig, H.-U. *Angew. Chem. Int. Ed., Engl,* ***1988****, 27*, 268.



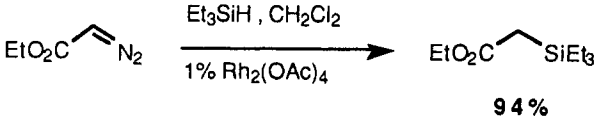
Miura, K.; Fugami, K.; Oshima, K.; Otimoto, K. *Tetrahedron Lett.,* ***1988****, 29*, 5135.



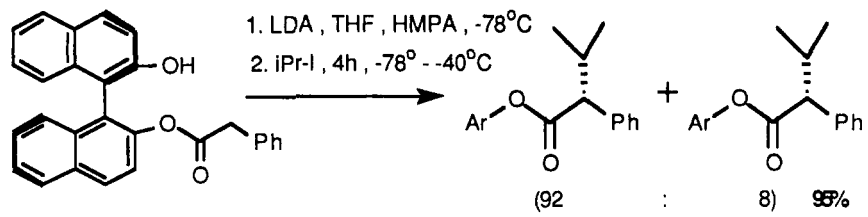
Barry, J.; Bram, G.; Petit, A. *Tetrahedron Lett.,* ***1988****, 29*, 4567.



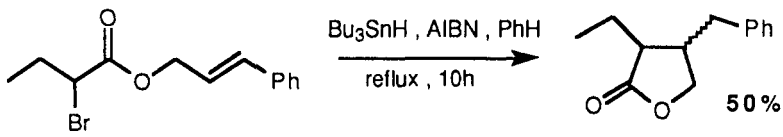
Lee, G.M.; Parvez, M.; Weinreb, S.M. *Tetrahedron,* ***1988****, 44*, 4671.



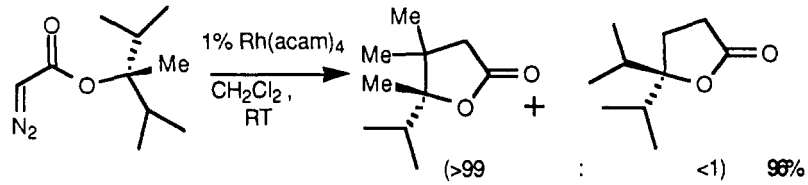
Bagler, V.; Doyle, M.P.; Taunton, J.; Claxton, E.E. *J. Org. Chem.,* ***1988****, 53*, 6158.



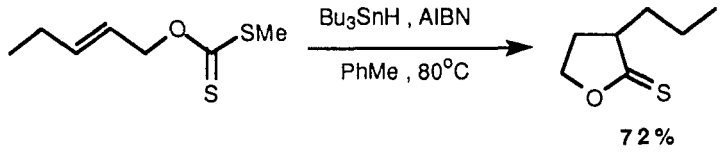
Fuji, K.; Node, M.; Tanaka, F.; Hosoi, S. *Tetrahedron Lett.*, ***1989***, *30*, 2825.



Belletire, J.L.; Mahmoodi, N.O. *Tetrahedron Lett.*, ***1989***, *30*, 4363.

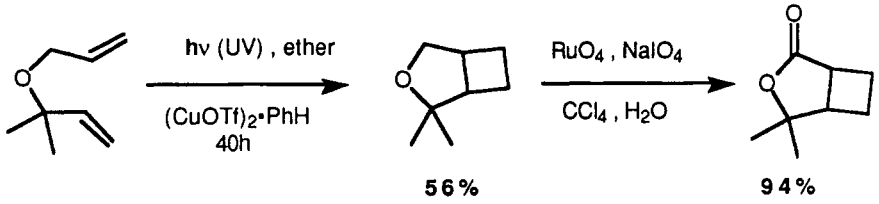


Doyle, M.P.; Bagheri, V.; Pearson, M.M.; Edwards, J.D. *Tetrahedron Lett.*, ***1989***, *30*, 7001.

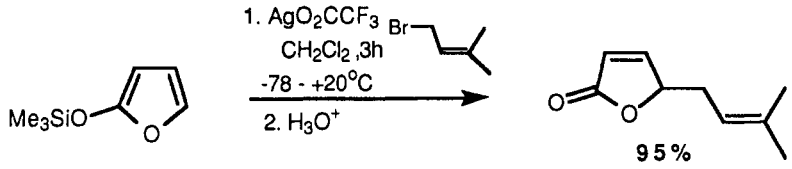


Yamamoto, M.; Uruma, T.; Iwasa, S.; Kohmoto, S.; Yamada, K. *J. Chem. Soc., Chem. Commun.*, ***1989***, 1265.

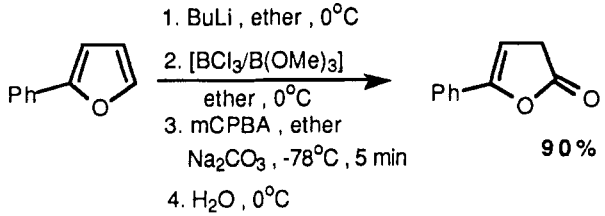
SECTION 114: ESTERS FROM ETHERS, EPOXIDES AND THIOETHERS



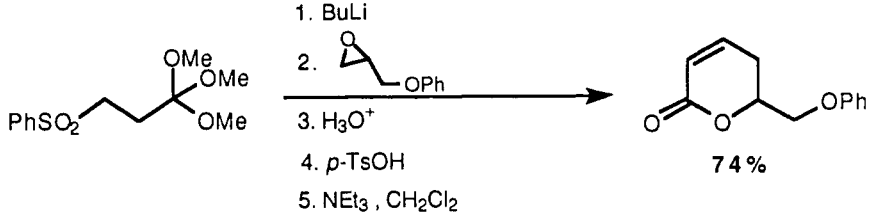
Ghosh, S.; Raychaudmuri, S.R.; Salomon, R.G. *J. Org. Chem.*, ***1987***, *52*, 83.



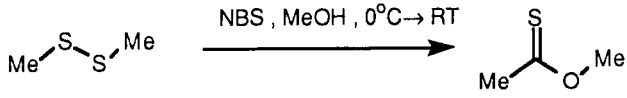
Jefford, C.W.; Sledeski, A.W.; Boukouvalas, J. *Tetrahedron Lett.*, ***1987***, *28*, 949.



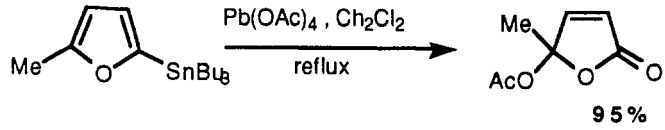
Pelter, A.; Rowlands, M. *Tetrahedron Lett.*, ***1987***, *28*, 1203.



Carretero, J.C.; Ghosez, L. *Tetrahedron Lett.*, ***1988***, *29*, 2059.

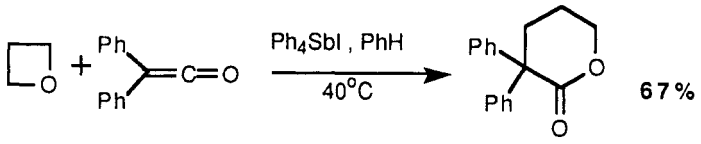


Brownbridge, P.; Jowett, I.C. *Synthesis*, ***1988***, 252.



95%

Yamamoto, M.; Izukawa, H.; Saiki, M.; Yamada, K. *J. Chem. Soc., Chem. Commun.*, ***1988***, 560.



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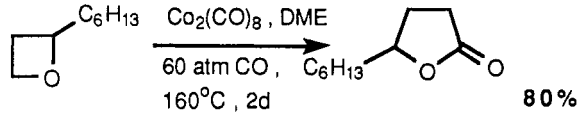
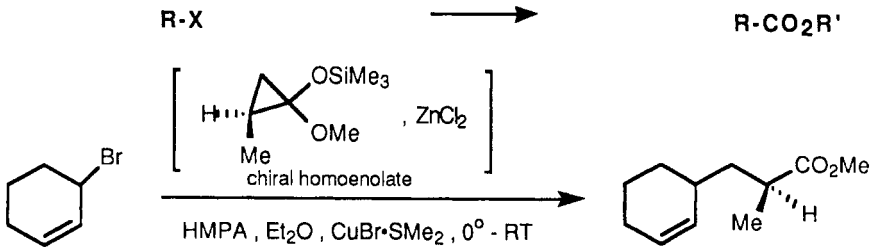
Fujiwara, M.; Imada, M.; Baba, A.; Matsuda, H. *J. Org. Chem.*, ***1988, 53***, 5974.



80%

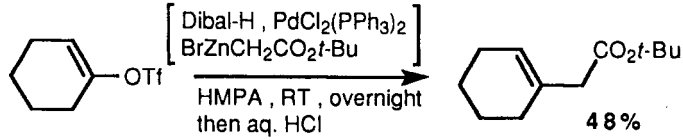
Wang, M.-D.; Calet, S.; Alper, H. *J. Org. Chem.*, ***1989, 54***, 20.

SECTION 115: ESTERS FROM HALIDES AND SULFONATES



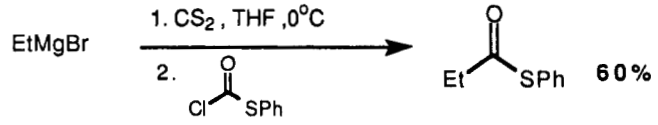
59% [96% ee]

Nakamura, E.; Sekiya, K.; Kuwajima, I. *Tetrahedron Lett.*, ***1987, 28***, 337.

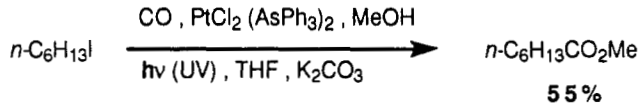


48%

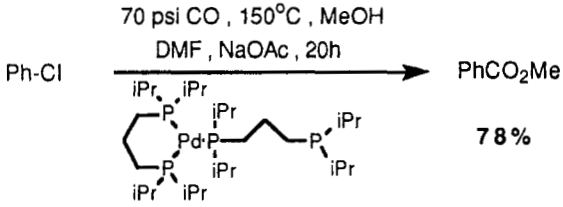
Orsini, F.; Pelizzoni, F. *Synth. Commun.*, ***1987, 17***, 1389.



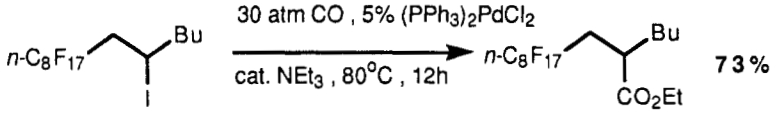
Beslin, P.; Dlubala, A.; Levesque, G. *Synthesis*, ***1987***, 835.



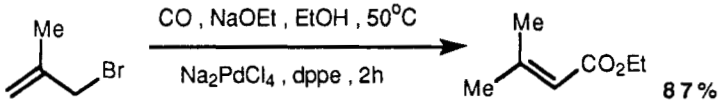
Kondo, T.; Tsuji, Y.; Watanabe, Y. *Tetrahedron Lett.*, ***1988***, *29*, 3833.



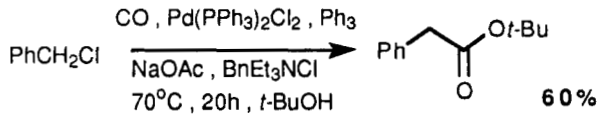
Ben-David, Y.; Portnoy, M.; Milstein, D. *J. Am. Chem. Soc.*, ***1989***, *111*, 8742.



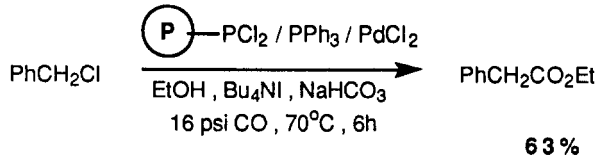
Urata, H.; Kosukegawa, O.; Ishii, Y.; Yugari, H.; Fuchikami, T. *Tetrahedron Lett.*, ***1989***, *30*, 4403.
Urata, H.; Ishii, Y.; Fuchikami, T. *Tetrahedron Lett.*, ***1989***, *30*, 4407.



Kiji, J.; Okano, T.; Konishi, H.; Nishiumi, W. *Chem. Lett.*, ***1989***, 1873.



Adapa, S.R.; Prasad, C.S.N. *J. Chem. Soc., Perkin Trans. I*, ***1989***, 1706.



Reddy, N.P.; Kantam, M.L.; Choudary, B.M. *Indian J. Chem.*, ***1989***, *28B*, 105.

REVIEW:

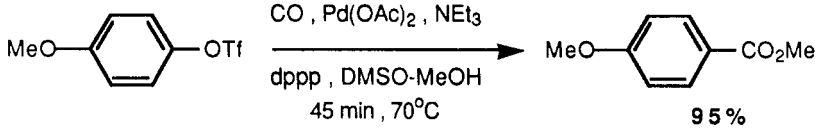
"Nickel-Aluminum Alloy as a Reducing Agent"

Keefer, L.K.; Lunn, G. *Chem. Rev.*, ***1989***, *89*, 459.

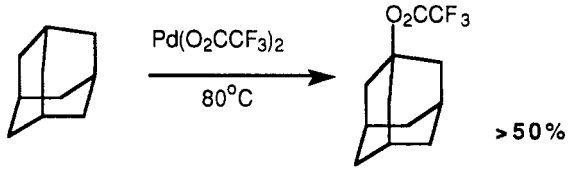
Related Methods: Section 25 (Acid Derivatives from Halides).

SECTION 116: ESTERS FROM HYDRIDES

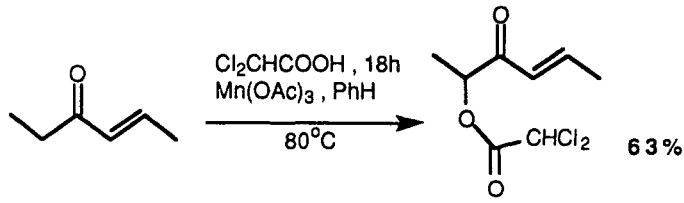
This section contains examples of the reaction R-H → RCO_2R' or $R'CO_2R$ (R = alkyl, aryl, etc.).



Dolle, R.E.; Schmidt, S.J.; Kruse, L.I. *J. Chem. Soc., Chem. Commun.*, ***1987***, 904.



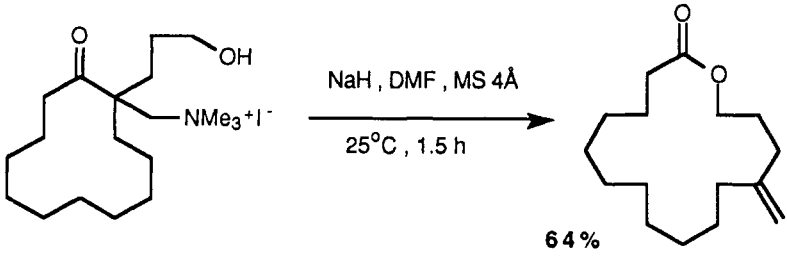
Gretz, E.; Oliver, T.F.; Sen, A. *J. Am. Chem. Soc.*, ***1987***, *109*, 8109.



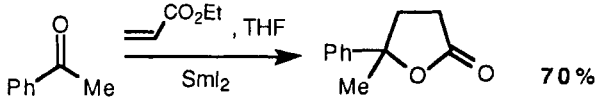
Demir, A.S.; Jeganathan, A.; Watt, D.S. *J. Org. Chem.*, ***1989***, *54*, 4020.

Also via: Section 26 (Acid Derivatives) and Section 41 (Alcohols).

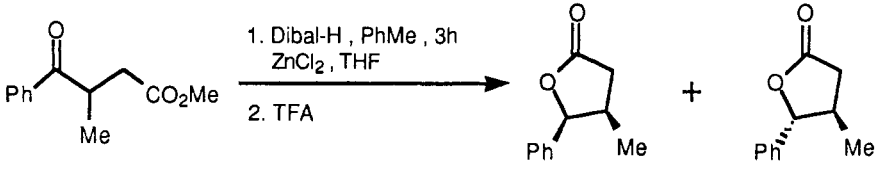
SECTION 117: ESTERS FROM KETONES



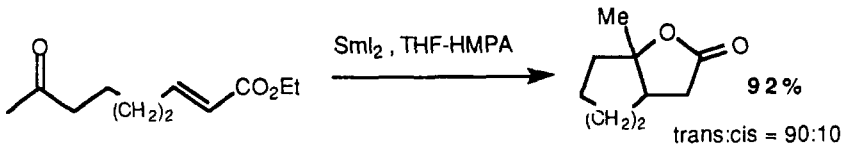
Milenkov, B.; Guggisberg, A.; Hesse, M. *Tetrahedron Lett.*, ***1987***, *28*, 315.



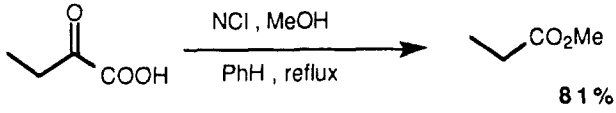
Fukuzawa, S.; Nakanishi, A.; Fujinami, T.; Sakai, S. *J. Chem. Soc., Perkin Trans. I*, ***1988***, 1669.



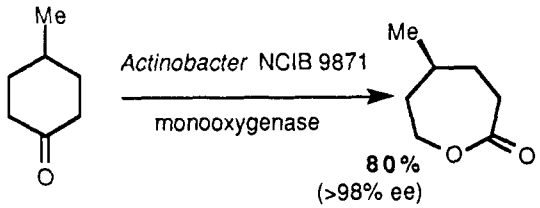
Frenette, R.; Kakushima, M.; Zamboni, R.; Young, R.N. *J. Org. Chem.*, ***1987***, *52*, 304.



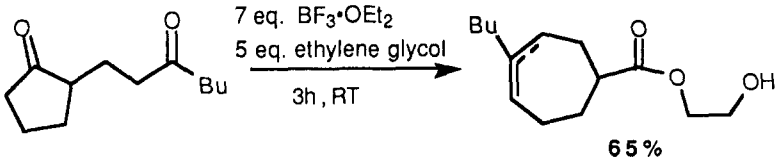
Fukuzawa, S.; Iida, M.; Nakanishi, A.; Fujinami, T.; Sakai, S. *J. Chem. Soc., Chem. Commun.*, ***1987***, 920.



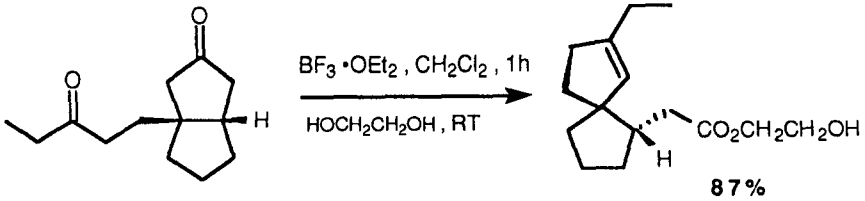
Beebe, T.R.; Baldridge, R.; Beard, M.; Cooke, D.; DeFays, I.; Hensley, V.; Hua, D.; Lao, J.-C.; McMillen, D.; Morris, D.; Noe, R.; O'Bryan, E.; Spielberger, C.; Stotle, M.; Waller Jr., J. *J. Org. Chem.*, ***1987***, *52*, 3165.



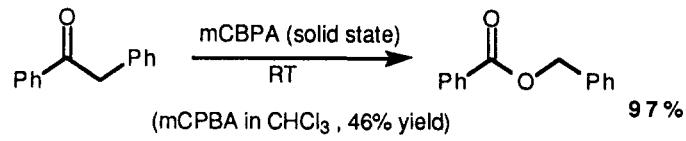
Taschner, M.J.; Black, D.J. *J. Am. Chem. Soc.*, ***1988***, *110*, 6892.



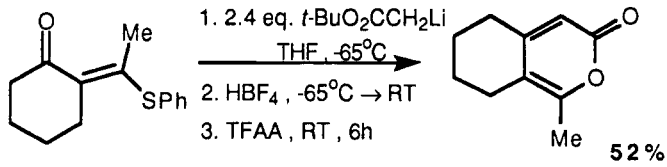
Tanaka, M.; Suemune, H.; Sakai, K. *Tetrahedron Lett.*, ***1988***, *29*, 1733.



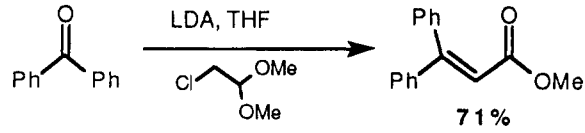
Nagumo, S.; Suemune, H.; Sakai, K. *Tetrahedron Lett.*, ***1988***, *29*, 6927.



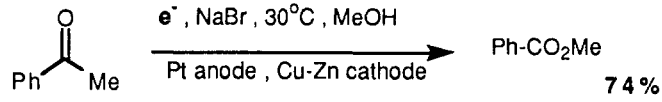
Toda, F.; Yagi, M.; Kiyoshige, K. *J. Chem. Soc., Chem. Commun.*, ***1988***, 958.



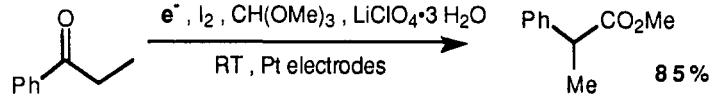
Dieter, R.K.; Fishpaugh, J.R. *J. Org. Chem.*, ***1988***, *53*, 2031.



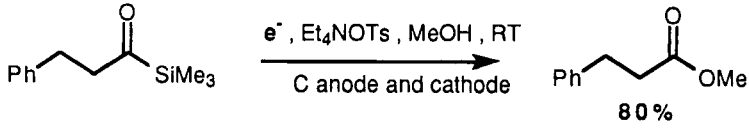
Olah, G.A.; Wu, A.; Farooq, O.; Surya Prakash, G.K. *Synthesis*, ***1988***, 537.



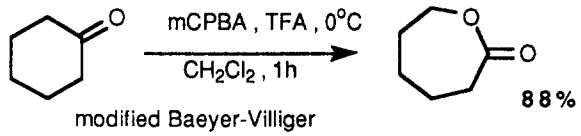
Nikishin, E.I.; Elinson, M.N.; Makhova, I.V. *Angew. Chem. Int. Ed., Engl*, ***1988***, *27*, 1716.



Shono, T.; Matsumura, Y.; Katoh, S.; Fujita, T.; Kamada, T. *Tetrahedron Lett.*, ***1989***, *30*, 371.



Yoshida, J.; Matsunaga, S.; Isoe, S. *Tetrahedron Lett.*, ***1989***, *30*, 5293.



modified Baeyer-Villiger

Koch, S.S.C.; Chamberlin, A.R. *Synth. Commun.*, ***1989***, *19*, 829.

REVIEWS:

"Enzymatic Baeyer-Villiger Oxidations by Flavin Dependent Monooxygenases"

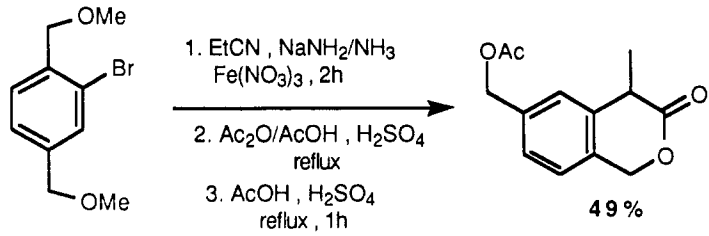
Walsh, C.T.; Chen, Y.-C.J. *Angew. Chem. Int. Ed., Engl*, ***1988***, *27*, 333.

"Syntheses of Macrocyclic Compounds by Ring Enlargement"

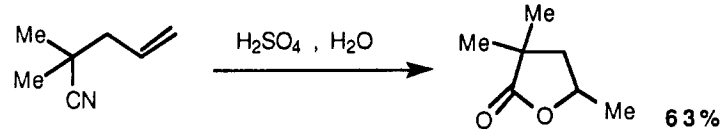
Stauch, H.; Hesse, M. *Tetrahedron*, ***1988***, *44*, 1573.

Also via: Section 27 (Acid Derivatives).

SECTION 118: ESTERS FROM NITRILES

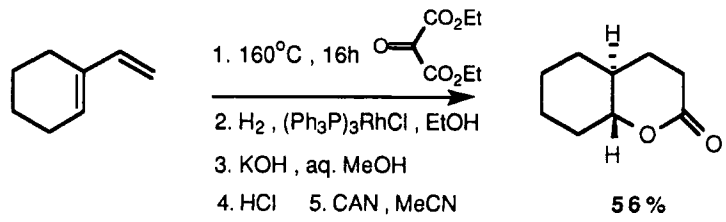


Khanapure, S.P.; Biehl, E.R. *J. Org. Chem.*, ***1987***, *52*, 1333.

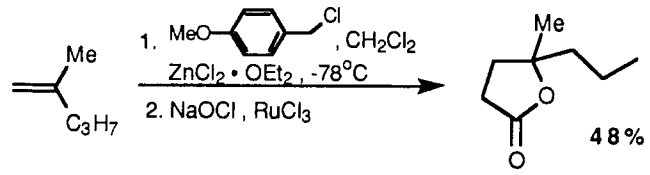


Tiecco, M.; Tingoli, M.; Testaferri, L.; Bartoli, D. *Synth. Commun.*, ***1989***, *19*, 2817.

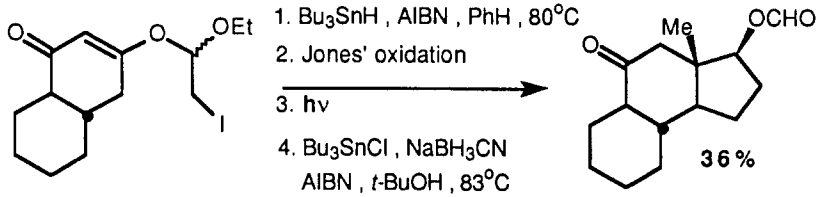
SECTION 119: ESTERS FROM ALKENES



Salomon, R.G.; Roy, S.; Salomon, M.F. *Tetrahedron Lett.*, ***1988***, *29*, 769.



Bäuml, E.; Tscheschlok, K.; Pock, R.; Mayr, H. *Tetrahedron Lett.*, ***1988***, *29*, 6925.



Stork, G.; Mah, R. *Tetrahedron Lett.*, ***1989***, *30*, 3609.

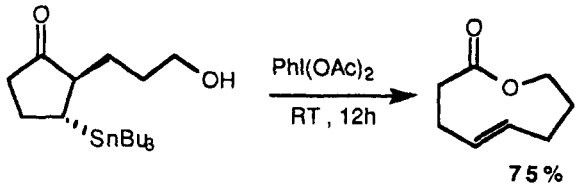
REVIEW:

"Transition Metal-Catalyzed Epoxidations"

Jørgensen, K.A. *Chem. Rev.*, ***1989***, *89*, 431.

Also via: Section 44 (Alcohols).

SECTION 120: ESTERS FROM MISCELLANEOUS COMPOUNDS



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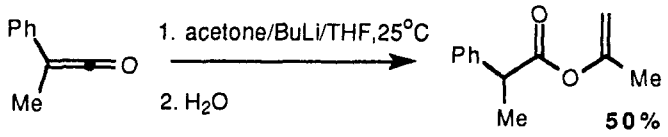
Ochiai, M.; Iwaki, S.; Ukita, T.; Nagao, Y. *Chem. Lett.*, ***1987***, 133.



50%

Bairgrie, L.M.; Leung-Toung, R. Tidwell, T.T. *Tetrahedron Lett.*, ***1988***, *29*, 1673.

REVIEW:

"Reactions of Carbon Dioxide with Carbon-Carbon Bond Formation Catalyzed by Transition Metal Complexes"

Braunstein, P.; Matt, D.; Nobel, D. *Chem. Rev.*, ***1988***, *88*, 747.

Compendium of Organic Synthetic Methods, Volume 7
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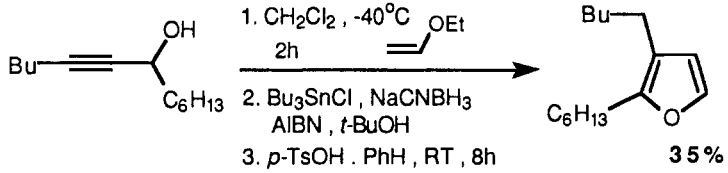
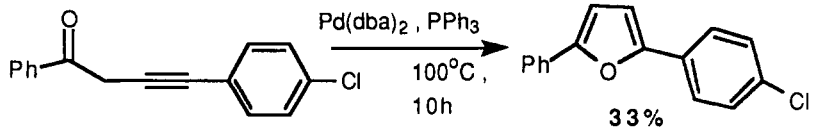
CHAPTER 9

PREPARATION OF ETHERS, EPOXIDES AND THIOETHERS

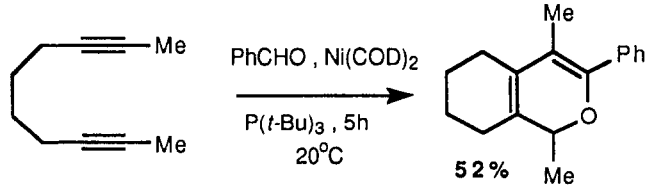
SECTION 121: ETHERS, EPOXIDES AND THIOETHERS FROM ALKYNES



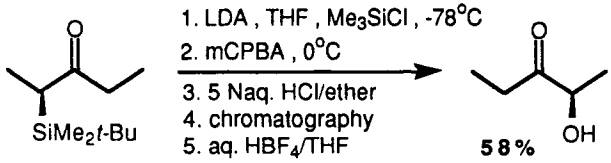
Srikrishna, A.; Sunderbabu, G. *Tetrahedron Lett.*, ***1987***, *28*, 6393.



Sheng, H.; Lin, S.; Huang, Y. *Synthesis,* ***1987***, 1022.

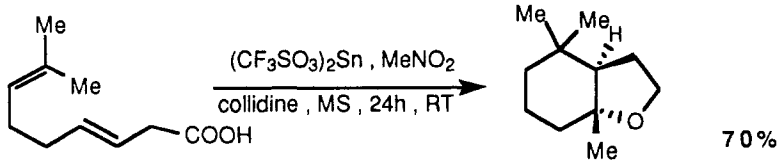


Tsuda, T.; Kiyoi, T.; Miyane, T.; Saegusa, T. *J. Am. Chem. Soc.*, ***1988***, *110*, 8570.



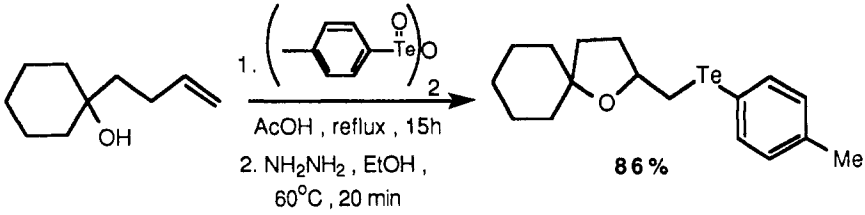
Obrecht, D. *Helv. Chim. Acta*, ***1989***, *72*, 447.

SECTION 122: ETHERS, EPOXIDES AND THIOETHERS FROM ACID DERIVATIVES

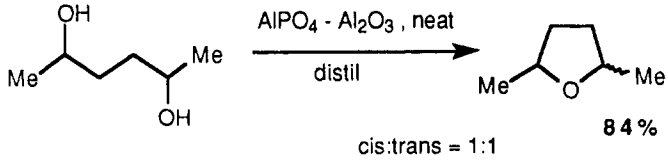


Gnonlonfoun, N.; Zamarlik, H. *Tetrahedron Lett.*, ***1987***, *28*, 4053.

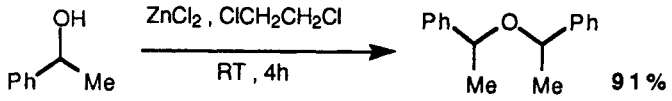
SECTION 123: ETHERS, EPOXIDES AND THIOETHERS FROM ALCOHOLS AND THIOLS



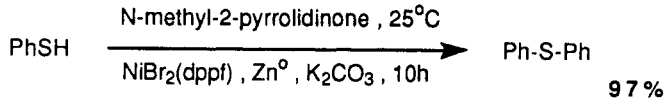
Hu, N.X.; Aso, Y.; Otsubo, T.; Ogura, F. *Tetrahedron Lett.*, ***1987***, *28*, 1281.



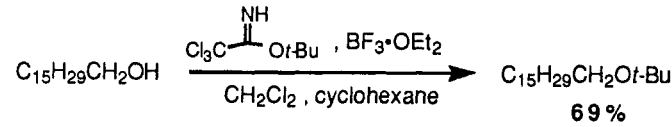
Costa, A.; Riego, J.M. *Synth. Commun.*, ***1987***, *17*, 1373.



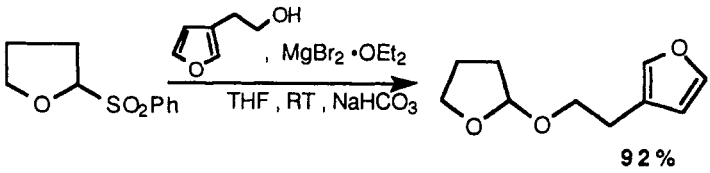
Kim, S.; Chung, K.N.; Yang, S. *J. Org. Chem.*, ***1987***, *52*, 3917.



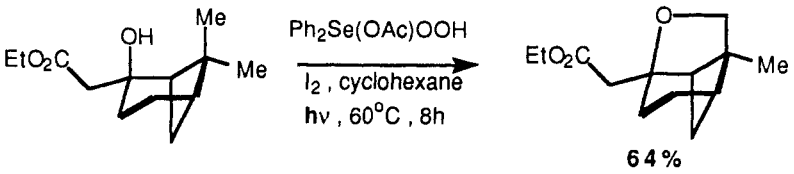
Takagi, K. *Chem. Lett.*, ***1987***, 2221.



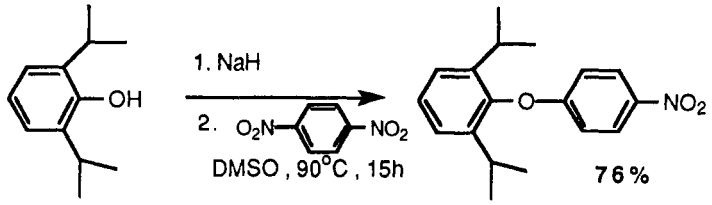
Armstrong, A.; Brackenridge, I.; Jackson, R.F.W.; Kirk, J.M. *Tetrahedron Lett.*, ***1988***, *29*, 2483.



Brown, D.S.; Ley, S.V.; Vile, S. *Tetrahedron Lett.*, ***1988***, *29*, 4873.

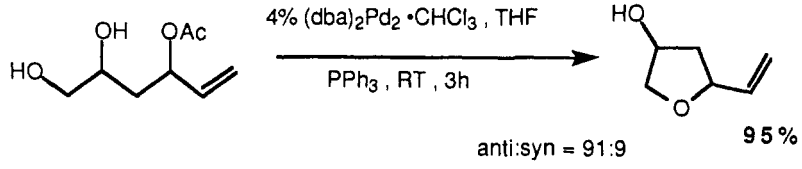


Dorta, R.L.; Francisco, C.G.; Freire, R.; Suárez, E. *Tetrahedron Lett.*, ***1988***, *29*, 5429.

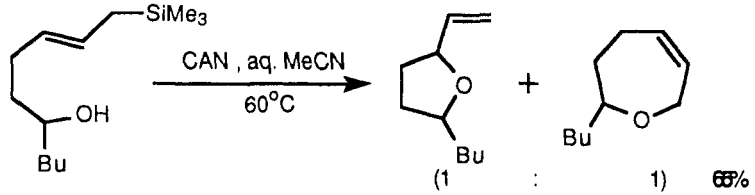


Sammes, P.G.; Thetford, D.; Voyle, M. *J. Chem. Soc., Perkin Trans. I, **1988**,* 3229.

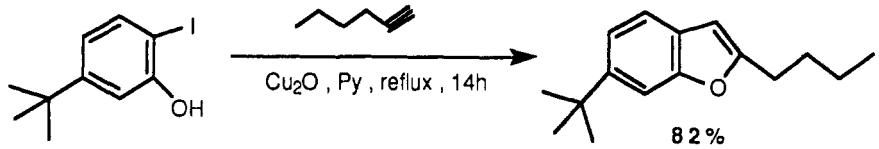
*J. Chem. Soc., Chem. Commun., **1987**,* 1373



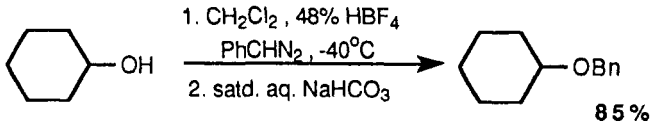
Trost, B.M.; Tenaglia, A. *Tetrahedron Lett., **1988**, 29*, 2927.



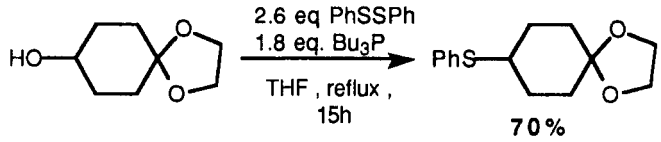
Wilson, S.R.; Augelli-Szafran, C.E. *Tetrahedron, **1988**, 44*, 3983.



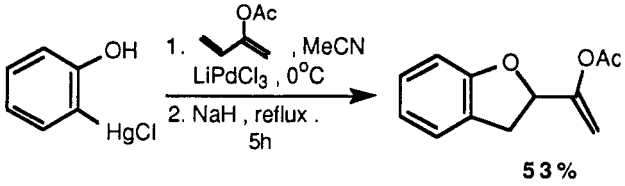
Doad, G.J.S.; Barltrop, J.A.; Petty, C.M.; Owen, T.C. *Tetrahedron Lett., **1989**, 30*, 1597.



Liotta, L.J.; Ganem, B. *Tetrahedron Lett., **1989**, 30*, 4759.

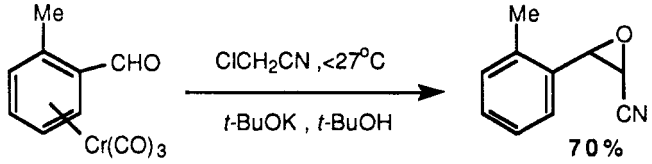


Cleary, D.G. *Synth. Commun.*, ***1989***, *19*, 737.



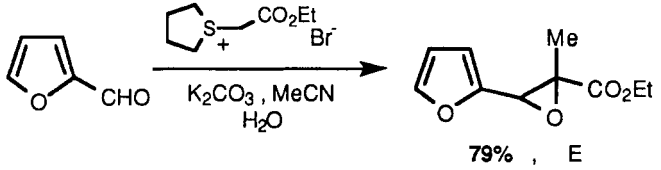
Larock, R.C.; Song, H. *Synth. Commun.*, ***1989***, *19*, 1463.

SECTION 124: ETHERS, EPOXIDES AND THIOETHERS FROM ALDEHYDES

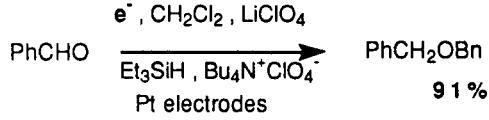


cis : trans = 69:31
(59%ee : 56% ee)

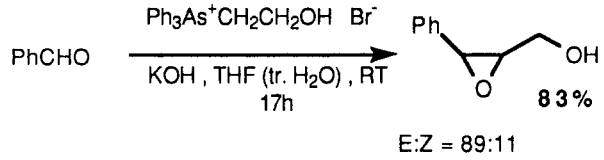
Baldoli, C.; Del Buttero, P.; Lincandro, E.; Maiorana, S.; Papagni, A. *J. Chem. Soc., Chem. Commun.*, ***1987***, 762.



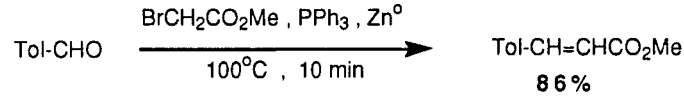
Oikoua, K.; Borredon, M.E.; Delmas, M.; Gaset, A. *Synth. Commun.*, ***1987***, *17*, 1593.



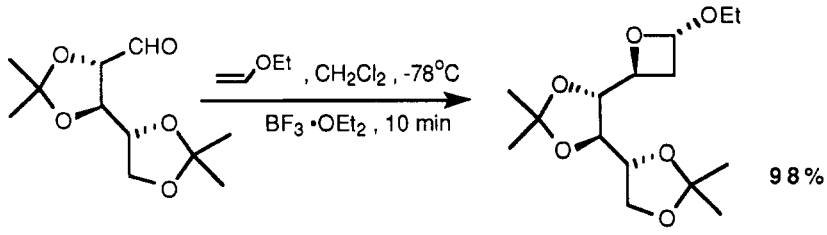
Torii, S.; Takagishi, S.; Inokuchi, T.; Okumoto, H. *Bull. Chem. Soc., Jpn.*, ***1987***, *60*, 775.



Shi, L.; Wang, W.; Huang, Y.-Z. *Tetrahedron Lett.*, ***1988***, *29*, 5295.



Shen, Y.; Xin, Y.; Zhao, J. *Tetrahedron Lett.*, ***1988***, *29*, 6119.

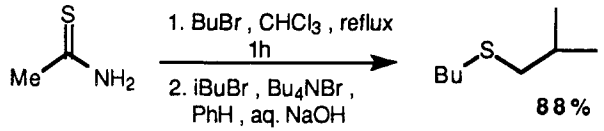


Sugimura, H.; Osumi, K. *Tetrahedron Lett.*, ***1989***, *30*, 1571.

SECTION 125: ETHERS, EPOXIDES AND THIOETHERS FROM ALKYLS, METHYLENES AND ARYLS

NO ADDITIONAL EXAMPLES

SECTION 126: ETHERS, EPOXIDES AND THIOETHERS FROM AMIDES

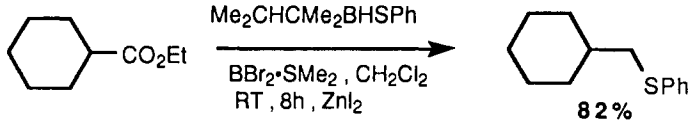


Takido, T.; Itabashi, K. *Synthesis, **1987**,* 817.

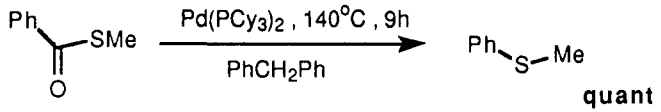
SECTION 127: ETHERS, EPOXIDES AND THIOETHERS FROM AMINES

NO ADDITIONAL EXAMPLES

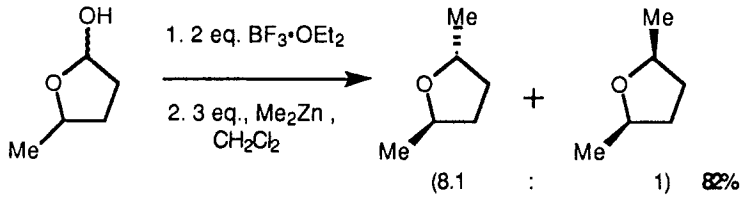
SECTION 128: ETHERS, EPOXIDES AND THIOETHERS FROM ESTERS



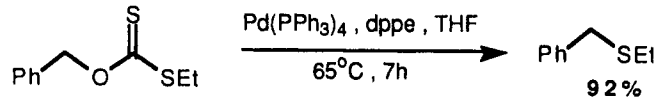
Kim, S.; Kim, S.S. *Tetrahedron Lett., **1987**, 28,* 1913.



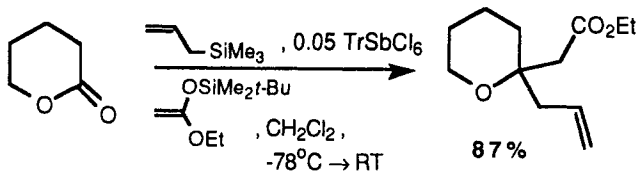
Osakada, K.; Yamamoto, T.; Yamamoto, A. *Tetrahedron Lett., **1987**, 28,* 6321.



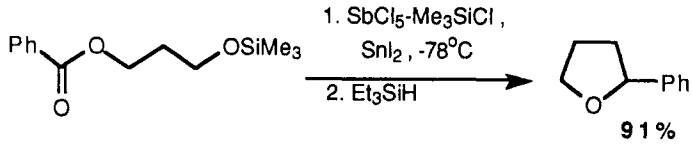
Tomooka, K.; Matsuzawa, K.; Suzuki, K.; Tsuchihashi, G. *Tetrahedron Lett., **1987**, 28,* 6339.



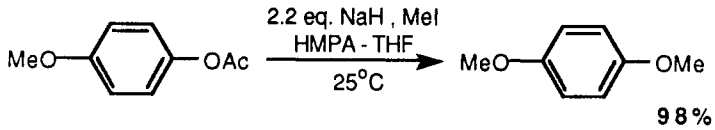
Lu, X.; Ni, Z. *Synthesis*, ***1987***, 66.



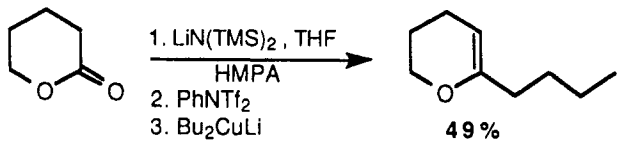
Mukaiyama,T.; Homma, K.; Takenoshita, H. *Chem. Lett.*, ***1988***, 1725.



Homma, K.; Mukaiyama, T. *Chem. Lett.*, ***1989***, 259.

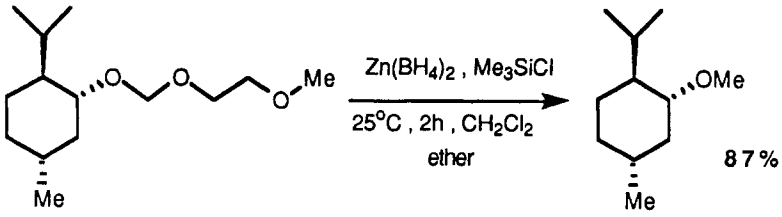


Yamashita, A.; Toy, A. *Synth. Commun.*, ***1989***, *19*, 755.

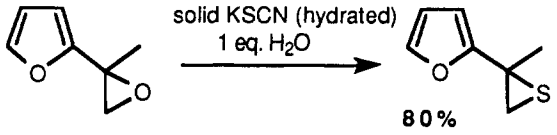


Tsuchima, K.; Araki, K.; Murai, A. *Chem. Lett.*, ***1989***, 1313.

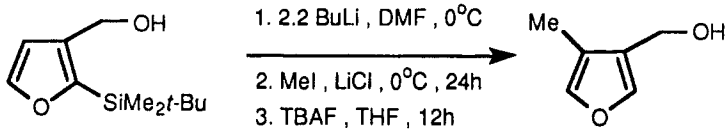
SECTION 129: ETHERS, EPOXIDES AND THIOETHERS FROM ETHERS, EPOXIDES AND THIOETHERS



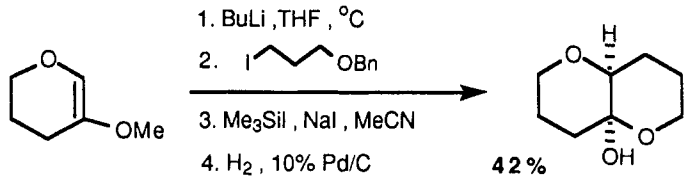
Katsuki, H.; Ushio, Y.; Yoshimura, N.; Ochi, M. *J. Org. Chem.*, ***1987***, *52*, 2594.



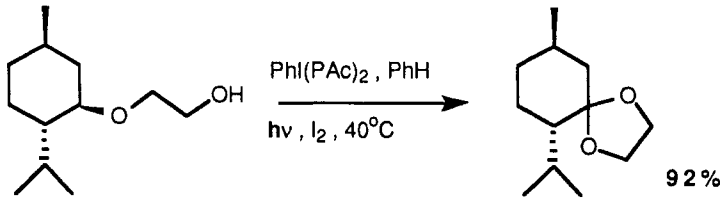
Bouda, H.; Borredon, M.E.; Delmas, M.; Gaset, A. *Synth. Commun.*, ***1987***, *17*, 943.



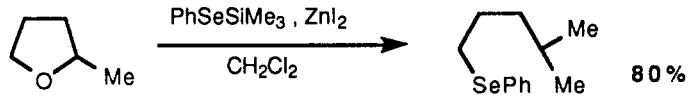
Bures, E.J.; Keay, B.A. *Tetrahedron Lett.*, ***1988***, *29*, 1247.



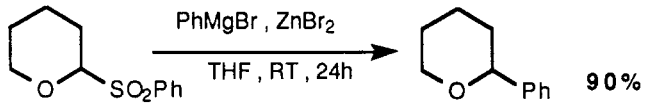
Cox, P.; Mahon, M.F.; Molloy, K.C.; Lister, S.; Gallagher, T. *Tetrahedron Lett.*, ***1988***, *29*, 1993.



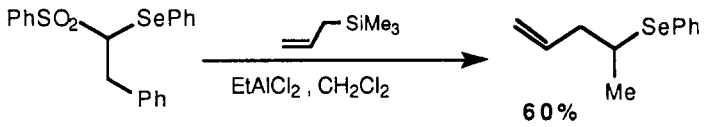
Furuta, K.; Nagata, T.; Yamamoto, H. *Tetrahedron Lett.*, ***1988***, *29*, 2215.



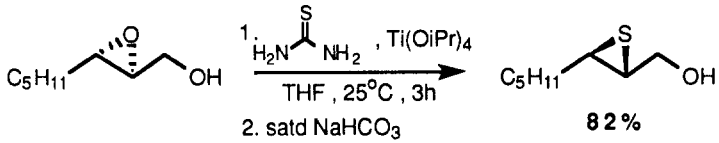
Miyoshi, N.; Hatayama, Y.; Ryu, I.; Kambe, N.; Murai, T.; Murai, S.; Sonoda, N. *Synthesis,* ***1988***, 175.



Brown, D.S.; Ley, S.V. *Tetrahedron Lett.,* ***1988, 29***, 4869.

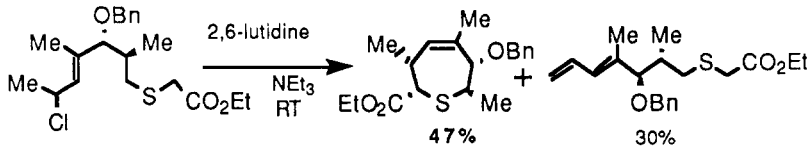


Simpkins, N.S. *Tetrahedron Lett.,* ***1988, 29***, 6787.

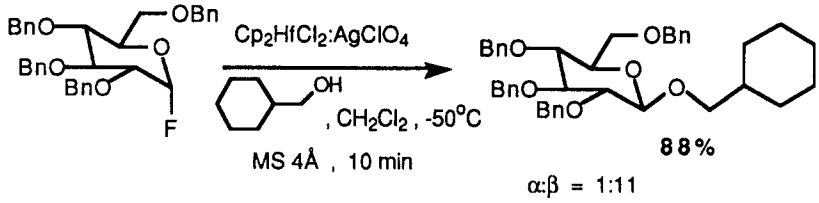


Gao, Y.; Sharpless, K.B. *J. Org. Chem.,* ***1988, 53***, 4114.

SECTION 130: ETHERS, EPOXIDES AND THIOETHERS FROM HALIDES AND SULFONATES



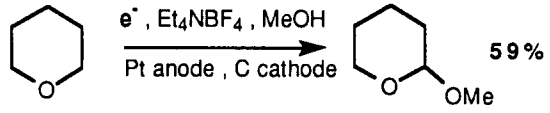
Vedejs, E.; Buchanan, R.A.; Conrad, P.C.; Meier, G.P.; Mullins, M.J.; Schaffhausen, J.G.; Schwartz, C.E. *J. Am. Chem. Soc.,* ***1989, 111***, 8421.



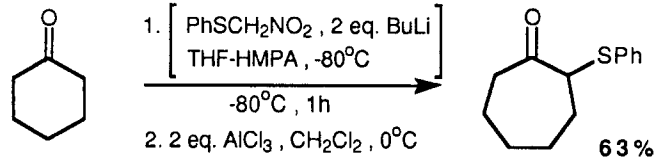
Suzuki, K.; Maeta, H.; Matsumoto, T. *Tetrahedron Lett.*, ***1989***, *30*, 4853.
also with $Cp_2ZrCl_2 \cdot AgClO_4$ (99% , 1.3:1 (α:β).
Matsumoto, T.; Maeta, H.; Suzuki, K.; Tsuchihashi, G. *Tetrahedron Lett.*, ***1988***, *29*, 3567, 3571.
Suzuki, K.; Maeta, H.; Suzuki, T.; Matsumoto, T. *Tetrahedron Lett.*, ***1989***, *30*, 6879.

Related Methods: Section 123 (Ethers from Alcohols).

SECTION 131: ETHERS, EPOXIDES AND THIOETHERS FROM HYDRIDES

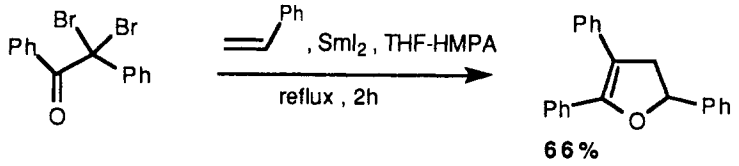


Shono, T.; Matsumura, Y.; Onomura, O.;Yamada, Y. *Synthesis*, ***1987***, 1099.

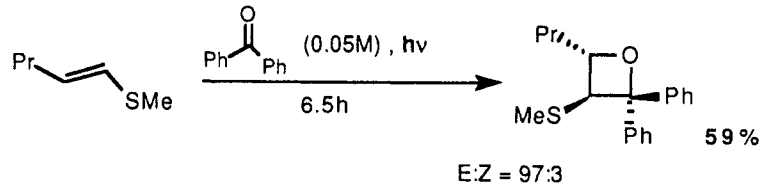


Kim, S.; Park, J.H. *Chem. Lett.*, ***1988***, 1323.

SECTION 132: ETHERS, EPOXIDES AND THIOETHERS FROM KETONES

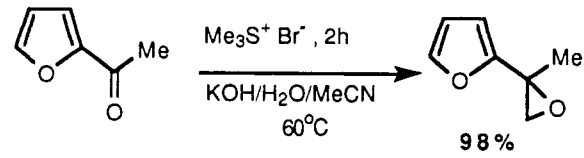


Fukuzawa, S.; Fujinami, T.; Sakai, S. *J. Chem. Soc., Chem. Commun.*, ***1987***, 919.

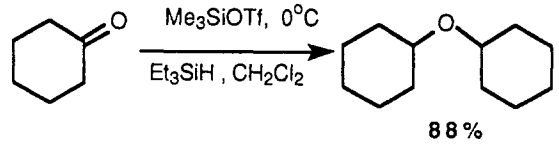


E:Z = 97:3

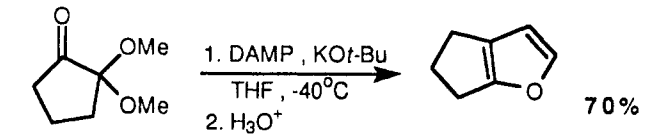
Morris, T.H.; Smith, E.H.; Walsh, R. *J. Chem. Soc., Chem. Commun.*, ***1987***, 964.



Bouda, H.; Borredon, M.E.; Delmas, M.; Gaset, A. *Synth. Commun.*, ***1987***, *17*, 503.

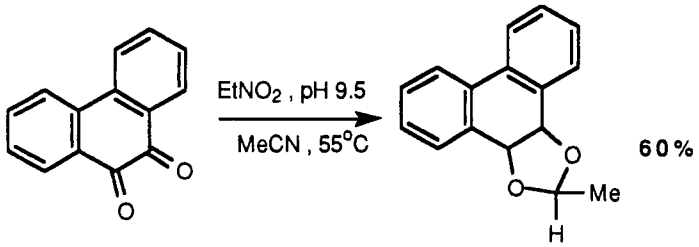


Sassaman, M.B.; Kotian, K.D.; Prakash, G.K.S.; Olah, G.A. *J. Org. Chem.*, ***1987***, *52*, 4314.

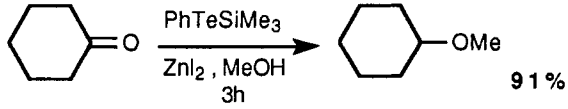


DAMP = diethyl diazomethyl phosphonate

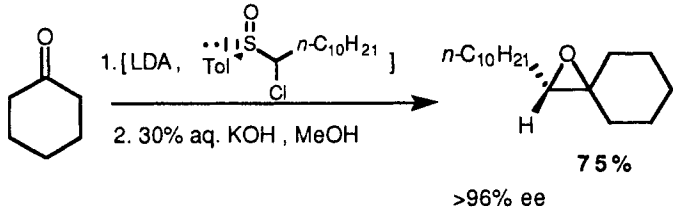
Buxton, S.R.; Holm, K.H.; Skattebøl, L. *Tetrahedron Lett.*, ***1987***, *28*, 2163.



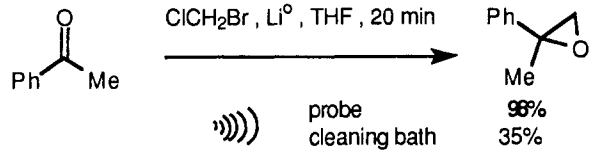
Itoh, S.; Nil, K.; Mure, M.; Ohshiro, Y. *Tetrahedron Lett.*, ***1987***, *28*, 3975.



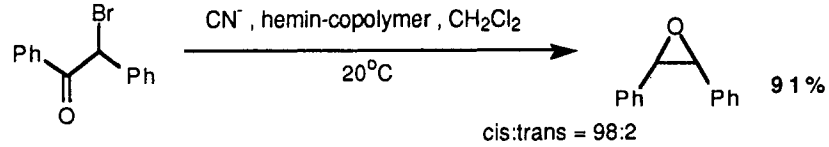
Nagakawa, K.; Osuka, M.; Sasaki, K.; Aso, Y.; Otsubo, T.; Ogura, F. *Chem. Lett.*, ***1987***, 1331.



Satoh, T.; Oohara, T.; Yamakawa, K. *Tetrahedron Lett.*, ***1988***, *29*, 2851.



Einhorn, C.; Allavena, C.; Luche, J.-L. *J. Chem. Soc., Chem. Commun.*, ***1988***, 333.



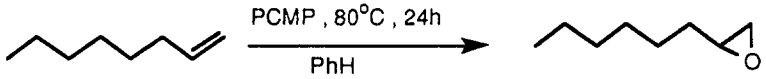
Saito, K.; Harada, K. *Tetrahedron Lett.*, ***1989***, *30*, 1651.

Related Methods: Section 124 (Epoxides from Aldehydes).

SECTION 133: ETHERS, EPOXIDES AND THIOETHERS FROM NITRILES

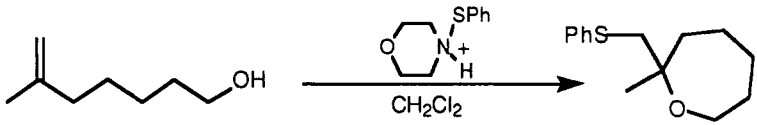
NO ADDITIONAL EXAMPLES

SECTION 134: ETHERS, EPOXIDES AND THIOETHERS FROM ALKENES



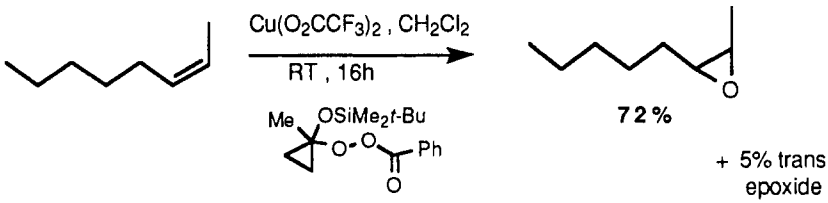
PCMP =[π-$C_5H_5N^+$ $(CH_2)_{15}CH_3]_3[PMo_{12}O_{40}]^{3-}$ **79%**

Ishii, Y.; Yamawaki, K.; Yoshida, T.; Ura, T.; Ogawa, M. *J. Org. Chem.*, ***1987***, *52*, 1868.



78%

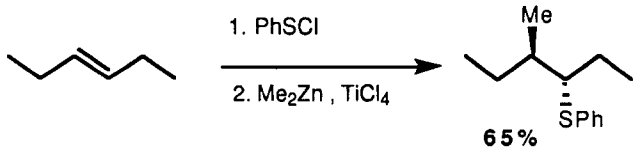
Brownbridge, P. *J. Chem. Soc., Chem. Commun.*, ***1987***, 1280.



72%

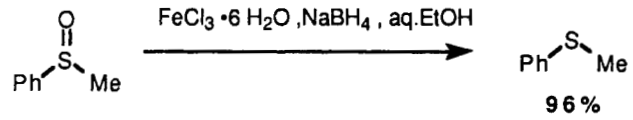
+ 5% trans epoxide

Saito, I.; Mano, T.; Nagata, R.; Matsuura, T. *Tetrahedron Lett.*, ***1987***, *28*, 1901.

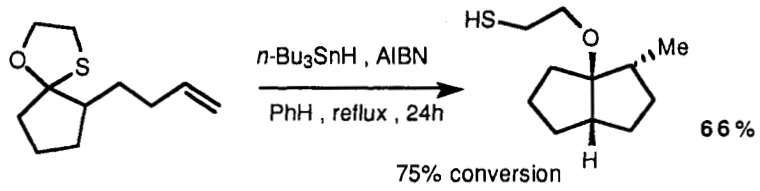


65%

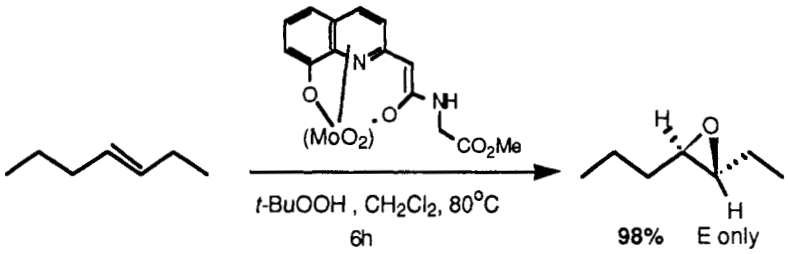
Reetz, M.T.; Seitz, T. *Angew. Chem. Int. Ed., Engl*, ***1987***, *26*, 1028.



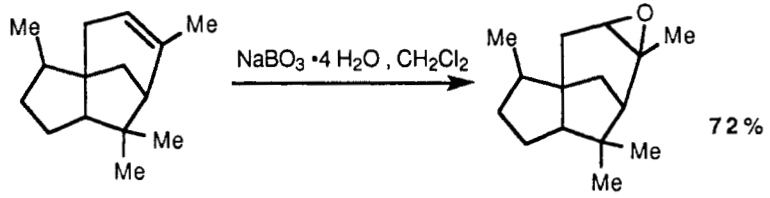
Lin, R.; Zhang, Y. *Synth. Commun.*, ***1987***, *17*, 1403.



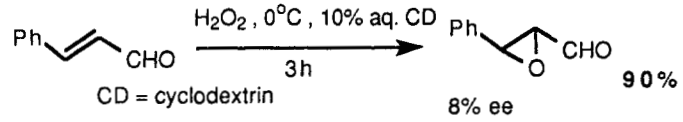
Yadov, V.K.; Fallis, A.G. *Tetrahedron Lett.*, ***1988***, *29*, 897.



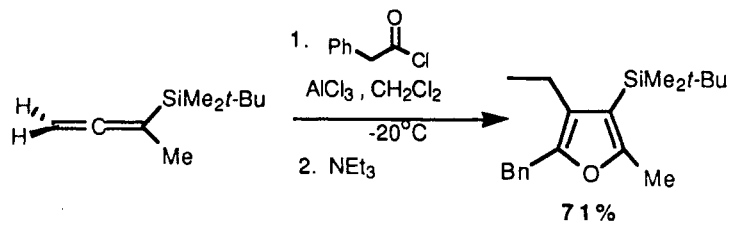
Okamoto, Y.; Still, W.C. *Tetrahedron Lett.*, ***1988***, *29*, 971.



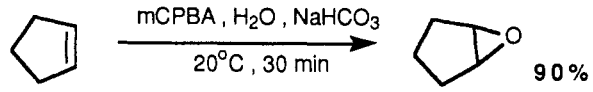
Xie, G.; Xu, L.; Hu, J.; Ma, S.; Hou, W.; Tao, F. *Tetrahedron Lett.*, ***1988***, *29*, 2967.



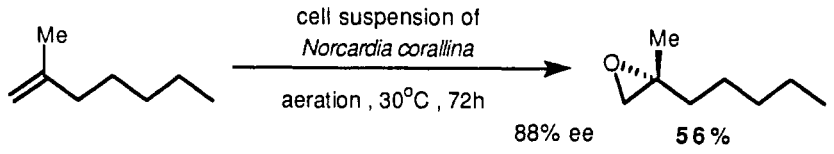
Hu, Y.; Harada, A.; Takahashi, S. *Synth. Commun.*, ***1988***, *18*, 1607.



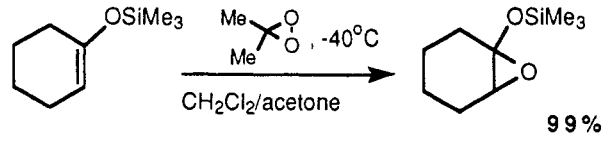
Danheiser, R.L.; Stoner, E.J.; Koyama, H.; Yamashita, D.S.; Klade, C.A. *J. Am. Chem. Soc.*, ***1989***, *111*, 4407.



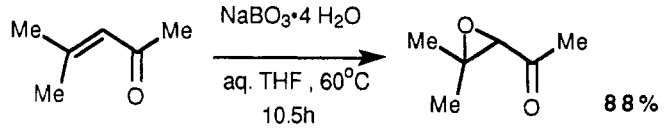
Fringuelli, F.; Germani, R.; Pizzo, F.; Savelli, G. *Tetrahedron Lett.*, ***1989***, *30*, 1427.



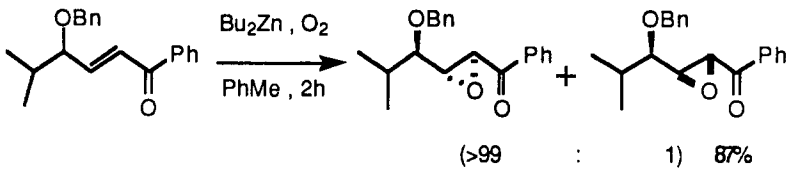
Takahashi, O.; Umezawa, J.; Furuhashi, K.; Takagi, M. *Tetrahedron Lett.*, ***1989***, *30*, 1583.



Adam, W.; Hadjiarapoglou, L.; Wang, X. *Tetrahedron Lett.*, ***1989***, *30*, 6497.



Reed, K.L.; Gupton, J.T.; Solarz, T.L. *Synth. Commun.*, ***1989***, *19*, 3579.



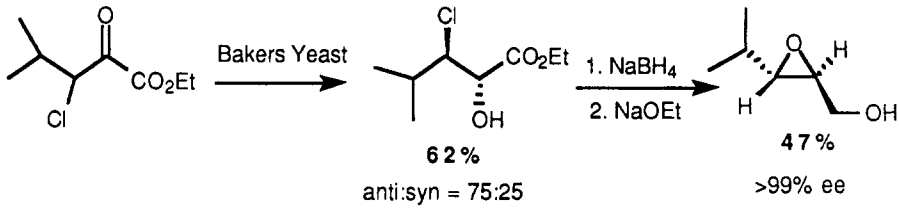
Yamamoto, K.; Yamamoto, N. *Chem. Lett.*, ***1989***, 1149.

REVIEW:

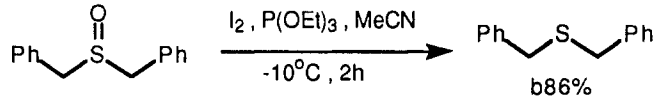
"Original Syntheses of Epoxides Involving Organoselenium Intermediates"

Krief, A.; Dumont, W.; Van Ende, D.; Halazy, S.; Labar, D.; Laboureur, J.-L.; Lê, T *Heterocycles*, ***1989***, *28*, 1203.

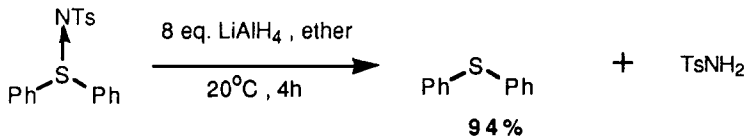
SECTION 135: ETHERS, EPOXIDES AND THIOETHERS FROM MISCELLANEOUS COMPOUNDS



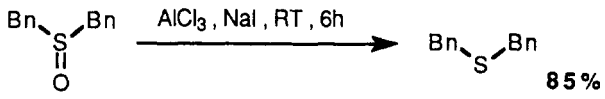
Tsuboi, S.; Furutani, H.; Utaka, M.; Takeda, A. *Tetrahedron Lett.*, ***1987***, *28*, 2709.



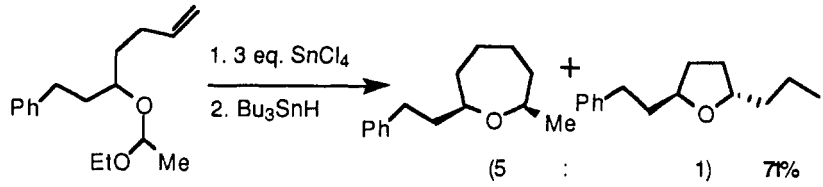
Singh, S.P.; Saxena, R.K. *Synth. Commun.*, ***1987***, *17*, 575.



Kim, K.S.; Jung, I.B.; Kim, Y.H.; Oae, S. *Tetrahedron Lett.*, ***1989***, *30*, 1087.



Bhatt, M.; Babu, J.R. *Indian J. Chem.*, ***1988***, *27B*, 259.



Castañeda, A.; Kucera, D.J.; Overman, L.E. *J. Org. Chem.*, ***1989***, *54*, 5691.

REVIEWS:

"Synthetic Routes to Tetrahydrofuran, Tetrahydropyran and Spiroketal Units of Polyether Antibiotics and a Survey of Spiroketals of Other Natural Products"

Boivin, T.L. *Tetrahedron*, ***1987***, *43*, 3309.

"α-Thioalkylation via Aldehydes and Thiols"

Massy, D.J.R. *Synthesis*, ***1987***, 589.

"Reduction of Sulfoxides to Thioethers"

Madesclaire, M. *Tetrahedron*, ***1988***, *44*, 6537.

SECTION 135A: PROTECTION OF ETHERS, EPOXIDES AND THIOETHERS

NO ADDITIONAL EXAMPLES

Compendium of Organic Synthetic Methods, Volume 7
Edited by Michael B. Smith
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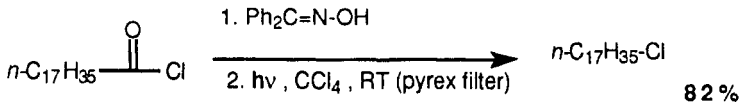
CHAPTER 10

PREPARATION OF HALIDES AND SULFONATES

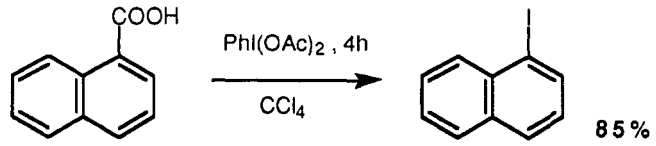
SECTION 136: HALIDES AND SULFONATES FROM ALKYNES

NO ADDITIONAL EXAMPLES

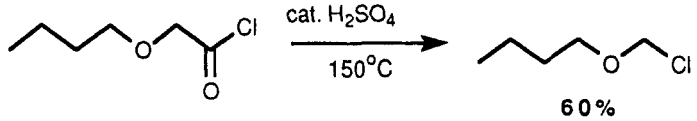
SECTION 137: HALIDES AND SULFONATES FROM ACID DERIVATIVES



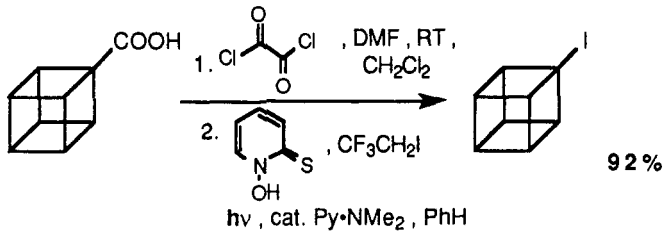
Hasebe, M.; Tsuchiya, T. *Tetrahedron Lett.*, ***1988***, *29*, 6287.



Singh, R.; Just, G. *Synth. Commun.*, ***1988***, *18*, 1327.

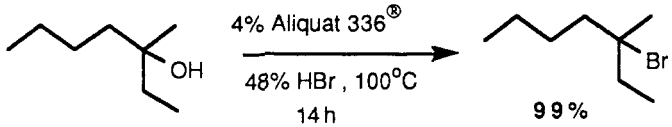


Basavaiah, D.; Dharma Rao, P.; Gowriswari, V.V.L. *Synth. Commun.*, ***1988***, *18*, 1411.

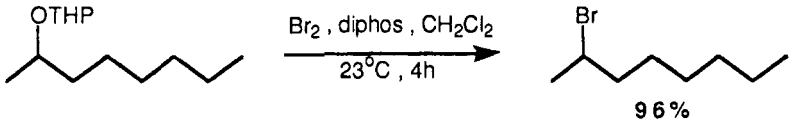


Tsanaktsidis, J.; Eaton, P.E. *Tetrahedron Lett.*, ***1989***, *30*, 6967.

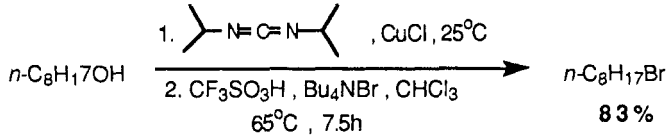
SECTION 138: HALIDES AND SULFONATES FROM ALCOHOLS AND THIOLS



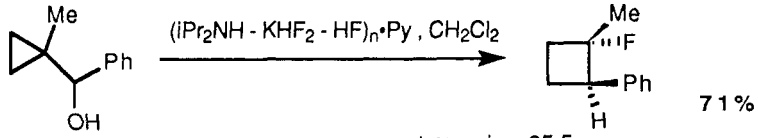
Dakka, G.; Sasson, Y. *Tetrahedron Lett.*, ***1987***, *28*, 1223.



Schmidt, S.P.; Brooks, D.W. *Tetrahedron Lett.*, ***1987***, *28*, 767.



Collingwood, S.P.; Davies, A.P.; Golding, B.T. *Tetrahedron Lett.*, ***1987***, *28*, 4445.



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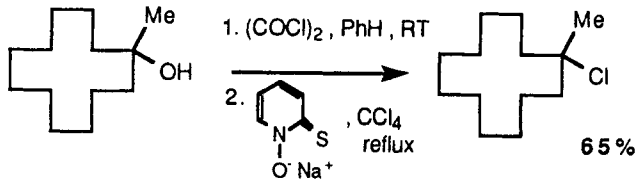
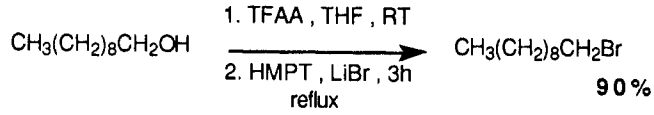
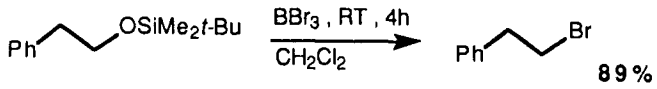
Kanemoto, S.; Shimizu, M.; Yoshioka, H. *Tetrahedron Lett.*, ***1987***, *28*, 6313.



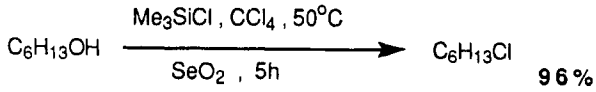
Crich, D.; Fortt, S.M. *Synthesis, **1987**,* 35.



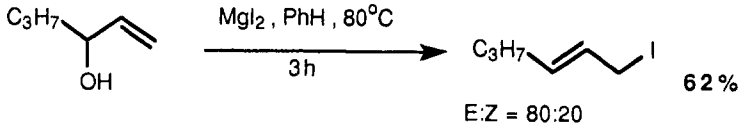
Camps, F.; Gasol, V.; Guerrero, A. *Synthesis, **1987**,* 511.



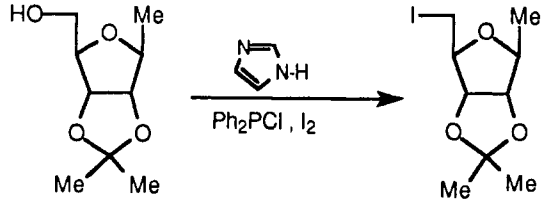
Kim, S.; Park, J.H. *J. Org. Chem., **1988**, 53,* 3111.



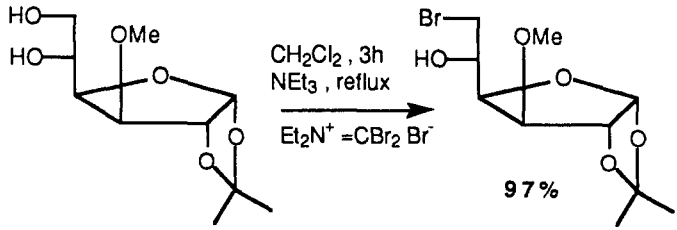
Lee, J.G.; Kang, K.K. *J. Org. Chem., **1988**, 53,* 3634.



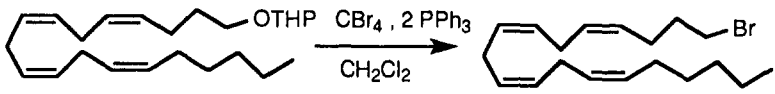
Martinez, A.G.; Villalobos, A.C.; Ruiz, M.O. *Synthesis, **1988**,* 58.



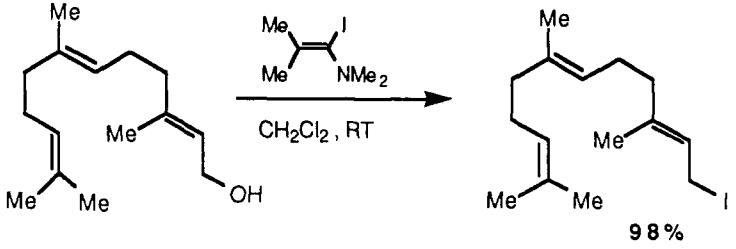
Classon, B.; Liu, Z. *J. Org. Chem., **1988**, 53,* 2126.



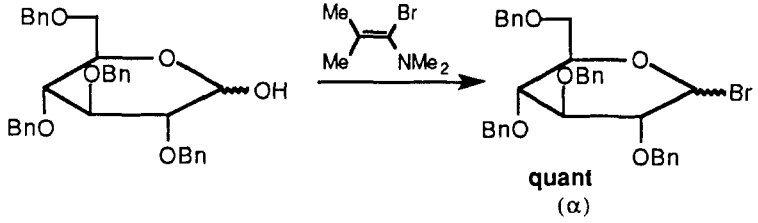
McAdam, D.P.; Stick, R.V. *Aust. J. Chem.*, ***1988***, *41*, 1988.



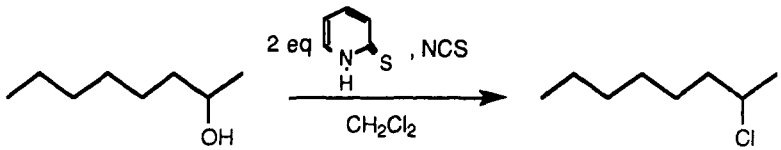
Wagner, A.; Heitz-M.-P.; Mioskowski, C. *Tetrahedron Lett.*, ***1989***, *30*, 557.



Munyemana, F.; Frisque-Hesbain, A.-M.; DeVos, A.; Ghosez, L. *Tetrahedron Lett.*, ***1989***, *30*, 3077.



Ernst, B.; Winkler, T. *Tetrahedron Lett.*, ***1989***, *30*, 3081.



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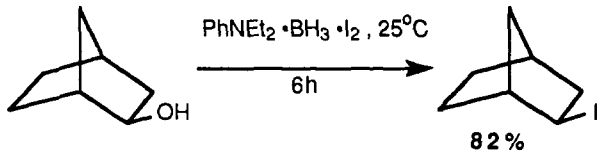
Hanessian, S.; Kagotani, M.; Komaglou, K. *Heterocycles*, ***1989***, *28*, 1115.



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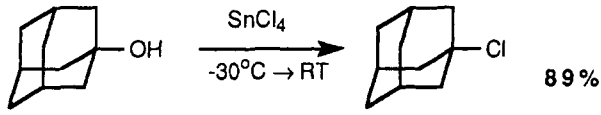
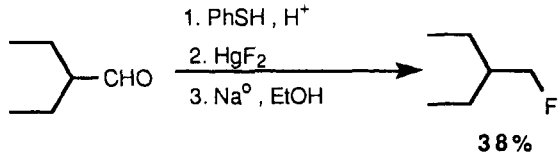
Kishan Reddy, Ch.; Perisamy, M. *Tetrahedron Lett.*, ***1989***, *30*, 5663.



89%

Amroliah-Madjdabadi, A.; Pham, T.N.; Ashby, E.C. *Synthesis*, ***1989***, 614.

SECTION 139: HALIDES AND SULFONATES FROM ALDEHYDES



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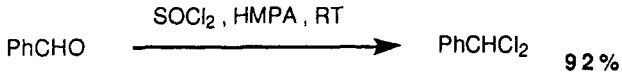
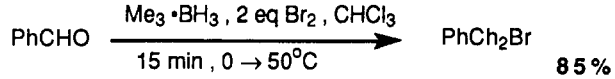
Purrington, S.T.; Pittman, J.H. *Tetrahedron Lett.*, ***1988***, *29*, 6851.



92%

Khurana, J.M.; Mehta, S. *Indian J. Chem.*, ***1988***, *27B*, 1128.

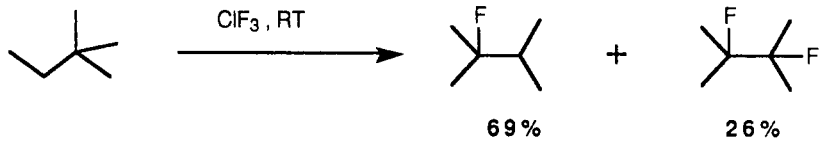


also for ketones

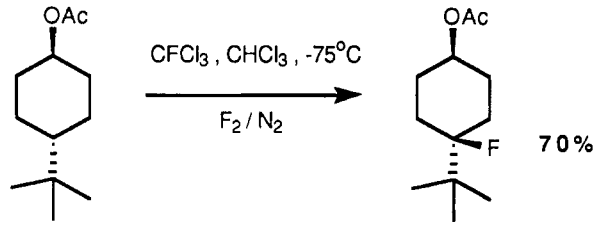
LeCorre, M.; Gheerbrant, E.; LeDeit, H. *J. Chem. Soc., Chem. Commun.*, ***1989***, 313.

SECTION 140: HALIDES AND SULFONATES FROM ALKYLS, METHYLENES AND ARYLS

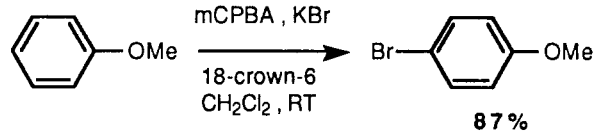
For the conversion R-H → R-Halogen, see Section 146 (Halides from Hydrides).



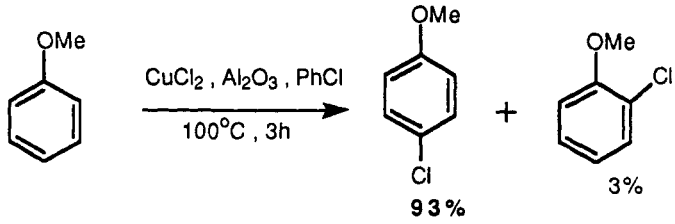
Brower, K.R. *J. Org. Chem.*, ***1987***, *52*, 798.



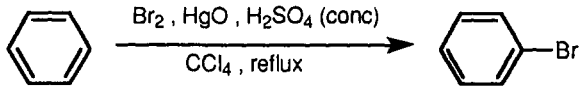
Rozen, S.; Gal, C. *J. Org. Chem.*, ***1987***, *52*, 2769.



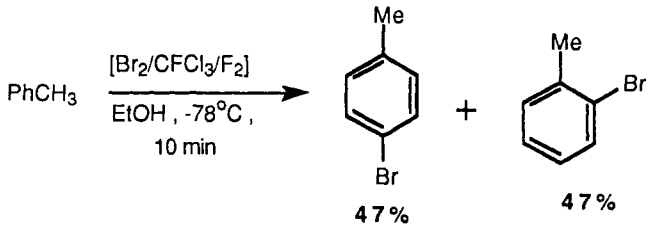
Srebnik, M.; Mechoulam, R.; Yona, I. *J. Chem. Soc., Perkin Trans. I*, ***1987***, 1423.



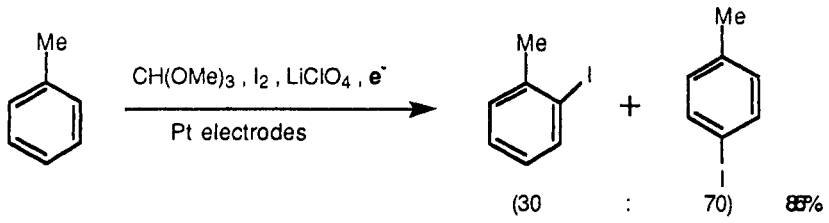
Kodomari, M.; Takahashi, S.; Yoshiltomi, S. *Chem. Lett.*, ***1987***, 1901.



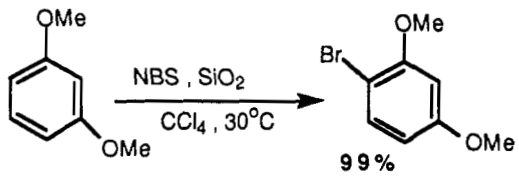
Khan, S.A.; Munawar, M.A.; Siddiq, M. *J. Org. Chem.*, ***1988***, *53*, 1799.



Rozen, S.; Brand, M.; Lidor, R. *J. Org. Chem.*, ***1988***, *53*, 5545.



Shono, T.; Matsumura, Y.; Katoh, S.; Ikeda, K.; Kamada, T. *Tetrahedron Lett.*, ***1989***, *30*, 1649.

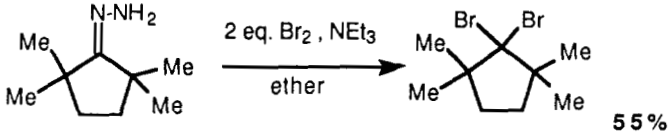


Konishi, H.; Aritomi, K.; Okano, T.; Kiji, J. *Bull. Chem. Soc., Jpn.*, ***1989***, *62*, 591.

SECTION 141: HALIDES AND SULFONATES FROM AMIDES

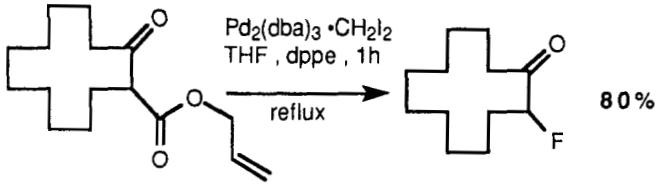
NO ADDITIONAL EXAMPLES

SECTION 142: HALIDES AND SULFONATES FROM AMINES



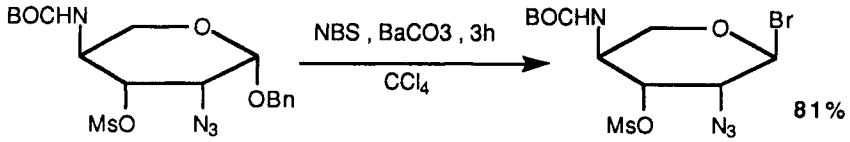
Guziec Jr., F.S.; San Filippo, L.J. *Synthesis*, ***1988***, 547.

SECTION 143: HALIDES AND SULFONATES FROM ESTERS

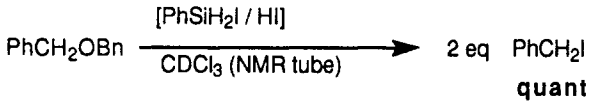


Shimizu, I.; Ishii, H. *Chem. Lett.*, ***1989***, 577.

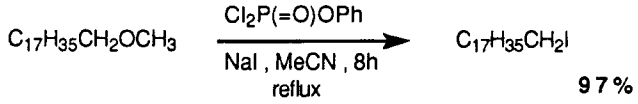
SECTION 144: HALIDES AND SULFONATES FROM ETHERS, EPOXIDES AND THIOETHERS



Hashimoto, H.; Kawa, M.; Saito, Y.; Datei, T.; Horito, S.; Yoshimura, J. *Tetrahedron Lett.*, ***1987***, *28*, 3505.

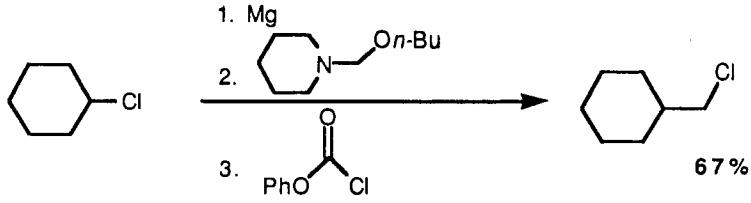


Keinan, E.; Perez, D. *J. Org. Chem.*, ***1987***, *52*, 4846.

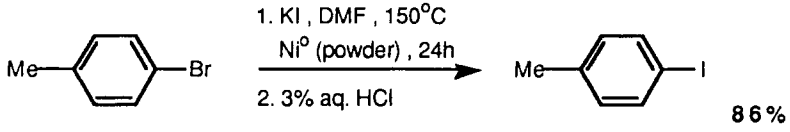


Liu, H.-J.; Wisniewski, V. *Synth. Commun.*, ***1988***, *18*, 119.

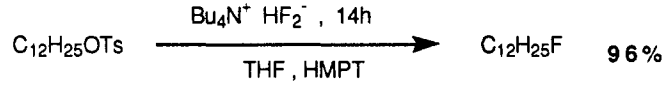
SECTION 145: HALIDES AND SULFONATES FROM HALIDES AND SULFONATES



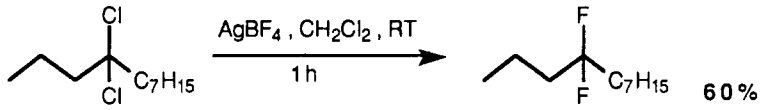
Yankep. E.; Charles, G. *Tetrahedron Lett.*, ***1987***, *28*, 427.



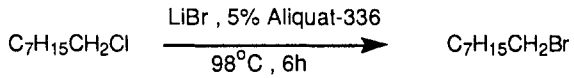
Yang, S.H.; Li, C.S.; Cheng, C.H. *J. Org. Chem.*, ***1987***, *52*, 691.



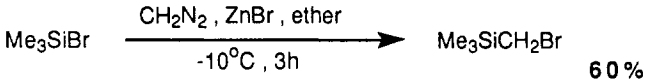
Bosch, P.; Camps, F.; Chamorro, E.; Gasol, V.; Guerrero, A. *Tetrahedron Lett.*, ***1987***, *28*, 4733.



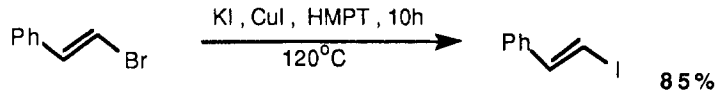
Bloodworth, A.J.; Bowyer, K.J.; Mitchell, J.C. *Tetrahedron Lett.*, ***1987***, *28*, 5347.



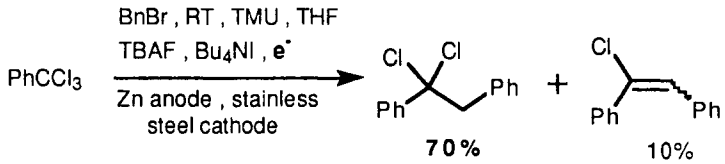
Loupy, A.; Pando, C. *Synth. Commun.*, ***1988***, *18*, 1275.



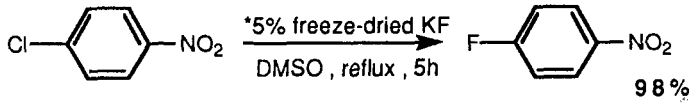
Lee, J.G.; Ha, D.S. *Synthesis*, ***1988***, 318.



Suzuki, H.I Aihara, M.; Yamamoto, H.; Takemoto, Y.; Ogawa, T. *Synthesis*, ***1988***, 236.

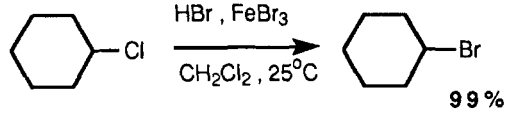


Nédélec, J.-Y.; Mouloud, H.A.H.; Folest,J.-C.; Périchon, J. *J. Org. Chem.*, ***1988***, *53*, 4720.
Nédélec, J.Y.; Ait-Haddou-Mauloud, H.; Folest, J.C.; Périchon, J. *Tetrahedron Lett.*, ***1988***, *29*, 1699.



* a freeze-dried 5% aq. solution of KF

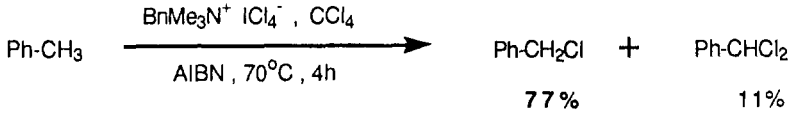
Kimura, Y.; Suzuki, H. *Tetrahedron Lett.*, ***1989***, *30*, 1271.



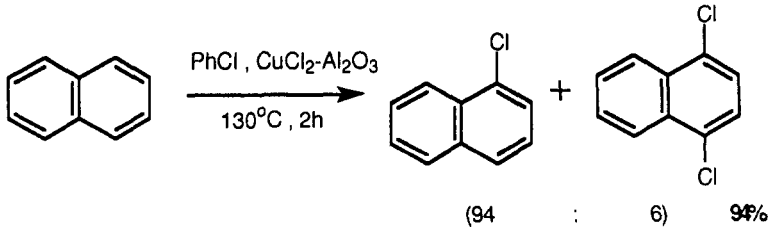
Yoon, K.B.; Kochi, J.K. *J. Org. Chem.*, ***1989***, *54*, 3028.
Yoon, K.B.; Kochi, J.K. *J. Chem. Soc., Chem. Commun.*, ***1987***, 1013.

SECTION 146: HALIDES AND SULFONATES FROM HYDRIDES

α-Halogenations of aldehydes, ketones and acids are found in Sections 338 (Halide-Aldehyde), 369 (Halide-Ketone), 359 (Halide-Esters) and 319 (Halide-Acids).

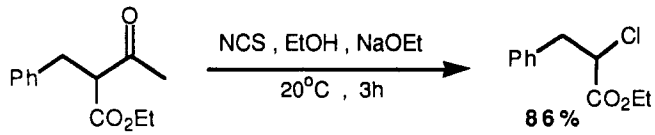


Kajigaeshi, S.; Kakinami, T.; Moriwaki, M.; Tanaka, T.; Fujisaki, S. *Tetrahedron Lett.*, ***1988***, *29*, 5783.



Kodomari, M.; Satoh, H.; Yoshitami, S. *J. Org. Chem.*, ***1988***, *53*, 2093.

SECTION 147: HALIDES AND SULFONATES FROM KETONES



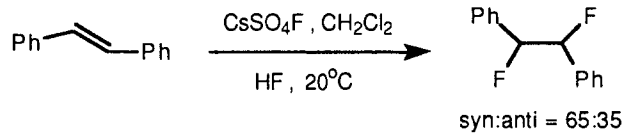
Mignani, G.; Morel, D.; Grass, F. *Tetrahedron Lett.*, ***1987***, *28*, 5505.

SECTION 148: HALIDES AND SULFONATES FROM NITRILES

NO ADDITIONAL EXAMPLES

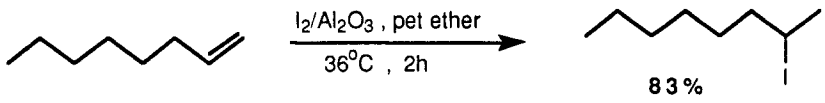
SECTION 149: HALIDES AND SULFONATES FROM ALKENES

For halocyclopropanations, see Section 74E (Alkyls from Alkenes).

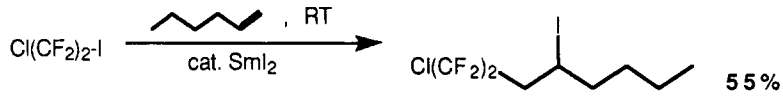


syn:anti = 65:35

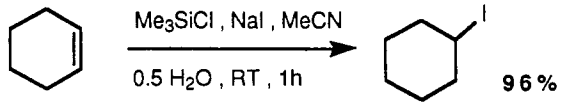
Stavber, S.; Zupan, M. *J. Org. Chem.*, ***1987***, *52*, 919.



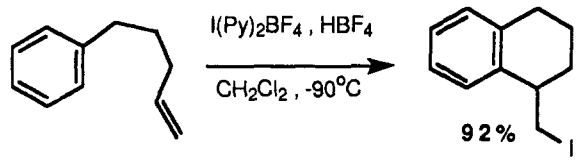
Stewart, L.J.; Gray, D.; Pagni, R.M.; Kabalka, G.W. *Tetrahedron Lett.*, ***1987***, *28*, 4497.



Lu, X.; Ma, S.; Zhu, J. *Tetrahedron Lett.*, ***1988***, *29*, 5129.

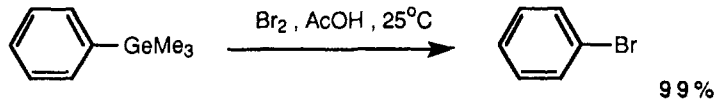


Irfune, S.; Kibayashi, T.; Ishii, Y.; Ogawa, M. *Synthesis*, ***1988***, 366.

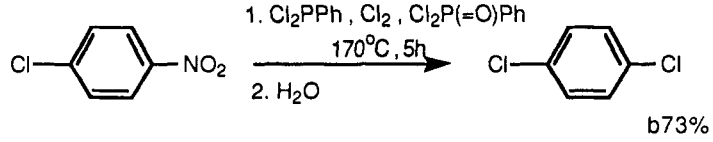


Barluenga, J.; González, J.M.; Campos, P.J.; Asensio, G. *Angew. Chem. Int. Ed., Engl,* ***1988****, 27,* 1546.

SECTION 150: HALIDES AND SULFONATES FROM MISCELLANEOUS COMPOUNDS



Moerlein, S.M. *J. Org. Chem.,* ***1987****, 52,* 664.



Bay, E.; Timony, P.E.; Leone-Bay, A. *J. Org. Chem.,* ***1988****, 53,* 2858.

REVIEW:

"Advances in the Synthesis of Iodoaromatic Compounds"

Merkushev, E.B. *Synthesis,* ***1988****,* 923.

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CHAPTER 11
PREPARATION OF HYDRIDES

This chapter lists hydrogenolysis and related reactions by which functional groups are replaced by hydrogen: e.g. $RCH_2X \rightarrow RCH_2\text{-}H$ or R-H.

SECTION 151: HYDRIDES FROM ALKYNES

NO ADDITIONAL EXAMPLES

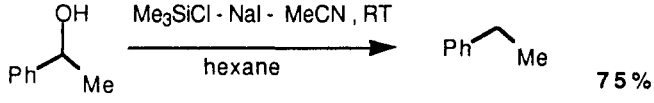
SECTION 152: HYDRIDES FROM ACID DERIVATIVES

This section lists examples of decarboxylations ($RCO_2H \rightarrow$ R-H) and related reactions.

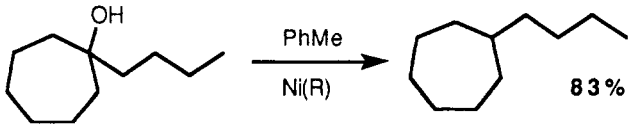
NO ADDITIONAL EXAMPLES

SECTION 153: HYDRIDES FROM ALCOHOLS AND THIOLS

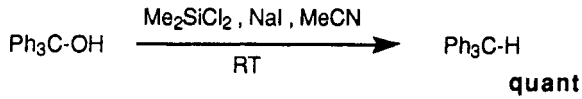
This section lists examples of the hydrogenolysis of alcohols and phenols (ROH → R-H).



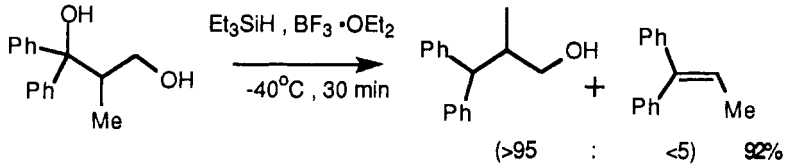
Sakai, T.; Miyata, K.; Utaka, M.; Takeda, A. *Tetrahedron Lett.*, ***1987***, *28*, 3817.



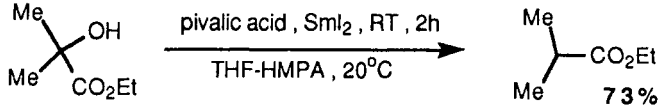
Krafft, M.A.; Crooks III, W.J. *J. Org. Chem.*, ***1988***, *53*, 432.



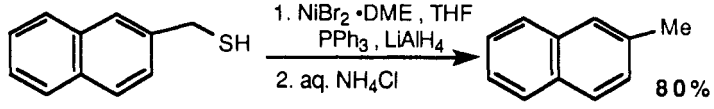
Wiggins, J.M. *Synth. Commun.*, ***1988***, *18*, 741.



Orfanopoulos, M.; Smoniu, I. *Synth. Commun.*, ***1988***, *18*, 833.



Kasuda, K.; Inanaga, J.; Yamaguchi, M. *Tetrahedron Lett.*, ***1989***, *30*, 2945.



Ho, K.M.; Lam, C.H.; Luh, T.-Y. *J. Org. Chem.*, ***1989***, *54*, 4474.

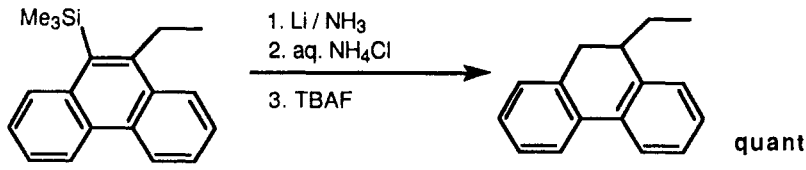
Also via: Section 160 (Halides and Sulfonates).

SECTION 154: HYDRIDES FROM ALDEHYDES

For the conversion RCHO → R-Me, etc., see Section 64 (Alkyls from Aldehydes).

NO ADDITIONAL EXAMPLES

SECTION 155: HYDRIDES FROM ALKYLS, METHYLENES AND ARYLS



Rabideau, P.W.; Marcinow, Z. *Tetrahedron Lett.*, ***1988***, *29*, 3761.

SECTION 156: HYDRIDES FROM AMIDES

NO ADDITIONAL EXAMPLES

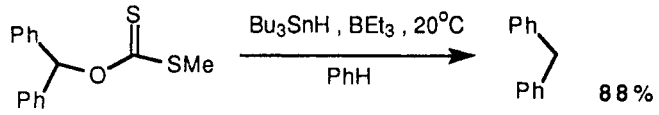
SECTION 157: HYDRIDES FROM AMINES

This section lists examples of the conversion RNH_2 (or R_2NH) → R-H.

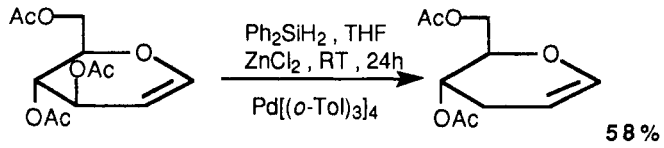
NO ADDITIONAL EXAMPLES

SECTION 158: HYDRIDES FROM ESTERS

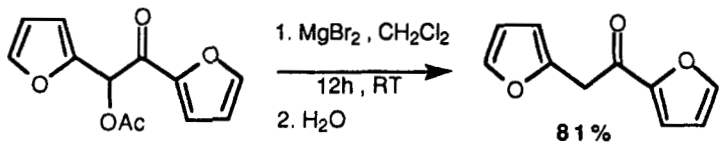
This section lists examples of the reactions RCO_2R' → R-H and RCO_2R' → R'H.



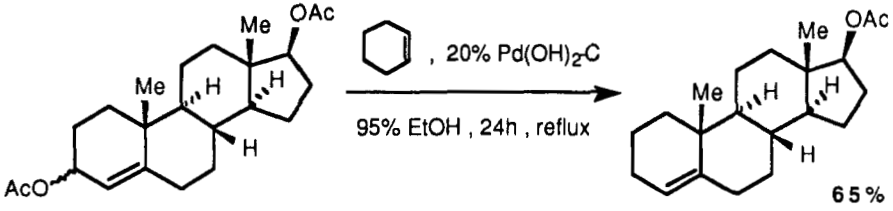
Nozaki, K.; Oshima, K.; Utimoto, K. *Tetrahedron Lett.*, ***1988***, *29*, 6125.



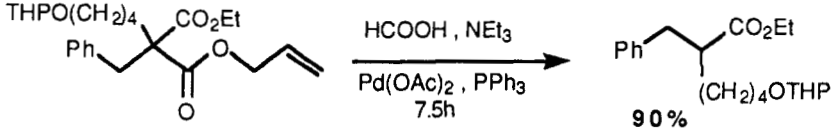
Greenspoon,.N.; Keinan, E. *J. Org. Chem.*, ***1988***, *53*, 3723.



Pennanen, S.I. *Synth. Commun.*, ***1988***, *18*, 1097.



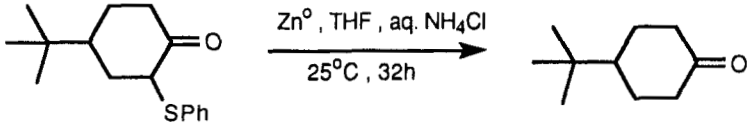
Bianco, A.; Passacantilli, P.; Righi, G. *Tetrahedron Lett.*, ***1989***, *30*, 1405.



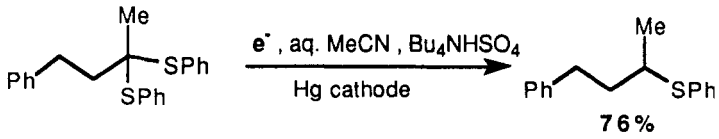
Mandai, T.; Imaj, M.; Takada, H.; Kawata, M.; Nokami, J.; Tsuji, J. *J. Org. Chem.*, ***1989***, *54*, 5395.

SECTION 159: HYDRIDES FROM ETHERS, EPOXIDES AND THIOETHERS

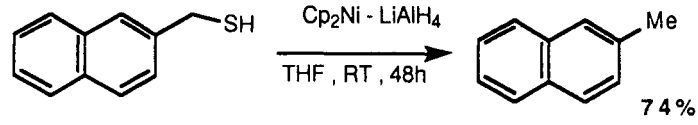
This section lists examples of the reaction R-O-R' → R-H.



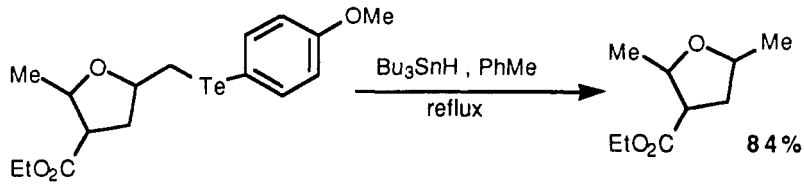
Holton, R.A.; Crouse, D.J.; Williams, A.D.; Kennedy, R.M. *J. Org. Chem.*, ***1987***, *52*, 2317.



Schultz-van Itter, N.; Steckhan, E. *Tetrahedron, **1987**, 43*, 2475.



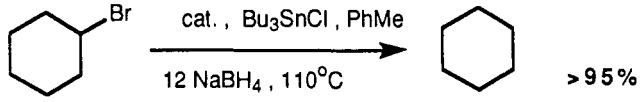
Chan, M.-C.; Cheng, K.-M.; Ho, K.M.; Ng, C.T.; Yam, T.M.; Wang, B.S.L.; Luh, T.-Y. *J. Org. Chem., **1988**, 53*, 4466.



Comasseto, J.V.; Ferraz, H.M.C.; Brandt, C.A.; Gaeta, K.K. *Tetrahedron Lett., **1989**, 30*, 1209.

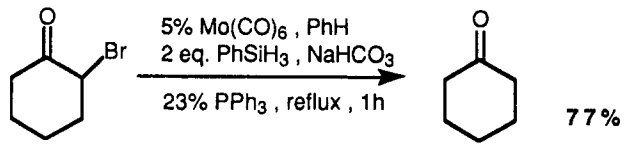
SECTION 160: HYDRIDES FROM HALIDES AND SULFONATES

This section lists the reductions of halides and sulfonates, R-X → R-H.

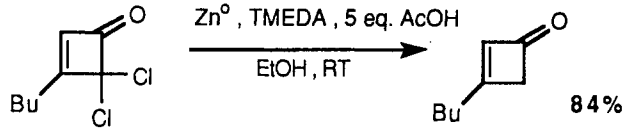


cat. = polyethylene bound crown ether

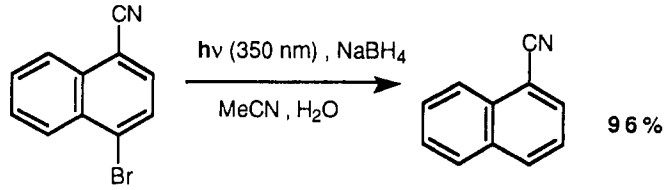
Bergbreiter, D.E.; Blanton, J.R. *J. Org. Chem., **1987**, 52*, 472.



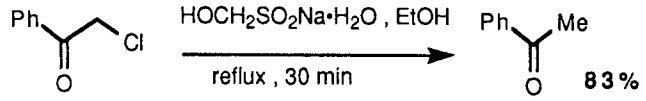
Perez, D.; Greenspoon, N.; Keinan, E. *J. Org. Chem.*, ***1987***, *52*, 5570.



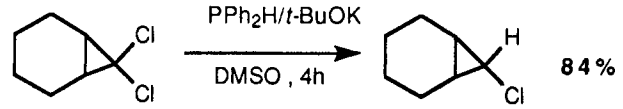
Danheiser, R.L.; Savariar, S. *Tetrahedron Lett.*, ***1987***, *28*, 3299.



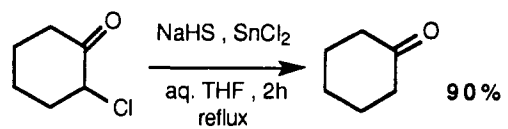
Kropp, M.; Schuster, G.B. *Tetrahedron Lett.*, ***1987***, *28*, 5295.



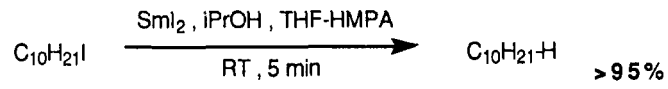
Harris, A.R. *Synth. Commun.*, ***1987***, *17*, 1587.



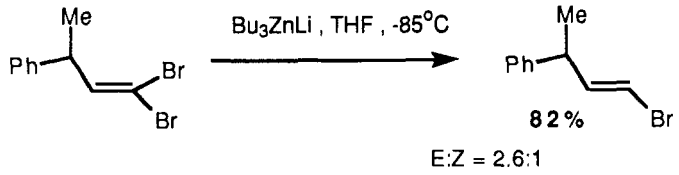
Meijs, G.F. *J. Org. Chem.*, ***1987***, *52*, 3923.



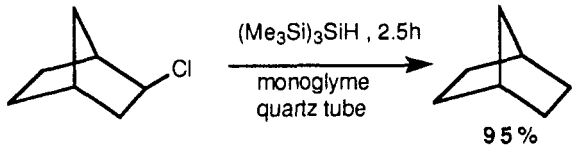
Ono, A.; Murayama, T.; Kamimura, J. *Synthesis*, ***1987***, 1093.
Ono, A.; Kamimura, J.; Suzuki, N. *Synthesis*, ***1987***, 406.



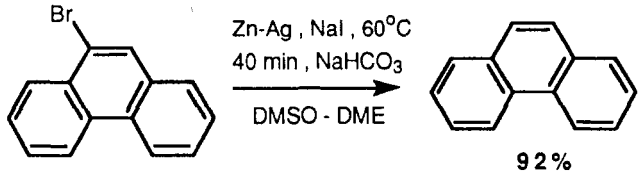
Inanaga, J.; Ishikawa, M.; Yamaguchi, M. *Chem. Lett.*, ***1987***, 1485.



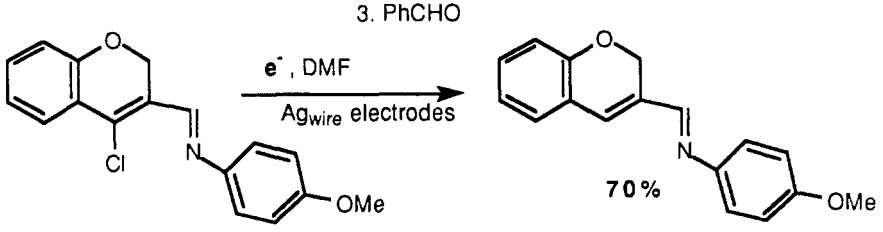
Harada, T.; Hara, D.; Hattori, K.; Oku, A. *Tetrahedron Lett.*, ***1988***, *29*, 3821.



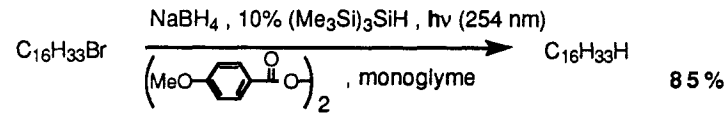
Chatgilialoglu, C.; Griller, D.; Lesage, M. *J. Org. Chem.*, ***1988***, *53*, 3641.



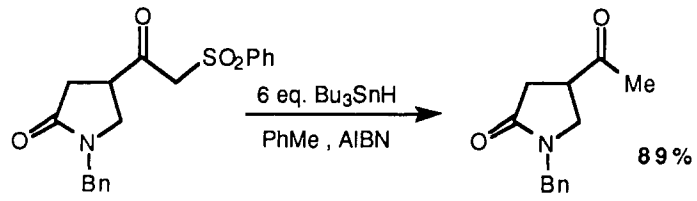
Chung, C.K.; Ho, M.S.; Lun, K.S.; Wong, M.O.; Wong, H.N.C.; Tam, S.W. *Synth. Commun.*, ***1988***, *18*, 507.



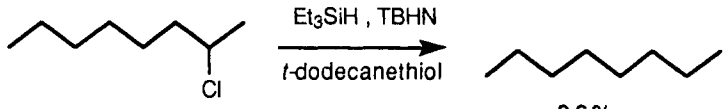
Saiganesh, R.; Balasubramanian, K.K.; Venkatachalam, C.S. *Tetrahedron Lett.*, ***1989***, *30*, 1711.



Lesage, M.; Chatgilialoglu, C.; Giller, D. *Tetrahedron Lett.*, ***1989***, *30*, 2733.

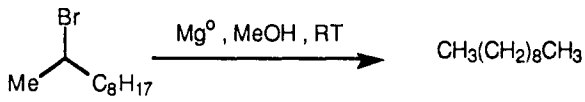


Smith III, A.B.; Hale, K.J.; McCauley Jr., J.P. *Tetrahedron Lett.*, ***1989***, *30*, 5579.

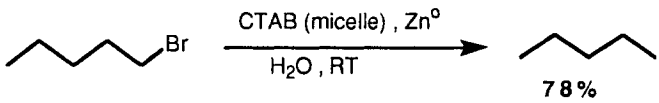


TBNH = di-*t*-butyl hyponitrite

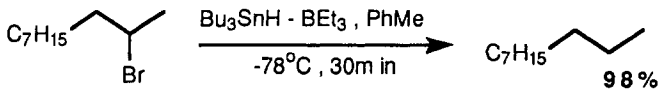
Allen, R.P.; Roberts, B.P.; Willis, C.R. *J. Chem. Soc., Chem. Commun.*, ***1989***, 11387.



Hutchins, R.O.; Suchismita; Zipkin, R.E.; Taffer, I.M. *Synth. Commun.*, ***1989***, *19*, 1519.



Juršić, B.; Galoši, A. *Synth. Commun.*, ***1989***, *19*, 1649.



Miura, K.; Ichinose, Y.; Nozaki, K.; Fugami, K.; Oshima, K.; Utimoto, K. *Bull. Chem. Soc., Jpn.*, ***1989***, *62*, 143.

REVIEW:

"Tri-*n*-Butyltin Hydide as Reagent in Organic Synthesis"

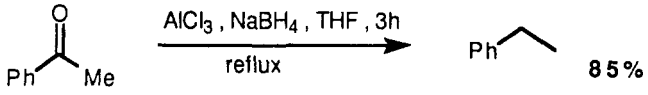
Neumann, W.P. *Synthesis, **1987***, 665

SECTION 161: HYDRIDES FROM HYDRIDES

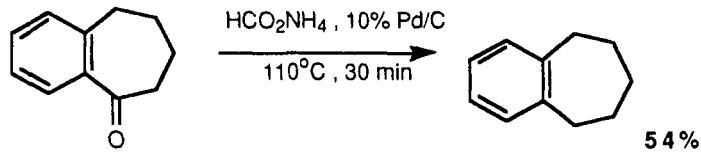
NO ADDITIONAL EXAMPLES

SECTION 162: HYDRIDES FROM KETONES

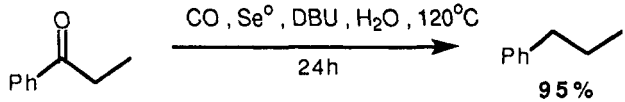
This section lists examples of the reaction R_2C-(C=O)R → R_2C-H.



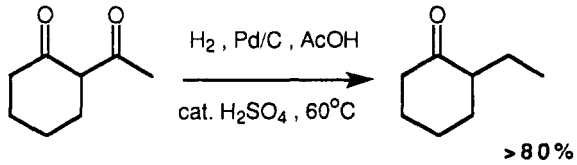
Ono, A.; Suzuki, N.; Kamimura, J. *Synthesis, **1987***, 736.



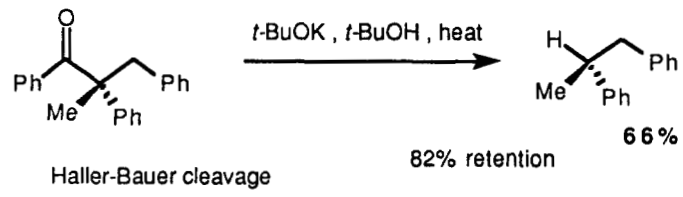
Ram, S.; Spicer, L.D. *Tetrahedron Lett., **1988**, 29*, 3741.



Nishiyama, Y.; Hamanaka, S.; Ogawa, A.; Kambe, N.; Sonoda, N. *J. Org. Chem., **1988**, 53*, 1326.

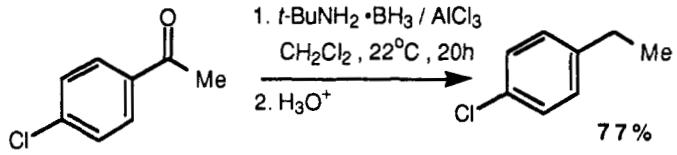


Cormier, R.A.; McCauley, M.D. *Synth. Commun., **1988**, 18*, 675.



Haller-Bauer cleavage

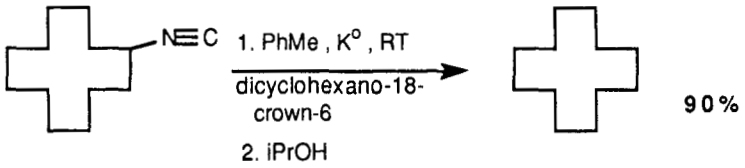
Paquette, L.A.; Gilday, J.P. *J. Org. Chem.*, ***1988***, *53*, 4972.



Lau, C.K.; Tardif, S.; Dufresne, C.; Scheigetz, J. *J. Org. Chem.*, ***1989***, *54*, 491.

SECTION 163: HYDRIDES FROM NITRILES

This section lists examples of the reaction, R-C≡N → R-H (includes reactions of isonitriles (R-N≡C).

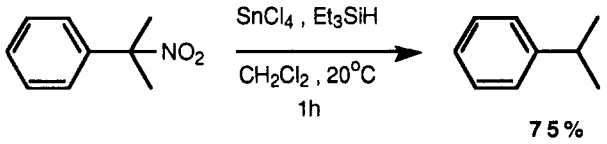


Ohsawa, T.; Mitsuda, N.; Nezu, J.; Oishi, T. *Tetrahedron Lett.*, ***1989***, *30*, 845.

SECTION 164: HYDRIDES FROM ALKENES

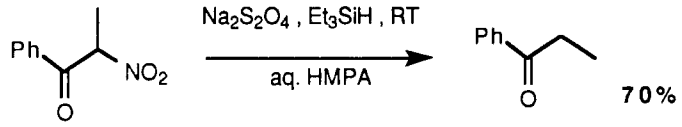
NO ADDITIONAL EXAMPLES

SECTION 165: HYDRIDES FROM MISCELLANEOUS COMPOUNDS



75%

Ono, N.; Hashimoto, T.; Jun, T.X.; Kaji, A. *Tetrahedron Lett.*, ***1987***, *28*, 2277.



70%

Kamimura, A.; Kurata, K.; Ono, N. *Tetrahedron Lett.*, ***1989***, *30*, 4819.

REVIEW:

"Synthetically Useful Extrusion Reactions of Organic Sulfur, Selenium and Tellurium Compounds"

Guziec Jr., F.S.; San Filippo, L.J. *Tetrahedron*, ***1988***, *44*, 6241.

Compendium of Organic Synthetic Methods, Volume 7
Edited by Michael B. Smith
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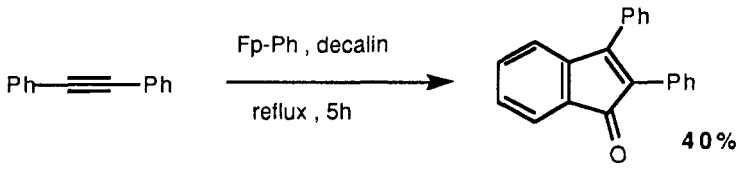
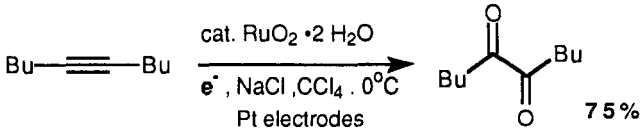
CHAPTER 12
PREPARATION OF KETONES

SECTION 166: KETONES FROM ALKYNES

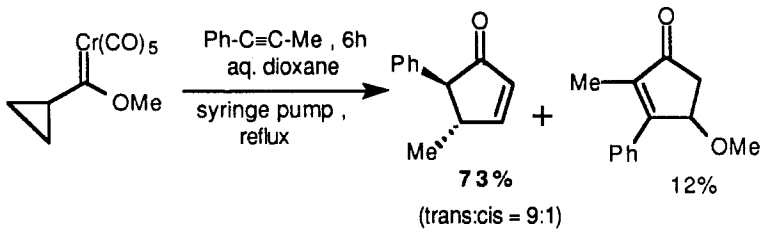


Butler, I.R.; Cullen, W.R.; Lindsell, W.E.; Preston, P.N.; Rettig, S.J. *J. Chem. Soc., Chem. Commun.*, ***1987***, 439.

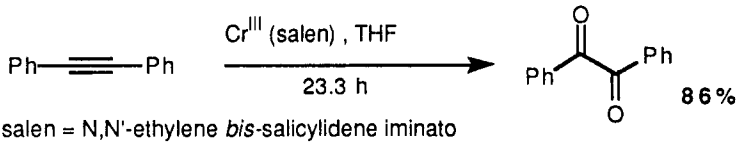
Imi, K.; Imai, K.; Utimoto, K. *Tetrahedron Lett.*, ***1987***, *28*, 3127.



Torii, S.; Inokuchi, T.; Hirata, Y. *Synthesis*, ***1987***, 377.

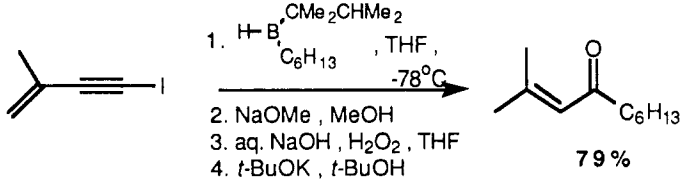


Herndon, J.W.; Turner, S.U.; Schnatter, W.F.K. *J. Am. Chem. Soc.*, ***1988***, *110*, 3334.

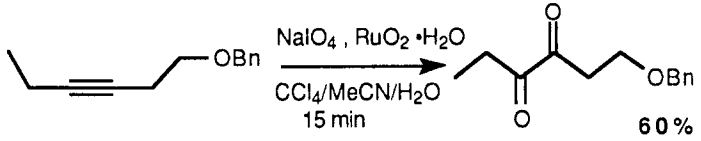


salen = N,N'-ethylene *bis*-salicylidene iminato

Rihter, B.; Masnovi, J. *J. Chem. Soc., Chem. Commun.*, ***1988***, 35.



Zweifel, G.; Shoup, T.M. *Synthesis,* ***1988***, 130.



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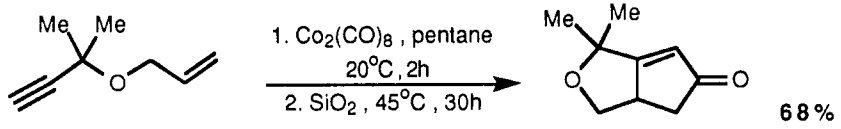

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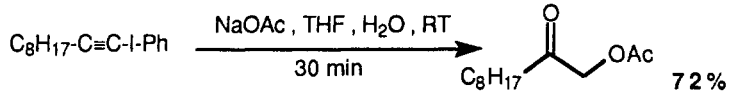

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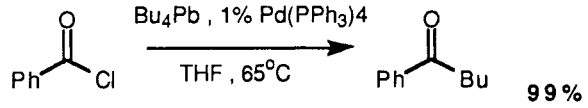
SECTION 167: KETONES FROM ACID DERIVATIVES



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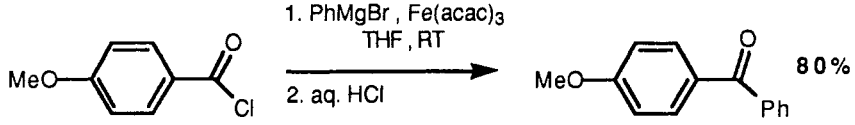

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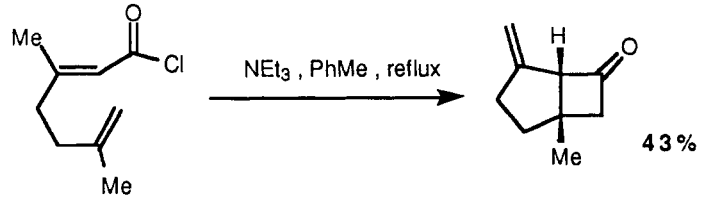

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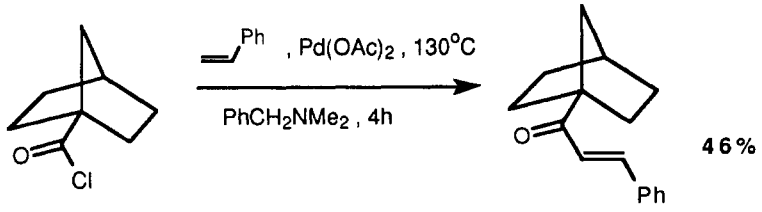

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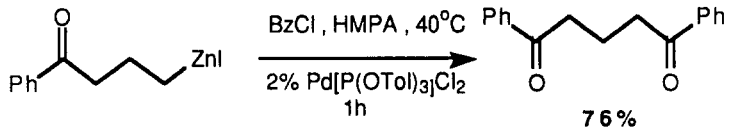

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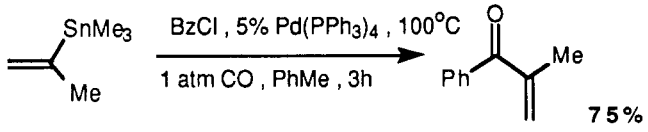

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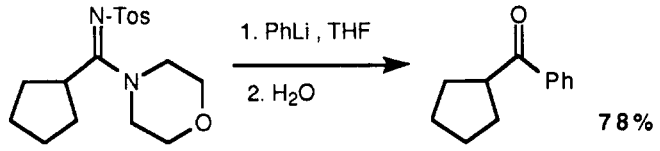

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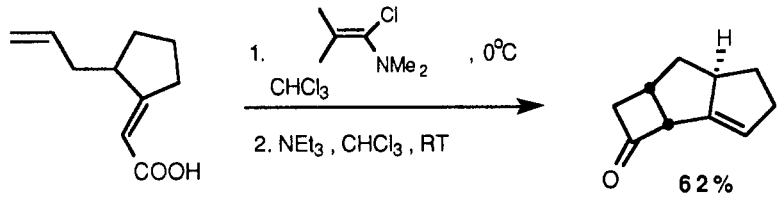

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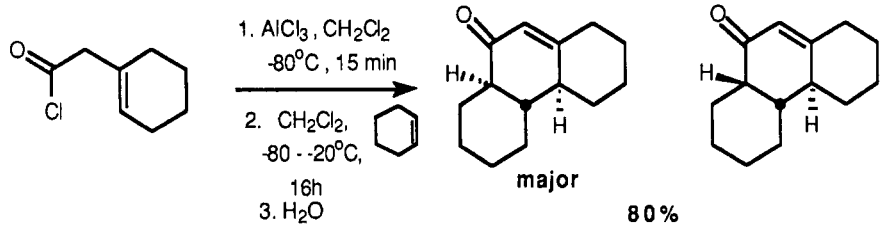

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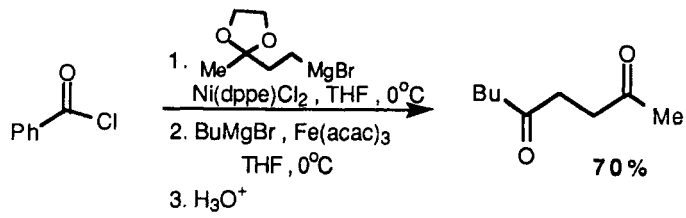
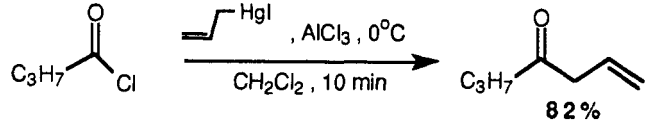
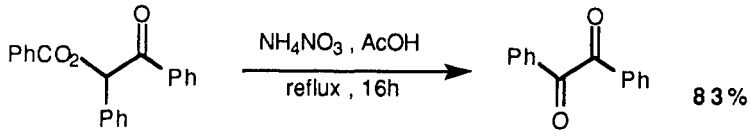


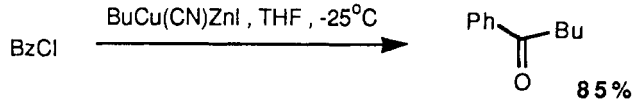
Fiandanesse, V.; Marchese, G.; Naso, F. *Tetrahedron Lett.*, ***1988***, *29*, 3587.



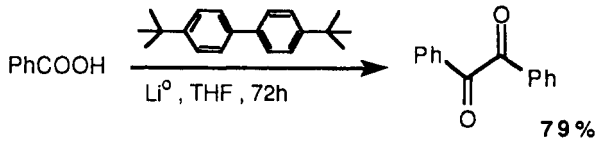
Larock, R.C.; Lu, Y. *Tetrahedron Lett.*, ***1988***, *29*, 6761.



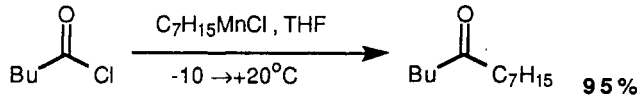
Armesto, D.; Horspool, W.M.; Ortiz, M.J.; Perez-Ossorio, R. *Synthesis*, ***1988***, 799.



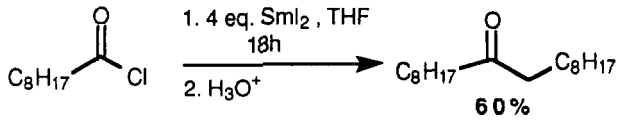
Knochel, P.; Yeh, M.C.P.; Berk, S.C.; Talbert, J. *J. Org. Chem.*, ***1988***, *53*, 2390.



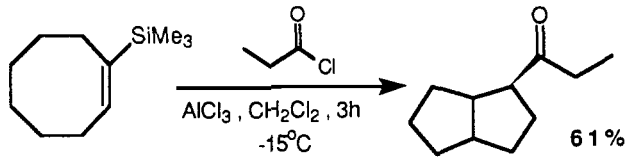
Karaman, R.; Fry, J.L. *Tetrahedron Lett.*, ***1989***, *30*, 6267.



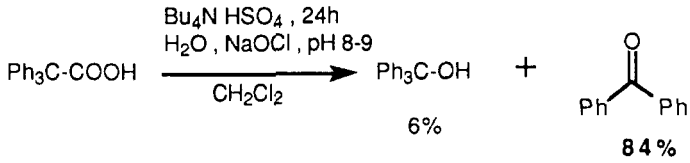
Cahiez, G.; Laboue, B. *Tetrahedron Lett.*, ***1989***, *30*, 7369.



Collin, J.; Dallemer, F.; Namy, J.L.; Kagan, H.B. *Tetrahedron Lett.*, ***1989***, *30*, 7407.



Bandodakar, B.S.; Nagendrappa, G. *Tetrahedron Lett.*, ***1989***, *30*, 7461.



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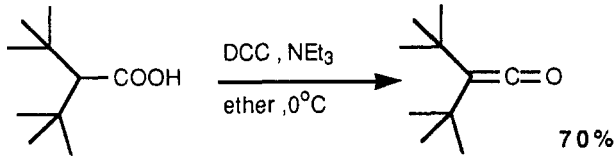

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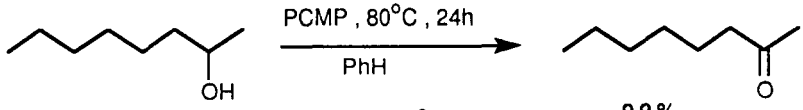
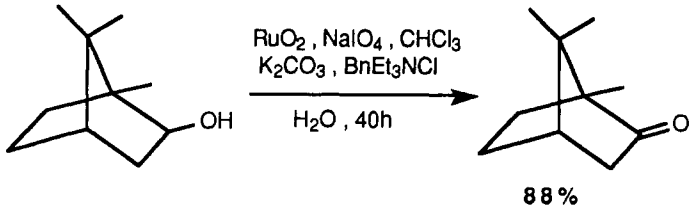
SECTION 168: KETONES FROM ALCOHOLS AND THIOLS

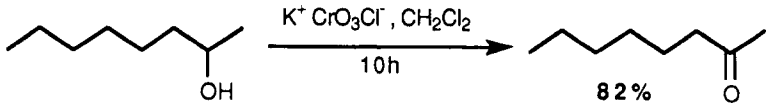


PCMP =[π-$C_5H_5N^+$ $(CH_2)_{15}CH_3]_3[PMo_{12}O_{40}]^{3-}$

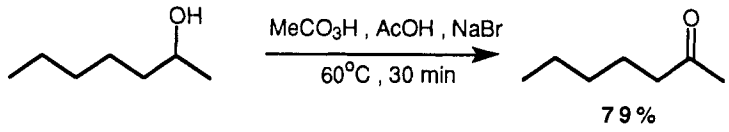
Ishii, Y.; Yamawaki, K.; Yoshida, T.; Ura, T.; Ogawa, M. *J. Org. Chem.*, ***1987***, *52*, 1868.



Morris Jr., P.E.; Kiely, D.E. *J. Org. Chem.*, ***1987***, *52*, 1149.



Carlsen, P.H.J.; Bræden, J.E. *Acta Chem. Scand. B*, ***1987***, *B41*, 313.



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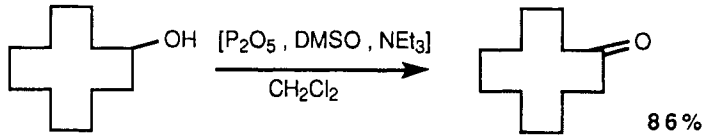
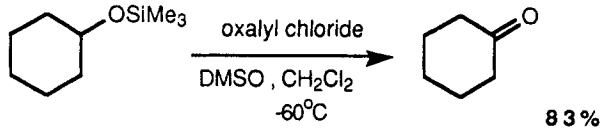
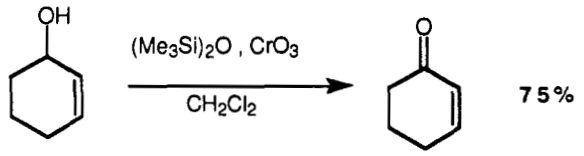


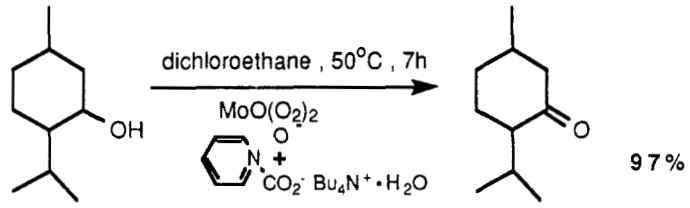
Taber, D.F.; Amedio Jr., J.C.; Jung, K.-C. *J. Org. Chem.*, ***1987***, *52*, 5621.



Afonso, C.M.; Barros, M.T.; Maycock, C.D. *J. Chem. Soc., Perkin Trans. I*, ***1987***, 1221.

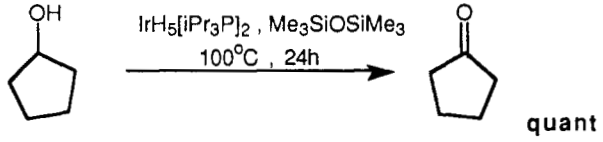


Moiseenkov, A.M.; Cheskis, B.A.; Veselovskii, A.B.; Romanovich, A.,Ya.; Chizhov, O.S. *J. Org. Chem., U.S.S.R.*, ***1987***, *23*, 1646.

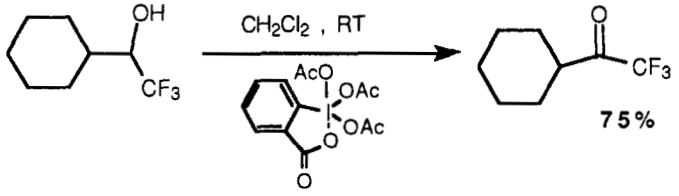


also converts 1° alcohols to aldehydes

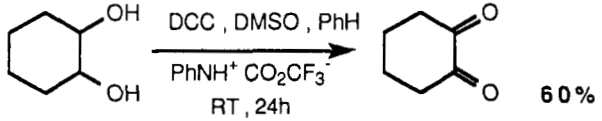
Bortolini, O.; Campestrini, S.; DiFuria, F.; Modena, G.; Valle, G. *J. Org. Chem.*, ***1987***, *52*, 5467.



Lin, Y.; Ma, D.; Lu, X. *Tetrahedron Lett.*, ***1987***, *28*, 3115.



Linderman, R.J.; Graves, D.M. *Tetrahedron Lett.*, ***1987***, *28*, 4259.



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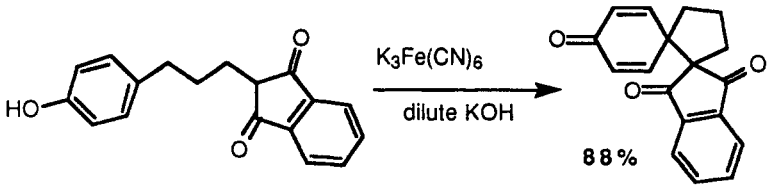
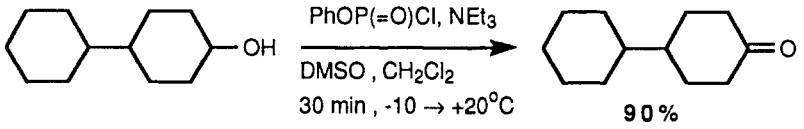
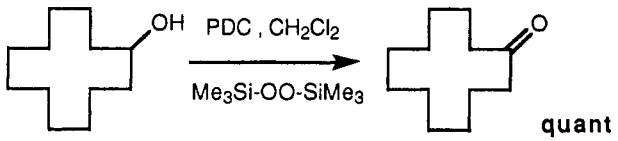


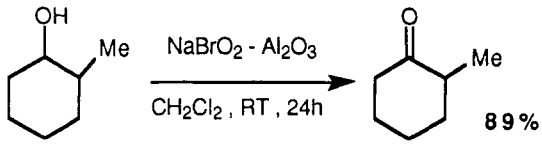
Kende, A.S.; Koch, K.; Smith, C.A. *J. Am. Chem. Soc.*, ***1988***, *110*, 2210.



Liu, H.-J.; Nyangulu, J.M. *Tetrahedron Lett.*, ***1988***, *29*, 3167.



Kanemoto, S.; Matsubara, S.; Takai, K.; Oshima, K.; Utimoto, K.; Nozaki, H. *Bull. Chem. Soc., Jpn.*, ***1988***, *61*, 3607.



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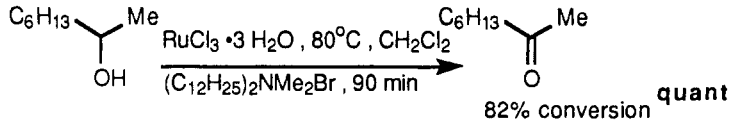

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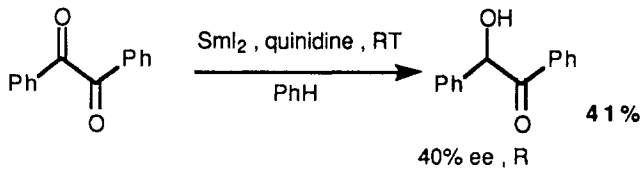
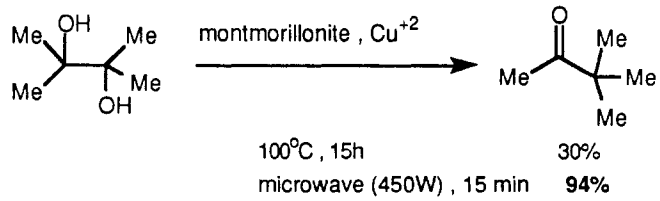
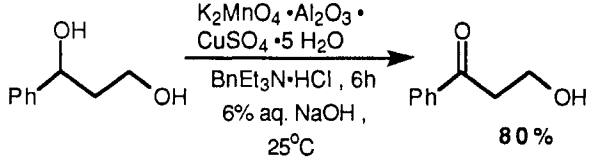


Takeuchi, S.; Ohgo, Y. *Chem. Lett.*, ***1988***, 403.



Gutierrez, E.; Loupy, A.; Bram, G.; Ruiz-Hitzky, E. *Tetrahedron Lett.*, ***1989***, *30*, 945.



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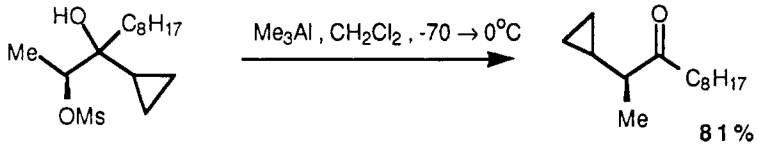
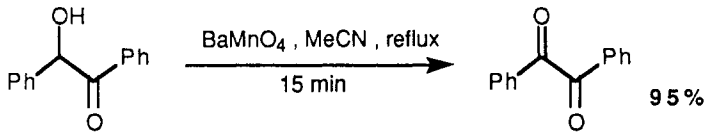


Shimazaki, M.; Hara, H.; Suzuki, K. *Tetrahedron Lett.*, ***1989***, *30*, 5443, 5447.



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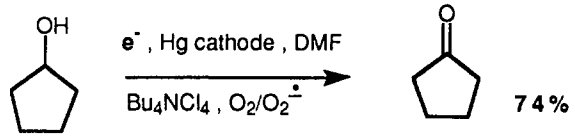
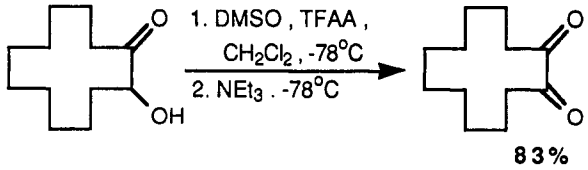
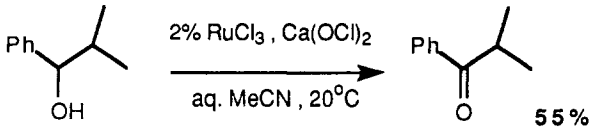


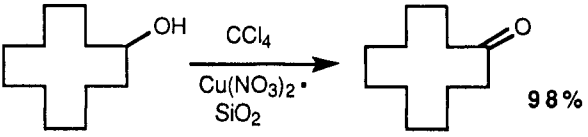
Singh, M.; Misra, R.A. *Synthesis*, ***1989***, 403.



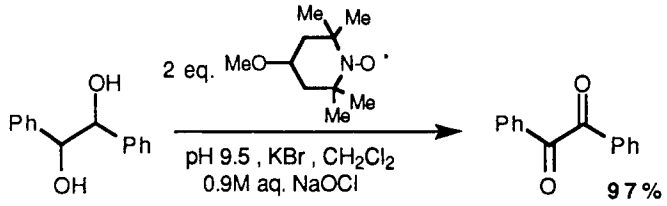
Kawada, K.; Gross, R.S.; Watt, D.S. *Synth. Commun.*, ***1989***, *19*, 777.



Genet, J.P.; Pons, D.; Jugé, S. *Synth. Commun.*, ***1989***, *19*, 1721.



Nishiguchi, T.; Asano, F. *J. Org. Chem.*, ***1989***, *54*, 1531.
Nishiguchi, T.; Asano, F. *Tetrahedron Lett.*, ***1988***, *29*, 6265.



Anelli, P.L.; Banfi, S.; Montanari, F.; Quici, S. *J. Org. Chem.*, ***1989***, *54*, 2970.

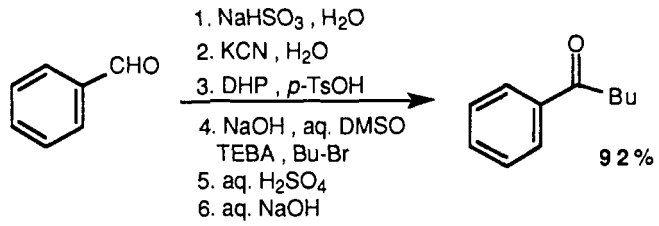
REVIEW:

"Recent Applications of Oxochromium-Amine Complexes as Oxidants in Organic Synthesis. A Review"

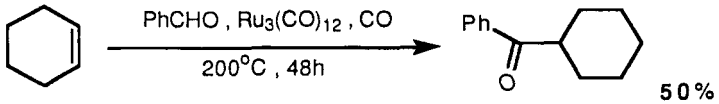
Luzzio, F.A.; Guziec Jr., F.S. *Org. Prep. Proceed. Int.*, ***1988***, *20*, 533.

Related Methods: Section 48 (Aldehydes from Alcohols and Phenols).

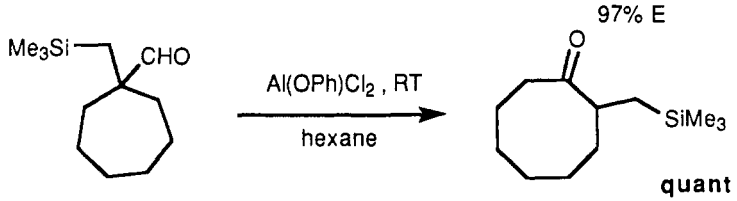
SECTION 169: KETONES FROM ALDEHYDES



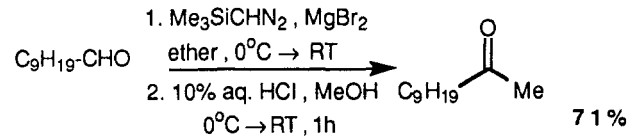
Barrios, H.; Sandoval, C.; Ortíz, B.; Sánchez-Obregón, R.; Yuste, F. *Org. Prep. Proceed. Int.*, ***1987***, *19*, 427.



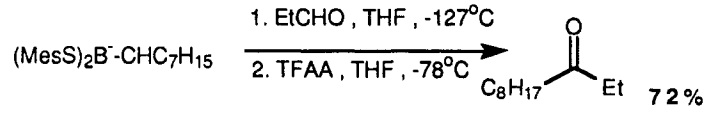
Kondo, T.; Tsuji, Y.; Watanabe, Y. *Tetrahedron Lett.*, ***1987***, *28*, 6229.



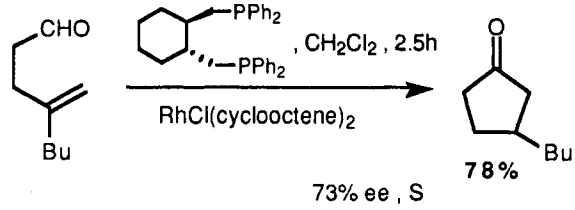
Tanino, K.; Katoh, T.; Kuwajima, I. *Tetrahedron Lett.*, ***1988***, *29*, 1815, 1819.



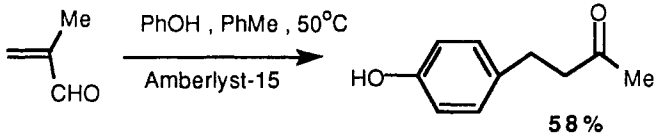
Aoyama, T.; Shioiri, T. *Synthesis*, ***1988***, 228.



Pelter, A.; Smith, K.; Elgendy, S.; Rowlands, M. *Tetrahedron Lett.*, ***1989***, *30*, 5643.



Taura, Y.; Tanaka, M.; Funakoshi, K.; Sakai, K. *Tetrahedron Lett.*, ***1989***, *30*, 6349.



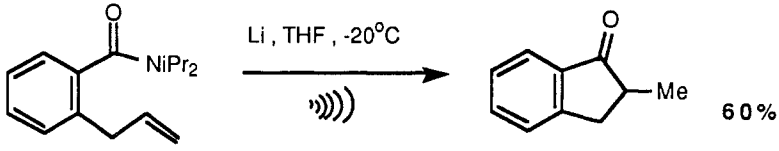
Bunce, R.A.; Reeves, H.D. *Synth. Commun.*, ***1989***, *19*, 1109.

SECTION 170: KETONES FROM ALKYLS, METHYLENES AND ARYLS

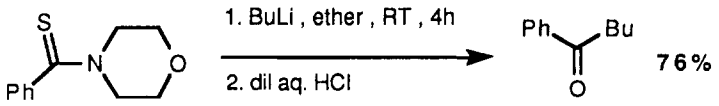
This section lists examples of the reaction, R-CH_2-R' → R(C=O)-R'.

NO ADDITIONAL EXAMPLES

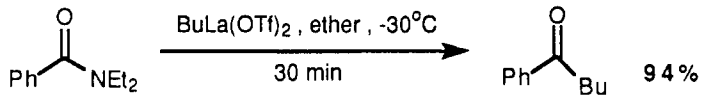
SECTION 171: KETONES FROM AMIDES



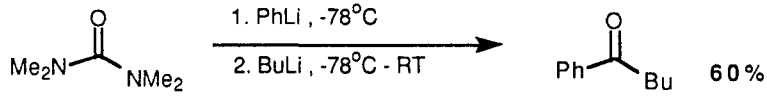
Einhorn, J.; Einhorn, C.; Luche, J.-L. *Tetrahedron Lett.*, ***1988***, *29*, 2183.



Tominaga, Y.; Kohra, S.; Hosomi, A. *Tetrahedron Lett.*, ***1987***, *28*, 1529.

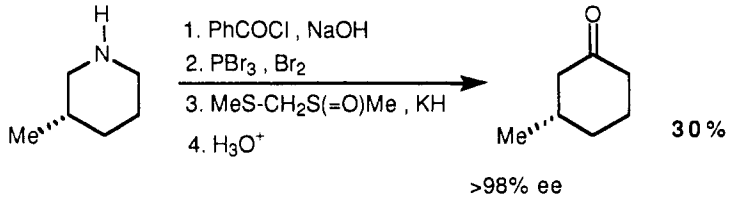


Collins, S.; Hong, Y. *Tetrahedron Lett.*, ***1987***, *28*, 4391.

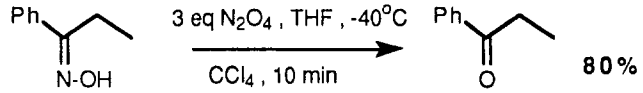


Hlasta, D.J.; Court, J.J. *Tetrahedron Lett.*, ***1989***, *30*, 1773.

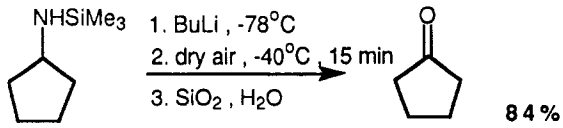
SECTION 172: KETONES FROM AMINES



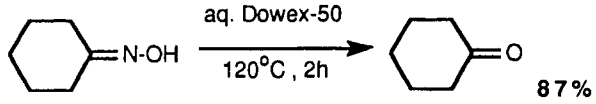
Thurkauf, A.; Hillery, P.; Jacobson, A.E.; Rice, K.C. *J. Org. Chem.*, ***1987***, *52*, 5466.



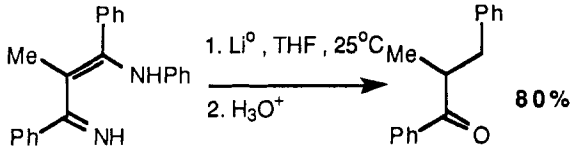
Shim, S.B.; Kim, K.; Kim, Y.H. *Tetrahedron Lett.*, ***1987***, *28*, 645.



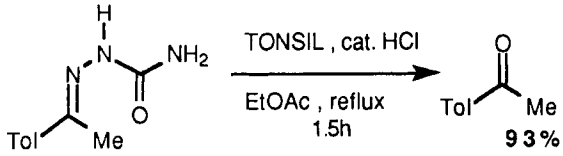
Chen, H.C.; Knochel, P. *Tetrahedron Lett.*, ***1988***, *29*, 6701.



Ranu, B.C.; Sarkar, D.C. *J. Org. Chem.*, ***1988***, *53*, 878.

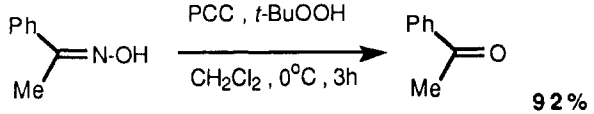


Barluenga, J.; Aguilar, E.; Olano, B.; Fustero, S. *J. Org. Chem.*, ***1988***, *53*, 1741.

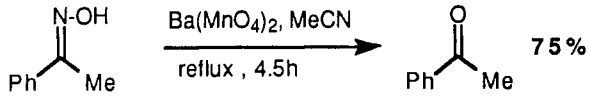


TONSIL = Mexican bentonite clay

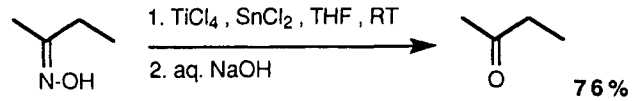
Cano, A.C.; Delgado, F.; Córdoba, A.A.; Márquez, C.; Alvarez, C. *Synth. Commun.*, ***1988***, *18*, 2051.



Chidambaram, N.; Satyanarayana, K.; Chandrasekaran, S. *Synth. Commun.*, ***1989***, *19*, 1727.

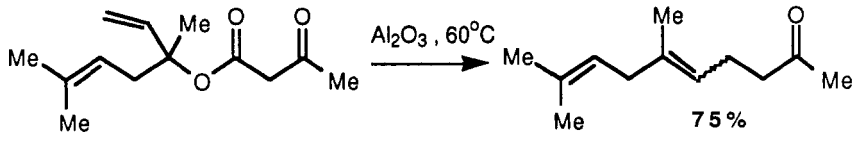


Firouzabadi, H.; Mottaghineiad, E.; Seddighi, M. *Synth. Commun.*, ***1989***, *19*, 3469.

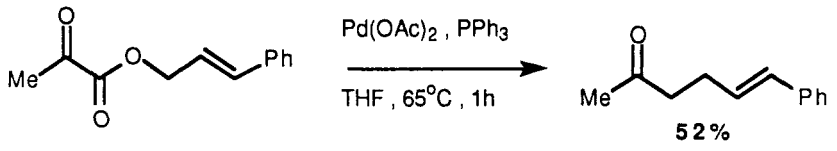


Balicki, R.; Kaczmarek, L.; Malinowski, M. *Liebigs Ann. Chem.*, ***1989***, 1139.

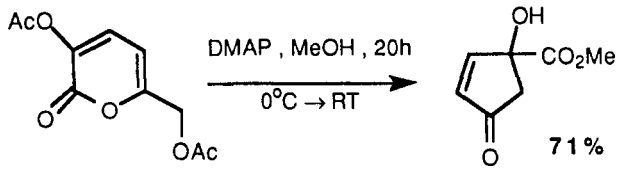
SECTION 173: KETONES FROM ESTERS



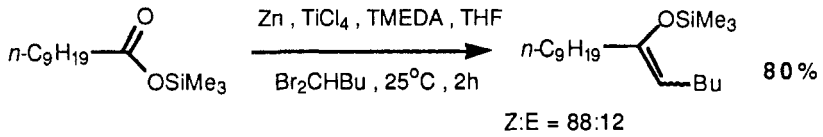
Pogrebnoi, S.I.; Kalyan, Y.B.; Krimer, M.Z.; Smit, W.A. *Tetrahedron Lett.*, ***1987***, *28*, 4893.



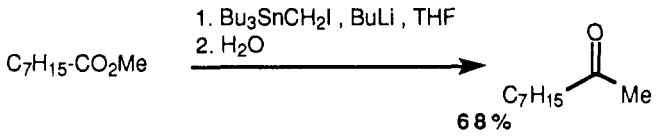
Tsuji, J.; Yamada, T.; Minami, I.; Yuhara, M.; Nisar, M.; Shimizu, I. *J. Org. Chem.*, ***1987***, *52*, 2988.



Tajima, K. *Chem. Lett.*, ***1987***, 1319.



Takai, K.; Kataoka, Y.; Okazoe, T.; Utimoto, K. *Tetrahedron Lett.*, ***1988***, *29*, 1065.

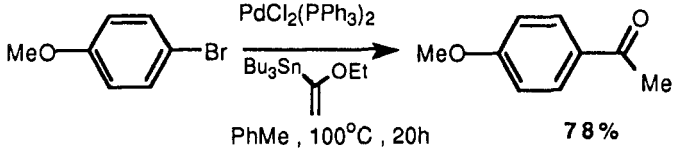


Sato, T.; Matsuoka, H.; Igarashi, T.; Minomura, M.; Murayama, E. *J. Org. Chem.*, ***1988***, *53*, 1207.

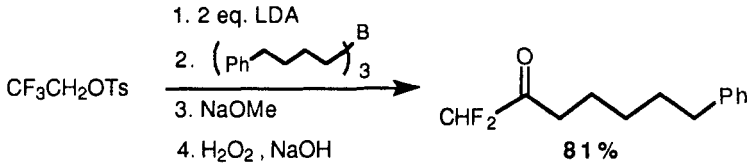
SECTION 174: KETONES FROM ETHERS, EPOXIDES AND THIOETHERS

NO ADDITIONAL EXAMPLES

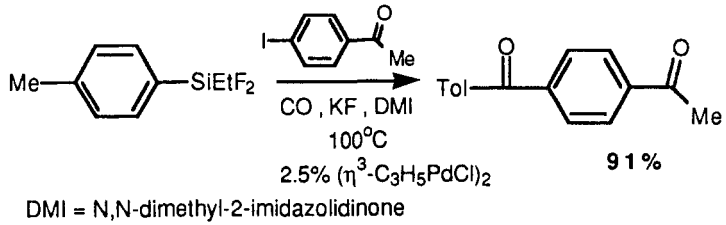
SECTION 175: KETONES FROM HALIDES AND SULFONATES



Kosugi, M.; Sumiya, T.; Obara, Y.; Suzuki, M.; Sano, H.; Migita, T. *Bull. Chem. Soc., Jpn.*, ***1987***, *60*, 767.

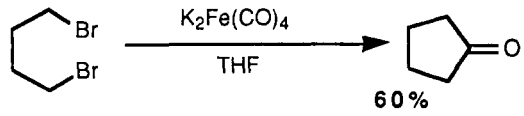


Ichikawa, J.; Sonoda, T.; Kobayashi, H. *Tetrahedron Lett.*, ***1989***, *30*, 5437.



DMI = N,N-dimethyl-2-imidazolidinone

Hatanaka, Y.; Hiyama, T. *Chem. Lett.*, ***1989***, 2049.

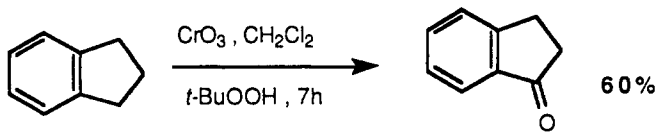


Yamashita, M.; Uchida, M.; Takashika, H.; Suemitsu, R. *Bull. Chem. Soc., Jpn.*, ***1989***, *62*, 2728.

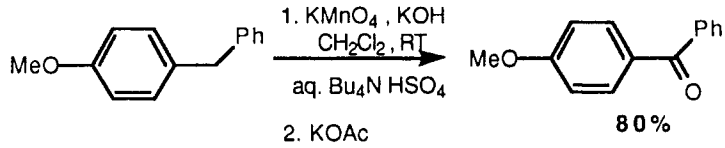
Related Methods: Section 177 (Ketones from Ketones).
Section 55 (Aldehydes from Halides).

SECTION 176: KETONES FROM HYDRIDES

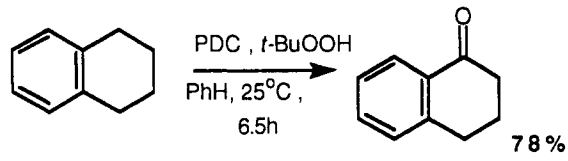
This section lists examples of the replacement of hydrogen by ketonic groups, R-H → R(C=O)-R'. For the oxidation of methylenes, R_2CH_2 → $R_2C{=}O$, see section 170 (Ketones from Alkyls).



Muzart, J. *Tetrahedron Lett.*, ***1987***, *28*, 2131.
Muzart, J. *Tetrahedron Lett.*, ***1987***, *28*, 4665.

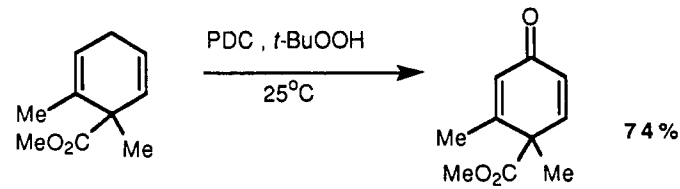


Gannon, S.M.; Krause, J.G. *Synthesis*, ***1987***, 915.

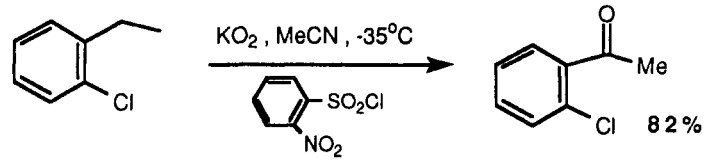


82% conversion

Chidambaram, N.; Chandrasekaran, S. *J. Org. Chem.*, ***1987***, *52*, 5048.



Schultz, A.G.; Taverns, A.G.; Harrington, R.E. *Tetrahedron Lett.*, ***1988***, *29*, 3907.

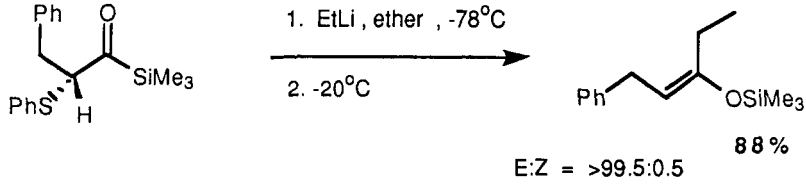


Kim, Y.H.; Kim, K.S.; Lee, H.Y. *Tetrahedron Lett.*, ***1989***, *30*, 6357.

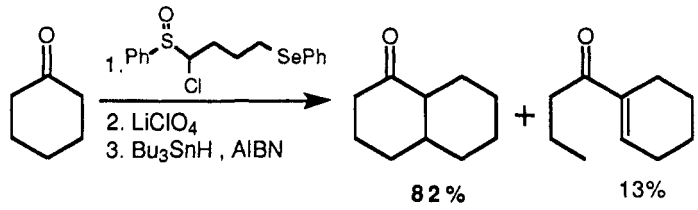
SECTION 177: KETONES FROM KETONES

This section contains alkylations of ketones and protected ketones, ketone transpositions and annulations, ring expansions and ring openings and dimerizations. Conjugate reductions and Michael alkylations of enone are listed in Section 74 (Alkyls from Alkenes).

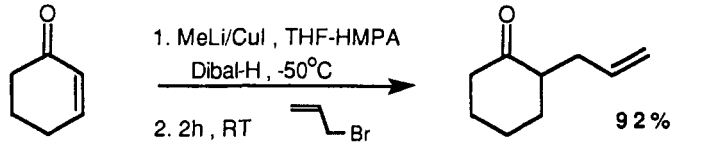
For the preparation of enamines or imines from ketones, see Section 356 (Amine-Alkene).



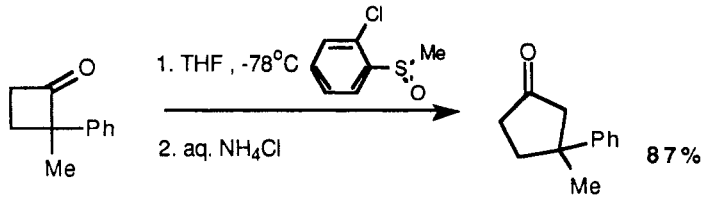
Reich, H.J.; Holtan, R.C.; Borkowsky, S.L. *J. Org. Chem.*, ***1987***, *52*, 312.



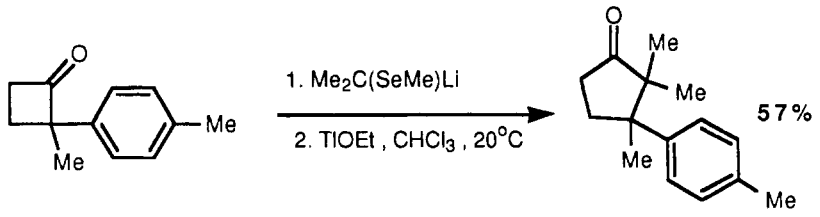
Satoh, T.; Itoh, M.; Yamakawa, K. *Chem. Lett.*, ***1987***, 1949.



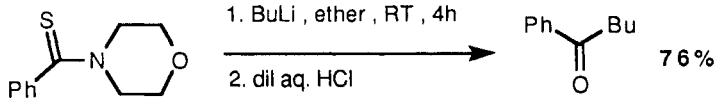
Tsuda, T.; Satomi, H.; Hayashi, T. Saegusa, T. *J. Org. Chem.*, ***1987***, *52*, 439.



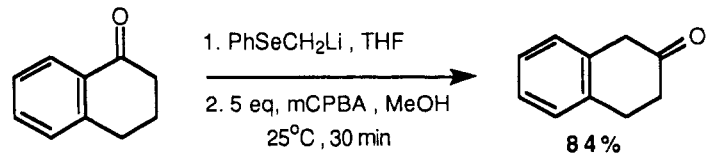
Gadwood, R.C.; Mallick, I.M.; DeWinter, A.J. *J. Org. Chem.*, ***1987***, *52*, 774.



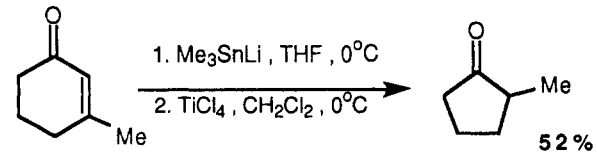
Krief, A.; Laboureur, J.L. *Tetrahedron Lett.*, ***1987***, *28*, 1545.
Krief, A.; Laboureur , J.L. ; Dumont, W. *Tetrahedron Lett.*, ***1987***, *28*, 1549.



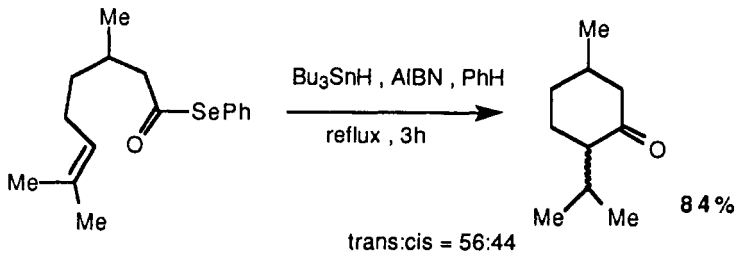
Tominaga, Y.; Kohra, S.; Hosomi, A. *Tetrahedron Lett.*, ***1987***, *28*, 1529. 1545.



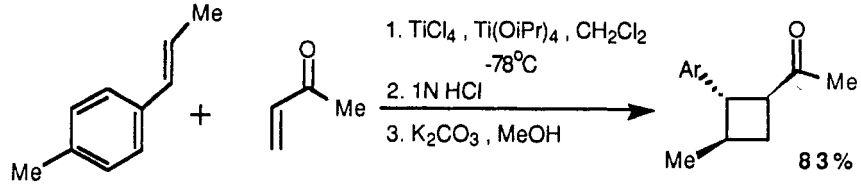
Uemura, S.; Ohe, K.; Sugita, N. *J. Chem. Soc., Chem. Commun.*, ***1988***, 111.



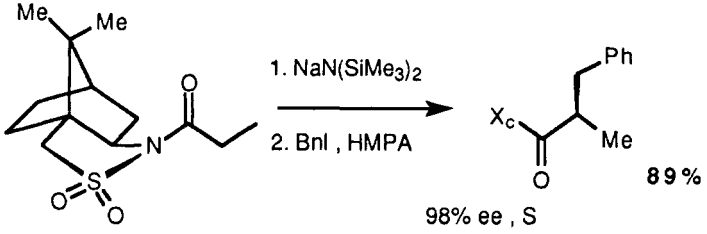
Sato, T.; Watanabe, M.; Watanabe, T.; Onoda, Y.; Murayama, E. *J. Org. Chem.*, ***1988***, *53*, 1894.



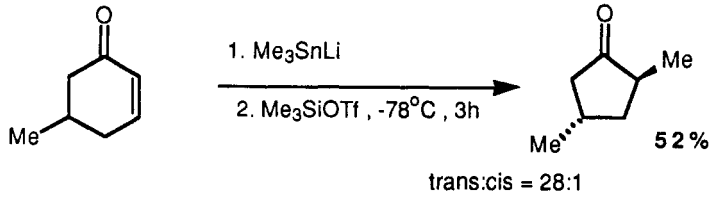
Boger, D.L.; Mathvink, R.J. *J. Org. Chem.*, ***1988***, *53*, 3377.



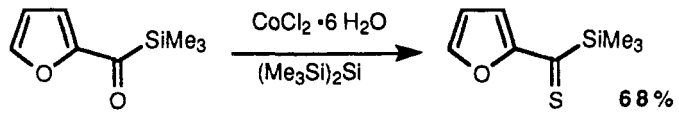
Engler, T.A.; Ali, M.H.; Velde, D.V. *Tetrahedron Lett.*, ***1989***, *30*, 1761.



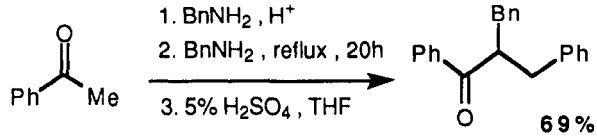
Oppolzer, W.; Moretti, R.; Thomi, S. *Tetrahedron Lett.*, ***1989***, *30*, 5603.



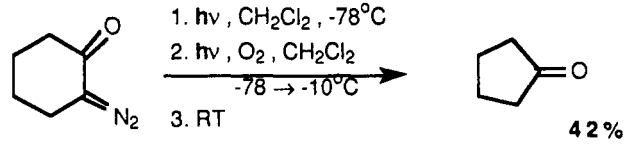
Sato, T.; Watanabe, T.; Hayata, T.; Tsukui, T. *J. Chem. Soc., Chem. Commun.*, ***1989***, 153.



Ricci, A.; Degl'Innocenti, A.; Capperucci, A.; Reginato, G. *J. Org. Chem.*, ***1989***, *54*, 19.



Armesto, D.; Esteban, S.; Horspool, W.M.; Martin, J.-A.F.; Martínez-Alcazar, P.; Perez-Ossorio, R. *J. Chem. Soc., Perkin Trans. I*, ***1989***, 751.



Majerski, Z.; Vinković, V. *Synthesis*, ***1989***, 559.

REVIEW:

"One Carbon Ring Expansions of Bridged Bicyclic Ketones"

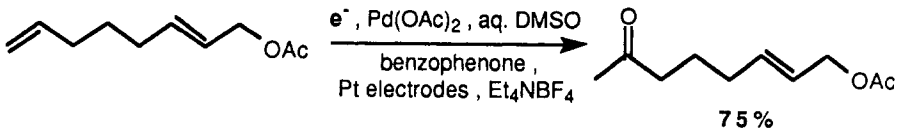
Krow, G.R. *Tetrahedron*, ***1987***, *43*, 3.

Related Methods: Section 49 (Aldehydes from Aldehydes).

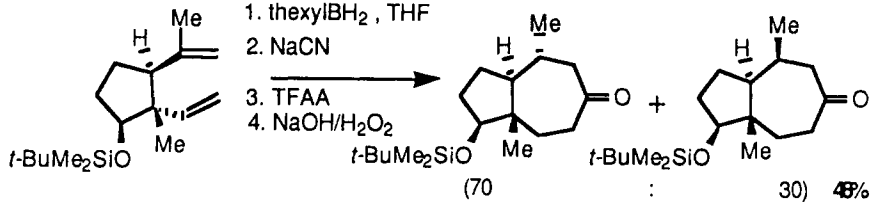
SECTION 178: KETONES FROM NITRILES

NO ADDITIONAL EXAMPLES

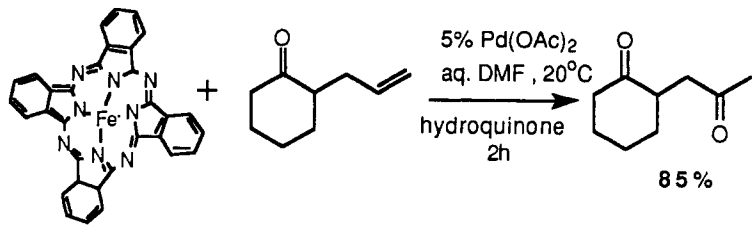
SECTION 179: KETONES FROM ALKENES



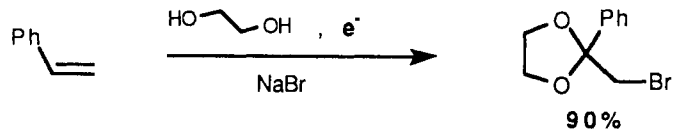
Tsuji, J.; Minato, M. *Tetrahedron Lett.*, ***1987***, *28*, 3683.



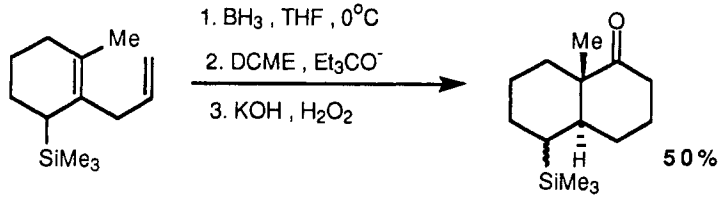
Welch, M.C.; Bryson, T.A. *Tetrahedron Lett.*, ***1988***, *29*, 521.



Bäckvall, J.-E.; Hopkins, R.B. *Tetrahedron Lett.*, ***1988***, *29*, 2885.

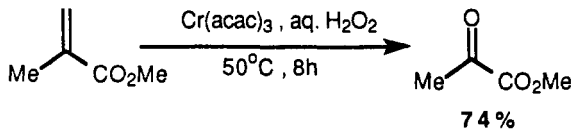


Nikishin, G.I.; Elinson, M.N.; Makhova, I.V. *Tetrahedron Lett.*, ***1988***, *29*, 1603.



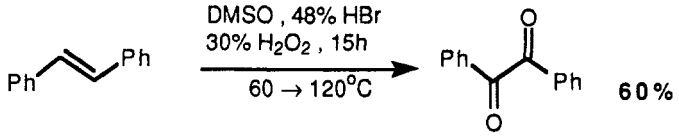
DCME = dichloromethylmethyl ether β:α = 1:1.2

Akers, J.A.; Bryson, T.A. *Tetrahedron Lett.*, ***1989***, *30*, 2187.



74%

Inoue, M.; Uragaki, T.; Kashiwagi, H.; Enomoto, S. *Chem. Lett.*, ***1989***, 99.



60%

Yusubov, M.S.; Filimonov, V.D. *J. Org. Chem., U.S.S.R.*, ***1989***, *25*, 199.

REVIEWS:

"Intramolecular Cycloaddition Reactions of Ketones and Keteniminium Salts with Alkenes"

Snider, B.B. *Chem. Rev.*, ***1988***, *88*, 793.

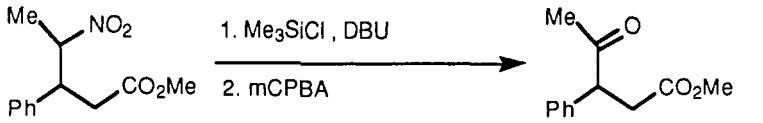
"Synthetic Applications of Intramolecular Enone-Olefin Photocycloadditions"

Crimins, M.T. *Chem. Rev.*, ***1988***, *88*, 1453.

See also: Section 134 (Ethers from Alkenes).
Section 174 (Ketones from Ethers).

SECTION 180: KETONES FROM MISCELLANEOUS COMPOUNDS

Conjugate reductions and reductive alkylations of enones are listed in Section 74 (Alkyls from Alkenes).



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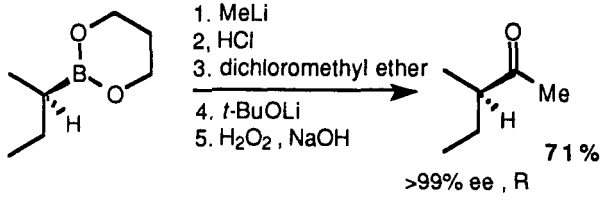
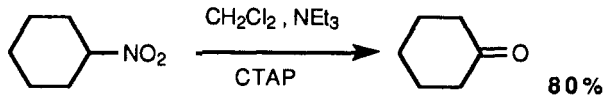
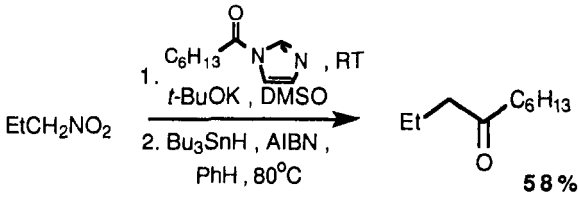
Aizpurua, J.M.; Oiarbide, M.; Palomo, C. *Tetrahedron Lett.*, ***1987***, *28*, 5361.



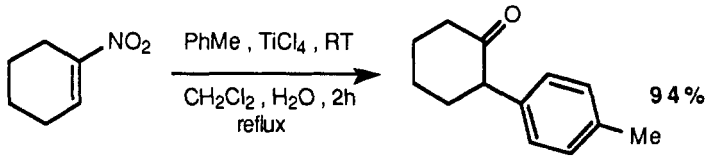
Brown, H.C.; Srebnik, M.; Bakshi, R.K.; Cole, T.E. *J. Am. Chem. Soc.*, ***1987***, *109*, 5420.



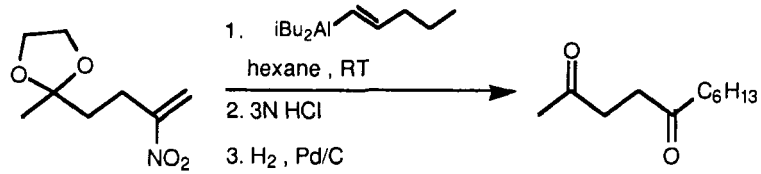
Vankar, P.S.; Rathore, R.; Chandrasekaran, S. *Synth. Commun.*, ***1987***, *17*, 195.



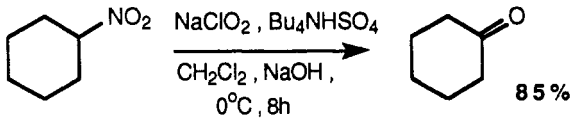
Ono, N.; Fujii, M.; Kaji, A. *Synthesis*, ***1987***, 532.



Lee, K.; Oh, D.Y. *Tetrahedron Lett.*, ***1988***, *29*, 2977.

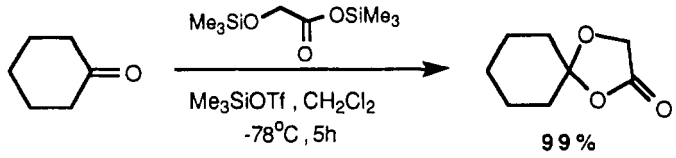


Pecunioso, A.; Menicagli, R. *J. Org. Chem.*, ***1988***, *53*, 2614.

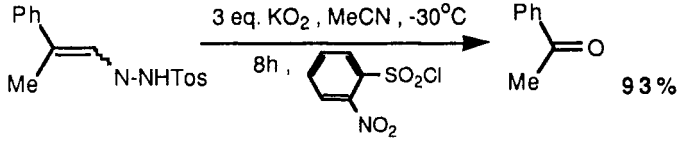


Ballini, R.; Petrini, M. *Tetrahedron Lett.*, ***1989***, *30*, 5329.

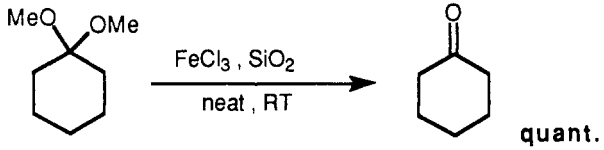
SECTION 180A: PROTECTION OF KETONES



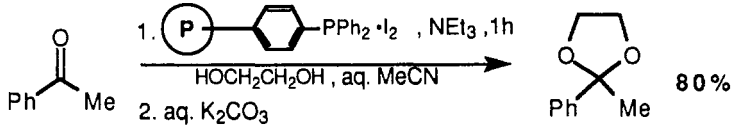
Pearson, W.H.; Cheng, M.-C. *J. Org. Chem.*, ***1987***, *52*, 1353.



Kim, Y.H.; Lee, H.K.; Chang, H.S. *Tetrahedron Lett.*, ***1987***, *28*, 4285.

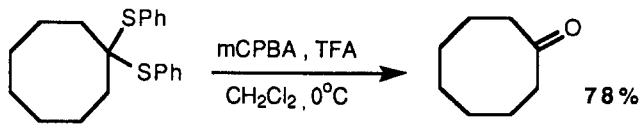


Fadel, A.; Yefsah, R.; Salaün, J. *Synthesis*, ***1987***, 37.

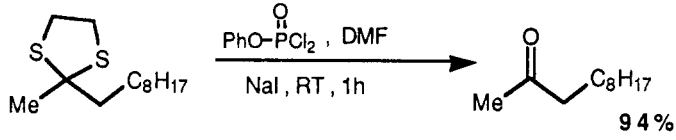


polystyrene backbone

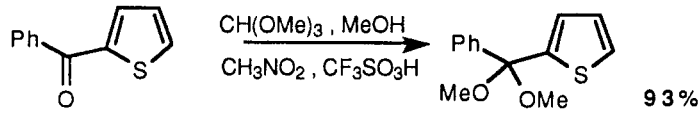
Caputo, R.; Ferreri, C.; Palumbo, G. *Synthesis*, ***1987***, 386.



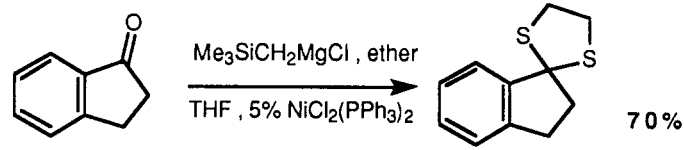
Cossy, J. *Synthesis,* ***1987***, 1113.



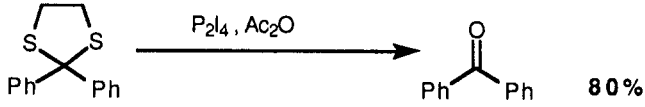
Liu, H.-J.; Wiszniewski, V. *Tetrahedron Lett.,* ***1988***, *29*, 5471.



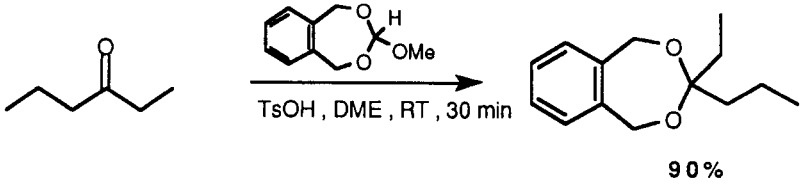
Thurkauf, A.; Jacobson, A.E.; Rice, K.C. *Synthesis,* ***1988***, 233.



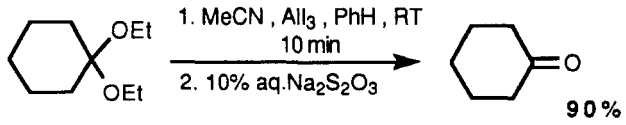
Ni, Z.-J.; Luh, T.-Y. *J. Chem. Soc., Chem. Commun.,* ***1988***, 1011.



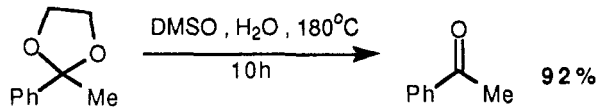
Shigemasa, Y.; Ogawa, M.; Sashiwa, H.; Saimoto, H. *Tetrahedron Lett.,* ***1989***, *30*, 1277.



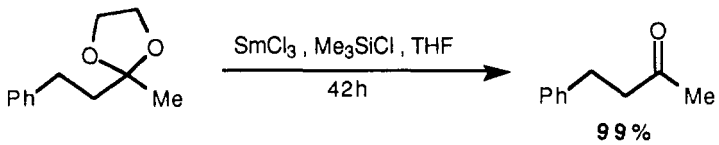
Machinaga, N.; Kibayashi, C. *Tetrahedron Lett.,* ***1989***, *30*, 4165.



Sarmeh, P.; Barua, N.C. *Tetrahedron Lett.*, ***1989***, *30*, 4703.



Kametani, T.; Kondoh, H.; Honda, T.; Ishizone, H.; Suzuki, Y.; Mori, W. *Chem. Lett.*, ***1989***, 901.



Ukaji, Y.; Koumoto, N.; Fujisawa, T. *Chem. Lett.*, ***1989***, 1623.

REVIEW:

"Synthetic Uses of the 1,3-Dithiane Grouping from 1977 to 1988"

Page, P.C.B.; van Niel, M.B.; Prodger, J.C. *Tetrahedron*, ***1989***, *45*, 7643.

See Section 362 (Ester-Alkene) for the formation of enol esters and Section 367 (Ether-Alkenes) for the formation of enol ethers. Many of the methods in Section 60A (Protection of Aldehydes) are also applicable to ketones.

Compendium of Organic Synthetic Methods, Volume 7
Edited by Michael B. Smith
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CHAPTER 13
PREPARATION OF NITRILES

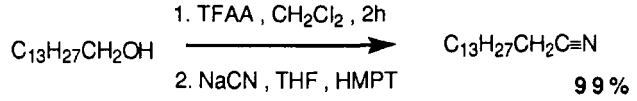
SECTION 181: NITRILES FROM ALKYNES

NO ADDITIONAL EXAMPLES

SECTION 182: NITRILES FROM ACID DERIVATIVES

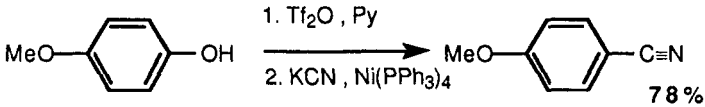
NO ADDITIONAL EXAMPLES

SECTION 183: NITRILES FROM ALCOHOLS AND THIOLS



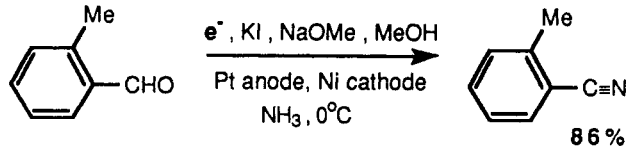
one pot - two step

Camps, F.; Gasol, V.; Guerrero, A. *Synth. Commun.*, ***1988***, *18*, 445.

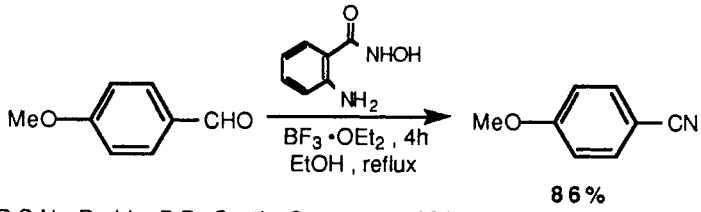


Chambers, M.R.I.; Widdowson, D.A. *J. Chem. Soc., Perkin Trans. I*, ***1989***, 1365.

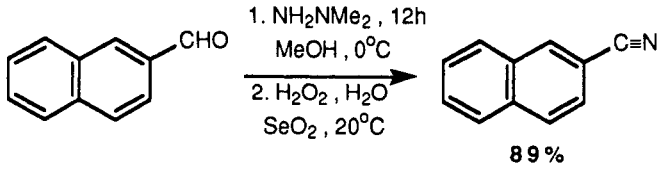
SECTION 184: NITRILES FROM ALDEHYDES



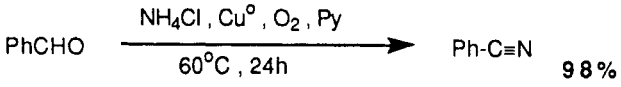
Okimoto, M.; Chiba, T. *J. Org. Chem.*, ***1988***, *53*, 218.



Reddy, P.S.N.; Reddy, P.P. *Synth. Commun.*, ***1988***, *18*, 2179.



Said, S.B.; Skarzewski, J.; Młochowski, J. *Synthesis*, ***1989***, 223.

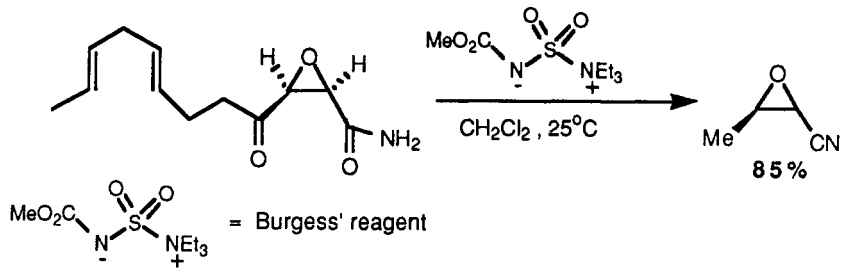


Capdevielle, P.; Lavigne, A.; Maumy, M. *Synthesis*, ***1989***, 451.

SECTION 185: NITRILES FROM ALKYLS, METHYLENES AND ARYLS

NO ADDITIONAL EXAMPLES

SECTION 186: NITRILES FROM AMIDES



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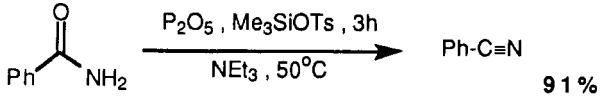

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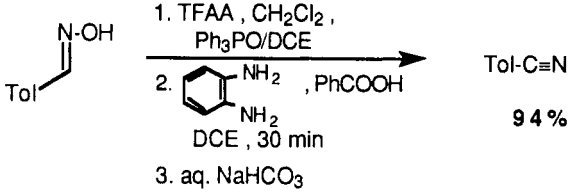
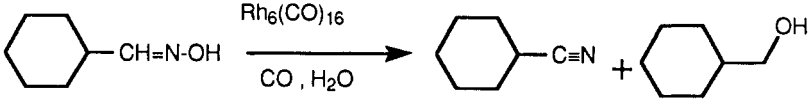
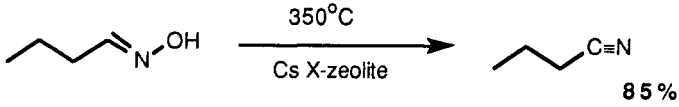
SECTION 187: NITRILES FROM AMINES



Hendrickson, J.B.; Hussoin, Md.S. *J. Org. Chem.*, ***1987***, *52*, 4138.



Kaneda, K.; Doken, K.; Imanaka, T. *Chem. Lett.*, ***1988***, 285.



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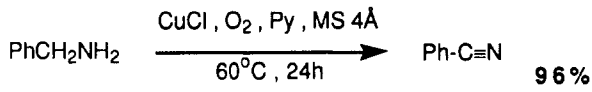
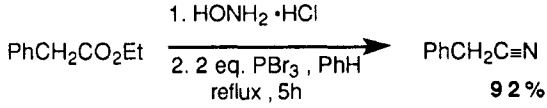


Capdevielle, P.; Lavigne, A.; Maumy, M. *Synthesis,* ***1989***, 453.

SECTION 188: NITRILES FROM ESTERS

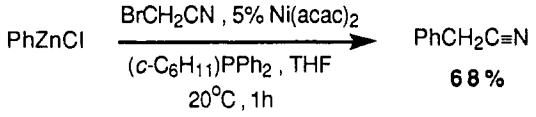


Liguori, A.; Sindona, G.; Romeo, G.; Uccella, N. *Synthesis,* ***1987***, 168.

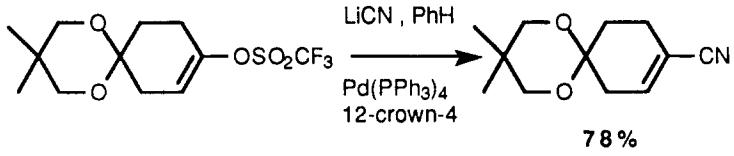
SECTION 189: NITRILES FROM ETHERS, EPOXIDES AND THIOETHERS

NO ADDITIONAL EXAMPLES

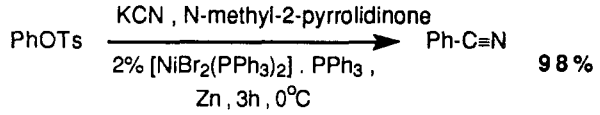
SECTION 190: NITRILES FROM HALIDES AND SULFONATES



Frejd, T.; Klingstedt, T. *Synthesis,* ***1987***, 40.



Piers, E.; Fleming, F.F. *J. Chem. Soc., Chem. Commun.,* ***1989***, 756.



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REVIEW:

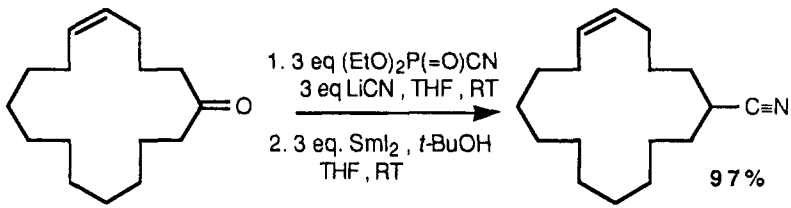
"Cyanation of Aromatic Halides"

Bellis, G.P.; Romney-Alexander, T.M. *Chem. Rev.*, ***1987***, *87*, 779.

SECTION 191: NITRILES FROM HYDRIDES

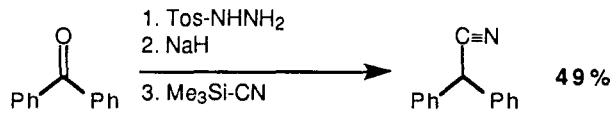
NO ADDITIONAL EXAMPLES

SECTION 192: NITRILES FROM KETONES



also works with aldehydes

Yoneda, R.; Harusawa, S.; Kurihara, T. *Tetrahedron Lett.*, ***1989***, *30*, 3681.



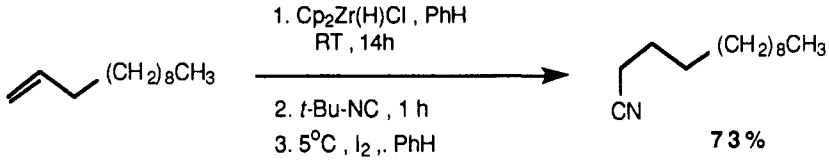
Saito, K.; Kagabu, S. *Org. Prep. Proceed. Int.*, ***1989***, *21*, 354.

SECTION 193: NITRILES FROM NITRILES

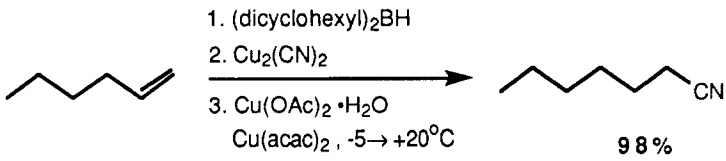
Conjugate reductions and Michael alkylations of alkene nitriles are found in Section 74D (Alkyls from Alkenes).

NO ADDITIONAL EXAMPLES

SECTION 194: NITRILES FROM ALKENES



Buchwald, S.L.; LaMaire, S.J. *Tetrahedron Lett.*, ***1987***, *28*, 295.



Masuda, Y.; Hoshi, M.; Arase, A. *J. Chem. Soc., Chem. Commun.*, ***1989***, 266.

SECTION 195: NITRILES FROM MISCELLANEOUS COMPOUNDS

NO ADDITIONAL EXAMPLES

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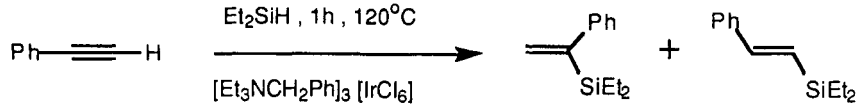
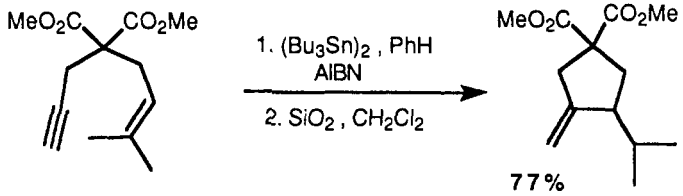
CHAPTER 14
PREPARATION OF ALKENES

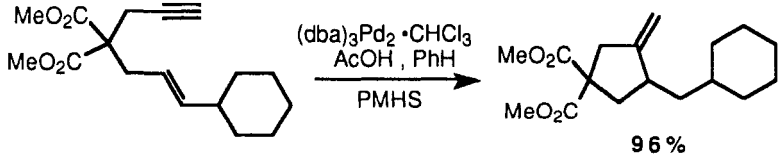
SECTION 196: ALKENES FROM ALKYNES



Iovel, I.G.; Goldberg, Y.Sh.; Shymanska, M.V.; Lukevics, E. *J. Chem. Soc., Chem. Commun.*, ***1987***, 31.

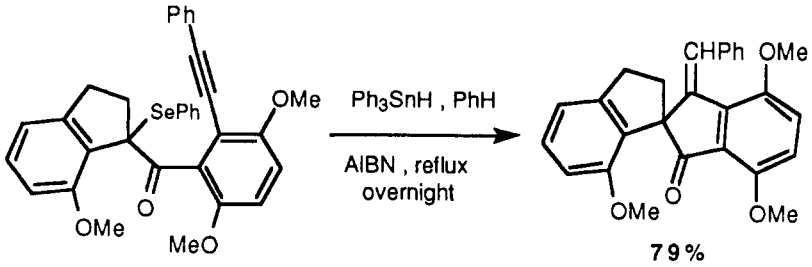


Stork, G.; Mook Jr., R. *J. Am. Chem. Soc.*, ***1987***, *109*, 2829.

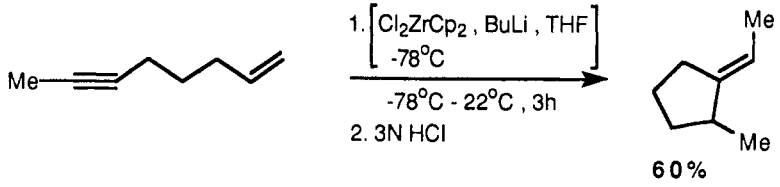


PMHS = polymetylhydrosiloxane

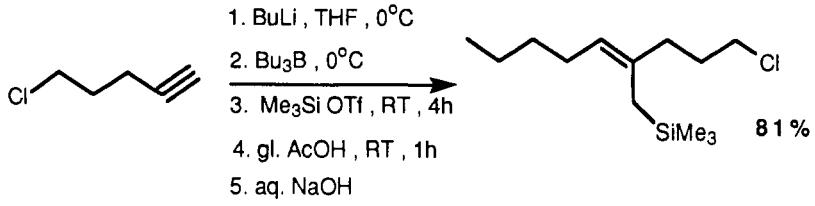
Trost, B.M.; Rise, F. *J. Am. Chem. Soc.*, ***1987***, *109*, 3161.



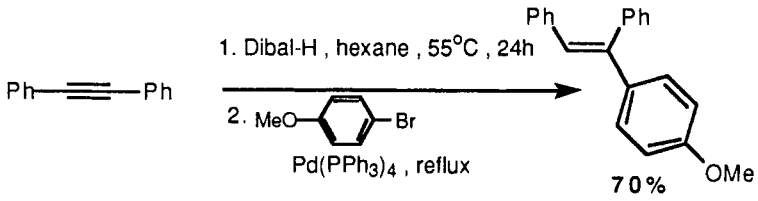
Clive, D.L.J.; Angoh, A.G.; Bennett, S.M. *J. Org. Chem.*, ***1987***, *52*, 1339.



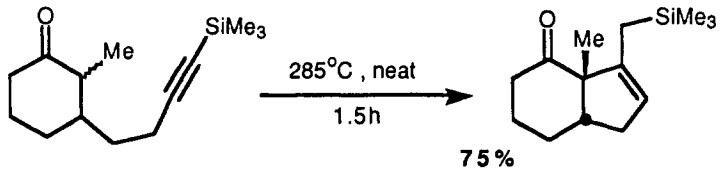
Negishi, E.; Swanson, D.R.; Cederbaum, F.E.; Takahashi, T. *Tetrahedron Lett.*, ***1987***, *28*, 917.



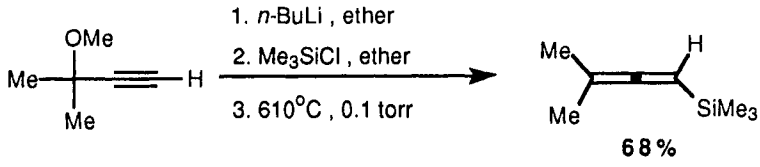
Wang, K.K.; Yang, K.E. *Tetrahedron Lett.*, ***1987***, *28*, 1003.
Wang, K.K.; Dhumrongvaraporn, S. *Tetrahedron Lett.*, ***1987***, *28*, 1007.



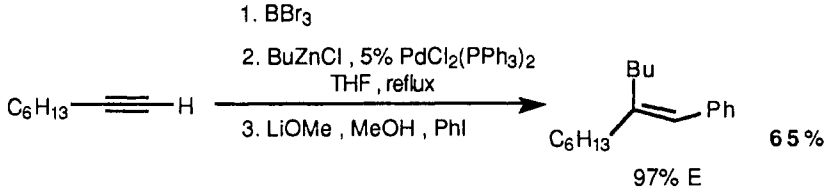
Al-Hassan, M.I. *Synth. Commun.*, ***1987***, *17*, 1413.



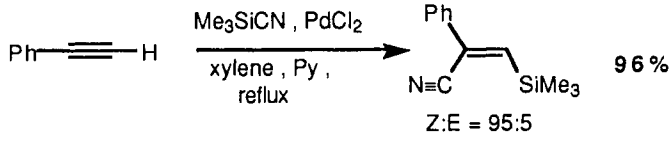
Kende, A.S.; Hebeisen, P.; Newbold, R.C. *J. Am. Chem. Soc.*, ***1988***, *110*, 3315.



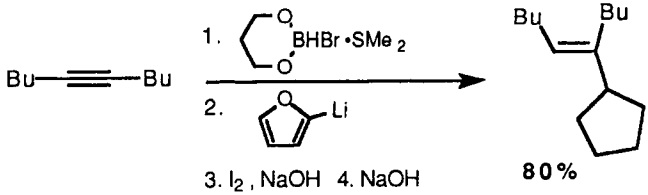
Hopf, H.; Naujoks, E. *Tetrahedron Lett.*, ***1988***, *29*, 609.



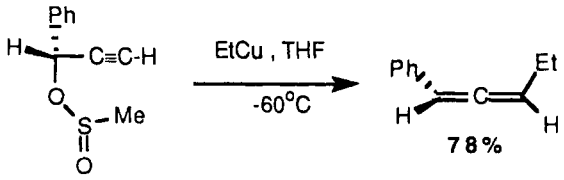
Satoh, Y.; Serizawa, H.; Miyaura, N.; Hara, S.; Suzuki, A. *Tetrahedron Lett.*, ***1988***, *29*, 1811.



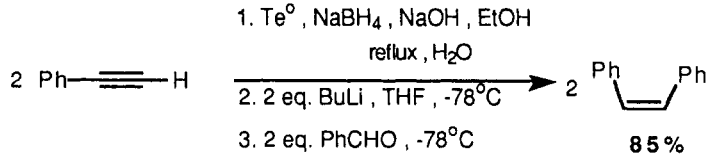
Chatani, N.; Takeyasu, T.; Horiuchi, N.; Hanafusa, T. *J. Org. Chem.*, ***1988***, *53*, 3539.



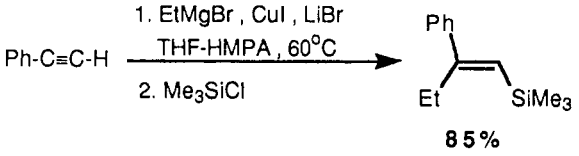
Brown, H.C.; Bhat, N.G. *J. Org. Chem.*, ***1988***, *53*, 6009.



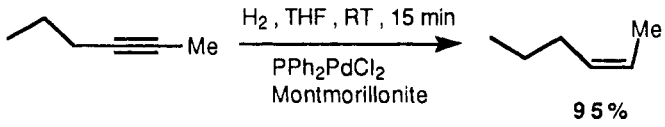
Elsevier, C.J.; Vermeer, P. *J. Org. Chem.*, ***1989***, *54*, 3726.



Barros, S.M.; Comasseto, J.V.; Berriet, J. *Tetrahedron Lett.*, ***1989***, *30*, 7353.

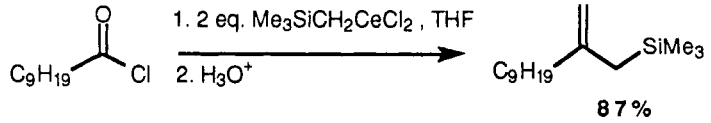


Chou, S.-S.P.; Kuo, H.-L.; Wang, C.-J.; Tsai, C.-Y.; Sun, C.-M. *J. Org. Chem.*, ***1989***, *54*, 868.

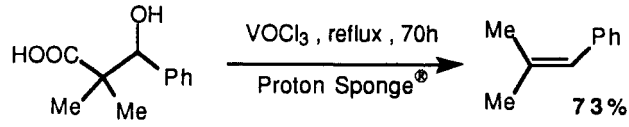


Sharma, G.V.M.; Choudary, B.M.; Sarma, M.R.; Rao, K.K. *J. Org. Chem.*, ***1989***, *54*, 2997.
Choudary, B.M.; Vasantha, G.; Sharma, M.; Bharathi, P. *Angew. Chem. Int. Ed., Engl.*, ***1989***, *28*, 465.

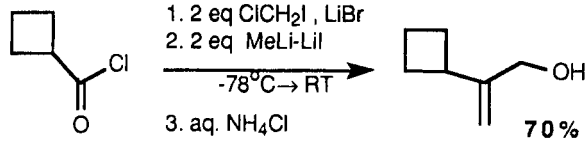
SECTION 197: ALKENES FROM ACID DERIVATIVES



Anderson, M.B.; Fuchs, P.L. *Synth. Commun.*, ***1987***, *17*, 621.

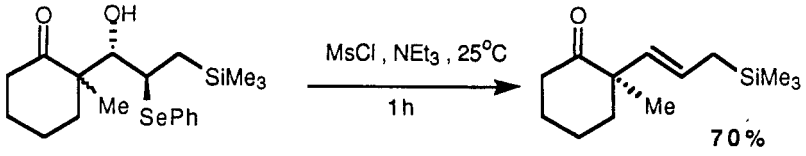


Meier, I.K.; Schwartz, J. *J. Am. Chem. Soc.*, ***1989***, *111*, 3069.

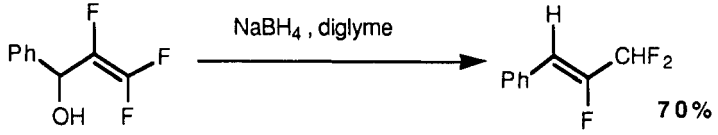


Barluenga, J.; Fernández-Simon, F.; Concellón, J.M.; Yus, M. *J. Chem. Soc., Perkin Trans. I*, ***1989***, 77.

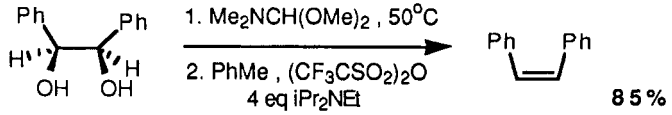
SECTION 198: ALKENES FROM ALCOHOLS AND THIOLS



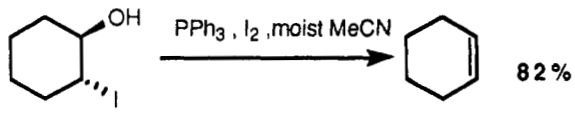
Sarkar, T.K.; Ghosh, S.K. *Tetrahedron Lett.*, ***1987***, *28*, 2061.



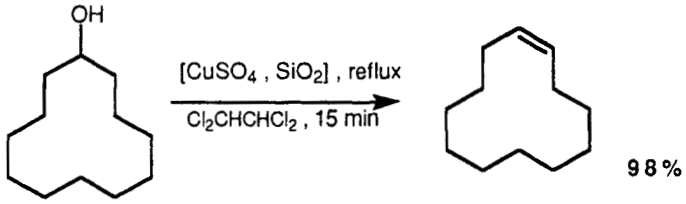
Tellier, F.; Sauvêtre, R.; Normant, J.-F. *Tetrahedron Lett.*, ***1987***, *28*, 3335.



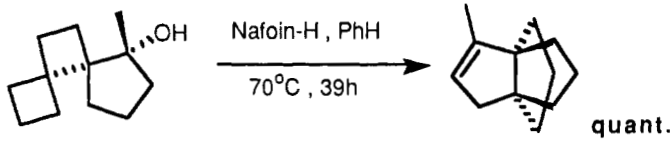
King, J.L.; Posner, B.A.; Mak, K.T.; Yang, N.C. *Tetrahedron Lett.*, ***1987***, *28*, 3917.



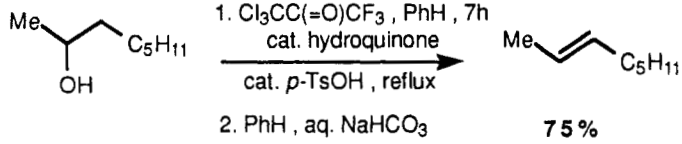
Garlaschelli, L.; Vidari, G. *Gazz. Chim. Ital.*, ***1987***, *117*, 251.



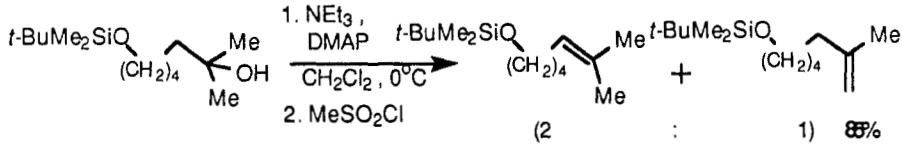
Nishiguchi, T.; Machida, N.; Yamamoto, E. *Tetrahedron Lett.*, ***1987***, *28*, 4565.



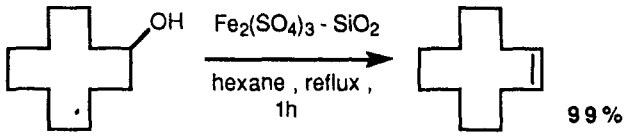
Fitjer, L.; Majewski, M.; Kanschik, A. *Tetrahedron Lett.*, ***1988***, *29*, 1263.



Abdel-Baky, S.; Moussa, A. *Synth. Commun.*, ***1988***, *18*, 1795.



Yadav, J.S.; Mysorekar, S.V. *Synth. Commun.*, ***1989***, *19*, 1057.



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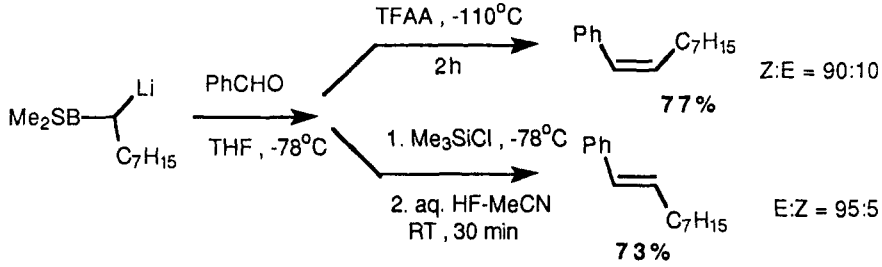
REVIEW:

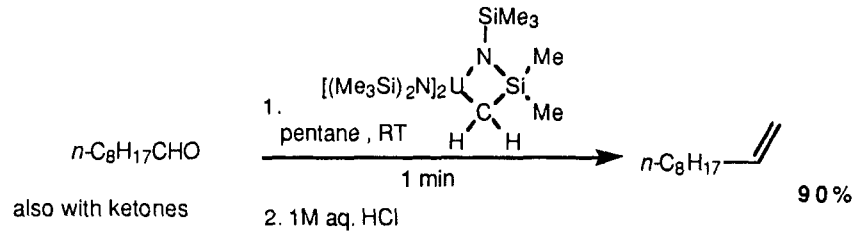
"Carbonyl-Coupling Reactions Using Low-Valent Titanium"

McMurry, J.E. *Chem. Rev., **1989**, 89*, 1513.

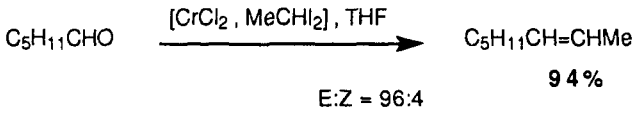
SECTION 199: ALKENES FROM ALDEHYDES



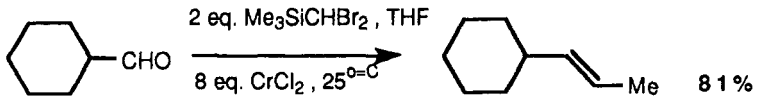
Pelter, A.; Buss, D.; Colclough, E. *J. Chem. Soc., Chem. Commun., **1987***, 297.



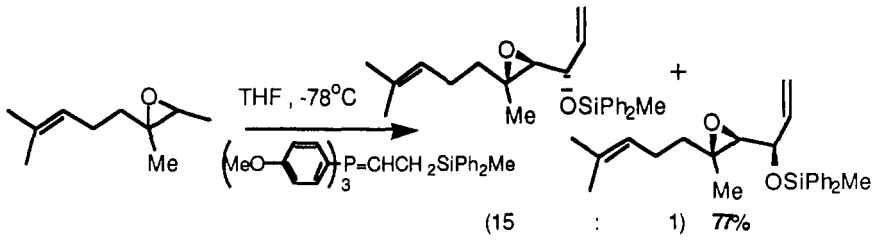
Dormand, A.; El Boudadili, A.; Moise, C. *J. Org. Chem., **1987**, 52*, 688.



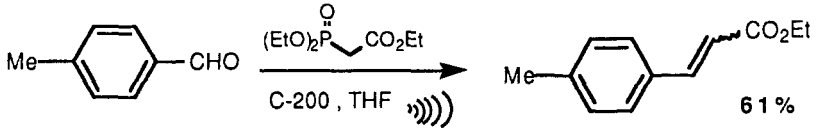
Okazoe, T.; Takai, K.; Utimoto, K. *J. Am. Chem. Soc., **1987**, 109*, 951.



Takai, K.; Kataoka, Y.; Okazoe, T.; Utimoto, K. *Tetrahedron Lett.*, ***1987***, *28*, 1443.

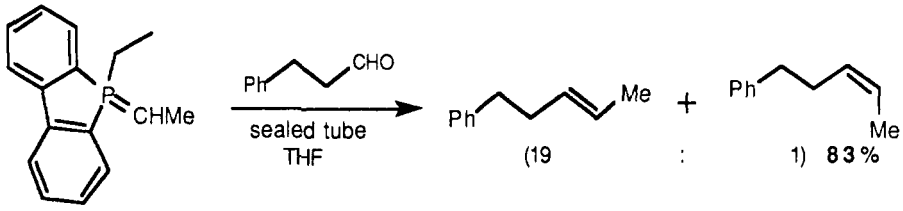


Iio, H.; Mizobuchi, T.; Tokoroyama, T. *Tetrahedron Lett.*, ***1987***, *28*, 2379.

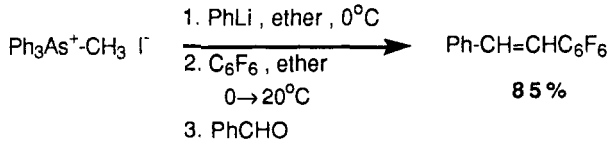


C-200 = activated barium hydroxide catalyst

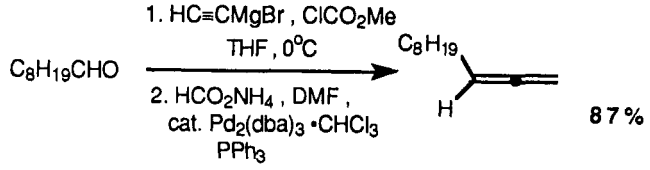
Fuentes, A.; Marinas, J.M.; Sinisterra, J.V. *Tetrahedron Lett.*, ***1987***, *28*, 2951.



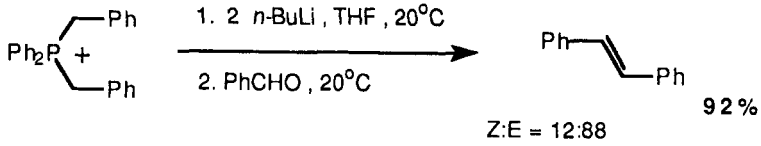
Vedejs, E.; Marth, C. *Tetrahedron Lett.*, ***1987***, *28*, 3445.



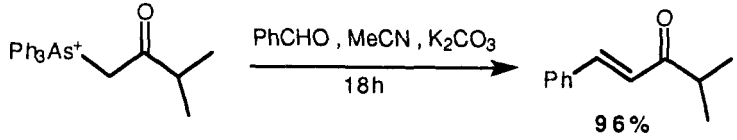
Shen, Y.; Qiu, W. *Synthesis*, ***1987***, 65.



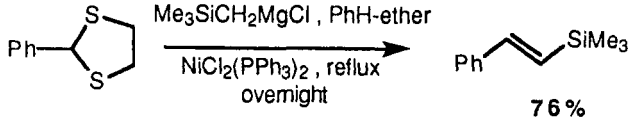
Tsuji, J.; Sugiura, T.; Minami, I. *Synthesis, **1987**, 603.*



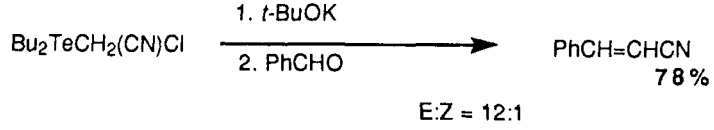
McKenna, E.G.; Walker, B.J. *Tetrahedron Lett., **1988**, 29*, 485.



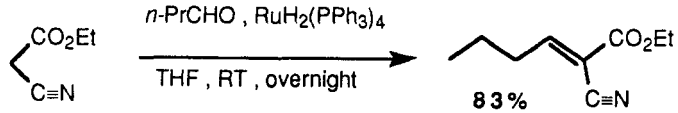
Huang, Y.-Z.; Shi, L.-L.; Li, S.-W. *Synthesis, **1988**, 975.*



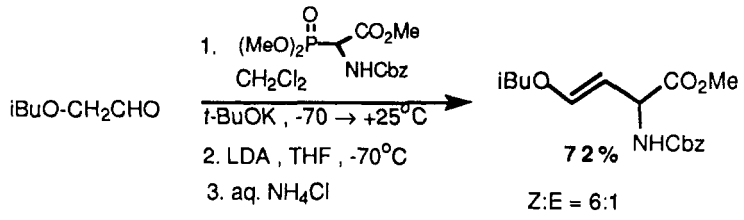
Ni, Z.-J.; Luh, T.-Y. *J. Org. Chem., **1988**, 53*, 2129.



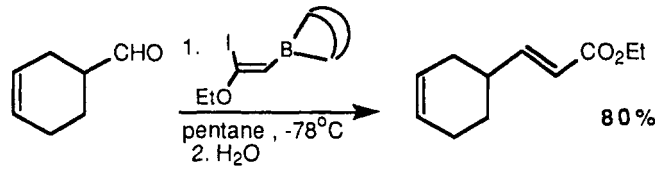
Huang, X.; Xie, L.; Wu, H. *J. Org. Chem., **1988**, 53*, 4862.
Huang, X.; Xie, L.; Wu, H. *Tetrahedron Lett., **1987**, 28*, 801.



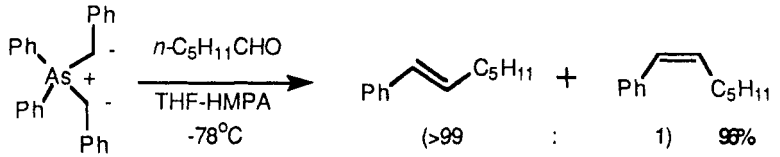
Naota, T.; Taki, H.; Mizuno, M.; Murahashi, S. *J. Am. Chem. Soc., **1989**, 111*, 5954.



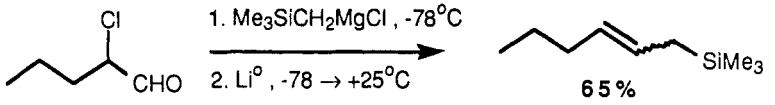
Daumas, M.; Vo-Quang, L.; Vo-Quang, Y.; LeGoffic, F. *Tetrahedron Lett.*, ***1989***, *30*, 5121.



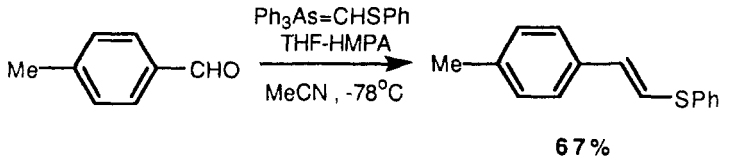
Satoh, Y.; Tayano, T.; Hara, S.; Suzuki, A. *Tetrahedron Lett.*, ***1989***, *30*, 5153.



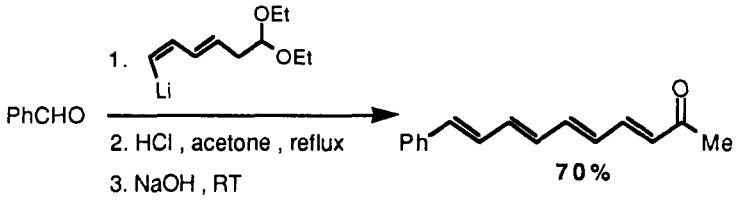
Boub, A.B.; Mioskowski, C.; Bellamy, F. *Tetrahedron Lett.*, ***1989***, *30*, 5263.



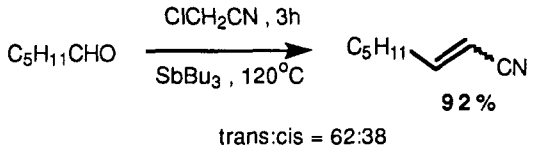
Barluenga, J.; Fernández-Simón, J.L.; Concellón, J.M.; Yus, M. *Tetrahedron Lett.*, ***1989***, *30*, 5927.



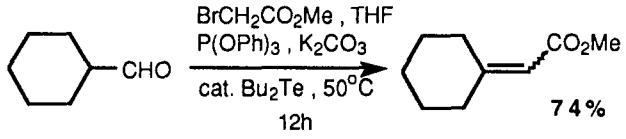
Boubia, B.; Mioskowski, C.; Manna, S.; Falck, J.R. *Tetrahedron Lett.*, ***1989***, *30*, 6023.
Chabert, P.; Mioskowski,C., *Tetrahedron Lett.*, ***1989***, *30*, 6031.



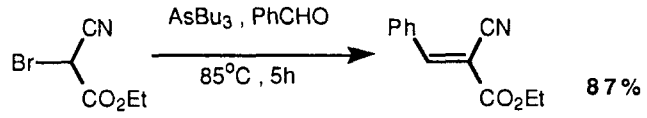
Duhamel, L.; Ple, G.; Ramondenc, Y. *Tetrahedron Lett.*, ***1989***, *30*, 7377.



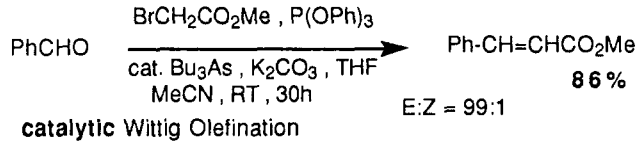
Huang, Y.-Z.; Shen, Y.; Chen, C. *Synth. Commun.*, ***1989***, *19*, 83.
Huang, Y.-Z.; Chen, C.; Shen, Y. *Synth. Commun.*, ***1989***, *19*, 501.



Huang, Y.-Z.; Shi, L.-L.; Li, S.-W.; Wen, X.-Q. *J. Chem. Soc., Perkin Trans. I*, ***1989***, 2397.



Shen, Y.; Yang, B. *Synth. Commun.*, ***1989***, *19*, 3069.



Shi, L.; Wang, W.; Wang, Y.; Huang, Y.-Z. *J. Org. Chem.*, ***1989***, *54*, 2027.

REVIEWS:

"Reductions Promoted by Low Valent Transition Metal Complexes in Organic Synthesis"

Pons, J.-M.; Santelli, M. *Tetrahedron, **1988**, 44*, 4295.

"The Applications of Low-Valent Titanium Reagents in Organic Synthesis"

Lenior, D. *Synthesis, **1989***, 883.

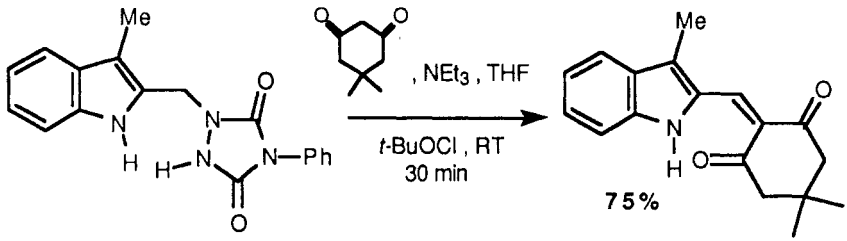
"The Wittig Olefination Reaction and Modifications Involving Phosphoryl-Stabilized Carbanions. Stereochemistry, Mechanism and Selected Synthetic Aspects"

Maryanoff, B.E.; Reitz, A.B. *Chem. Rev., **1989**, 89*, 863.

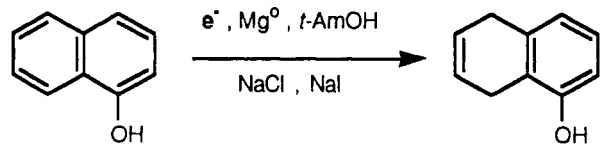
Related Methods: Section 207 (Alkenes from Ketones).

SECTION 200: ALKENES FROM ALKYLS, METHYLENES AND ARYLS

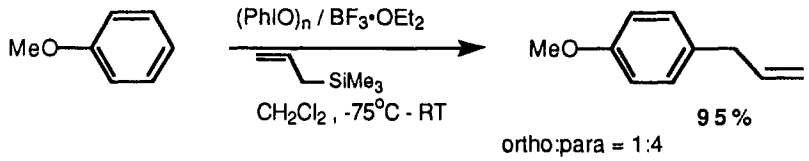
This section contains dehydrogenations to form alkenes and unsaturated ketones, esters and amides. It also includes the conversion of aromatic rings to alkenes.
Reduction of aryls to dienes is found in Section 377 (Alkene-Alkene).
Hydrogenation of aryls to alkanes and dehydrogenations to form aryls are included in Section 74 (Alkyls from Alkenes).



Wilson, R.M.; Hengge, A. *J. Org. Chem., **1987**, 52*, 2699.



Chaussard, J.; Combellas, G.; Thiebault, A. *Tetrahedron Lett., **1987**, 28*, 1173.



Lee. K.; Kim, D.Y.; Oh, D.Y. *Tetrahedron Lett.*, ***1988***, *29*, 667.

REVIEW:

"The Metal-Ammonia Reduction of Aromatic Compounds"

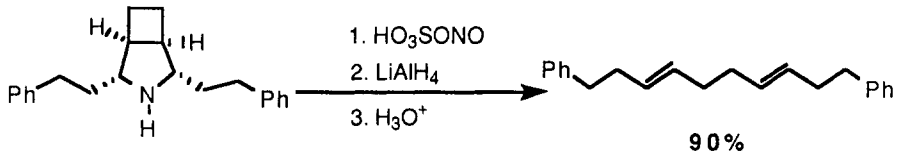
Rabideau, P.W. *Tetrahedron*, ***1989***, *45*, 1579.

SECTION 201: ALKENES FROM AMIDES

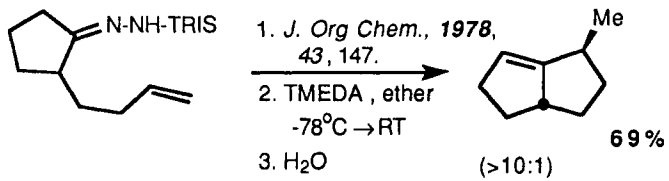
Related Methods: Section 65 (Alkyls from Alkyls).
Section 74 (Alkyls from Alkenes).

NO ADDITIONAL EXAMPLES

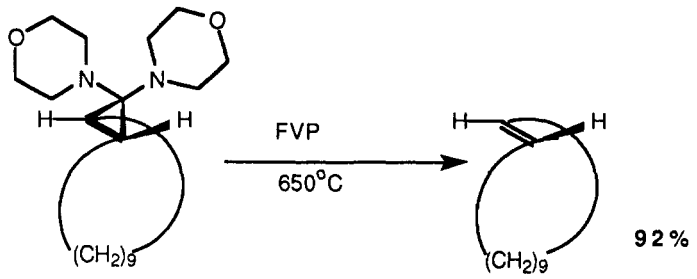
SECTION 202: ALKENES FROM AMINES



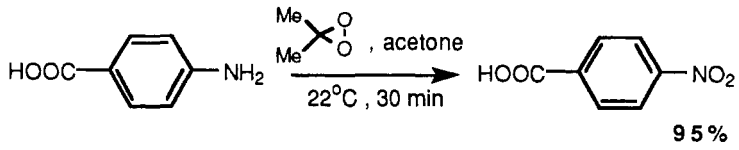
Tufariello, J.J.; Milowsky, A.S.; Al-Nuri, M.; Goldstein, S. *Tetrahedron Lett.*, ***1987***, *28*, 263, 267.



Chamberlin, A.R.; Bloom, S.H.; Vervini, L.A.; Fotsch, C.H. *J. Am. Chem. Soc.*, ***1988***, *110*, 4788.

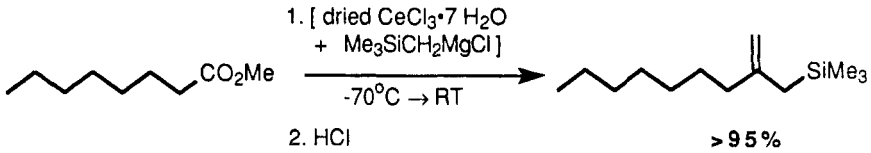


Vilsmaier, E.; Kristen, G.; Tetzlaff, C. *J. Org. Chem.*, ***1988***, *53*, 1806.

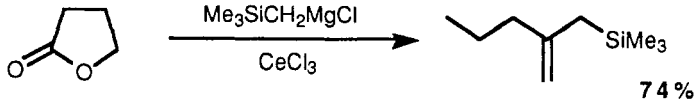


Murray, R.W.; Rajadhyaksha, S.N.; Mohan, L. *J. Org. Chem.*, ***1989***, *54*, 5783.

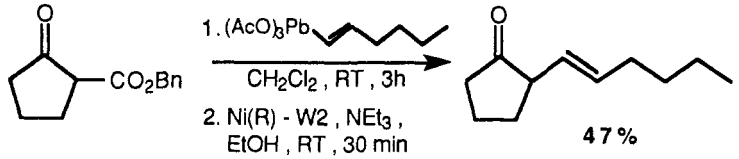
SECTION 203: ALKENES FROM ESTERS



Narayanan, B.A.; Bunnelle, W.H. *Tetrahedron Lett.*, ***1987***, *28*, 6261.

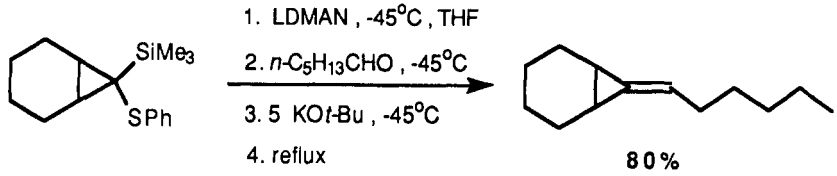


Lee, T.V.; Porter, J.R.; Roden, F.S. *Tetrahedron Lett.*, ***1988***, *29*, 5009.



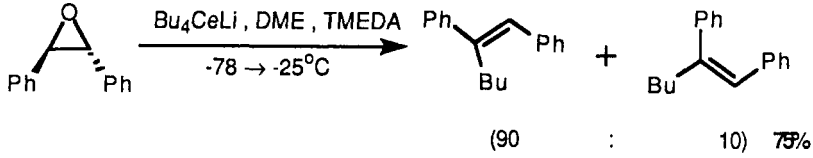
Hashimoto, S.; Miyazaki, Y.; Shinoda, T.; Ikegami, S. *Tetrahedron Lett.*, ***1989***, *30*, 7195.

SECTION 204: ALKENES FROM ETHERS, EPOXIDES AND THIOETHERS

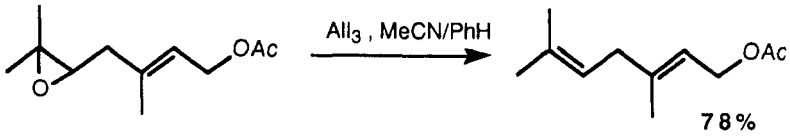


LDMAN = lithium 1-(dimethylamino)-naphthalenide

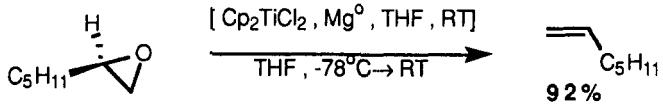
Cohen, T.; Jung, S.-H.; Romberger, M.L.; McCullough, D.W. *Tetrahedron Lett., **1988**, 29*, 25.



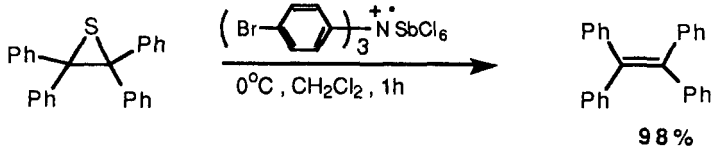
Ukaji, Y.; Fujisawa, T. *Tetrahedron Lett., **1988**, 29*, 5165.



Sarmah, P.; Barua, N.C. *Tetrahedron Lett., **1988**, 29*, 5815.



Schobert, R. *Angew. Chem. Int. Ed., Engl, **1988**, 27*, 855.



Kamata, M.; Muruyama, K.; Miyashi, T. *Tetrahedron Lett., **1989**, 30*, 4129.

REVIEWS:

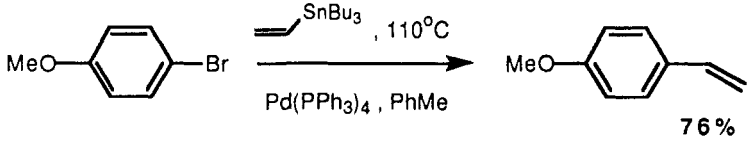
"Ether Cleavage with Organo-Alkali Metal Compounds and Alkali Metals"

Maercker, A. *Angew. Chem. Int. Ed., Engl, **1987**, 26*, 972.

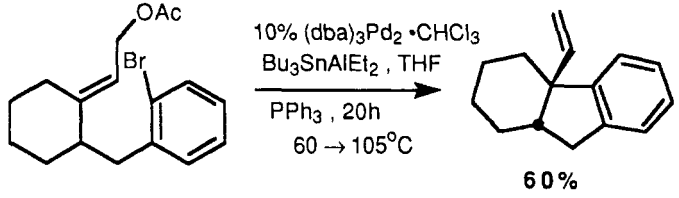
"Stereospecific Deoxygenation of Epoxides to Olefins"

Wong, H.N.C.; Fok, C.C.M.; Wong, T. *Heterocycles, **1987**, 25*, 1345.

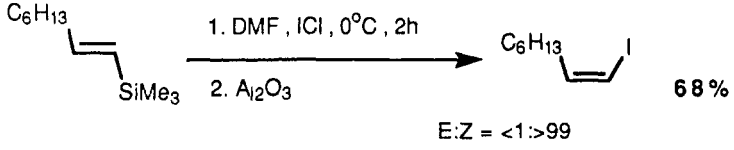
SECTION 205: ALKENES FROM HALIDES AND SULFONATES



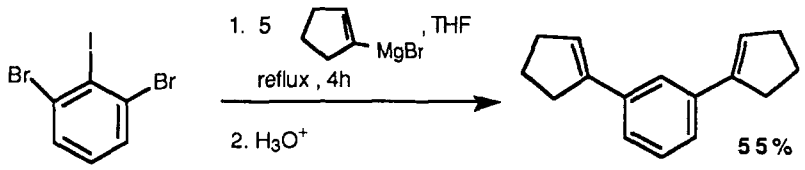
McKean, D.R.; Parrinello, G.; Renaldo, A.F.; Stille, J.K. *J. Org. Chem., **1987**, 52*, 422.



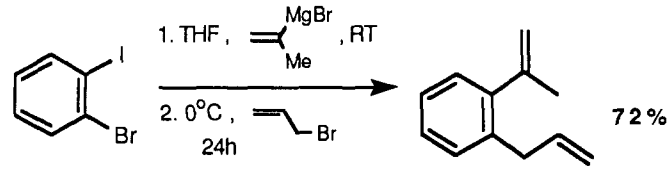
Trost, B.M.; Walchli, R. *J. Am. Chem. Soc., **1987**, 109*, 3487.



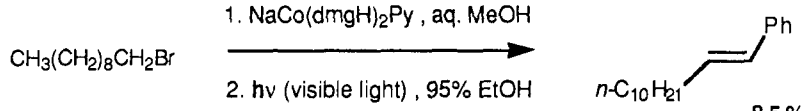
Suárez, A.R.; Mazzieri, M.R. *J. Org. Chem., **1987**, 52*, 1145.



Hart, H.; Ghosh, T. *Tetrahedron Lett.*, ***1988***, *29*, 881.

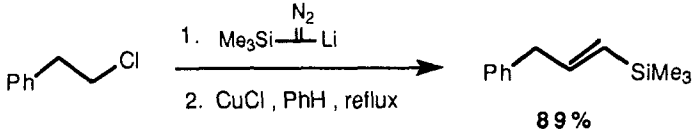


Hart, H.; Saednya, A. *Synth. Commun.*, ***1988***, *18*, 1749.



dmgH = dimethylglyoxime monoanion

Branchaud, B.P.; Meier, M.S.; Choi, Y. *Tetrahedron Lett.*, ***1988***, *29*, 167.



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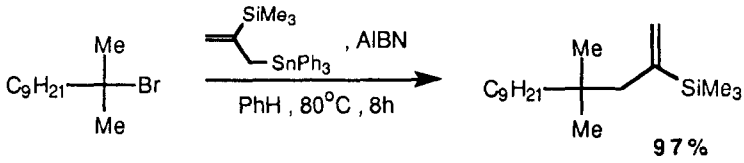
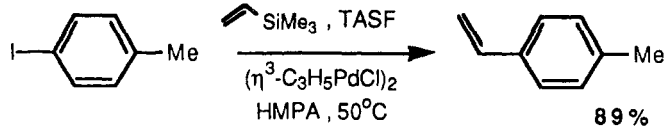
Aoyama, T.; Shioiri, T. *Tetrahedron Lett.*, ***1988***, *29*, 6295.

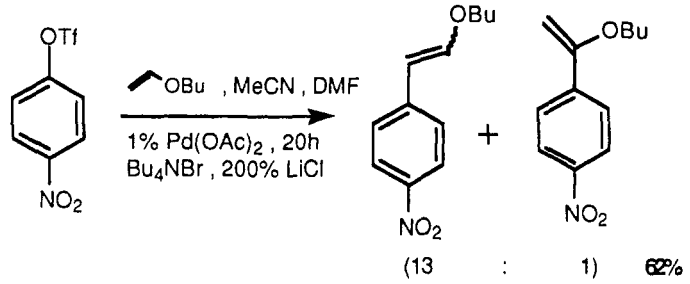


Lee, E.; Yu, S.-G.; Hur, C.-U.; Yang, S.-M. *Tetrahedron Lett.*, ***1988***, *29*, 6969.

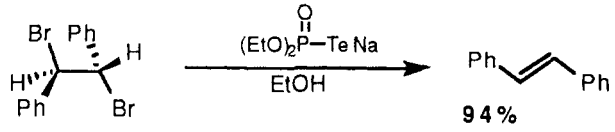


TASF = tris(diethylamino)sulfonium difluorotrimethyl silicate

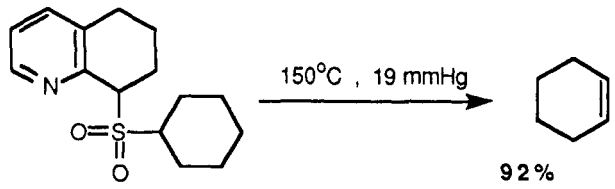
Hatanaka, Y.; Hiyama, T. *J. Org. Chem.*, ***1988***, *53*, 918.



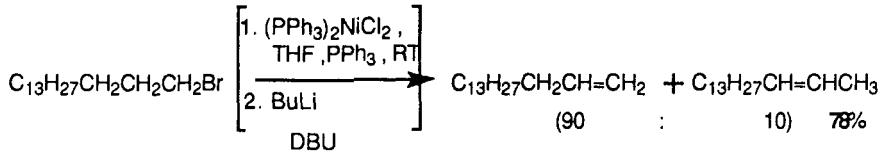
Andersson, C.-M.; Hallberg, A. *J. Org. Chem.*, ***1988***, *53*, 2112.



Huang, X.; Hou, Y.Q. *Synth. Commun.*, ***1988***, *18*, 2201.



Corey, E.J.; Posner, G.H.; Atkinson, R.F.; Wingard, A.K.; Halloran, D.J.; Radzik, D.M.; Nash, J.J. *J. Org. Chem.*, ***1989***, *54*, 389.



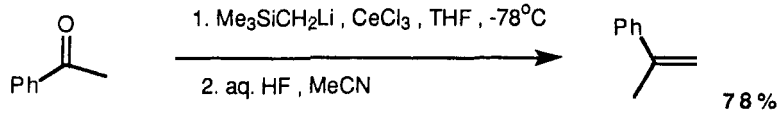
Henningsen, M.C.; Jeropoulos, S.; Smith, E.H. *J. Org. Chem.*, ***1989***, *54*, 3015.

SECTION 206: ALKENES FROM HYDRIDES

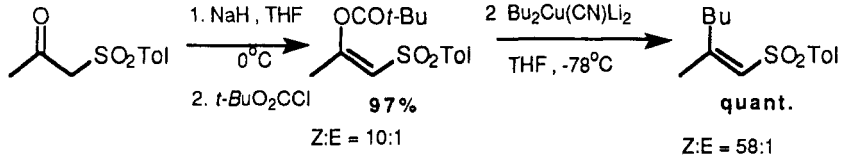
For conversions of methylenes to alkenes ($RCH_2R' \rightarrow RR'C{=}CH_2$), see Section 200 (Alkenes from Alkyls).

NO ADDITIONAL EXAMPLES

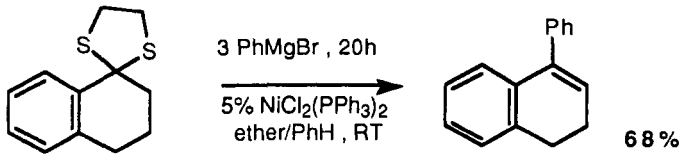
SECTION 207: ALKENES FROM KETONES



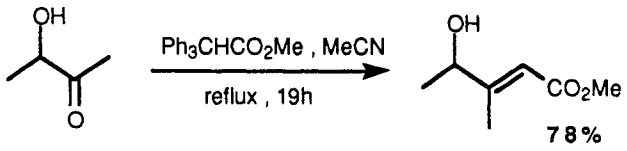
Johnson, C.R.; Tait, B.D. *J. Org. Chem.*, ***1987***, *52*, 281.



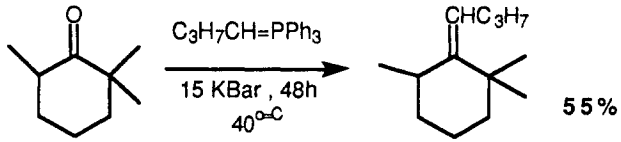
Giblin, G.M.P.; Simpkins, N.S. *J. Chem. Soc., Chem. Commun.*, ***1987***, 207.



Ni, Z.-T.; Luh, T.-Y. *J. Chem. Soc., Chem. Commun.*, ***1987***, 1515.



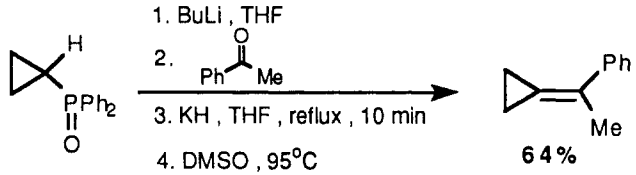
Garner, P.; Ramakanth, S. *J. Org. Chem.*, ***1987***, *52*, 2629.



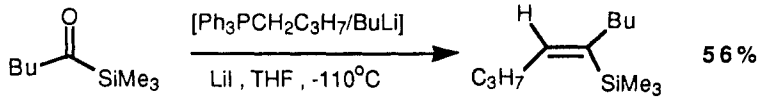
for hindered ketones

+35% recovered ketone

Dauben, W.G.; Takasugi, J.J. *Tetrahedron Lett.*, ***1987***, *28*, 4377.

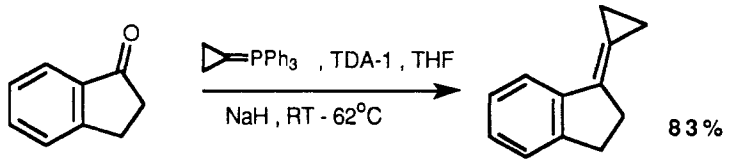


Meijs, G.F.; Eichinger, P.C.H. *Tetrahedron Lett.*, ***1987***, *28*, 5559.



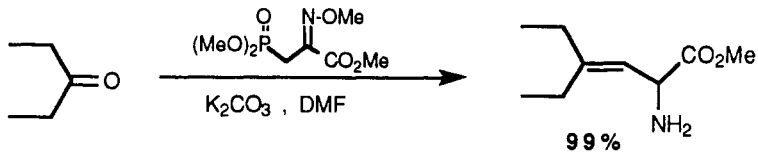
+31% recovered acyl silane

Soderquist, J.A.; Anderson, C.L. *Tetrahedron Lett.*, ***1988***, *29*, 2425.

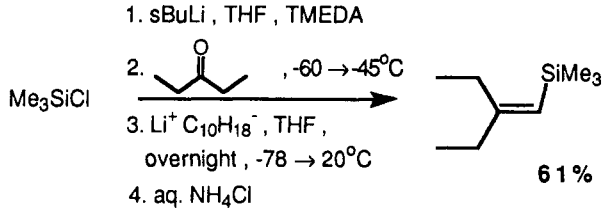


TDA-1 = phase transfer catalyst
tris[2-(2-methoxyethoxy)ethyl]amine

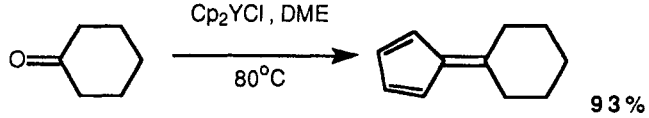
Stafford, J.J.; McMurry, J.E. *Tetrahedron Lett.*, ***1988***, *29*, 2531.



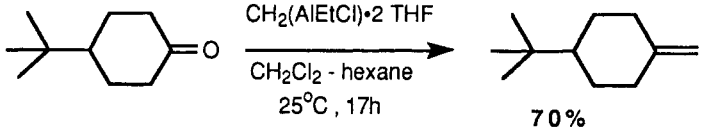
Bicknell, A.J.; Burton, G.; Elder, J.S. *Tetrahedron Lett.*, ***1988***, *29*, 3361.



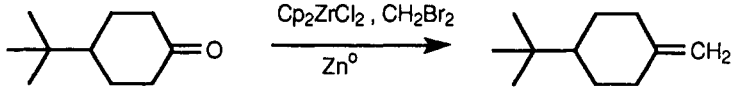
Barluenga, J.; Fernández-Simón, J.L.; Concellón, J.M.; Yus, M. *Synthesis*, ***1988***, 234.



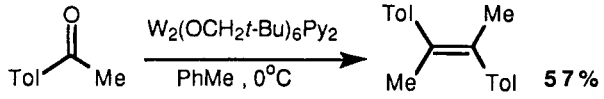
Qian, C.; Qiu, A. *Tetrahedron Lett.*, ***1988***, *29*, 6931.



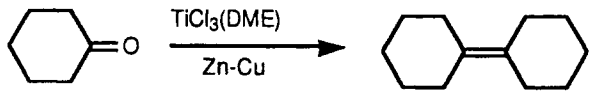
Piotrowski, A.M.; Malpass, D.B.; Boleslawski, M.P.; Eisch, J.J. *J. Org. Chem.*, ***1988***, *53*, 2829.



Tour, J.M.; Bedworth, P.V.; Wu, R. *Tetrahedron Lett.*, ***1989***, *30*, 3927.



Chisholm, M.H.; Klang, J.A *J. Am. Chem. Soc.*, ***1989***, *111*, 2324.



optimized procedure **97%**

McMurry, J.E.; Lectka, T.; Rico, J.G. *J. Org. Chem.*, ***1989***, *54*, 3748.

REVIEWS:

"Reductions Promoted by Low Valent Transition Metal Complexes in Organic Synthesis"

Pons, J.-M.; Santelli, M. *Tetrahedron*, ***1988***, *44*, 4295.

"The Applications of Low-Valent Titanium Reagents in Organic Synthesis"

Lenior, D. *Synthesis*, ***1989***, 883.

"The Wittig Olefination Reaction and Modifications Involving Phosphoryl-Stabilized Carbanions. Stereochemistry, Mechanism and Selected Synthetic Aspects"

Maryanoff, B.E.; Reitz, A.B. *Chem. Rev.*, ***1989***, *89*, 863.

"Carbonyl-Coupling Reactions Using Low-Valent Titanium"

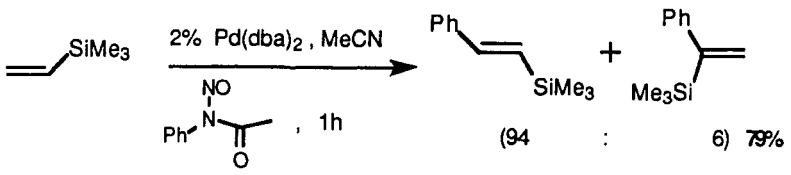
McMurry, J.E. *Chem. Rev.*, ***1989***, *89*, 1513.

Related Methods: Section 199 (Alkenes from Aldehydes).

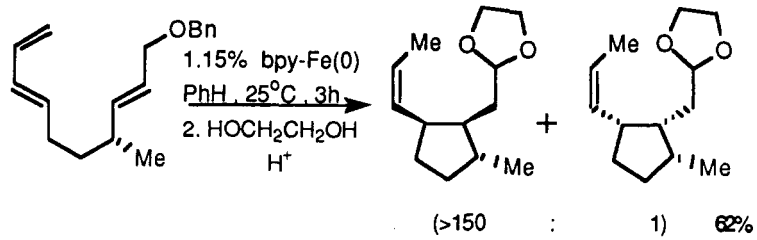
SECTION 208: ALKENES FROM NITRILES

NO ADDITIONAL EXAMPLES

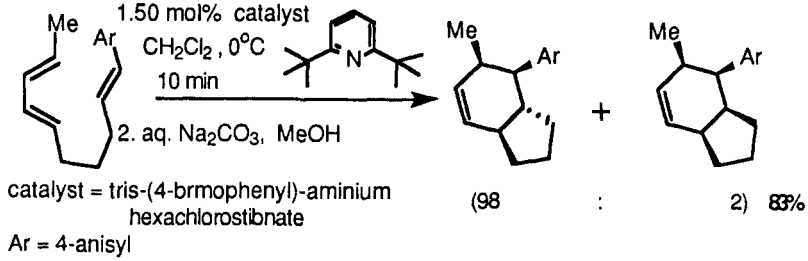
SECTION 209: ALKENES FROM ALKENES



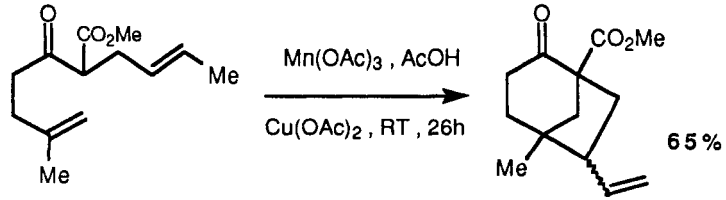
Ikenaga, K.; Kikukawa, K.; Matsuda, T. *J. Org. Chem.*, ***1987***, *52*, 1276.



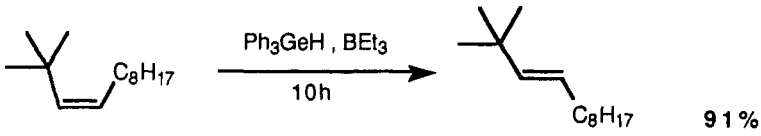
Takacs, J.M.; Anderson, L.G. *J. Am. Chem. Soc.*, ***1987***, *109*, 2200.



Harirchian, B.; Bauld, N.L. *Tetrahedron Lett.*, ***1987***, *28*, 927.



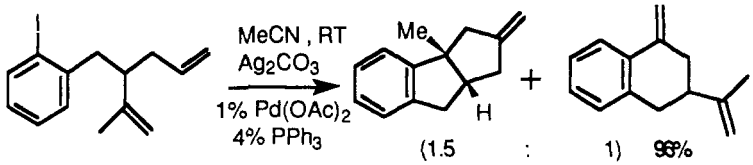
Snider, B.B.; Dombroski, M.A. *J. Org. Chem.*, ***1987***, *52*, 5487.



Z:E = >20:1

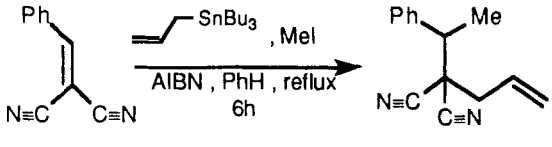
Z:E = 0:100

Ichinose, Y.; Nozaki, K.; Wakamatsu, K.; Oshima, K.; Utimoto, K. *Tetrahedron Lett.*, ***1987***, *28*, 3709.



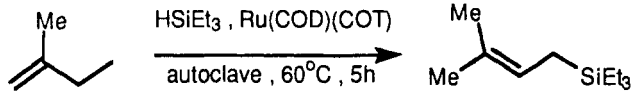
(1.5 : 1) 96%

Abelman, M.M.; Overman, L.E. *J. Am. Chem. Soc.*, ***1988***, *110*, 2328.



85%

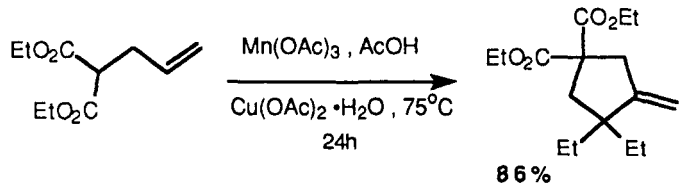
Mizumo, K.; Ikeda, M.; Toda, S.; Otsuji, Y. *J. Am. Chem. Soc.*, ***1988***, *110*, 1288.



56%

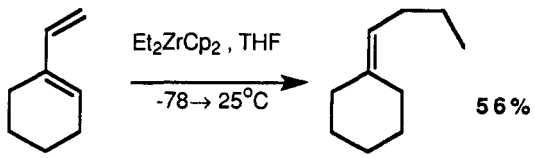
other silyl derivatives were produced

Hori, Y.; Mitsudo, T.; Watanabe, Y. *Bull. Chem. Soc., Jpn.*, ***1988***, *61*, 3011.

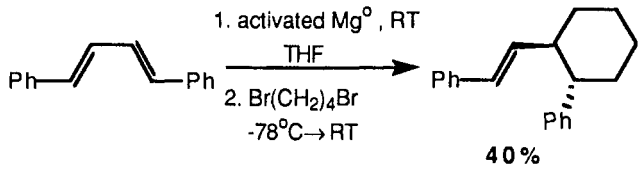


86%

Snider, B.B.; Buckman, B.O. *Tetrahedron*, ***1989***, *45*, 6969.



Negishi, E.; Miller, S.R. *J. Org. Chem.*, ***1989***, *54*, 6014.



Xiong, H.; Rieke, R.D. *J. Org. Chem.*, ***1989***, *54*, 3247.

REVIEWS:

"Intramolecular, Stoichiometric (Li, Mg, Zn) and Catalytic (Ni, Pd, Pt) Metallo-Ene Reactions in Organic Synthesis"

Oppolzer, W. *Angew. Chem. Int. Ed., Engl.*, ***1989***, *28*, 52.

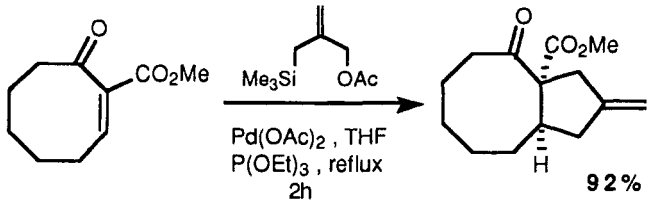
"Cyclizations via Palladium Catalyzed Allylic Alkylation"

Trost, B.M. *Angew. Chem. Int. Ed., Engl.*, ***1989***, *28*, 1173.

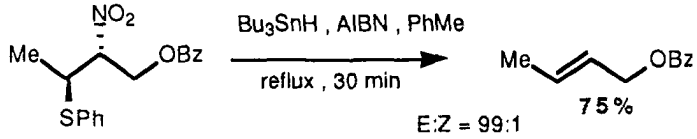
"Cation Radical Pericyclic Reactions"

Bauld, N.L.; Belleville, D.J.; Harirchian, B.; Lorenz, K.T.; Pabon Jr., R.A.; Reynolds, D.W.; Wirth, D.D.; Chion, H.S.; Marsh, B.K. *Acc. Chem. Res.*, ***1987***, *20*, 371.

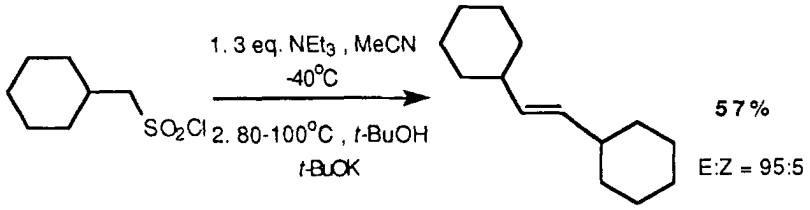
SECTION 210: ALKENES FROM MISCELLANEOUS COMPOUNDS



Cleary, D.G.; Paquette, L.A. *Synth. Commun.*, ***1987***, *17*, 497.



Kamimura, A.; Ono, N. *J. Chem. Soc., Chem. Commun.*, ***1988***, 1278.



Opitz, G.; Ehlis, T.; Rieth, K. *Tetrahedron Lett.*, ***1989***, *30*, 3131.

REVIEWS:

"Organozirconium Compounds in Organic Synthesis"

Negishi, E.; Takahashi, T. *Synthesis*, ***1988***, 11.

"Use of Cyclopropanes and Their Derivatives in Organic Synthesis"

Wong, H.N.C.; Hon, M.-Y.; Tse, C.-W.; Yip, Y.-C.; Tanko, J.; Hudlicky, T. *Chem. Rev.*, ***1989***, *89*, 431.

Compendium of Organic Synthetic Methods, Volume 7
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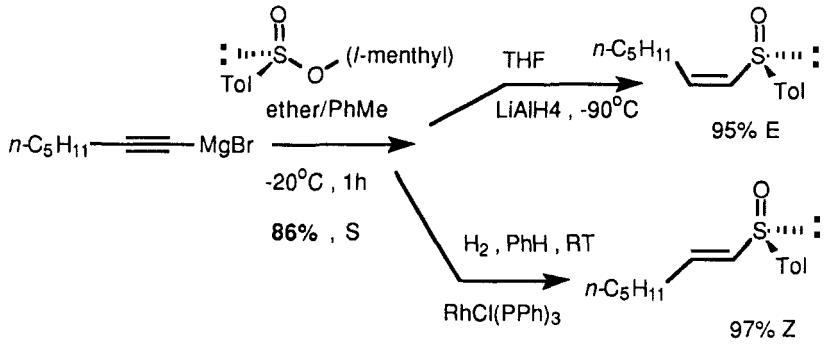
CHAPTER 15
PREPARATION OF OXIDES

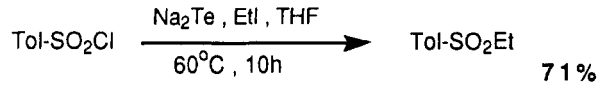
This chapter contains reactions which prepare the oxides of nitrogen, sulfur and selenium. Included are *N*-oxides, nitroso and nitro compounds, nitrile oxides, sulfoxides, selenoxides and sulfones. Oximes are considered to be amines and appear in those sections. Preparation of sulfonic acid derivatives are found in Chapter Two and the preparation of sulfonates in Chapter Ten.

SECTION 211: OXIDES FROM ALKYNES

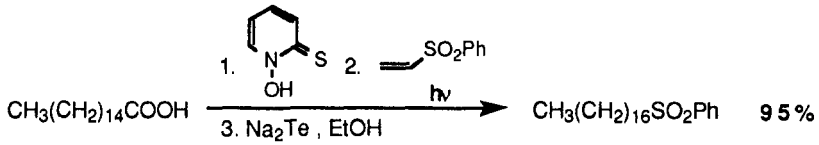


Kosugi, H.; Kitaoka, M.; Tagami, K.; Takahashi, A.; Uda, H. *J. Org. Chem.*, ***1987***, *52*, 1078.

SECTION 212: OXIDES FROM ACID DERIVATIVES

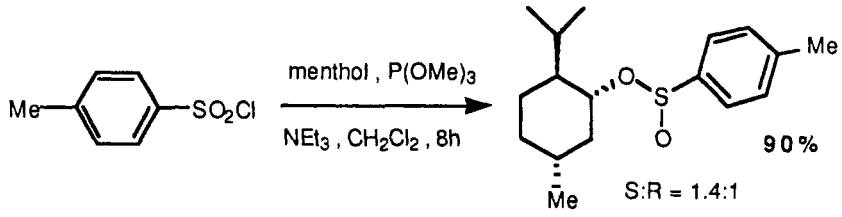


Suzuki, H.; Nishioka, Y.; Padmanabhan, S.I.; Ogawa, T. *Chem. Lett.*, ***1988***, 727.

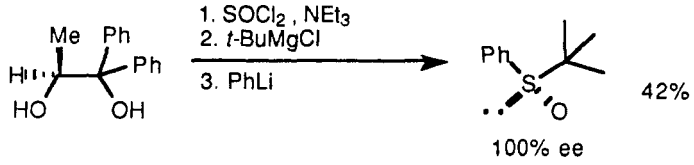


Barton, D.H.R.; Boivin, J.; Sarma, J.; da Silva, E.; Zard, S.Z. *Tetrahedron Lett.*, ***1989***, *30*, 4237.

SECTION 213: OXIDES FROM ALCOHOLS AND THIOLS



Klunder, J.M.; Sharpless, K.B. *J. Org. Chem.*, ***1987***, *52*, 2598.

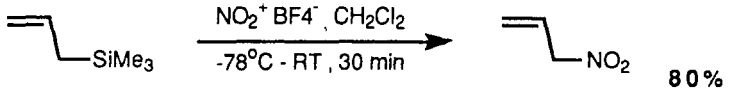


Rebiere, F.; Kagan, H.B. *Tetrahedron Lett.*, ***1989***, *30*, 3659.

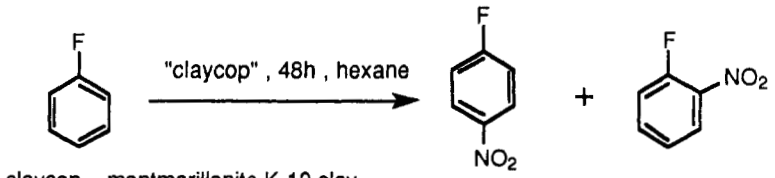
SECTION 214: OXIDES FROM ALDEHYDES

NO ADDITIONAL EXAMPLES

SECTION 215: OXIDES FROM ALKYLS, METHYLENES AND ARYLS



Olah, G.A.; Rochin, C. *J. Org. Chem.*, ***1987***, *52*, 701.



claycop = montmorillonite K-10 clay
$CuNO_2(H_2O)_3$

(87 : 12) 53%

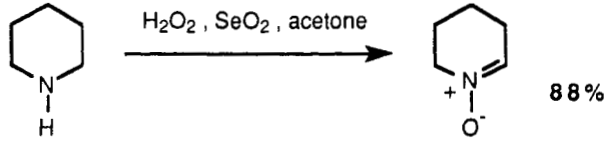
improved para selectivity

Laszlo, P.; Pennetreau, P. *J. Org. Chem.*, ***1987***, *52*, 2407.

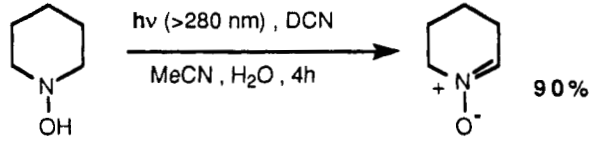
SECTION 216: OXIDES FROM AMIDES

NO ADDITIONAL EXAMPLES

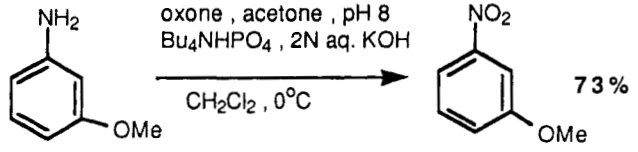
SECTION 217: OXIDES FROM AMINES



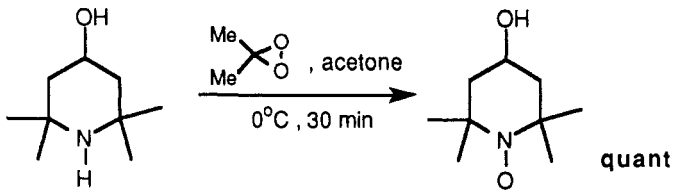
Murahashi, S.; Shiota, T. *Tetrahedron Lett.*, ***1987***, *28*, 2383.



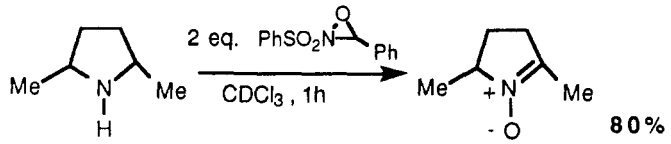
Pandey, G.; Kumaraswamy, G.; Krishna, A. *Tetrahedron Lett.*, ***1987***, *28*, 2649.



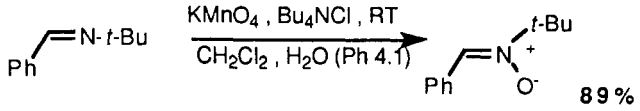
Zabrowski, D.L.; Moorman, A.E.; Beck Jr., K.R. *Tetrahedron Lett.*, ***1988***, *29*, 4501.



Murray, P.W.; Singh, M. *Tetrahedron Lett.*, ***1988***, *29*, 4677.



Zajac Jr., W.W.; Walters, T.R.; Darcy, M.G. *J. Org. Chem.*, ***1988***, *53*, 5856.

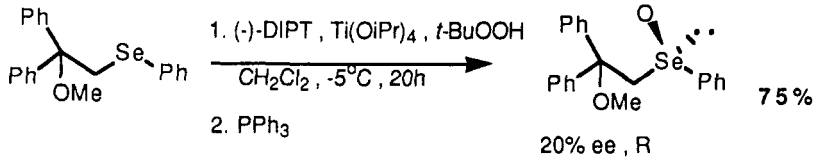


Christensen, D.; Jørgensen, K.A. *J. Org. Chem.*, ***1989***, *54*, 126.

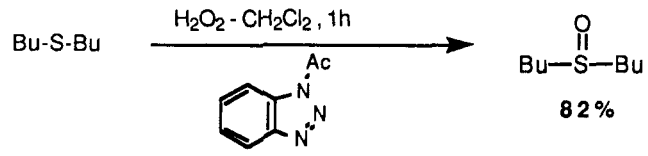
SECTION 218: OXIDES FROM ESTERS

NO ADDITIONAL EXAMPLES

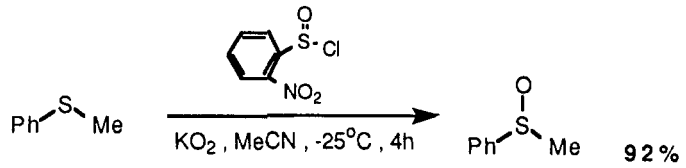
SECTION 219: OXIDES FROM ETHERS, EPOXIDES AND THIOETHERS



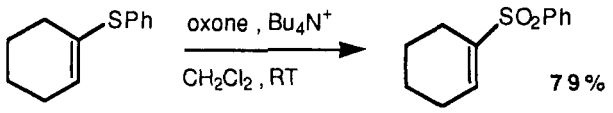
Tiecco, M.; Tingoli, M.; Testaferri, L.; Bartoli,.D. *Tetrahedron Lett.*, ***1987***, *28*, 3849.



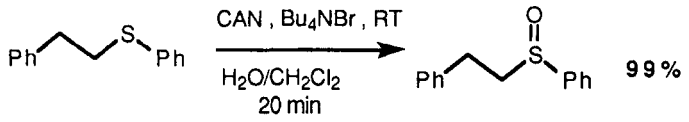
Torrini, I.; Paradisi, M.P.; Zecchini, G.P.; Agrosi, F. *Synth. Commun.*, ***1987***, *17*, 515.



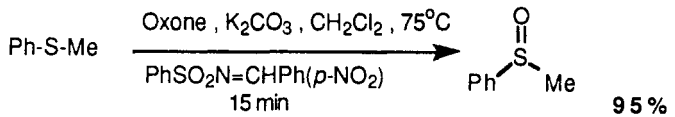
Kim, Y.H.; Yoon, D.C. *Tetrahedron Lett.*, ***1988***, *29*, 6453.



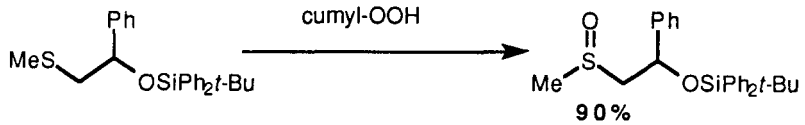
Trost, B.M.; Braslau, R. *J. Org. Chem.*, ***1988***, *53*, 532.



Baciocchi, E.; Piermatteri, A.; Ruzziconi, R. *Synth. Commun.*, ***1988***, *18*, 2167.

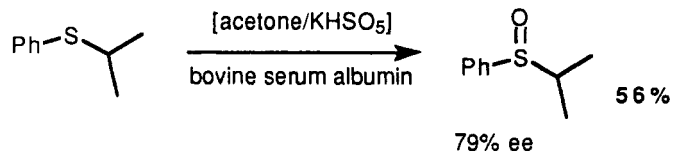


Davis, F.A.; Lal, S.G.; Durst, H.P. *J. Org. Chem.*, ***1988***, *53*, 5004.



87:13 (74% ee:76% ee)

Conte, V.; DiFuria, F.; Licini, G.; Modena, G. *Tetrahedron Lett.*, ***1989***, *30*, 4859.



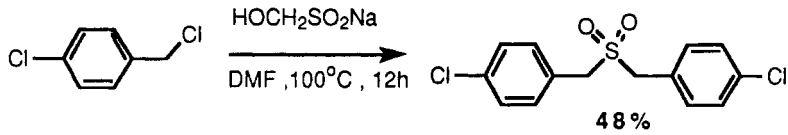
Colonna, S.; Gaggero, N. *Tetrahedron Lett.*, ***1989***, *30*, 6233.

REVIEW:

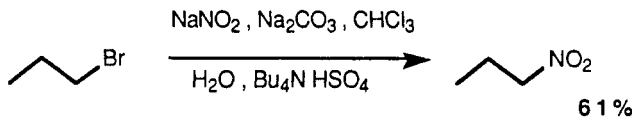
"Chiral Sulfoxidation by Biotransformation of Organic Sulfides"

Holland, H.L. *Chem. Rev.*, ***1988***, *88*, 473.

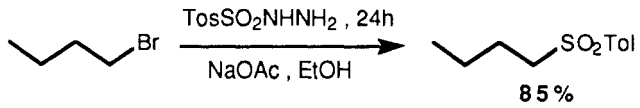
SECTION 220: OXIDES FROM HALIDES AND SULFONATES



Harris, A.R. *Synth. Commun.*, ***1988***, *18*, 659.

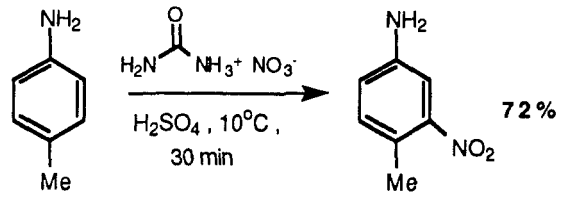


Sane, P.V.; Sharma, M.M. *Org. Prep. Proceed. Int.*, ***1988***, *20*, 598.

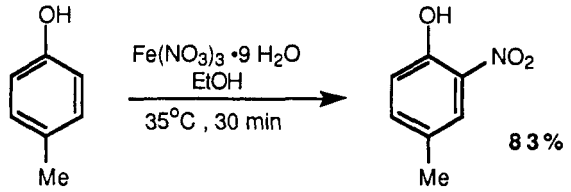


Ballini, R.; Marcantoni, E.; Petrini, M. *Tetrahedron*, ***1989***, *45*, 6791.

SECTION 221: OXIDES FROM HYDRIDES



Sura, T.P.; Ramana, M.M.V.; Kudav, N.A. *Synth. Commun.*, ***1988***, *18*, 2161.



Poirier, J.-M.; Vottero, C. *Tetrahedron*, ***1989***, *45*, 1415.

SECTION 222: OXIDES FROM KETONES

NO ADDITIONAL EXAMPLES

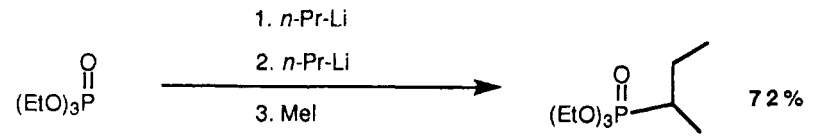
SECTION 223: OXIDES FROM NITRILES

NO ADDITIONAL EXAMPLES

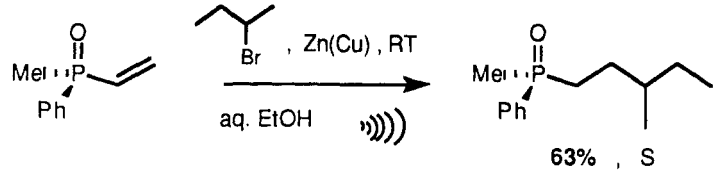
SECTION 224: OXIDES FROM ALKENES

NO ADDITIONAL EXAMPLES

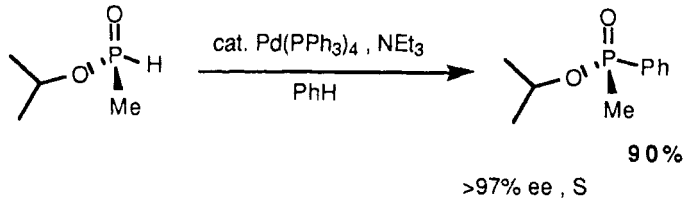
SECTION 225: OXIDES FROM MISCELLANEOUS COMPOUNDS



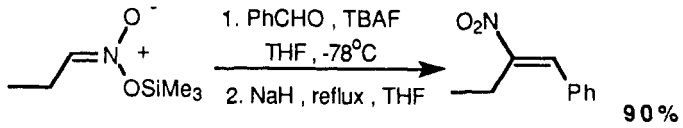
Teulade, M.-P.; Savignac, P. *Tetrahedron Lett.*, ***1987***, *28*, 405.



Pietrusiewicz, K.M.; Zablocka, M. *Tetrahedron Lett.*, ***1988***, *29*, 937.



Zhang, J.; Xu, Y.; Huang, G.; Guo, H. *Tetrahedron Lett.*, ***1988***, *29*, 1955.



Lee, K.; Oh, D.Y. *Synth. Commun.*, ***1989***, *19*, 3055.

REVIEWS:

"Synthesis and Selected Reductions of Conjugated Nitroalkanes: A Review"

Kabalka, G.W.; Varma, R.S. *Org. Prep. Proceed. Int.*, ***1987***, *19*, 285.

"Sultone Chemistry"

Roberts, D.W.; Williams, D.L. *Tetrahedron*, ***1987***, *43*, 1027.

"Applications of Oxaziridines in Organic Synthesis"

Davis, F.A.; Sheppard, A.C. *Tetrahedron*, ***1989***, *45*, 5703.

Compendium of Organic Synthetic Methods, Volume 7
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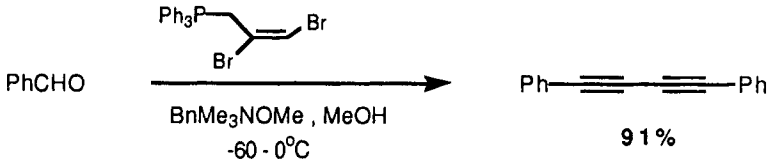
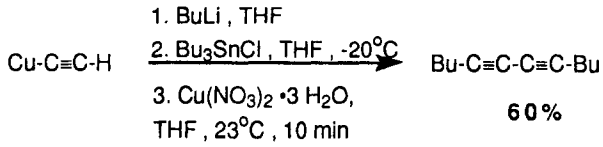
CHAPTER 16

PREPARATION OF DIFUNCTIONAL COMPOUNDS

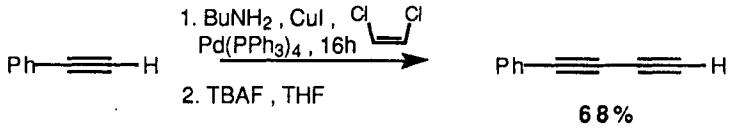
SECTION 300: ALKYNE - ALKYNE



Ziegler Jr., C.B.; Harris, S.M.; Baldwin, J.E. *J. Org. Chem.*, ***1987***, *52*, 443.



Ghosal, S.; Luke, G.P.; Kyler, K.S. *J. Org. Chem.*, ***1987***, *52*, 4296.

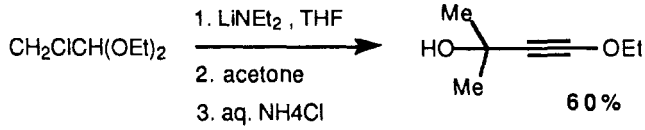


Kende, A.S.; Smith, C.A. *J. Org. Chem.*, ***1988***, *53*, 2655.

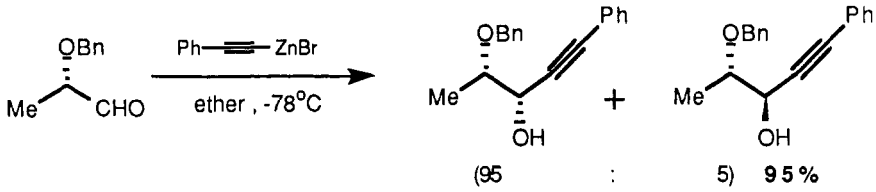
SECTION 301: ALKYNE - ACID DERIVATIVES

NO ADDITIONAL EXAMPLES

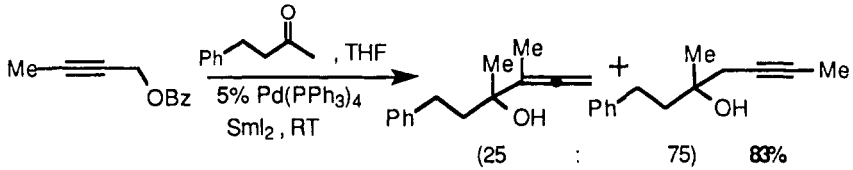
SECTION 302: ALKYNE - ALCOHOL, THIOL



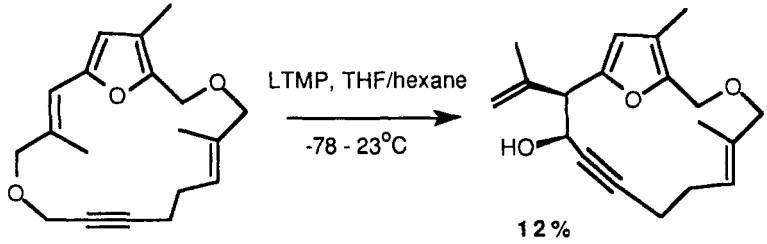
Raucher, S.; Bray, B.L. *J. Org. Chem.*, ***1987***, *52*, 2332.



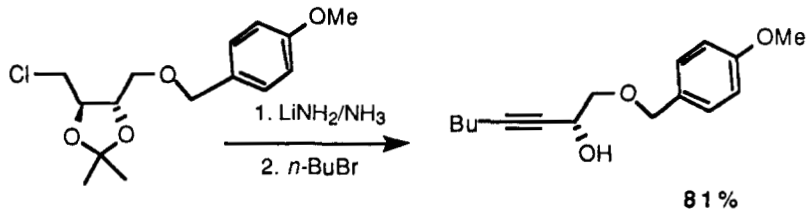
Mead, K.T. *Tetrahedron Lett.*, ***1987***, *28*, 1019.



Tabuchi, T.; Inanaga, J.; Yamaguchi, M. *Chem. Lett.*, ***1987***, 2273.

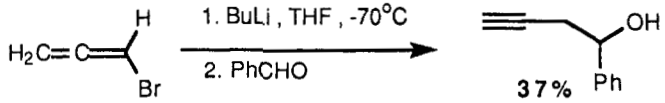


Marshall, J.A.; Nelson, D.J. *Tetrahedron Lett.*, ***1988***, *29*, 741.



Yadav, J.S.; Chander, M.C.; Joshi, B.V. *Tetrahedron Lett.*, ***1988***, *29*, 2737.
Yadav, J.S.; Chander, M.C.; Srinivas Rao, C. *Tetrahedron Lett.*, ***1989***, *30*, 5455.

Jeffery, T. *Tetrahedron Lett.*, ***1989***, *30*, 2225.

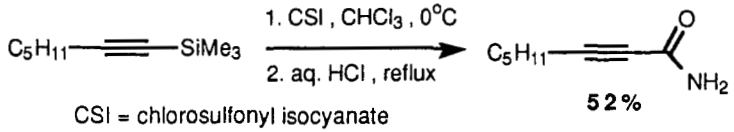


Michelot, D. *Synth. Commun.*, ***1989***, *19*, 1705.

SECTION 303: ALKYNE - ALDEHYDE

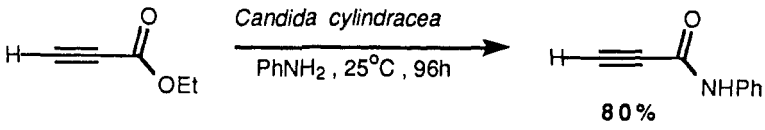
NO ADDITIONAL EXAMPLES

SECTION 304: ALKYNE - AMIDE



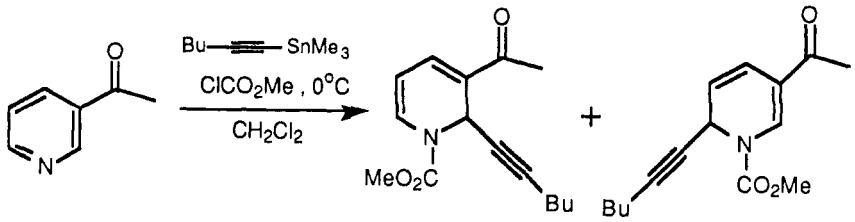
CSI = chlorosulfonyl isocyanate

Page, P.C.B.; Rosenthal, S.; Williams, R.V. *Synthesis*, ***1988***, 621.

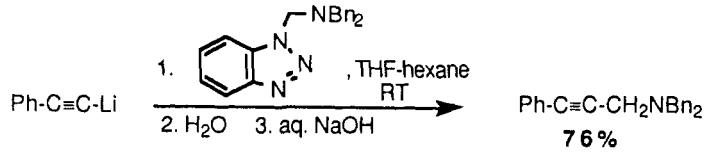


Rebolledo, F.; Brieva, R.; Gotor, V. *Tetrahedron Lett.*, ***1989***, *30*, 5345.

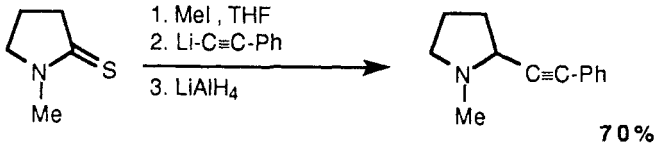
SECTION 305: ALKYNE - AMINE



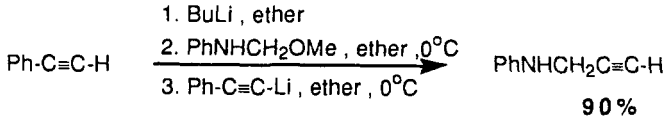
Yamaguchi, R.; Hata, E.; Utimoto, K. *Tetrahedron Lett.*, ***1988***, *29*, 1785.



Katritzky, A.R.; Gallos, J.K.; Yannakopoulou, K. *Synthesis*, ***1989***, 31.

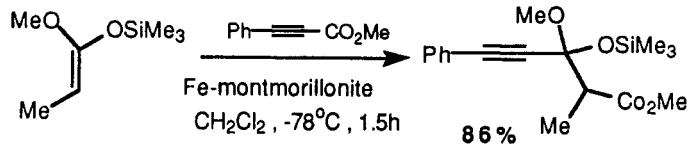


Takahata, H.; Yakahashi, K.; Wang, E.C.; Yamazaki, T. *J. Chem. Soc., Perkin Trans. I*, ***1989***, 1211.



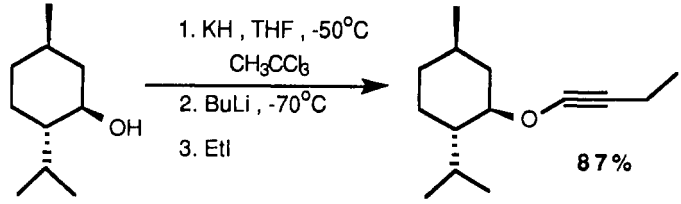
Barluenga, J.; Campos, P.J.; Canal, G. *Synthesis*, ***1989***, 33.

SECTION 306: ALKYNE - ESTER

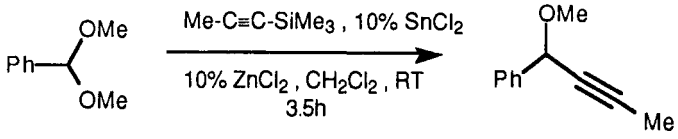


Onaka, M.; Mimura, T.; Ohno, R.; Iizumi, Y. *Tetrahedron Lett.*, ***1989***, *30*, 6341.

SECTION 307: ALKYNE - ETHER, EPOXIDE, THIOETHER

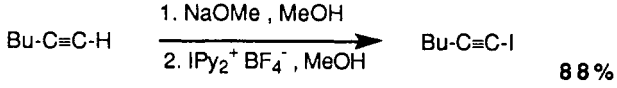


Moyano, A.; Charbonnier, F.; Greene, A.E. *J. Org. Chem.*, ***1987***, *52*, 2919.

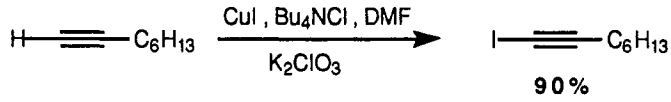


Hayashi, M.; Inumushi, A.; Mukaiyama, T. *Bull. Chem. Soc., Jpn.*, ***1988***, *61*, 4037.

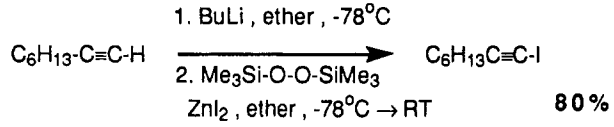
SECTION 308: ALKYNE - HALIDE



Barluenga, J.; González, J.M.; Rodríquez, M.A.; Campos, P.J.; Asensio, G. *Synthesis*, ***1987***, 661.

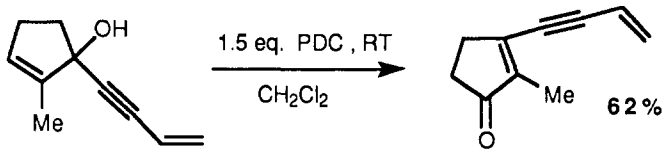


Jeffery, T. *J. Chem. Soc., Chem. Commun.*, ***1988***, 909.

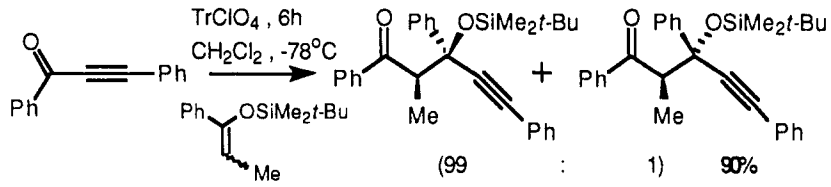


Ricci, A.; Taddei, M.; Dembechm, P.; Guerrini, A.; Seconi, G. *Synthesis*, ***1989***, 461.

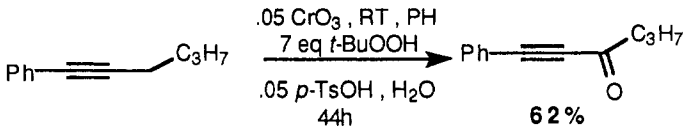
SECTION 309: ALKYNE - KETONE



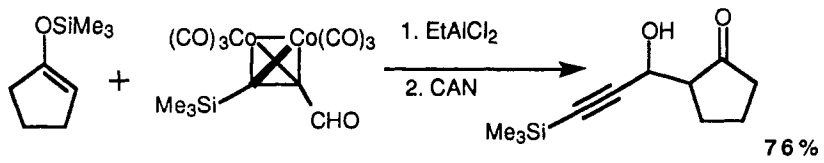
Liotta, D.; Brown, D.; Hoekstra, W.; Monahan III, R. *Tetrahedron Lett.*, ***1987***, *28*, 1069.



Kobayashi, S.; Matsui, S.; Mukaiyama, T. *Chem. Lett.*, ***1988***, 1491.

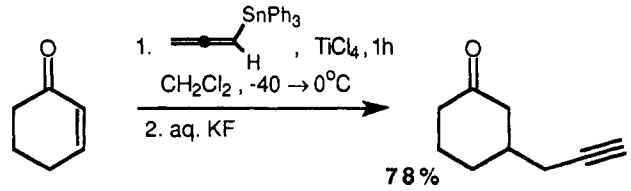


Muzart, J.; Piva, O. *Tetrahedron Lett.*, ***1988***, *29*, 2321.



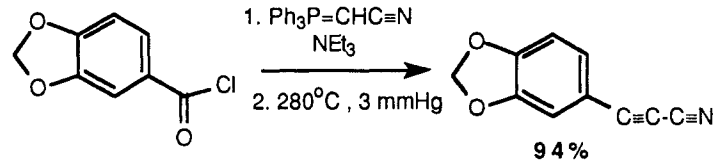
erythro:threo = 91:9

Mukai, C.; Nagami, K.; Hanaoka, M. *Tetrahedron Lett.*, ***1989***, *30*, 5623, 5627.



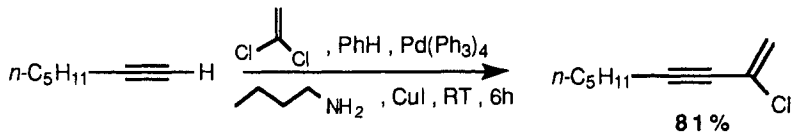
Haruta, J.; Nishi, K.; Matsuda, S.; Tamura, Y.; Kita, Y. *J. Chem. Soc., Chem. Commun.*, ***1989***, 1065.

SECTION 310: ALKYNE - NITRILE

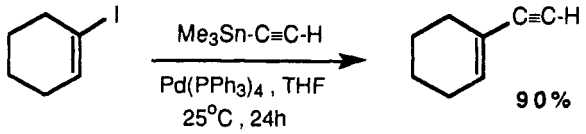


Yadla, R.; Rao, J.M. *Indian J. Chem.*, ***1988***, *27B*, 1125.

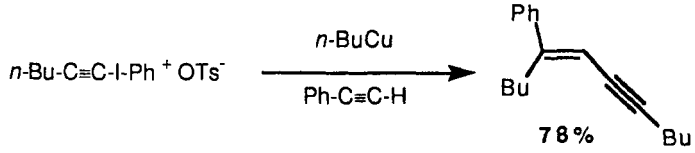
SECTION 311: ALKYNE - ALKENE



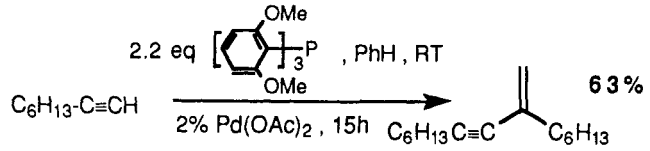
Ratovelomanana, V.; Hammoud, A.; Linstrumelle, G. *Tetrahedron Lett.*, ***1987***, *28*, 1649.



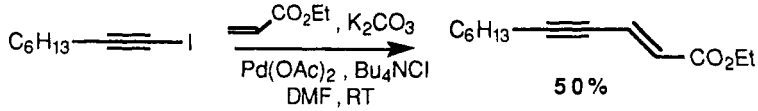
Stille, J.K.; Simpson, J.H. *J. Am. Chem. Soc.*, ***1987***, *109*, 2138.



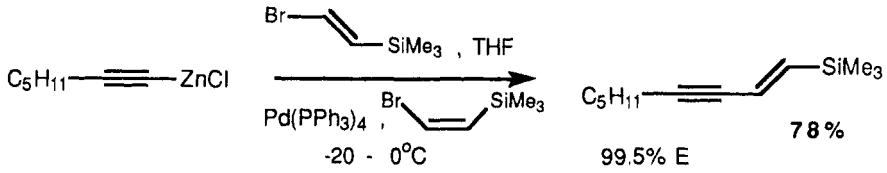
Stang, P.J.; Kitamura, T. *J. Am. Chem. Soc.*, ***1987***, *109*, 7561.



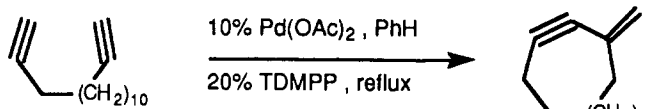
Trost, B.M.; Chan, C.; Ruhter, G. *J. Am. Chem. Soc.*, ***1987***, *109*, 3486.



Jeffery, T. *Synthesis*, ***1987***, 70.

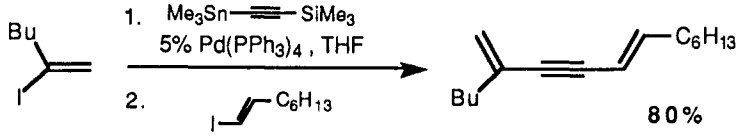


Andreini, B.P.; Carpita, A.; Rossi, R. *Tetrahedron Lett.*, ***1988***, *29*, 2239.



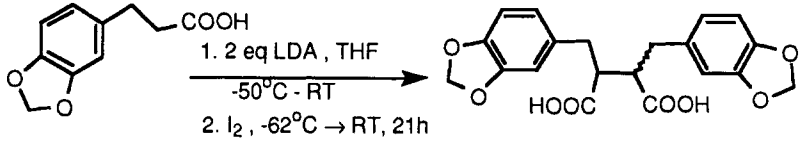
TDMPP = Tris-(2,6-dimethoxyphenyl) phosphine

Trost, B.M.; Matsubara, S.; Caringi, J.J. *J. Am. Chem. Soc.*, ***1989***, *111*, 8745.

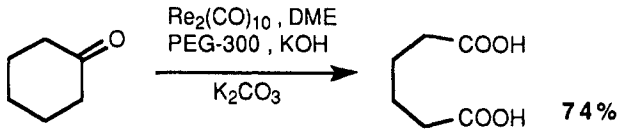


Hatanaka, Y.; Matsui, K.; Hiyama, T. *Tetrahedron Lett.*, ***1989***, *30*, 2403.

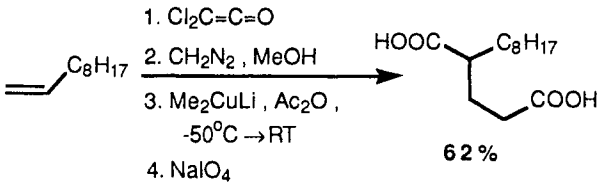
SECTION 312: CARBOXYLIC ACID - CARBOXYLIC ACID



Belletire, J.L.; Fry, D.F. *J. Org. Chem.*, ***1987***, *52*, 2549.

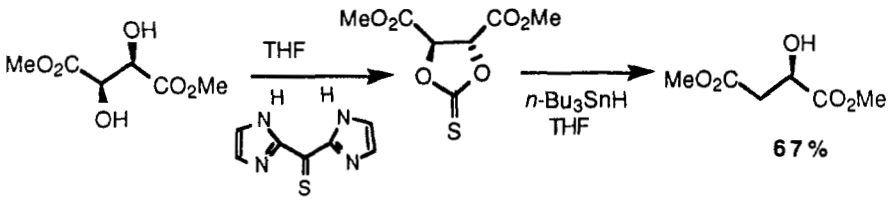


Osowska-Pacewicka, K.; Alper, H. *J. Org. Chem.*, ***1988***, *53*, 808.

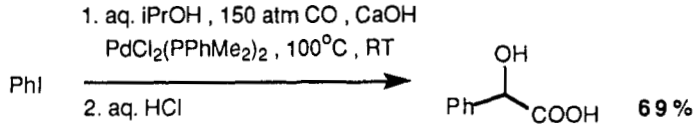


Depres, J.-P.; Greene, A.E. *Tetrahedron Lett.*, ***1989***, *30*, 7065.

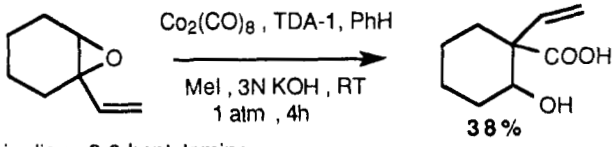
SECTION 313: CARBOXYLIC ACID - ALCOHOL, THIOL



Alpegiani, M.; Hanessian, S. *J. Org. Chem.*, ***1987***, *52*, 278.

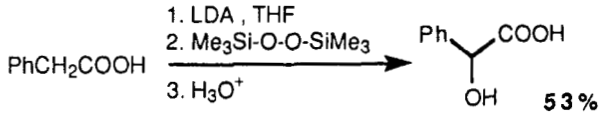


Kobayashi, T.; Sakakura, T.; Tanaka, M. *Tetrahedron Lett.*, ***1987***, *28*, 2721.



TDA-1 - tris-dioxa-3,6-heptylamine

Alper, H.; Calet, S. *Tetrahedron Lett.*, ***1988***, *29*, 1763.

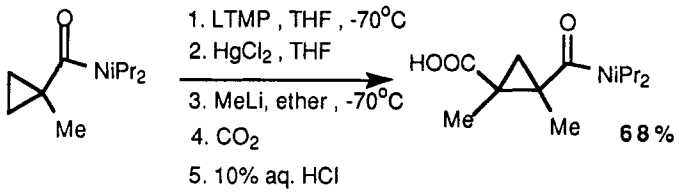


Pohmakotr, M.; Winotai, C. *Synth. Commun.*, ***1988***, *18*, 2141.

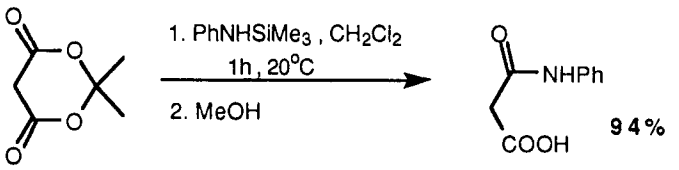
SECTION 314: CARBOXYLIC ACID - ALDEHYDE

NO ADDITIONAL EXAMPLES

SECTION 315: CARBOXYLIC ACID - AMIDE

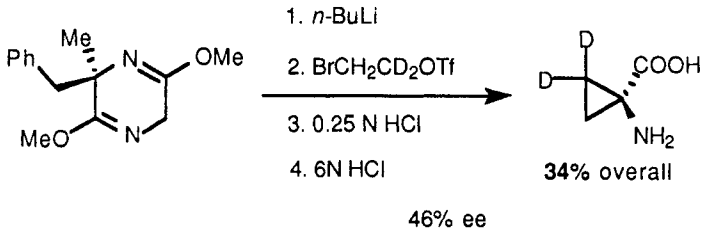


Eaton, P.E.; Daniels, R.G.; Casucci, D.; Cunkle, G.T.; Engel, P. *J. Org. Chem.*, ***1987***, *52*, 2100.

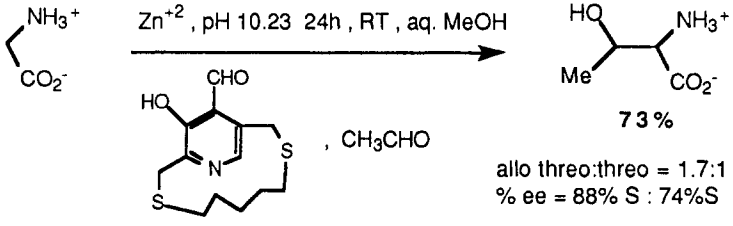


Rigo, B.; Fasseur, D.; Cauliez, P.; Couturier, D. *Tetrahedron Lett.*, ***1989***, *30*, 3073.

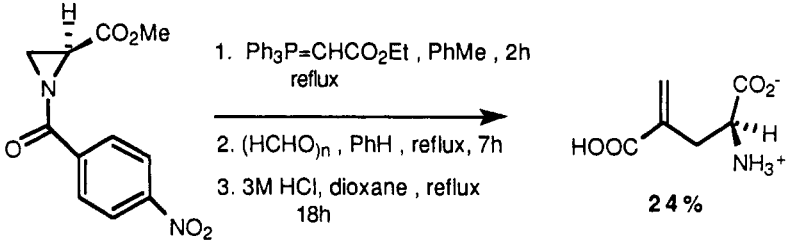
SECTION 316: CARBOXYLIC ACID - AMINE



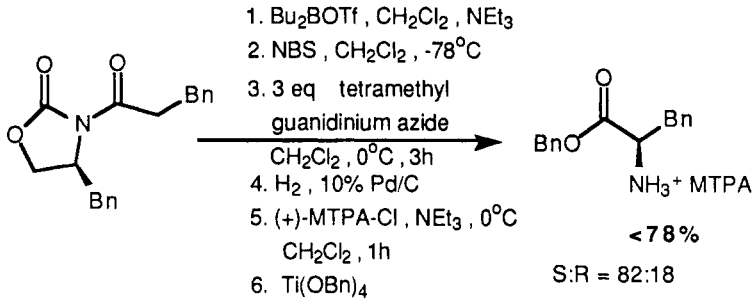
Subramanian, P.K.; Woodard, R.W. *J. Org. Chem.*, ***1987***, *52*, 15.



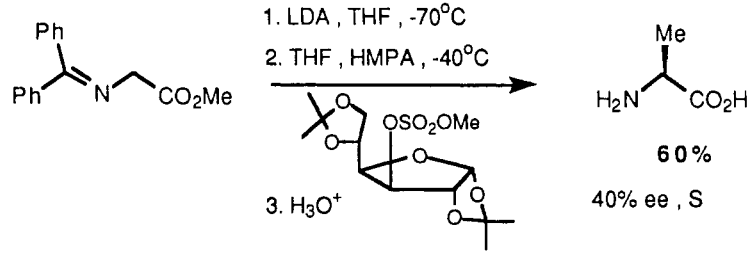
Kuzuhara, H.; Watanabe, N.; Ando, M. *J. Chem. Soc., Chem. Commun.*, ***1987***, 95.



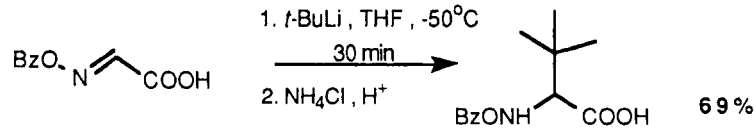
Baldwin, J.E.; Adlington, R.M.; Robinson, N.G. *J. Chem. Soc., Chem. Commun.*, ***1987***, 153.



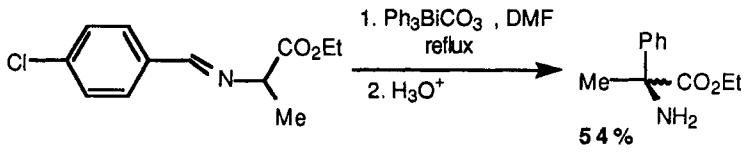
Evans, D.A.; Ellman, J.A.; Dorow, R.L. *Tetrahedron Lett.*, ***1987***, *28*, 1123.



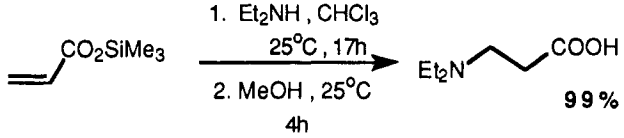
Duhamel, P.; Eddine, J.J.; Valnot, J.-Y. *Tetrahedron Lett.*, ***1987***, *28*, 3801.



Kolasa, T.; Sharma, S.; Miller, M.J. *Tetrahedron Lett.*, ***1987***, *28*, 4973.



O'Donnell, M.J.; Bennett, W.D.; Jacobsen, W.N.; Ma, Y. *Tetrahedron Lett.*, ***1989***, *30*, 3913.



Kwiatkowski, S.; Jeganathan, A.; Tobin, T.; Watt, D.S. *Synthesis*, ***1989***, 946.

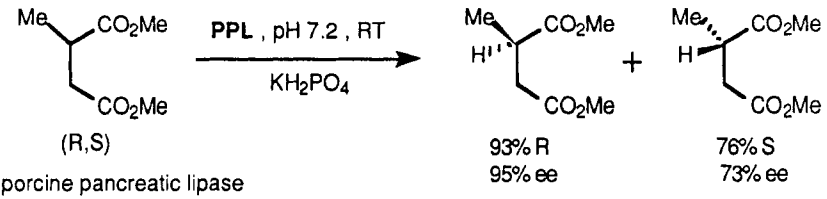
REVIEW:

A series of articles and reviews concerning amino acid synthesis

O'Donnell, M.J. (Ed.), *Tetrahedron*, ***1988***, *44*, 5253-5614.

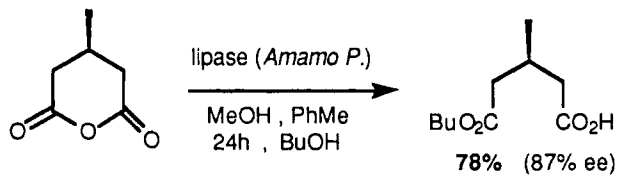
Related Methods: Section 315 (Carboxylic Acid - Amide).
Section 344 (Amide - Ester).
Section 351 (Amine - Ester).

SECTION 317: CARBOXYLIC ACID - ESTER

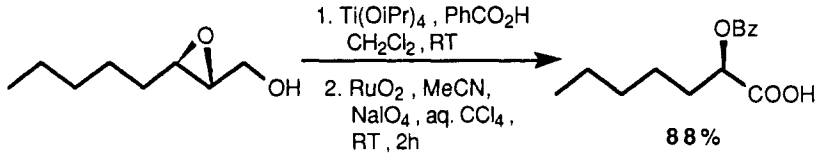


PPL = porcine pancreatic lipase

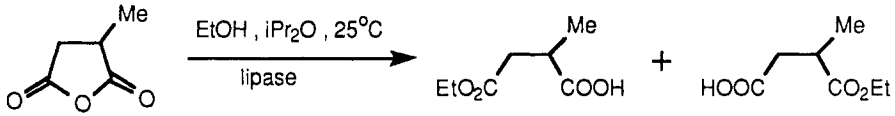
Guibé-Jampel, E.; Rousseau, G.; Salaün, J. *J. Chem. Soc., Chem. Commun.*, ***1987***, 1080.



Yamamoto, K.; Nishioka, T.; Oda, J. *Tetrahedron Lett.*, ***1988***, *29*, 1717.



Martín, V.S.; Nuñez, M.TY.; Tonn, C.E. *Tetrahedron Lett.*, ***1988***, *29*, 2701.



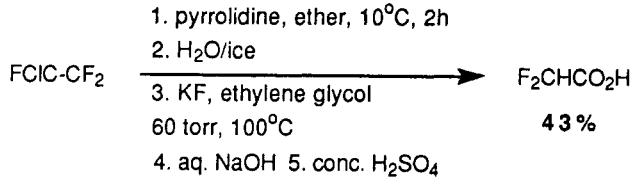
Pseudomonas fluorescens (Amano P) (92 : 8) **quant**
without lipase (57 : 43)

Hiratake, J.; Yamamoto, K.; Yamamoto, Y.; Oda, J. *Tetrahedron Lett.*, ***1989***, *30*, 1555.

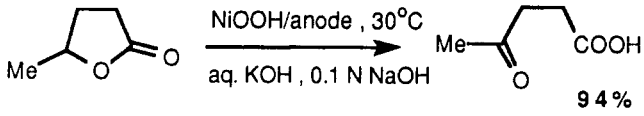
SECTION 318: CARBOXYLIC ACID - ETHER, EPOXIDE, THIOETHER

NO ADDITIONAL EXAMPLES

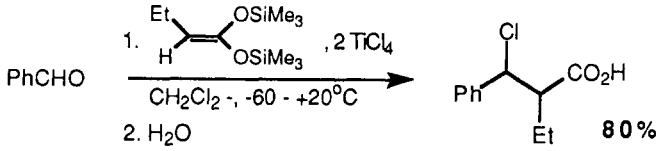
SECTION 319: CARBOXYLIC ACID - HALIDE, SULFONATE



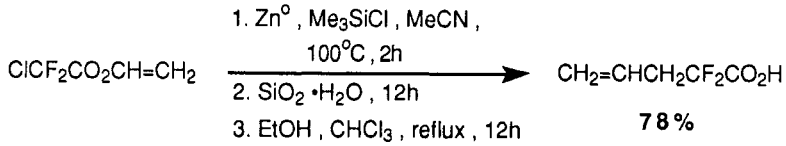
Luz, M.C.; Dailey, W.P. *Org. Prep. Proceed. Int.*, ***1987***, *19*, 468.



Ruholl, H.; Schäfer, H.-J. *Synthesis,* ***1987***, 408.

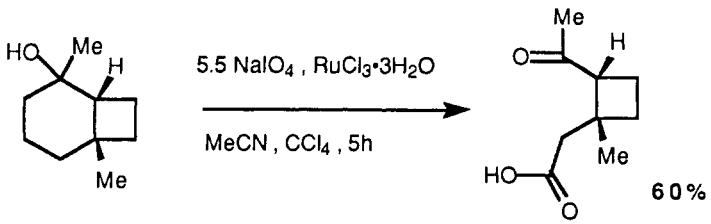


Bellassoued, M.; Dubois, J.-E.; Bertounesque, E. *Tetrahedron Lett.*, ***1988***, *29*, 1275.

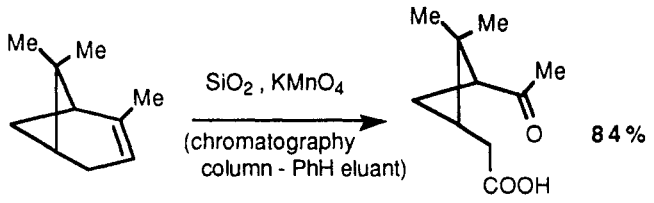


Greuter, H.; Lang, R.W.; Romann, A.J. *Tetrahedron Lett.*, ***1988***, *29*, 3291.

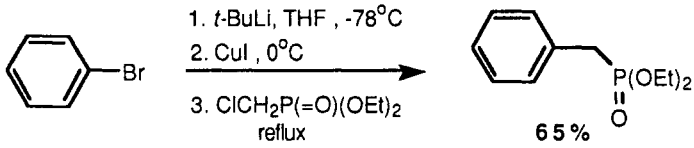
SECTION 320: CARBOXYLIC ACID - KETONE



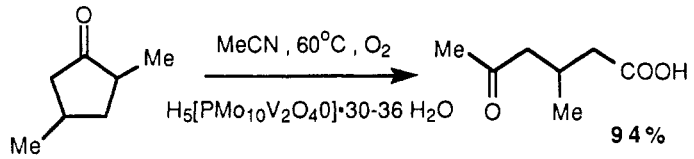
Webster, F.X.; Rivas-Enterrios, J.; Silverstein, R.M. *J. Org. Chem.*, ***1987***, *52*, 689.



Ferreira, J.T.B.; Cruz, W.O.; Vieira, P.C.; Yonashiro, M. *J. Org. Chem.*, ***1987***, *52*, 3698.



Poindexter, M.K.; Katz, T.J. *Tetrahedron Lett.*, ***1988***, *29*, 1513.



El Ali, B.; Brégeault, J.-M.; Mercier, J.; Martin, J.; Martin, C.; Convert, O. *J. Chem. Soc., Chem. Commun.*, ***1989***, 825.

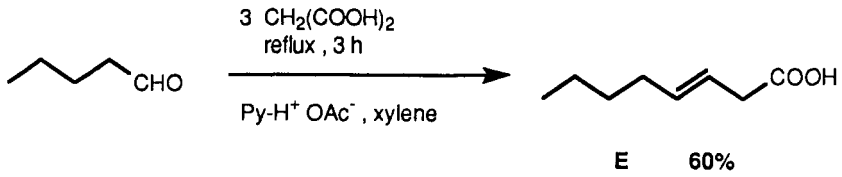
Also via: Section 360 (Ketone - Ester).

SECTION 321: CARBOXYLIC ACID - NITRILE

NO ADDITIONAL EXAMPLES

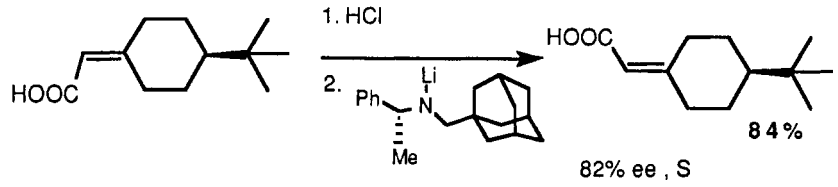
Also via: Section 361 (Nitrile - Ester).

SECTION 322: CARBOXYLIC ACID - ALKENE

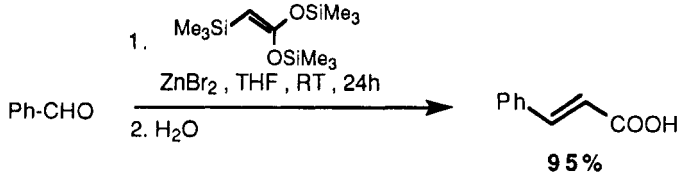


E **60%**

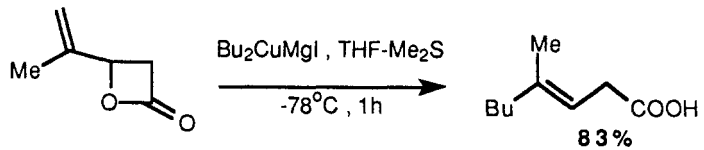
Ragoussis, N. *Tetrahedron Lett.*, ***1987,28***, 93.



Duhamel, L.; Ravard, A.; Plaquevent, J.,-C.; Davoust, D. *Tetrahedron Lett.*, ***1987***, *28*, 5517.

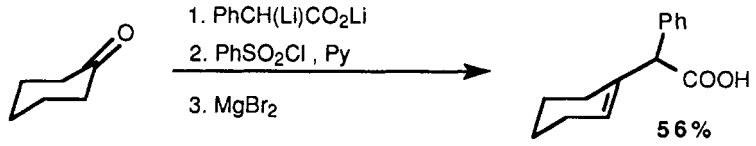


Bellassoued, M.; Gaudemar, M. *Tetrahedron Lett.*, ***1988***, *29*, 4551.



E:Z = 82:18

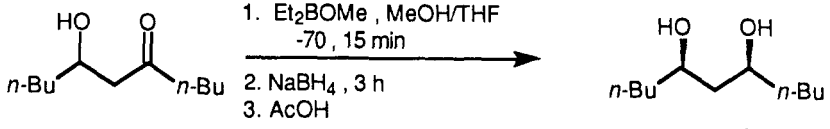
Kawashima, M.; Sato, T.; Fujiwsawa, T. *Bull. Chem. Soc., Jpn.*, ***1988***, *61*, 3255.



Black, T.H.; Maluleka, S.L. *Tetrahedron Lett.*, ***1989***, *30*, 531.

Also via: Section 313 (Alcohol - Carboxylic Acids).
Section 349 (Amide - Alkene).
Section 362 (Ester - Alkene).
Section 376 (Nitrile - Alkene).

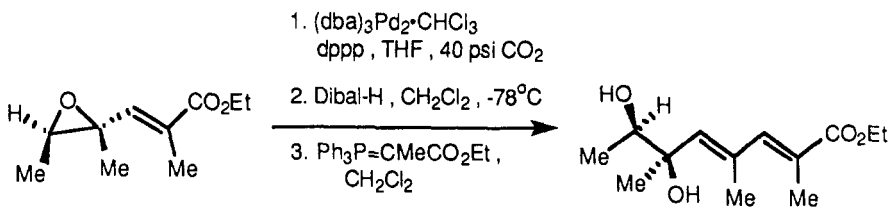
SECTION 323: ALCOHOL, THIOL - ALCOHOL, THIOL



99%

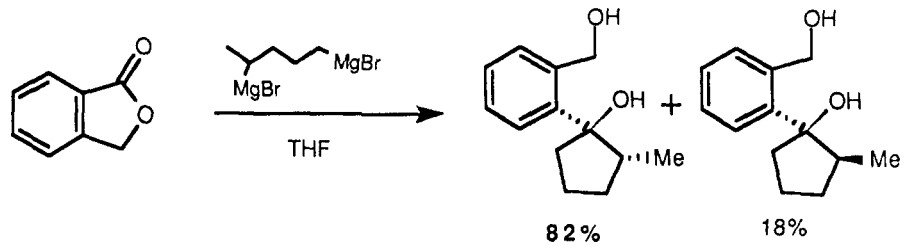
(syn:anti = 99:1)

Chen, K.-M.; Hardtmann, G.E.; Prasad, K.; Repič, O.; Shapiro, M.J. *Tetrahedron Lett.*, ***1987***,*.28*, 155.



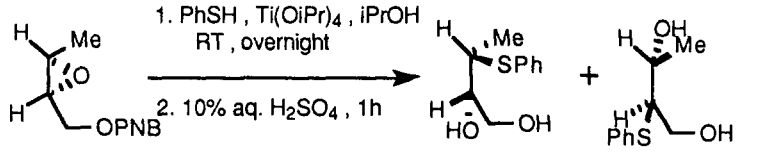
30% overall

Trost, B.M.; Lynch, J.K.; Angle, S.R. *Tetrahedron Lett.*, ***1987***, *28*, 375.



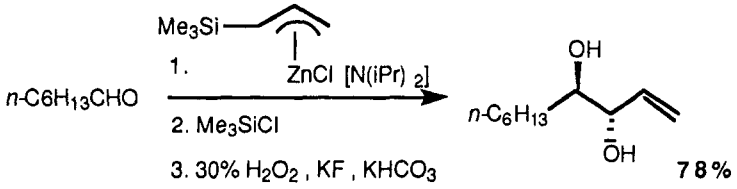
82% 18%

Canonne, P.; Boulanger, R.; Bernatchez, M. *Tetrahedron Lett.*, ***1987***, *28*, 4997.

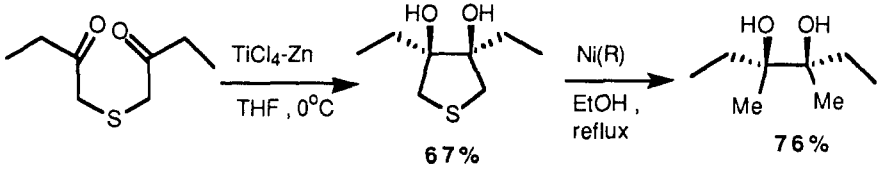


PNB = *p*-nitrobenzoate (2.3 : 1) 66%

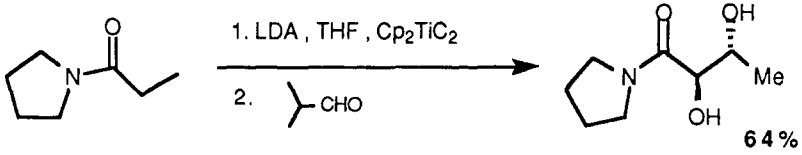
Ko, S.Y.; Masamune, H.; Sharpless, K.B. *J. Org. Chem.*, ***1987***, *52*, 667.



Tamao, K.; Nakajo, E.; Ito, Y. *J. Org. Chem.*, ***1987***, *52*, 957.

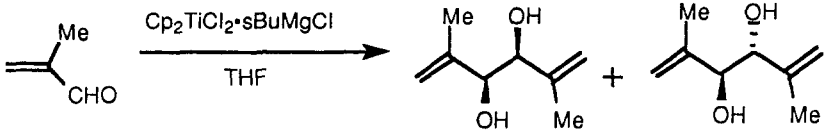


Nakayama, J.; Yamaoka, S.; Hoshino, M. *Tetrahedron Lett.*, ***1987***, *28*, 1799.



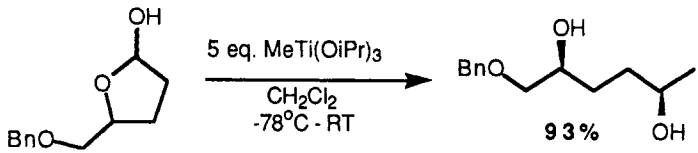
anti:syn = 87:13

Murphy, P.J.; Procter, G.; Russell, A.T. *Tetrahedron Lett.*, ***1987***, *28*, 2037.



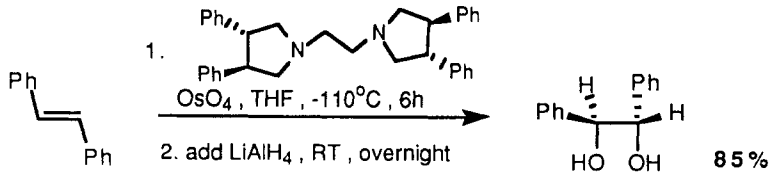
(100 : 1) 98%

Handa, Y.; Inanaga, J. *Tetrahedron Lett.*, ***1987***, *28*, 5717.



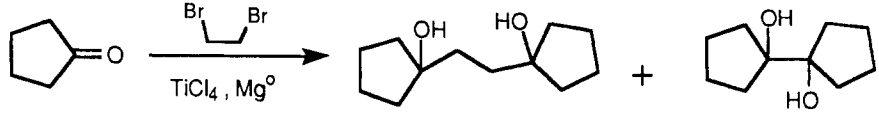
syn:anti = 7.3:1

Tomooka, K.; Okinaga, T.; Suzuki, K.; Tsuchihashi, G. *Tetrahedron Lett.*, ***1987***, *28*, 6335.



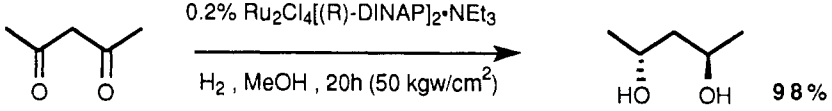
97% ee

Tomioka, K.; Nakajima, M.; Iitaka, Y.; Koga, K. *Tetrahedron Lett.*, ***1988***, *29*, 573.



(1 : 1) 60%

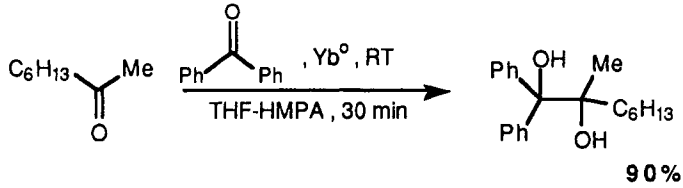
Rao, S.A.; Periasamy, M. *Tetrahedron Lett.*, ***1988***, *29*, 1583.



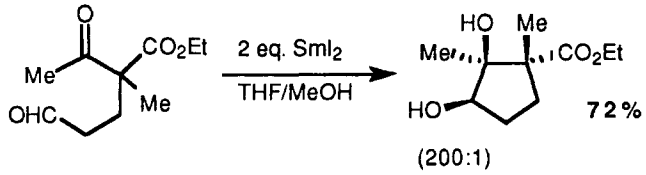
BINAP = 2,2'-bis-(diphenylphosphino)-1,1'-binaphthyl

anti:syn = 99:1
(>99% ee)

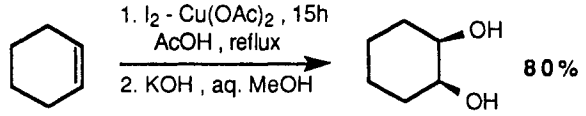
Kawano, H.; Ishii, Y.; Saburi, M.; Uchida, Y. *J. Chem. Soc., Chem. Commun.*, ***1988***, 87.



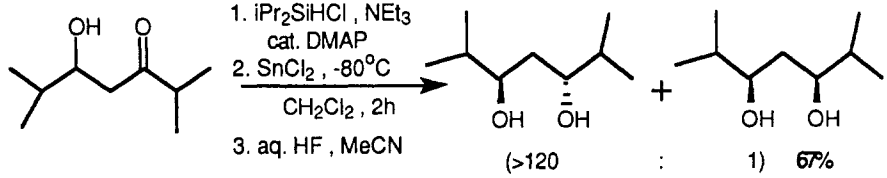
Hou, Z.; Takamine, K.; Aoki, O.; Shiraishi, H.; Fujiwara, Y.; Tankguchi, H. *J. Chem. Soc., Chem. Commun.*, ***1988***, 668.



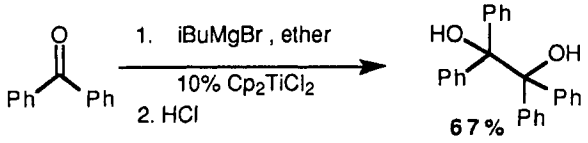
Molander, G.A.; Kenny, C. *J. Org. Chem.*, ***1988***, *53*, 2132.



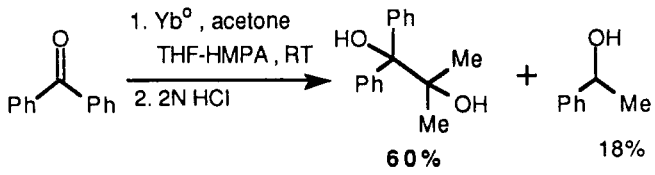
Horiuchi, C.A.; Satoh, J.Y. *Chem. Lett.*, ***1988***, 1209.



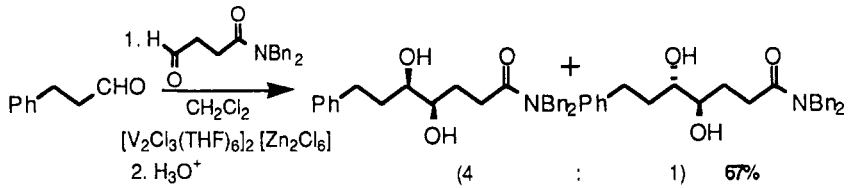
Anwar, S.; Davis, A.P. *Tetrahedron*, ***1988***, *44*, 3761.



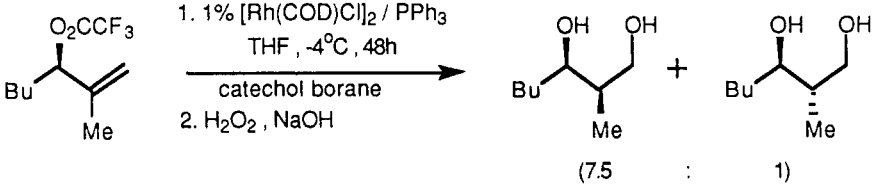
Zhang, Y.; Liu, T. *Synth. Commun.*, ***1988***, *18*, 2173.



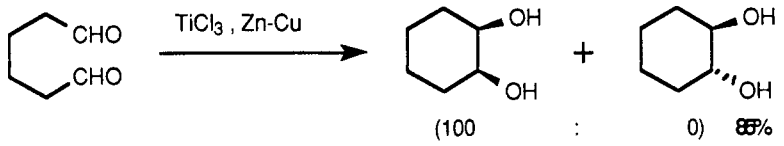
Hou, Z.; Takamine, K.; Aoki, O.; Shiraishi, H.; Fujiwara, Y.; Taniguchi, H. *J. Org. Chem.*, ***1988***, *53*, 6077.



Fruedenberger, J.H.; Jonradi, A.W.; Pedersen, S.F. *J. Am. Chem. Soc.*, ***1989***, *111*, 8014.

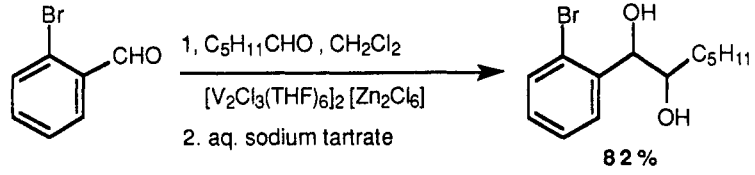


Burgess, K.; Ohlmeyer, M.J. *Tetrahedron Lett.*, ***1989***, *30*, 395.



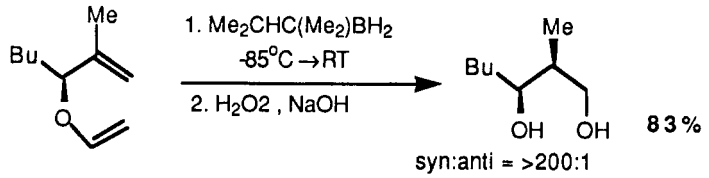
1,12-dodecanedicarboxaldehyde gave 75% of cis:trans diols (25:75).

McMurry, J.E.; Rico, J.G. *Tetrahedron Lett.*, ***1989***, *30*, 1169.



syn:anti = 1:1

Takahara, P.M.; Freudenberger, J.H.; Konradi, A.W.; Pedersen, S.F. *Tetrahedron Lett.*, ***1989***, *30*, 7177.



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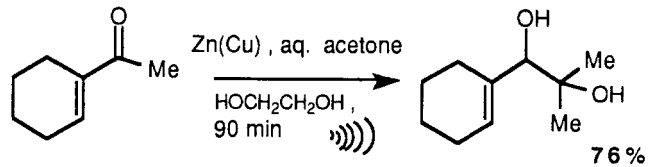

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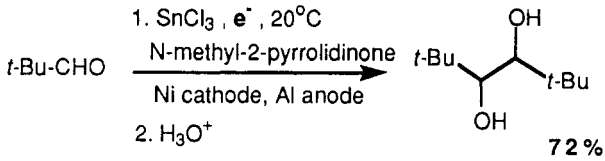

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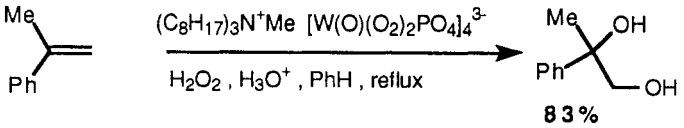

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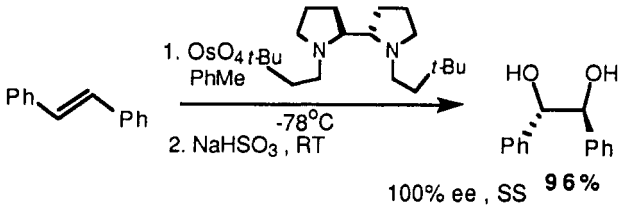

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REVIEWS:

"Polyketide-Derived Natural Products Containing Three or More Consecutive Stereogenic Centers"

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"Carbonyl Coupling Reactions Using Transition Metals, Lanthanides and Actinides"

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"Enzyme Catalyzed Synthesis of Carbohydrates"

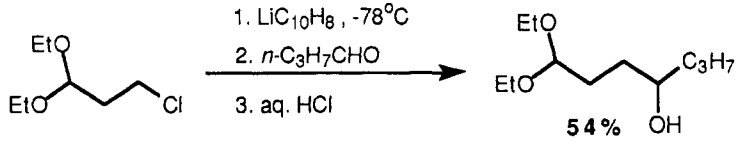
Toone, E.J.; Simon, E.S.; Bednarshi, M.D.; Whitesides, G.M. *Tetrahedron,* ***1989****, 45*, 5365.

"The Applications of Low-Valent Titanium Reagents in Organic Synthesis"

Lenior, D. *Synthesis,* ***1989***, 883.

Also via: Section 327 (Alcohol - Ester).
Section 357 (Ester - Ester).

SECTION 324: ALCOHOL, THIOL - ALDEHYDE



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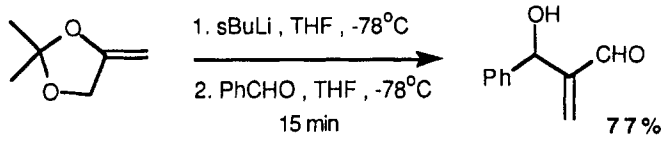

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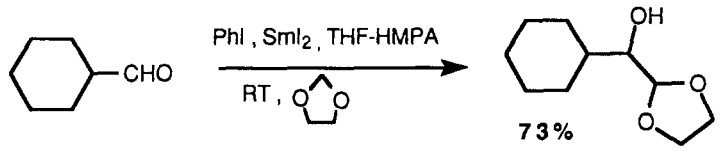

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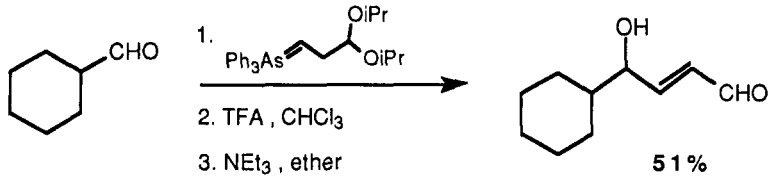

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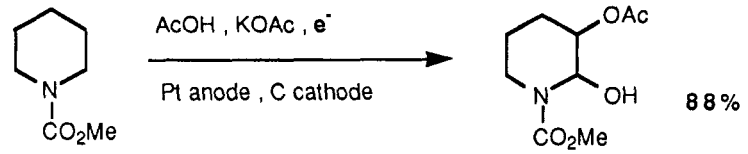
Related Methods: Section 330 (Alcohol - Ketone).

SECTION 325: ALCOHOL, THIOL - AMIDE



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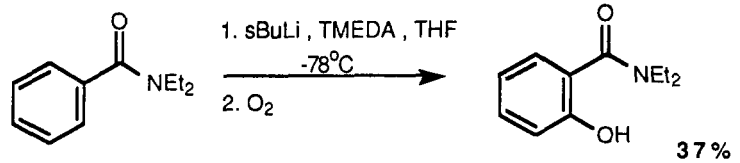

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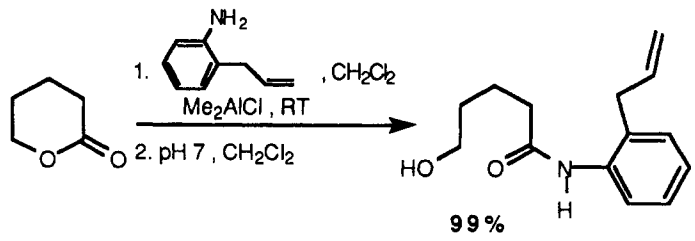

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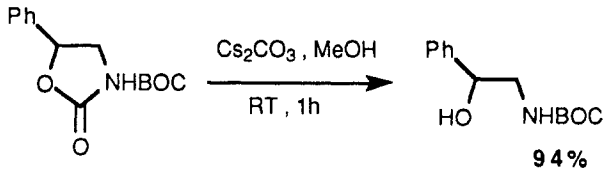

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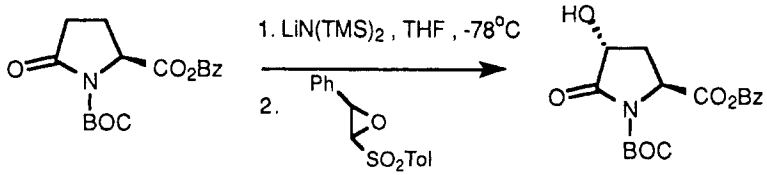

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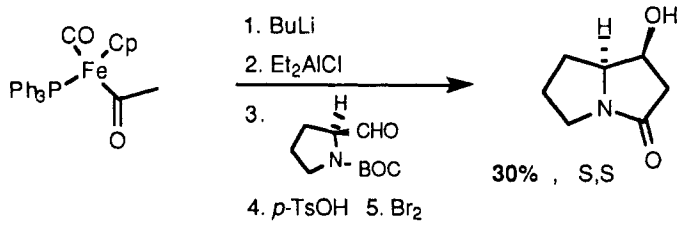

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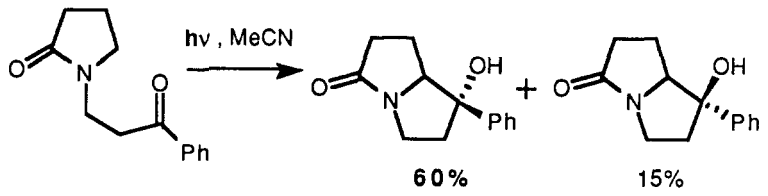

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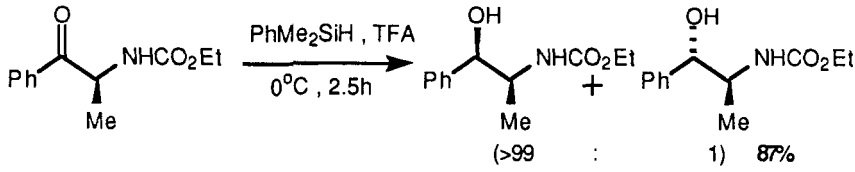

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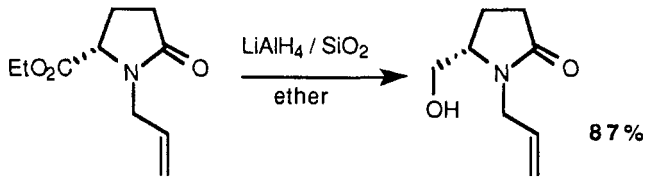

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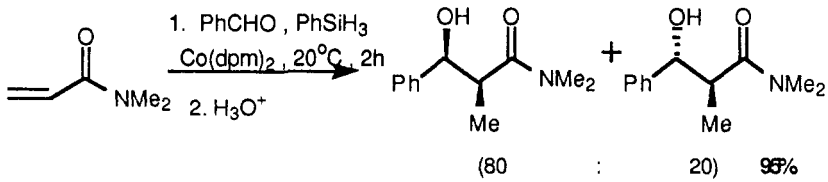

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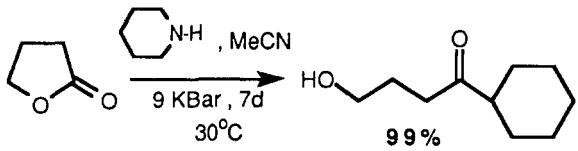

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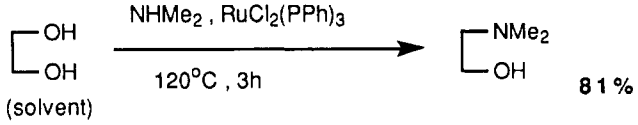
SECTION 326: ALCOHOL, THIOL - AMINE



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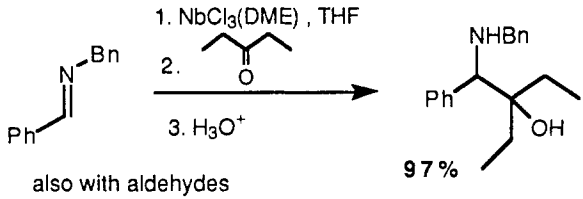

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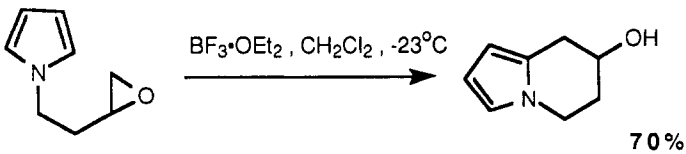

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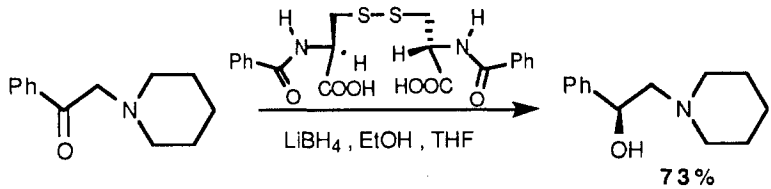

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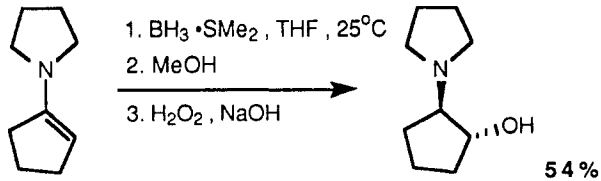

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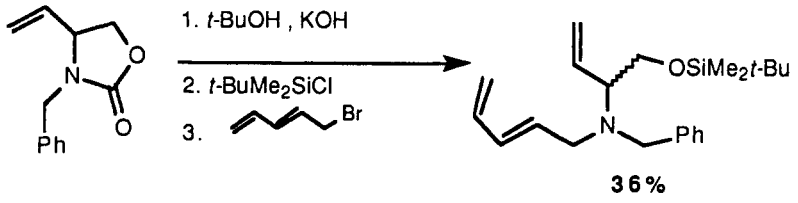

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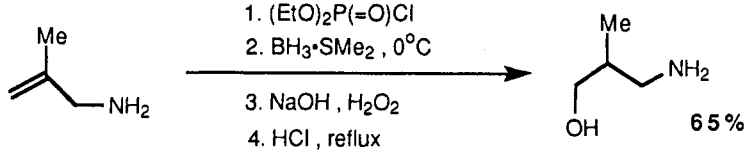

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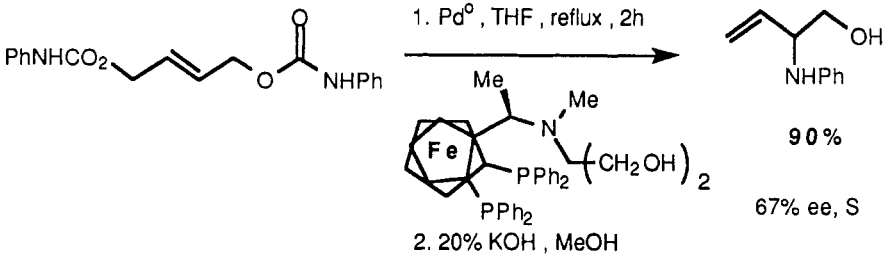

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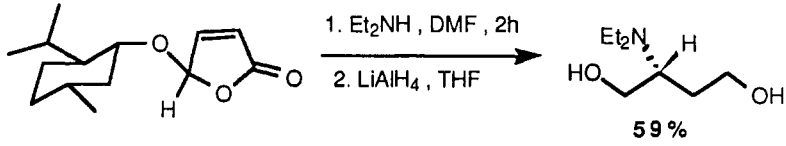

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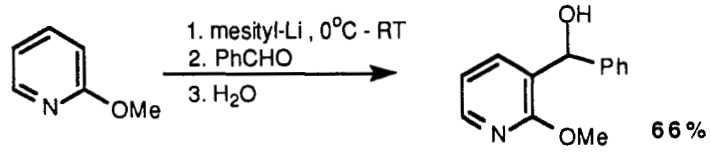

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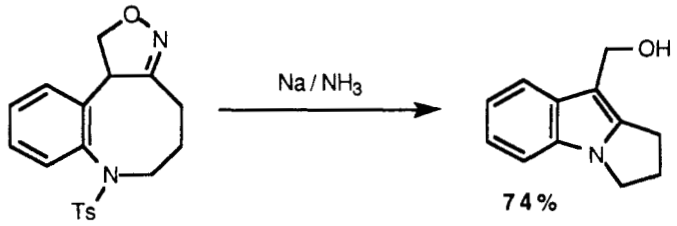

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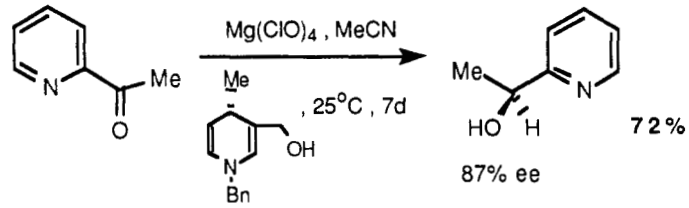

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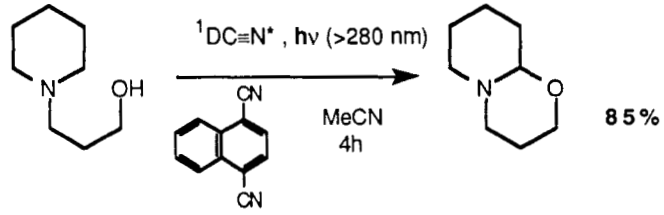

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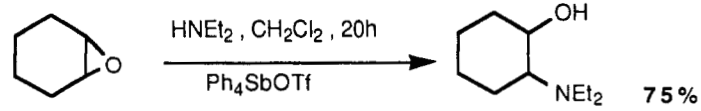
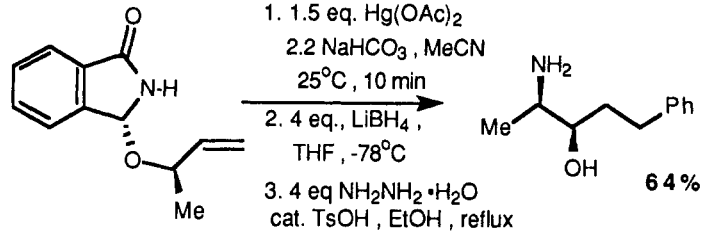


Fujiwara, M.; Imada, M.; Baba, A.; Matsuda, H. *Tetrahedron Lett.*, ***1989***, *30*, 739.



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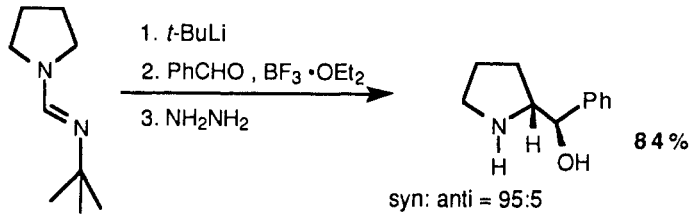

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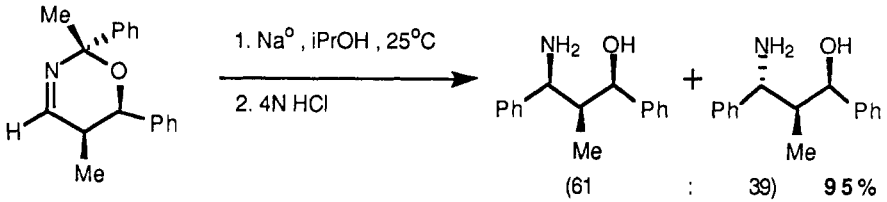

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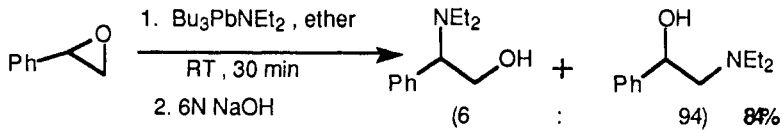

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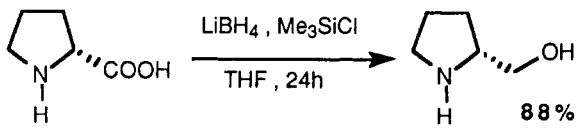

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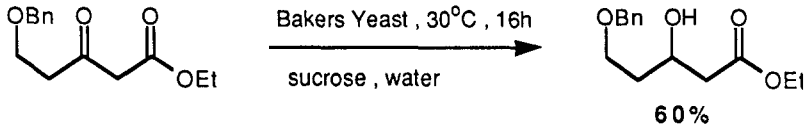
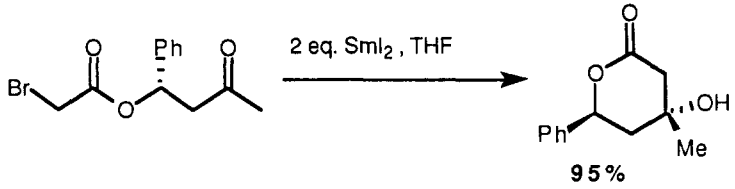
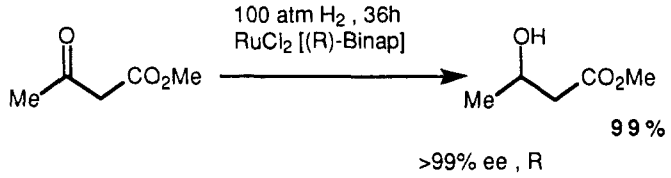
SECTION 327: ALCOHOL, THIOL - ESTER



Brooks, D.W.; Kellogg, R.P.; Cooper, C.S. *J. Org. Chem.*, ***1987***, *52*, 192.



Molander, G.A.; Etter, J.B. *J. Am. Chem. Soc.*, ***1987***, *109*, 6556.



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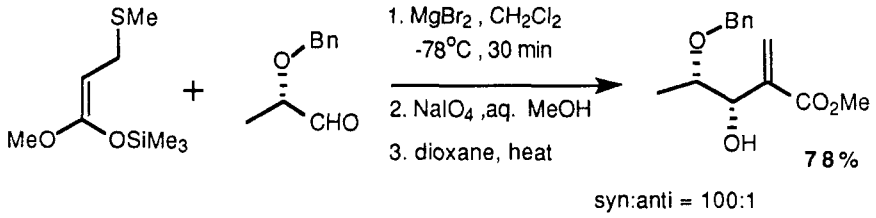
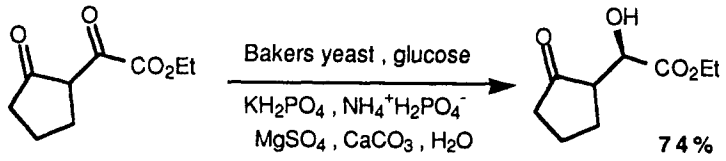
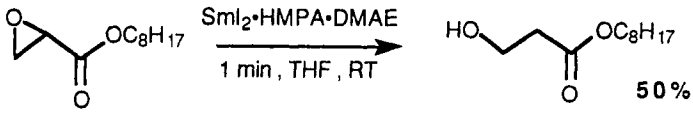


Bernardi, A.; Cardani, S.; Colombo, L.; Poli, G.; Schimperna, G.; Scolastico, C. *J. Org. Chem.*, ***1987***, *52*, 888.



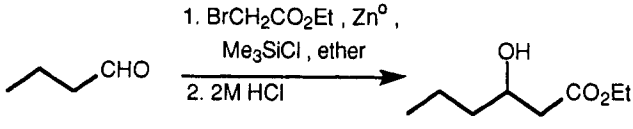
threo : erythro = 2:3
(76% ee RS : 88% ee RR)

Tsuboi, S.; Nishiyama, E.; Furutani, H.; Utaka, M.; Takeda, A. *J. Org. Chem.*, ***1987***, *52*, 1359.



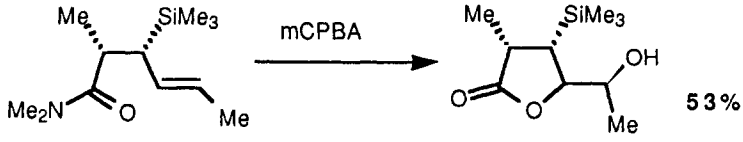
DMAE = N,N-dimethylamino ethanol β:α OH = 17:1

Otsubo, K.; Inanaga, J.; Yamaguchi, M. *Tetrahedron Lett.*, ***1987***, *28*, 4437.

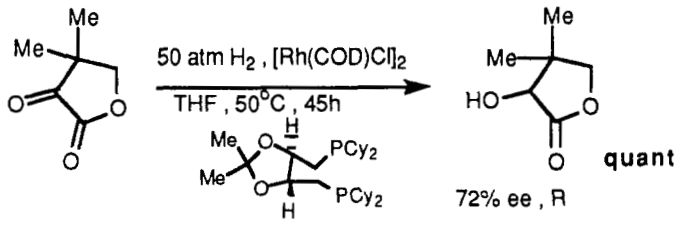


improved Reformatsky reaction

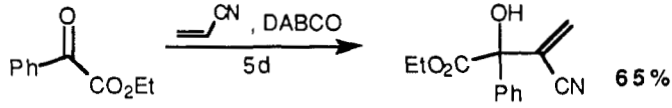
Picotin, G.; Miginiac, P. *J. Org. Chem.*, ***1987***, *52*, 4796.



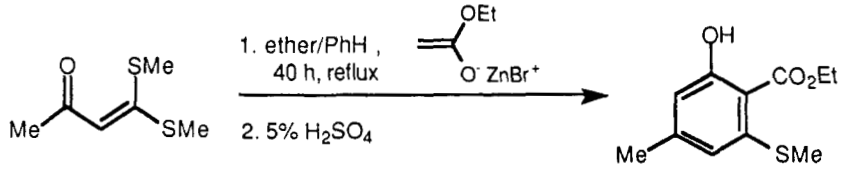
Russell, A.T.; Procter, G. *Tetrahedron Lett.*, ***1987***, *28*, 2041, 2045.



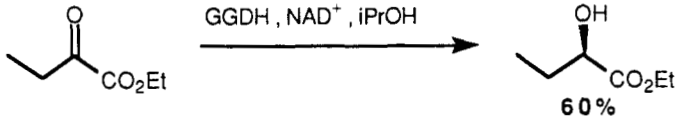
Chiba, M.; Takahashi, H.; Takahashi, H.; Morimoto, T.; Achiwa, K. *Tetrahedron Lett.*, ***1987***, *28*, 3675.



Basavaiah, D.; Bharathi, T.K.; Gowriswari, V.V.L. *Tetrahedron Lett.*, ***1987***, *28*, 4351.

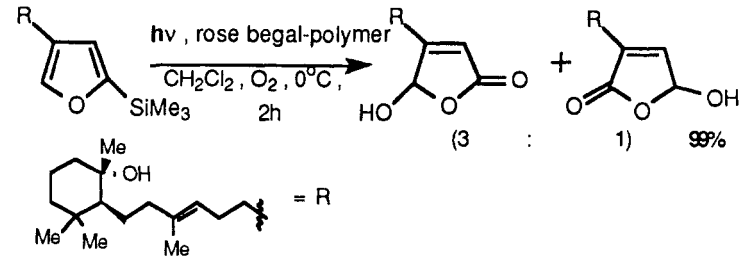


Datta, A.; Ila, H.; Junjappa, H. *Tetrahedron Lett.*, ***1988***, *29*, 497.

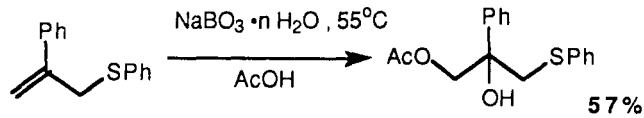


GGDH = glycerol dehydrogenase >99% ee

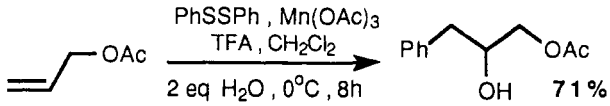
Nakamura, K.; Yoneda, T.; Miyai, T.; Ushio, K.; Oka, S.; Ohno, A. *Tetrahedron Lett.*, ***1988***, *29*, 2453.



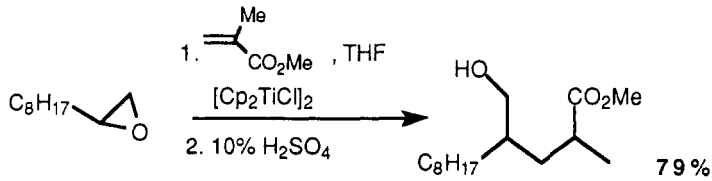
Kernan, M.R.; Faulkner, D.J. *J. Org. Chem.*, ***1988***, *53*, 2773.



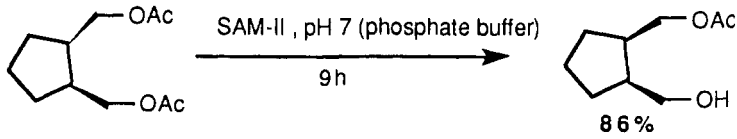
Gupton, J.T.; Dureanceau, S.J.; Miller, J.F.; Kosiba, M.L. *Synth. Commun.*, ***1988***, *18*, 937.



Abd ElSamii, Z.K.M.; Al Ashmawy, M.I.; Mellor, J.M. *J. Chem. Soc., Perkin Trans. I*, ***1988***, 2509.



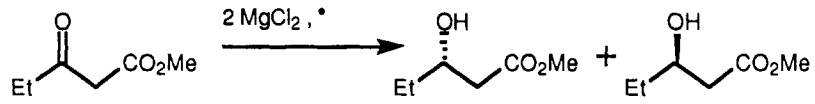
RajanBabu, T.V.; Nugent, W.A. *J. Am. Chem. Soc.*, ***1989***, *111*, 4525.



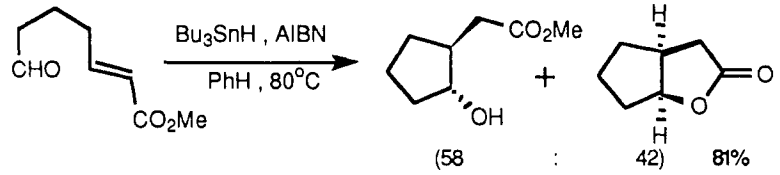
SAM-II = microbial ester hydrolase from *Psuedomonas sp.*

>95% ee

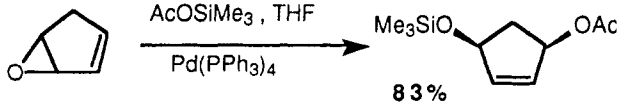
Ader, U.; Breitgoff, D.; Klein, P.; Laumen, K.E.; Schneider, M.P. *Tetrahedron Lett.*, ***1989***, *30*, 1793.



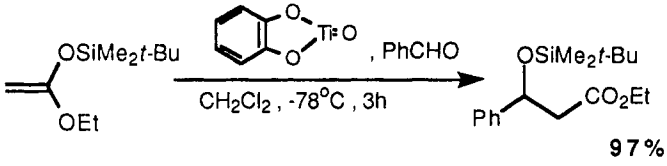
Nakamura, K.; Kawai, Y.; Oka, S.; Ohno, A. *Tetrahedron Lett.*, ***1989***, *30*, 2245.



Enholm, E.J.; Prasad, G. *Tetrahedron Lett.*, ***1989***, *30*, 4939.



Deardorff, D.R.; Shambayati, S.; Linde II, R.G.; Dunn, M.M. *J. Org. Chem.*, ***1988***, *53*, 189.



Hara, R.; Mukaiyama, T. *Chem. Lett.*, ***1989***, 1909.

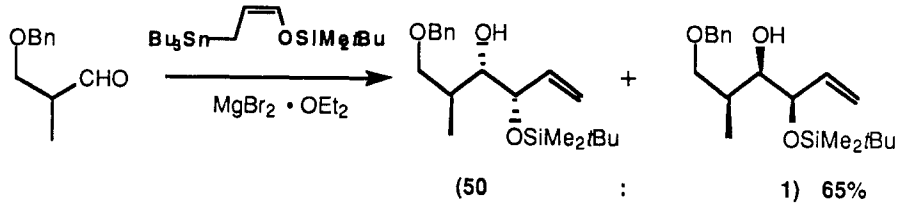
REVIEW:

"Recent Advances in the Reformatsky Reaction"

Fürstner, A. *Synthesis*, ***1989***, 571.

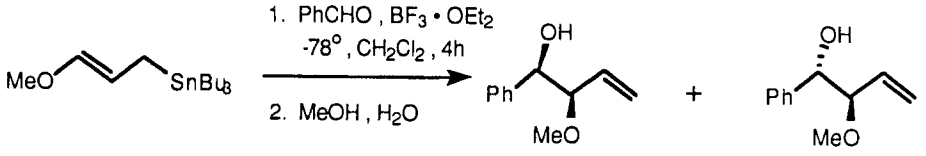
Also via: Section 313 (Alcohol - Carboxylic Acid).

SECTION 328: ALCOHOL, THIOL - ETHER, EPOXIDE, THIOETHER



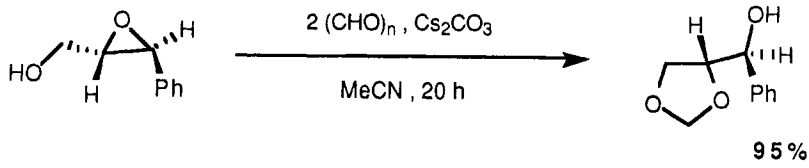
(50 : 1) 65%

Keck, G.E.; Abbott, D.E.; Wiley, M.R. *Tetrahedron Lett.*, ***1987,28***, 139.



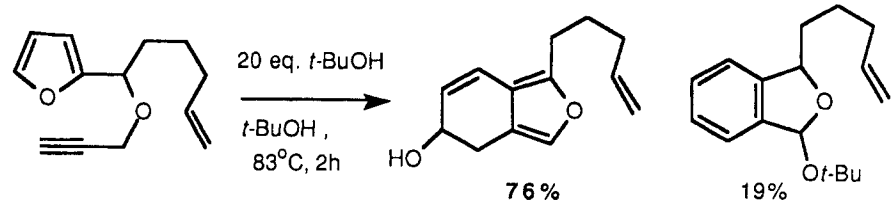
(14 : 1) 87%

Koreeda, M.; Tanaka, Y. *Tetrahedron Lett.*, ***1987,28***, 143.



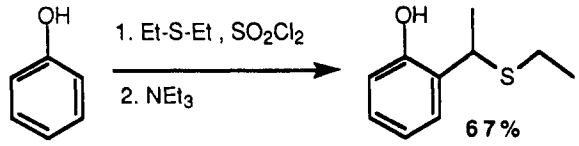
95%

McCombie, S.W.; Metz, W.A. *Tetrahedron Lett.*, ***1987, 28***, 383.

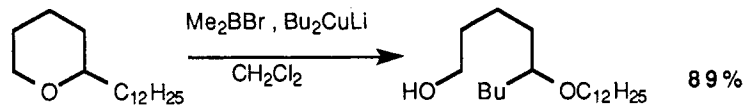


76% 19%

Yamaguchi, Y.; Yamada, H.; Hayakawa, K.; Kanematsu, K. *J. Org. Chem.*, ***1987, 52***, 2040.

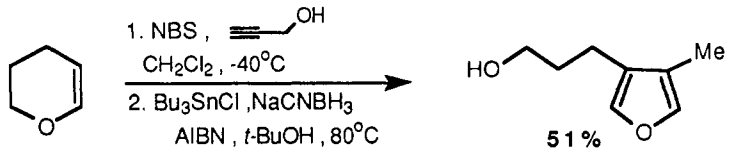


Sato, K.; Inoue, S.; Miyamoto, O.; Ikeda, H.; Ota, T. *Bull. Chem. Soc., Jpn.*, ***1987***, *60*, 4184.
Sato, K.; Inoue, S.; Ozawa, K.; Kobayashi, T.; Ota, T.; Tazaki, M. *J. Chem. Soc., Perkin Trans. I*, ***1987***, 1753.

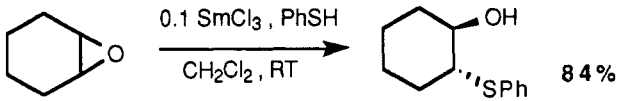


a variety of nucleophiles can be used

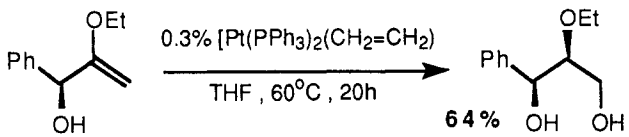
Guindon, Y.; Bernstein, M.A.; Anderson, P.C. *Tetrahedron Lett.*, ***1987***, *28*, 2225.



Srikrishna, A.; Pullaiah, K.C. *Tetrahedron Lett.*, ***1987***, *28*, 5203.

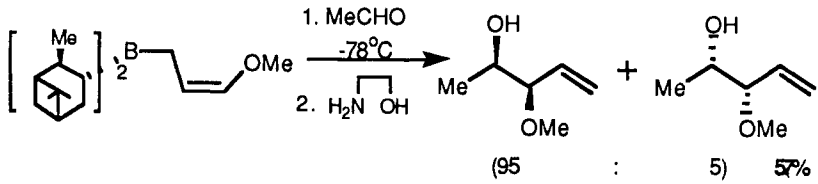


Vougioukas, A.E.; Kagan, H.B. *Tetrahedron Lett.*, ***1987***, *28*, 6065.

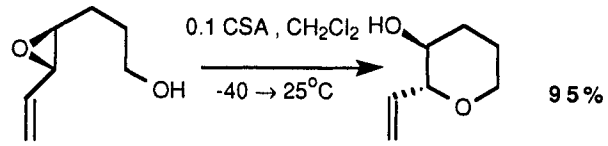


syn:anti = 94:1

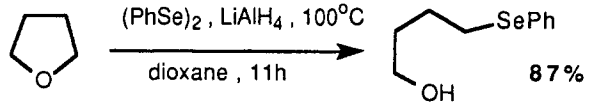
Tamao, K.; Nakagawa, Y.; Arai, H.; Higuchi, N.; Ito, Y. *J. Am. Chem. Soc.*, ***1988***, *110*, 3712.



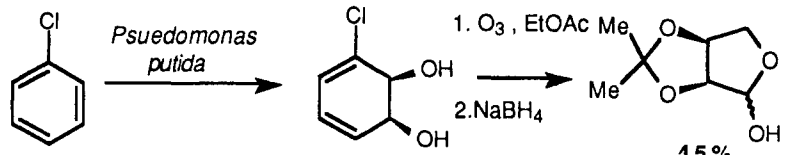
Brown, H.C.; Jadhav, P.K.; Bhat, K.S. *J. Am. Chem. Soc.*, ***1988***, *110*, 1535.



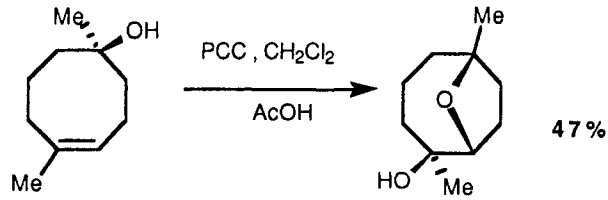
Nicolaou, K.C.; Prasad, C.V.C.; Somers, P.K.; Hwang, C.-K. *J. Am. Chem. Soc.*, ***1989***, *111*, 5330, 5335.



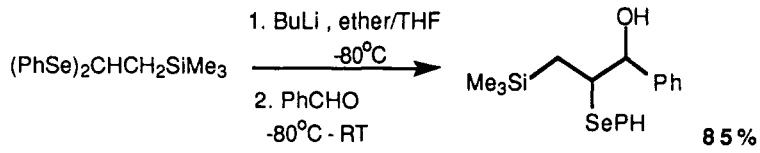
Haraguchi, K.; Tanaka, H.; Hayakawa, H.; Miyasaka, T. *Chem. Lett.*, ***1988***, 931.



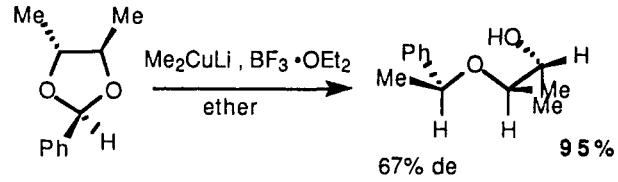
Hudlicky, T.; Luna, H.; Price, J.D.; Rulin, F. *Tetrahedron Lett.*, ***1989***, *30*, 4053.
Hudlicky, T.; Luna, H.; Barbieri, G.; Kwart, L.D. *J. Am. Chem. Soc.*, ***1988***, *110*, 4735.



Schlecht, M.F.; Kim, H. *J. Org. Chem.*, ***1989***, *54*, 583.



Sarkar, T.K.; Satapathi, T.K. *Tetrahedron Lett.*, ***1989***, *30*, 3333.



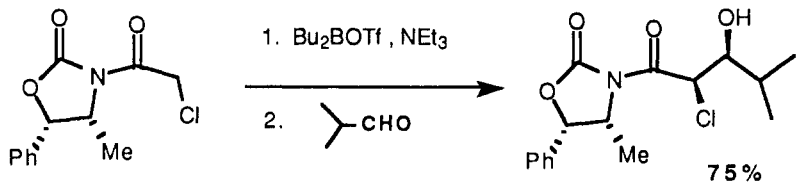
Normant, J.F.; Alexakis, A.; Ghribi, A.; Mangeney, P. *Tetrahedron*, ***1989***, *45*, 507.

REVIEW:

"Selective Dealkylations of Aryl Alkyl Ethers, Thioethers and Selenoethers"

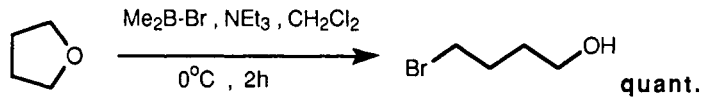
Tiecco, M. *Synthesis*, ***1988***, 749.

SECTION 329: ALCOHOL, THIOL - HALIDE, SULFONATE

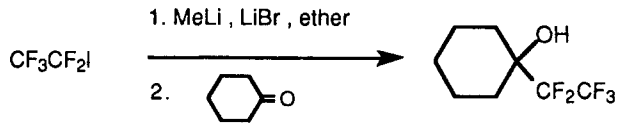


95:5 (major isomer:all others)

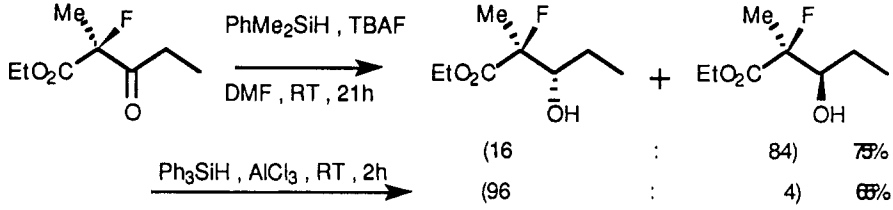
Evans, D.A.; Sjogren, E.B.; Weber, A.E.; Conn, R.E. *Tetrahedron Lett.*, ***1987***,.*28*, 39.



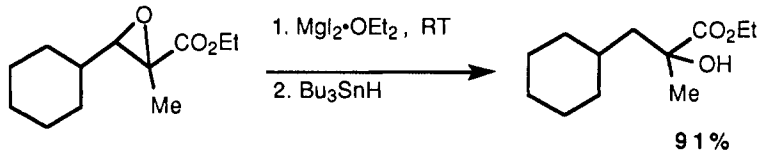
Guindon, Y.; Therien, M.; Girard, Y.; Yoakim, C. *J. Org. Chem.*, ***1987***, *52*, 1680.



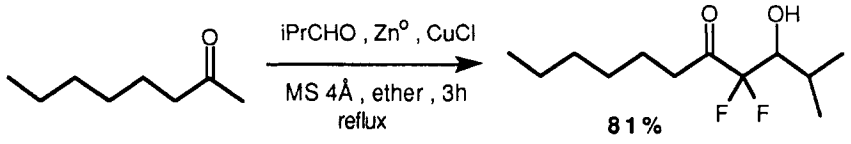
Gassman, P.G.; O'Reilly, N.J. *J. Org. Chem.*, ***1987***, *52*, 2481.



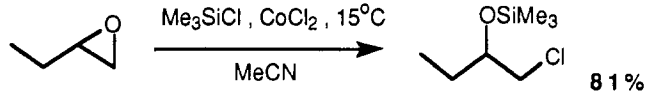
Kitazume, T.; Kobayashi, T.; Yamamoto, T.; Yamazaki, T. *J. Org. Chem.*, ***1987***, *52*, 3218.



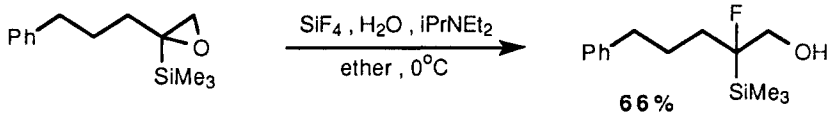
Otsubo, K.; Inanaga, J.; Yamaguchi, M. *Tetrahedron Lett.*, ***1987***, *28*, 4435.



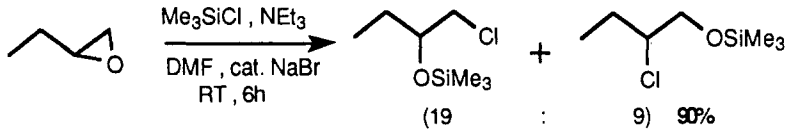
Kuroboshi, M.; Ishihara, T. *Tetrahedron Lett.*, ***1987***, *28*, 6481.



Iqbal, J.; Khan, M.A. *Chem. Lett.*, ***1988***, 1157.



Shimizu, M.; Yoshioka, H. *Tetrahedron Lett.*, ***1989***, *30*, 967.
Shimizu, M.; Yoshioka, H. *Tetrahedron Lett.*, ***1988***, *29*, 4101.



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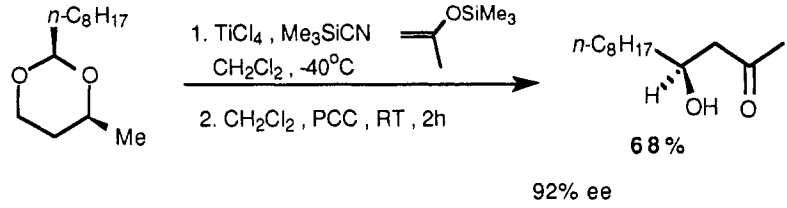
SECTION 330: ALCOHOL, THIOL - KETONE



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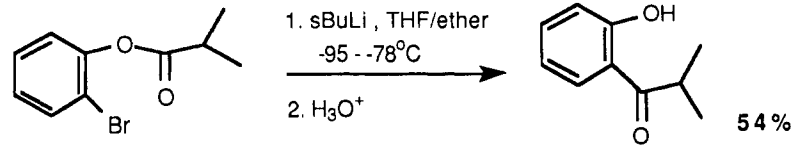

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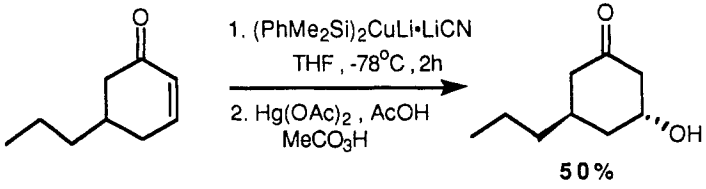

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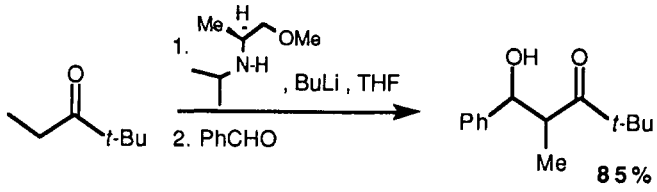

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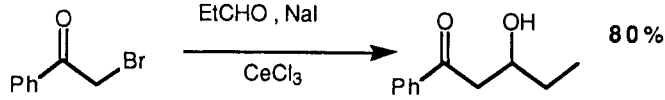

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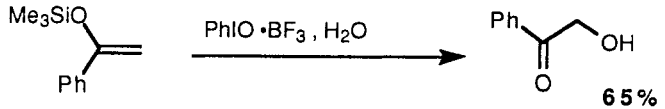

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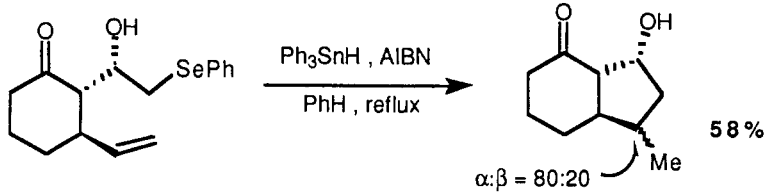

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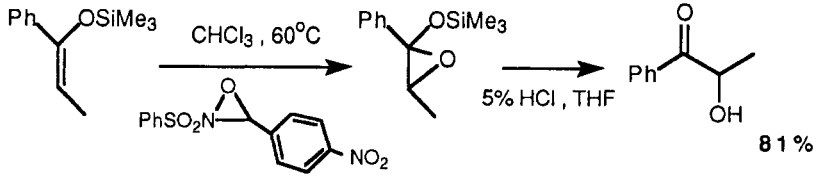

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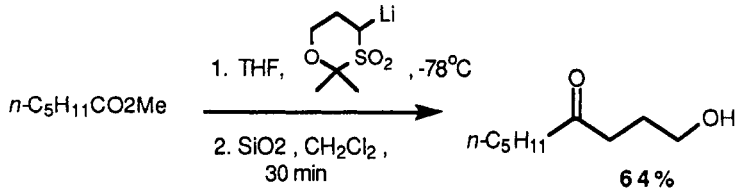

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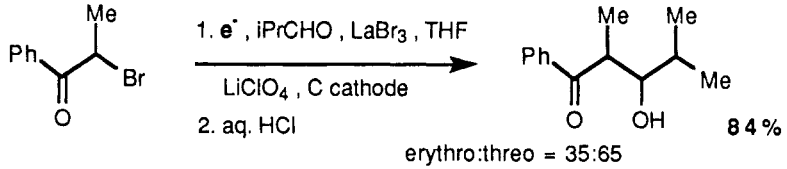

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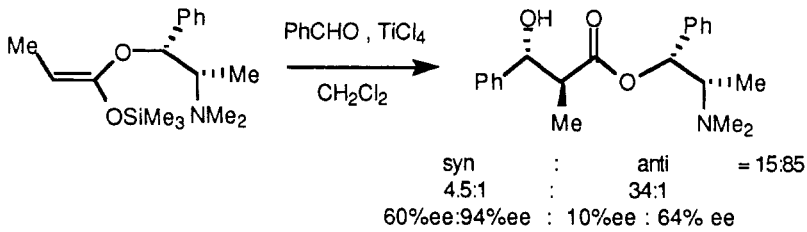

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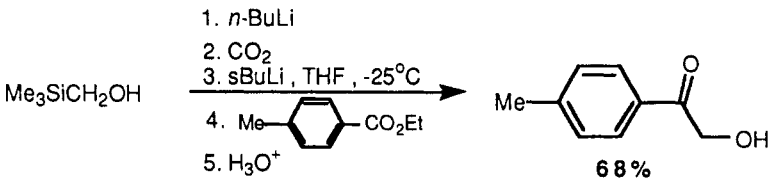

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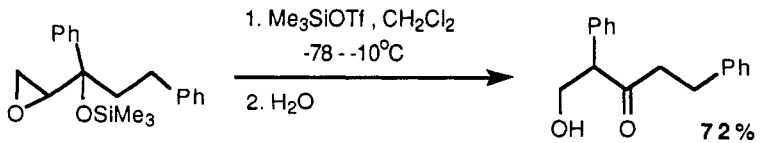
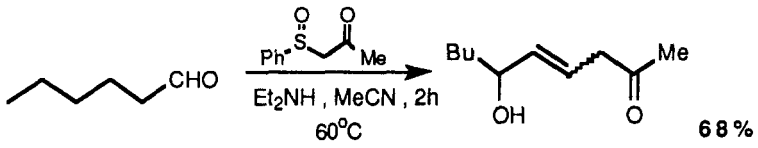


Suzuki, K.; Miyazawa, M.; Tsuchihashi, G. *Tetrahedron Lett.*, ***1987***, *28*, 3515.



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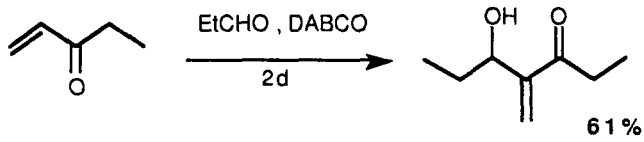

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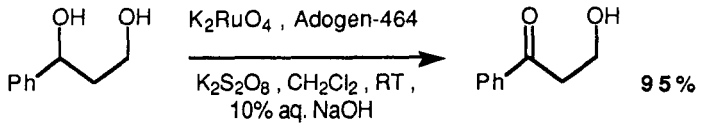

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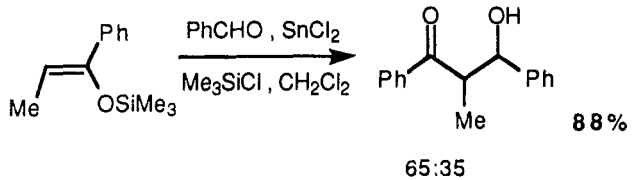

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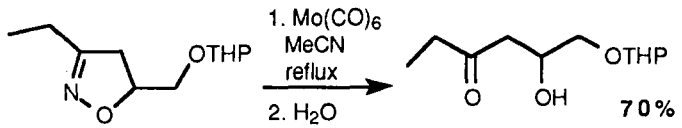
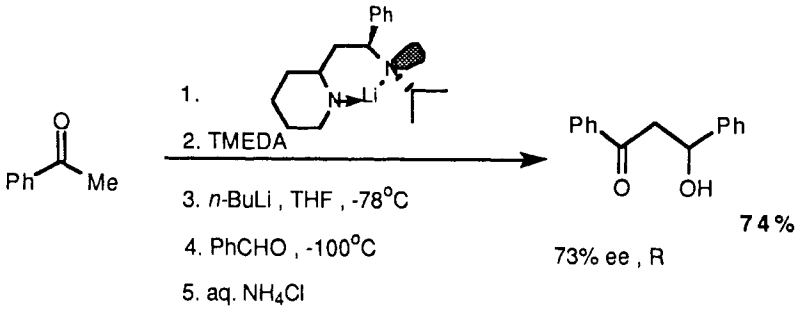


Baraldi, P.G.; Barco, A.; Benetti, S.; Manfredini, S.; Simoni, D. *Synthesis*, ***1987***, 276.



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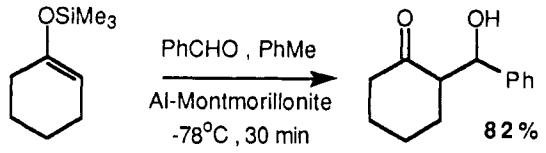

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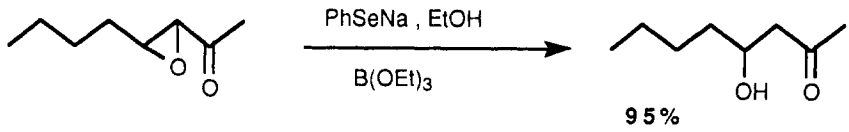

Miyashita, M.; Hoshino, M.; Yoshikoshi, A. *Tetrahedron Lett.*, ***1988***, *29*, 347.
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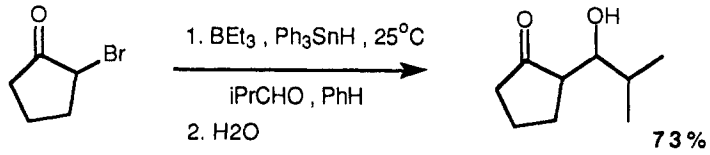

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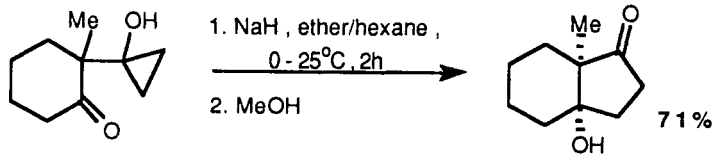
Nozaki, K.; Oshima, K.; Utimoto, K. *Tetrahedron Lett.*, ***1988***, *29*, 1041.



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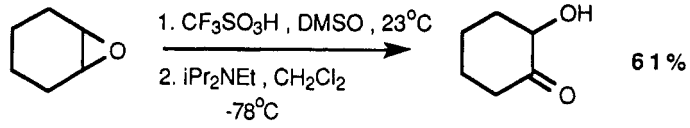
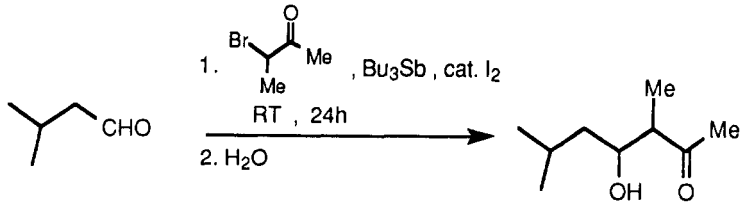


Trost, B.M.; Fray, M.J. *Tetrahedron Lett.*, ***1988***, *29*, 2163.



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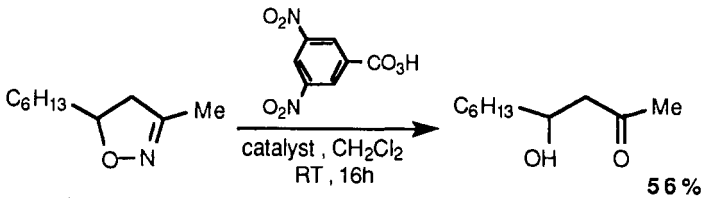
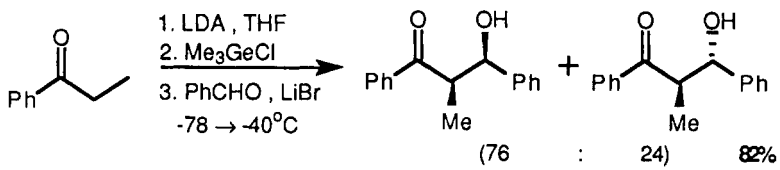


catalyst = 4,4'-thiobis(2-*t*-butyl-6-methyl)phenol

Park, P.; Kozikowski, A.P. *Tetrahedron Lett.*, ***1988***, *29*, 6703.



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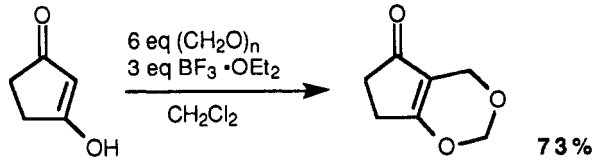

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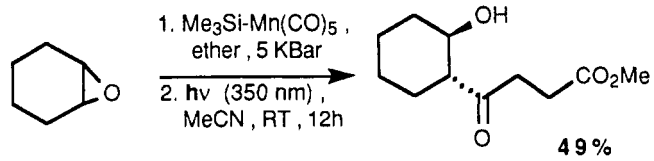

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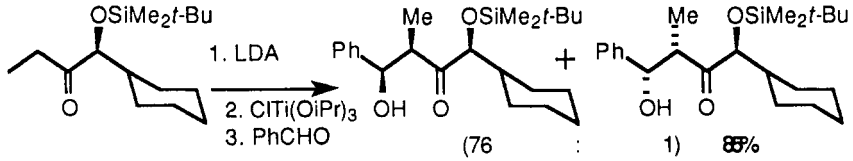

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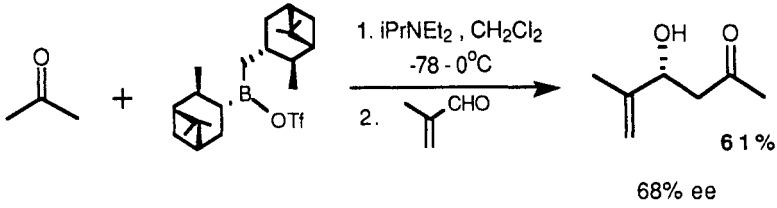

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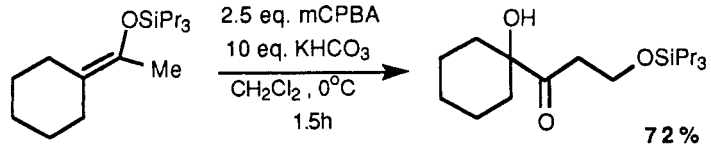

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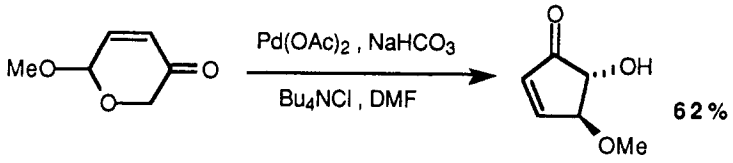

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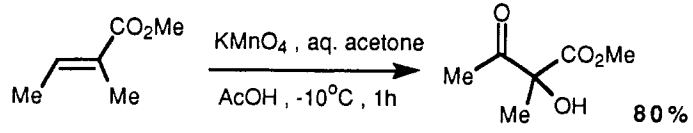

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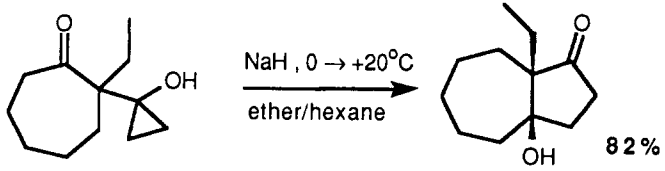

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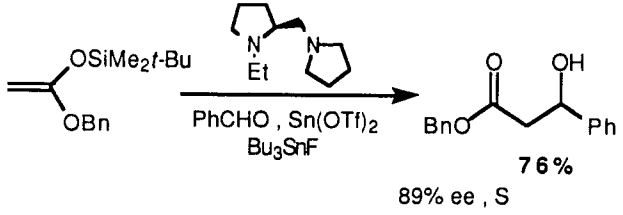

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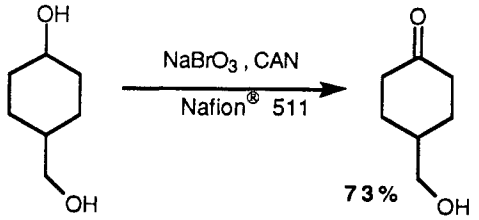
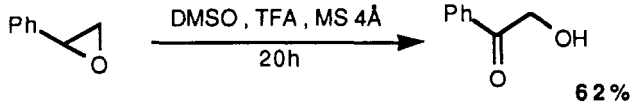


Kanemoto, S.; Saimoto, H.; Oshima, K.; Utimoto, K.; Nozaki, H. *Bull. Chem. Soc., Jpn.*, ***1989***, *62*, 519.



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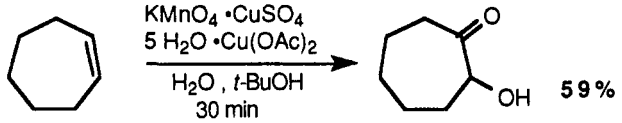

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REVIEWS:

"Stereoselective Carbon-Carbon Coupling"

Braun, M. *Angew. Chem. Int. Ed., Engl*, ***1987***, *26*, 24.

"Cross-Coupling Reactions Based on Acetals"

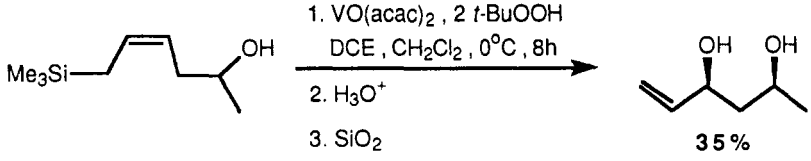
Mukaiyama, T.; Murakami, M. *Synthesis*, ***1987***, 1043.

SECTION 331: ALCOHOL, THIOL - NITRILE

NO ADDITIONAL EXAMPLES

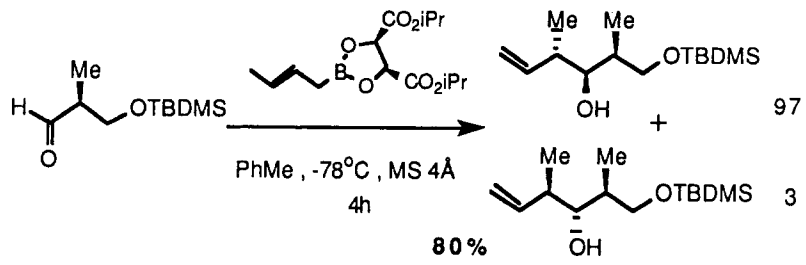
SECTION 332: ALCOHOL, THIOL - ALKENE

Allylic and benzylic hydroxylation (C=C-C-H → C=C-C-OH, etc.) is listed in Section 41 (Alcohols from Hydrides).



97:3 erythro:threo

Mohr, P.; Tamm, C. *Tetrahedron Lett.*, ***1987***, *28*, 395.



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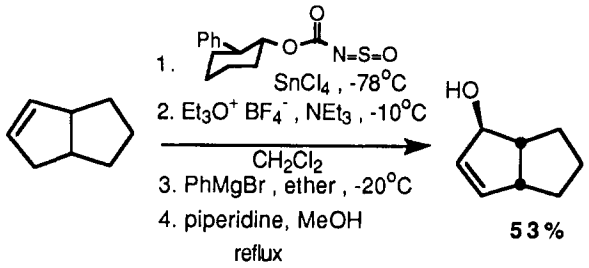

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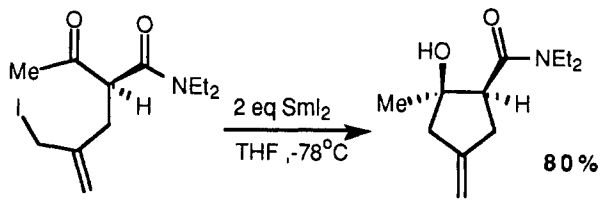
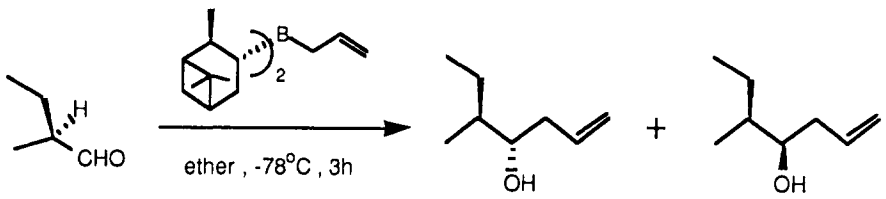


Molander, G.A.; Etter, J.B.; Zinke, P.W. *J. Am. Chem. Soc.*, ***1987***, *109*, 453.



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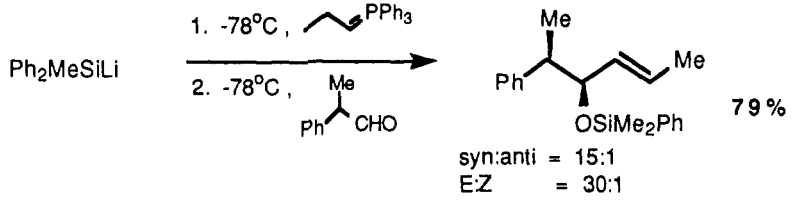
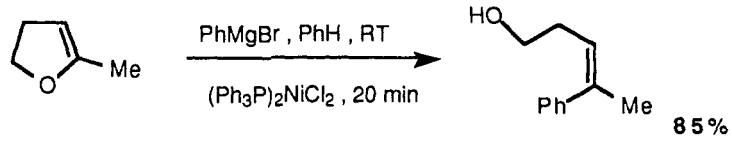
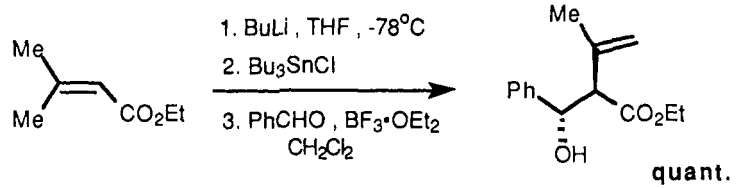


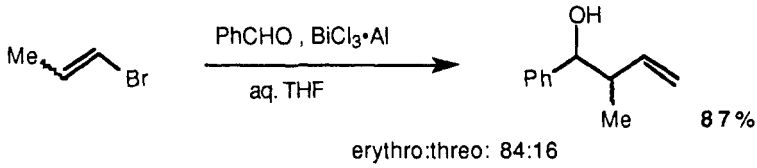
Tsukamoto, M.; Iio, H.; Tokoroyama, T. *Tetrahedron Lett.*, ***1987***, *28*, 4561,



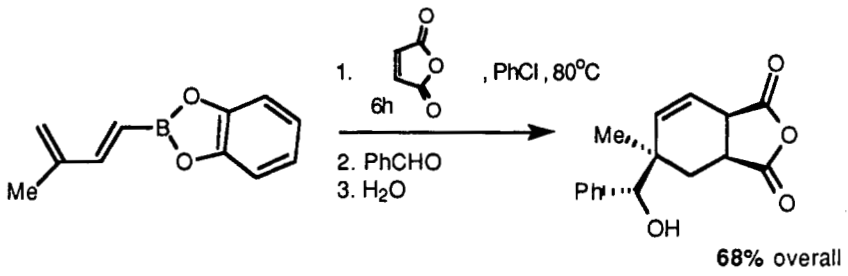
Wadman, S.; Whitby, R.; Yeates, C.; Kocienski, P. *J. Chem. Soc., Chem. Commun.*, ***1987***, 241.



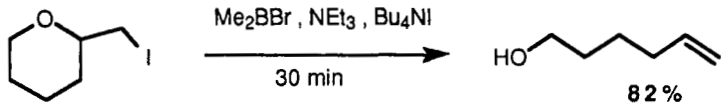
Yamamoto, Y.; Hatsuya, S.; Yamada, J. *J. Chem. Soc., Chem. Commun.*, ***1987***, 561.



Wada, M.; Ohki, H.; Akiba, K. *J. Chem. Soc., Chem. Commun.*, ***1987***, 708.



Vaultier, M.; Truchet, F.; Carboni, B.; Hoffmann, R.W.; Denne, I. *Tetrahedron Lett.*, ***1987***, *28*, 4169.



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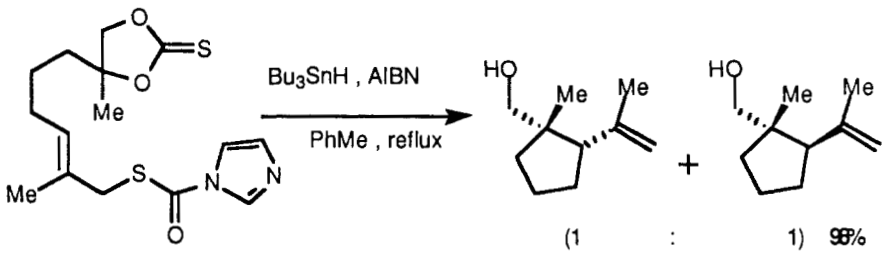
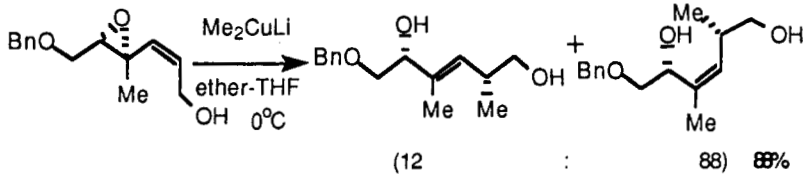


Ziegler, F.E.; Zheng, Z. *Tetrahedron Lett.*, ***1987***, *28*, 5973.



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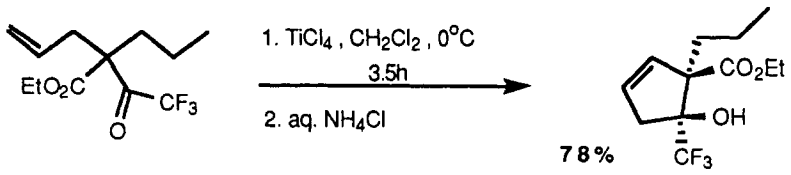

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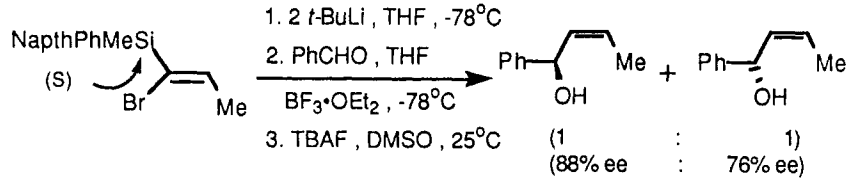
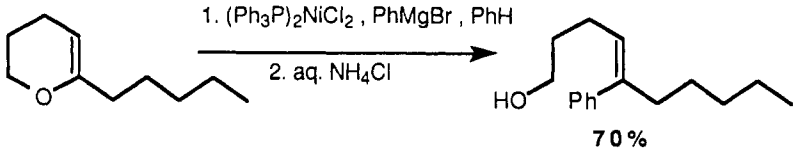
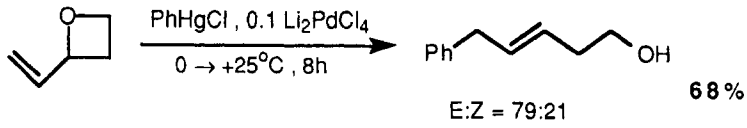


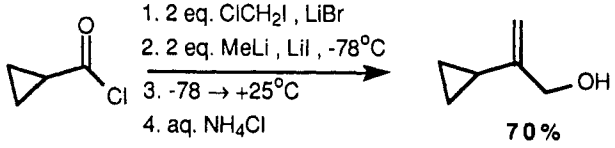
Torres, E.; Larson, G.L.; McGarvey, G.J. *Tetrahedron Lett.*, ***1988***, *29*, 1355.



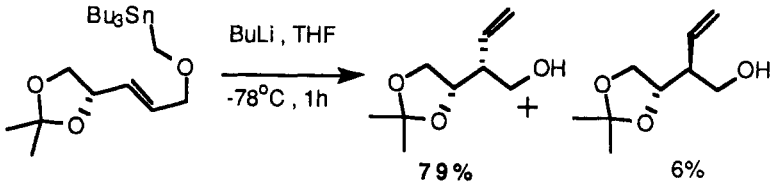
Kocieński, P.; Dixon, N.J.; Wadman, S. *Tetrahedron Lett.*, ***1988***, *29*, 2353.



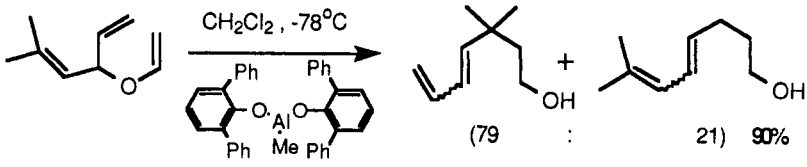
Larock, R.C.; Stolz-Dunn, S.K. *Tetrahedron Lett.*, ***1988***, *29*, 5069.



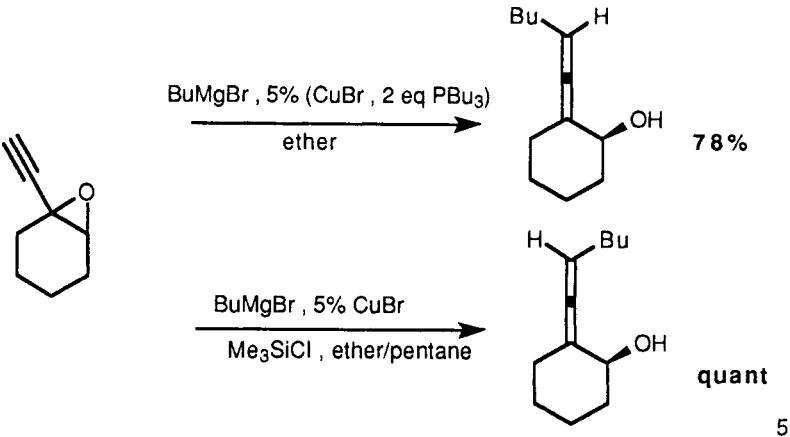
Barluenga, J.; Concellón, J.M.; Fernández-Simón, J.; Yus, M. *J. Chem. Soc., Chem. Commun.*, ***1988***, 536.



Brückner, R.; Priepke, H. *Angew. Chem. Int. Ed., Engl,* ***1988****, 27*, 278.



Maruoka, K.; Banno, H.; Nonoshita, K.; Yamamoto, H. *Tetrahedron Lett.,* ***1989****, 30*, 1265.



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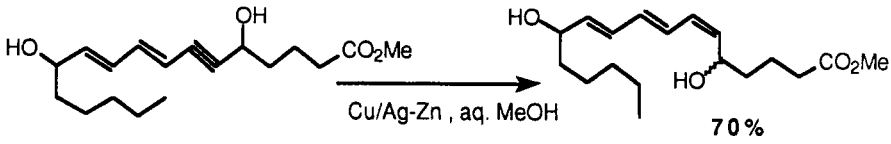
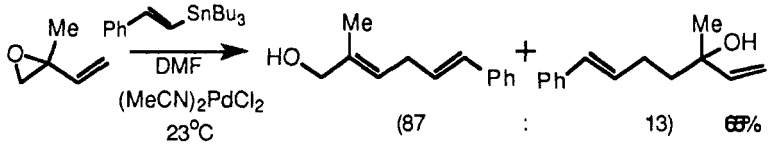
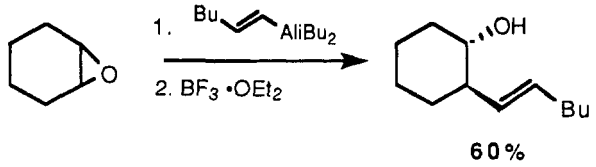
Alexakis, A.; Marek, I.; Mangeney, P.; Normant, J.F. *Tetrahedron Lett.,* ***1989****, 30*, 2391.



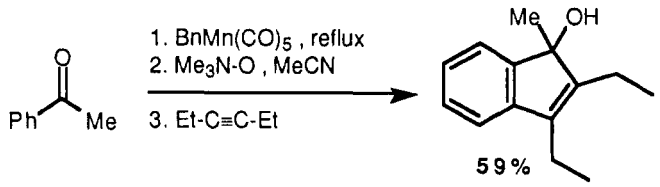
Avignon-Tropis, M.; Pougny, J.R. *Tetrahedron Lett.,* ***1989****, 30*, 4951.



Teuting, D.R.; Echavarren, A.M.; Stille, J.K. *Tetrahedron, **1989**, 45*, 979.



Alexakis, A.; Jachiet, D. *Tetrahedron, **1989**, 45*, 6197.



Liebeskind, L.S.; Gasdaska, J.R.; McCallum, J.S. *J. Org. Chem., **1989**, 54*, 669.

REVIEW:

"Intramolecular Addition Reactions of Allylic and Propargylic Silanes"

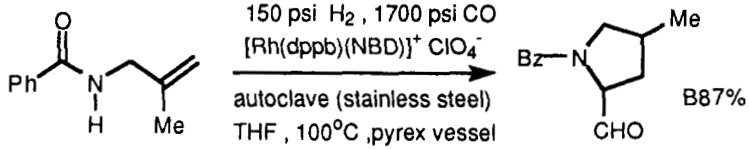
Schinzer, D. *Synthesis, **1988***, 263.

Also via: Section 302 (Alkyne - Alcohol).

SECTION 333: ALDEHYDE - ALDEHYDE

NO ADDITIONAL EXAMPLES

SECTION 334: ALDEHYDE - AMIDE



Ojima, I.; Zhang, Z. *J. Org. Chem.*, ***1988***, *53*, 4422.

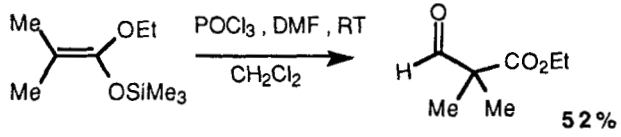
SECTION 335: ALDEHYDE - AMINE

REVIEW:

"Optically Active N-Protected α-Amino Aldehydes in Organic Synthesis"

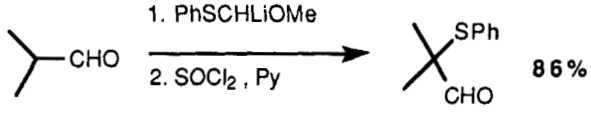
Jurczak, J.; Gułębiowski, A. *Chem. Rev.*, ***1989***, *89*, 149.

SECTION 336: ALDEHYDE - ESTER

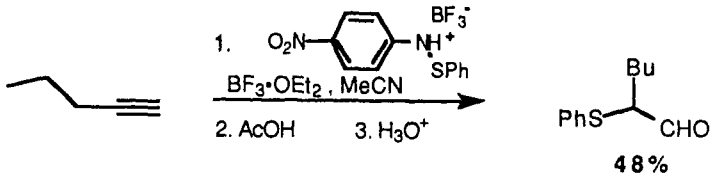


Reddy, C.P.; Tanimoto, S. *Synthesis*, ***1987***, 575.

SECTION 337: ALDEHYDE - ETHER, EPOXIDE, THIOETHER



Jansen, B.J.M.; Peperzak, R.M.; de Groot, Ae. *Recl. Trav. Chim., Pays-Bas*, ***1987***, *106*, 489.

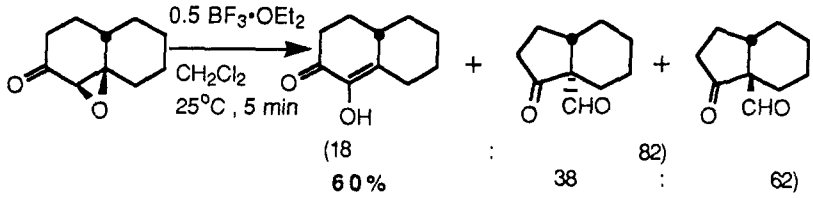


Benati, L.; Montevecchi, P.C.; Spagnoli, P. *Tetrahedron Lett.*, ***1988***, *29*, 2381.

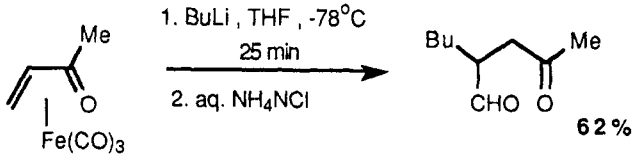
SECTION 338: ALDEHYDE - HALIDE, SULFONATE

NO ADDITIONAL EXAMPLES

SECTION 339: ALDEHYDE - KETONE



Klix, R.C.; Bach, R.D. *J. Org. Chem.*, ***1987***, *52*, 580.



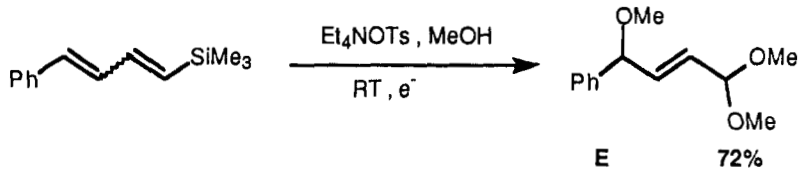
Kitahara, H.; Tozawa, Y.; Fujita, S.; Tajira, A.; Morita, N.; Asao, T. *Bull. Chem. Soc., Jpn.*, ***1988***, *61*, 3362.

SECTION 340: ALDEHYDE - NITRILE

NO ADDITIONAL EXAMPLES

SECTION 341: ALDEHYDE - ALKENE

For the oxidation of allylic alcohols to alkene aldehydes, also see Section 48 (Aldehydes from Alcohols).



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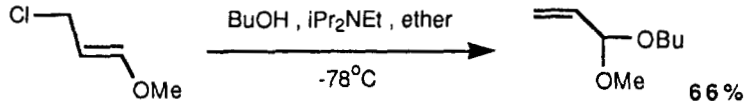
Yoshida, J.; Murata, T.; Isoe, S. *Tetrahedron Lett.*, ***1987***,*28*, 211.



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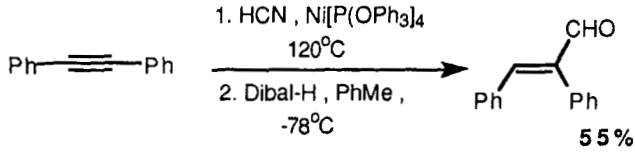
Hagen, J.P.; Harris, J.J.; Lakin, D. *J. Org. Chem.*, ***1987***, *52*, 782.



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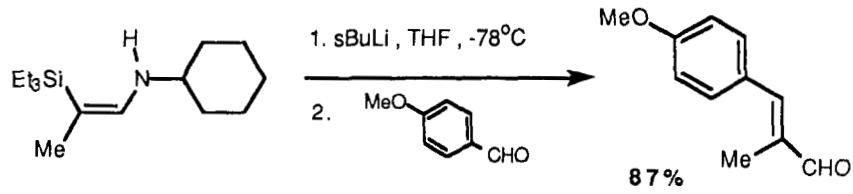
Campi, E.; Fitzmaurice, N.J.; Jackson, W.R.; Perlmutter, P.; Smallridge, A.J. *Synthesis*, ***1987***, 1032.



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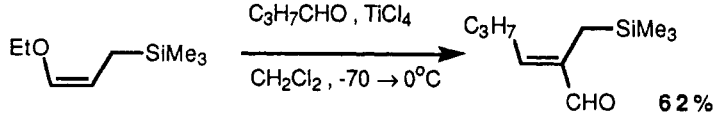
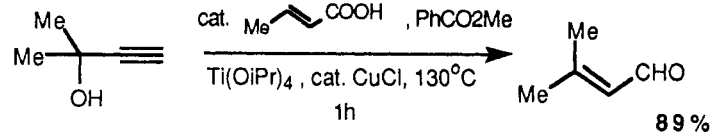
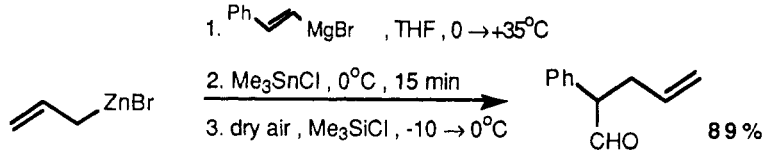
Desmond, R.; Mills, S.G.; Volante, R.P.; Shinkai, I. *Tetrahedron Lett.*, ***1988***, *29*, 3895.



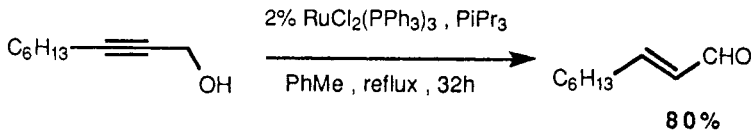
Pornet, J.; Rayadh, A.; Miginiac, L. *Tetrahedron Lett.*, ***1988***, *29*, 4717.



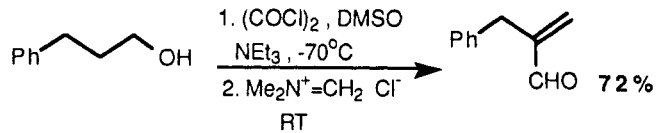
Chabardes, P. *Tetrahedron Lett.*, ***1988***, *29*, 6253.



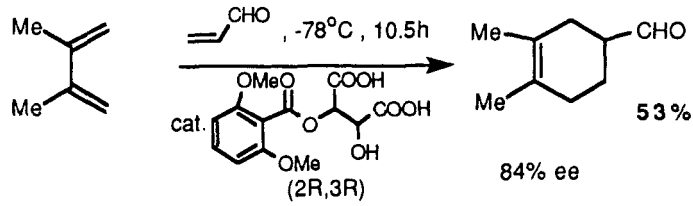
Knochel, P.; Xiao, C.; Yeh, M.C.P. *Tetrahedron Lett.*, ***1988***, *29*, 6697.



Ma, D.; Lu, X. *J. Chem. Soc., Chem. Commun.*, ***1989***, 890.



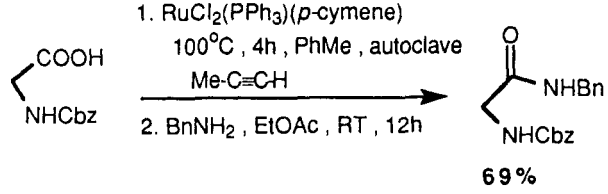
Takano, S.; Inomata, K.; Samizu,K.; Tomita, S.; Yanase, M.; Suzuki, M.; Iwabuchi, Y.; Sugihara, T.; Ogasawara, K. *Chem. Lett.*, ***1989***, 1283.



Furuta, K.; Shimizu, S.; Miwa, Y.; Yamamoto, H. *J. Org. Chem.*, ***1989***, *54*, 1481.

Also via β-Hydroxy aldehydes: Section 324 (Alcohols - Aldehyde).

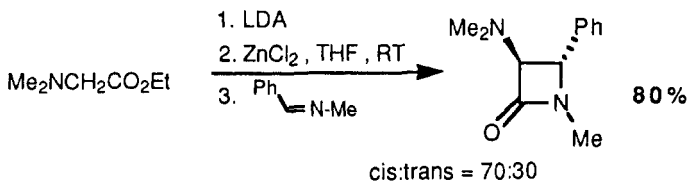
SECTION 342: AMIDE - AMIDE



Ruppin, C.; Dixneuf, P.H.; Lecolier, S. *Tetrahedron Lett.*, ***1988***, *29*, 5365.

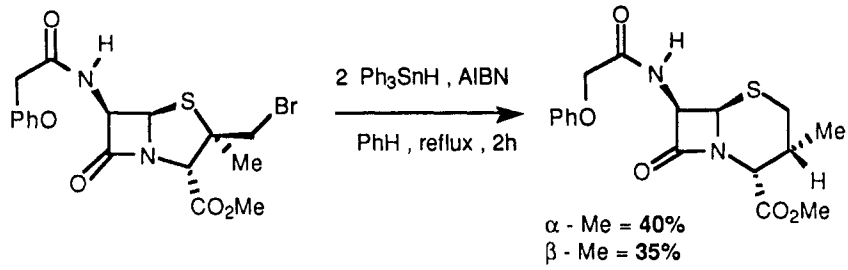
Also via Dicarboxylic Acids:	Section 312 (Carboxylic Acid - Carboxylic Acid)
Diamines	Section 350 (Amines - Amines)

SECTION 343: AMIDE - AMINE

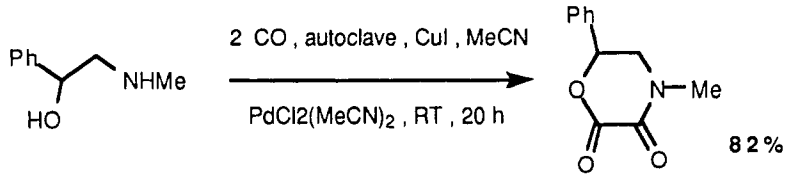


Van der Steen, F.H.; Kleijn, H.; Jastrebski, J.T.B.H.; van Koten, G. *Tetrahedron Lett.*, ***1989***, *30*, 765.

SECTION 344: AMIDE - ESTER



Baldwin, J.E.; Adlington, R.M.; Kang, T.W.; Lee, E.; Schofield, C.J. *J. Chem. Soc., Chem. Commun.*, ***1987***, 104.



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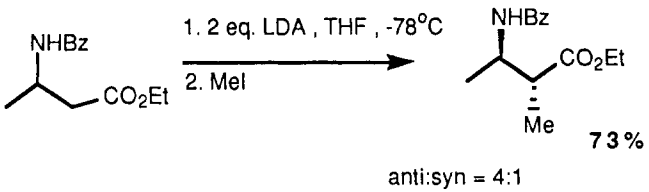

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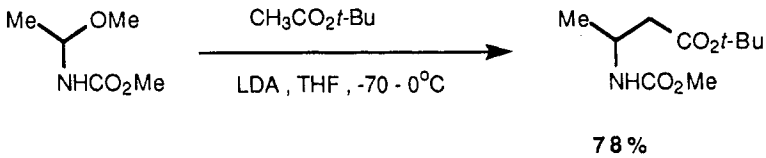

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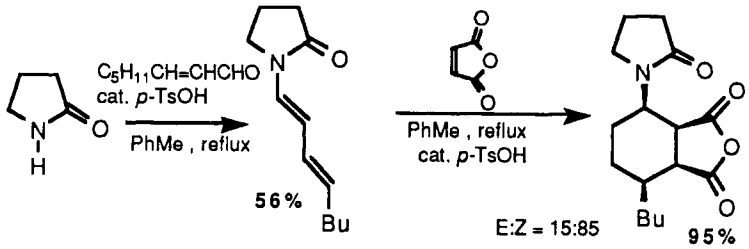

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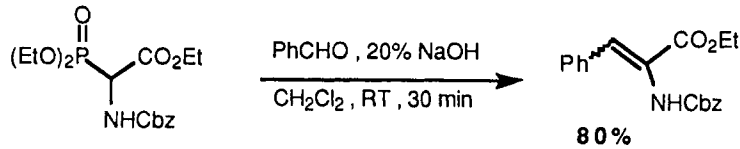

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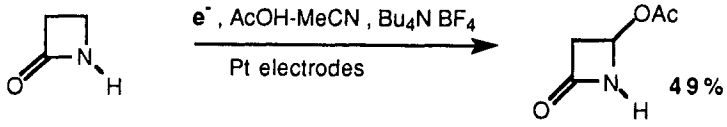

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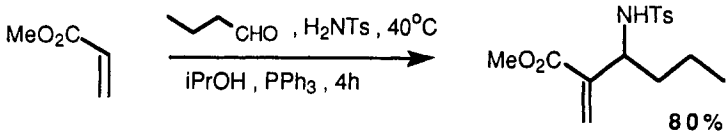

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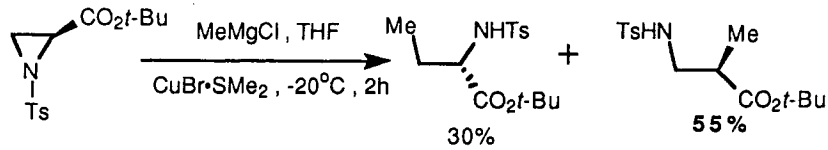

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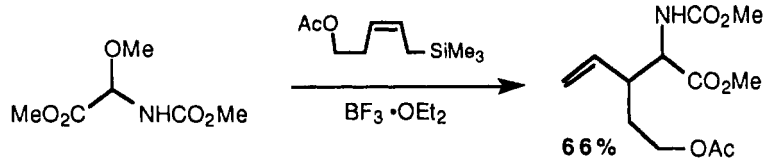

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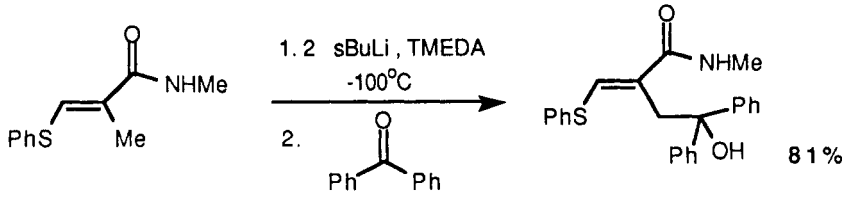
Related Methods: Section 315 (Carboxylic Acid - Amide)
Section 316 (Carboxylic Acid - Amine)
Section 351 (Amine - Ester)

SECTION 345: AMIDE - ETHER, EPOXIDE, THIOETHER



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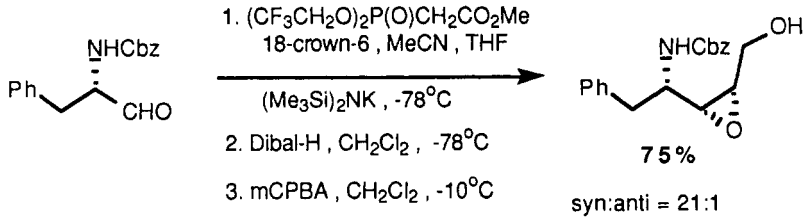

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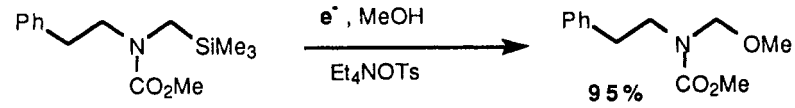

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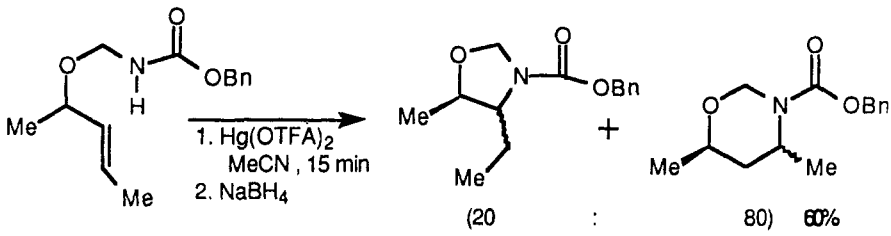

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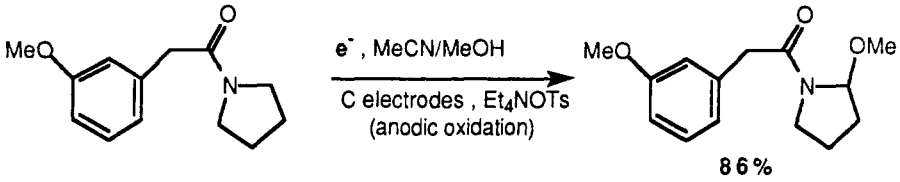

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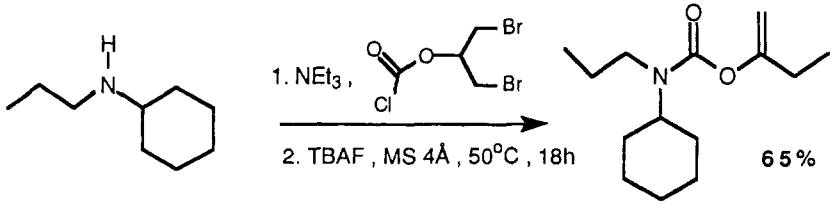
SECTION 346: AMIDE - HALIDE, SULFONATE



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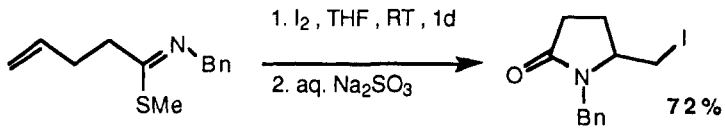

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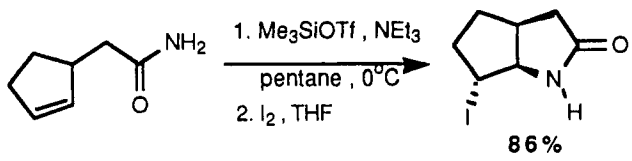

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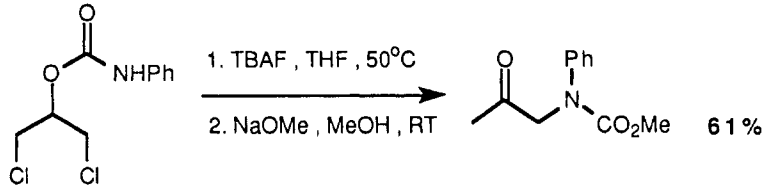
SECTION 347: AMIDE - KETONE



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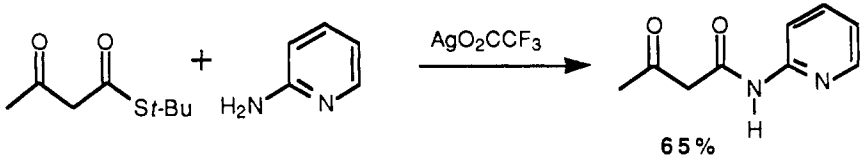
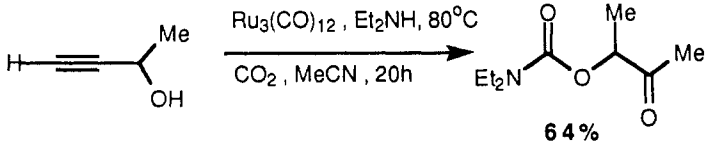


Ley, S.V.; Woodward, P.R. *Tetrahedron Lett.*, ***1987***, *28*, 3019.



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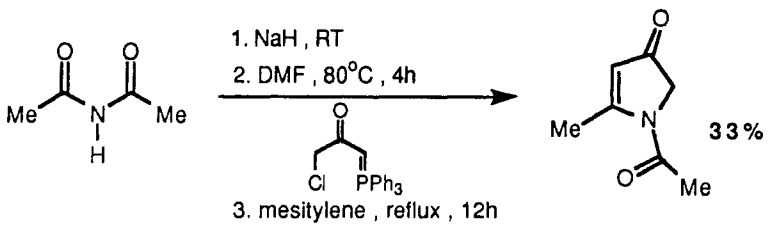
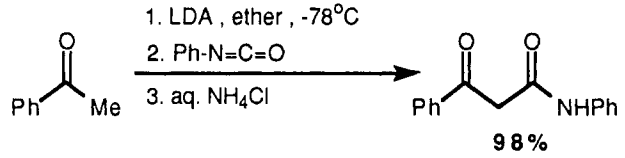


Flitsch, W.; Hampel, K.; Hohenhorst, M. *Tetrahedron Lett.*, ***1987***, *28*, 4395.



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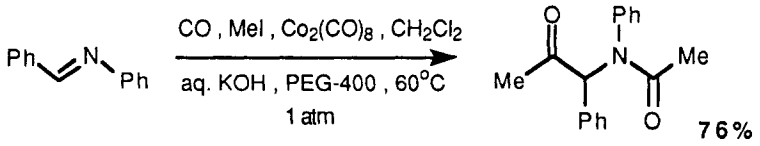

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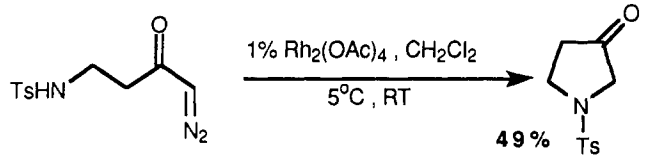

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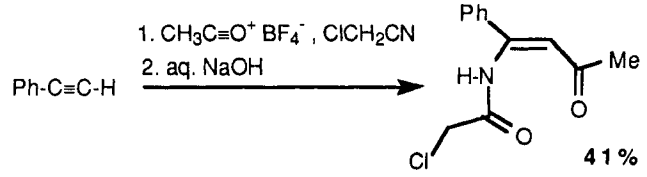
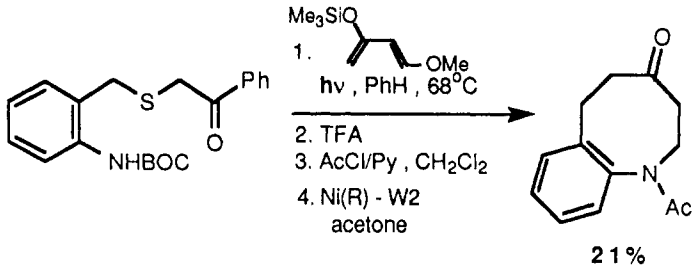


Gridnev, I.D.; Balenkova, E.S. *J. Org. Chem., U.S.S.R.*, ***1988***, *24*, 1447.



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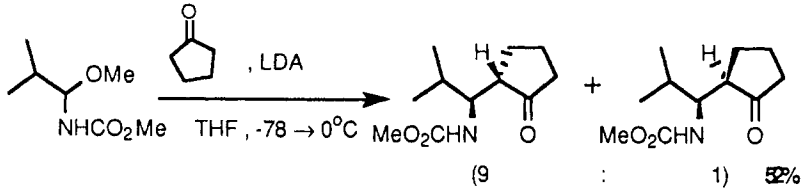
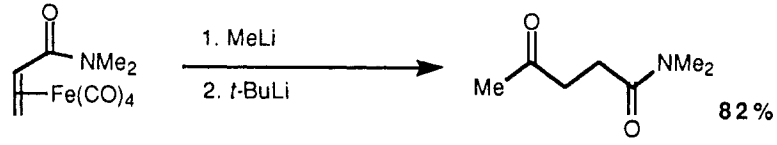


Shono, T.; Kise, N.; Sanda, F.; Ohi, S.; Yoshioka, K. *Tetrahedron Lett.*, ***1989***, *30*, 1253.



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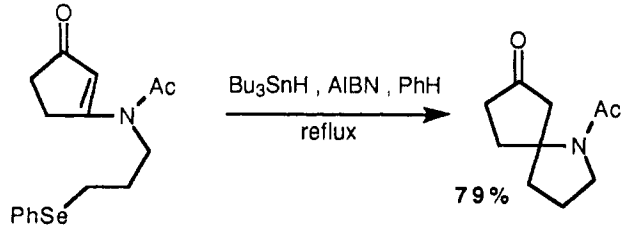

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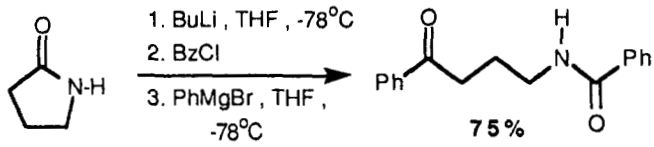

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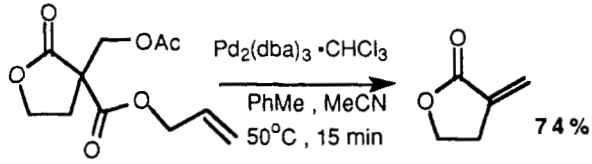
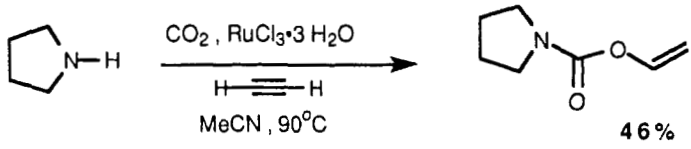
SECTION 348: AMIDE - NITRILE



Ognyanov, V.I.; Hesse, M. *Helv. Chim. Acta*, ***1989***, *72*, 1522.

SECTION 349: AMIDE - ALKENE



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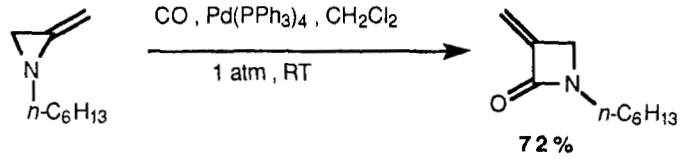

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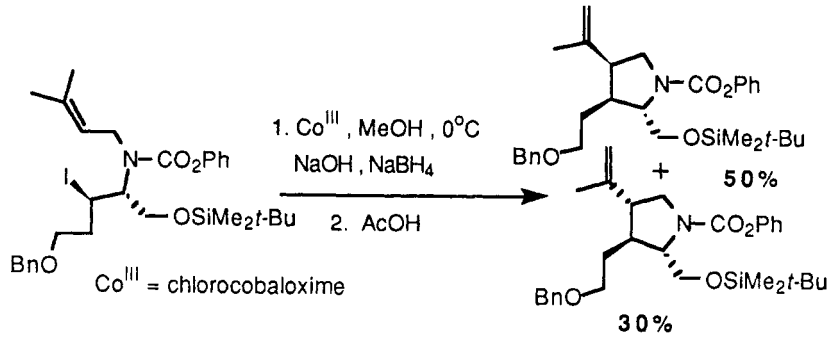

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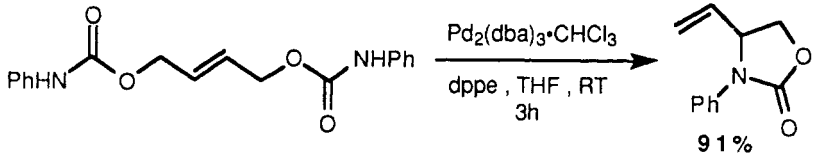

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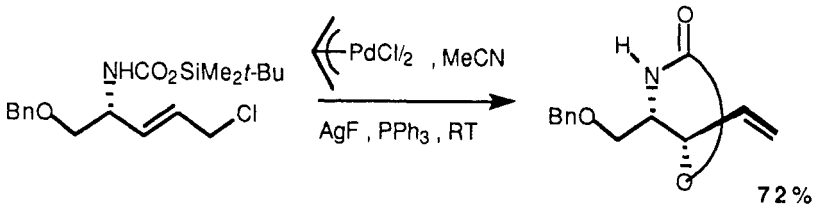

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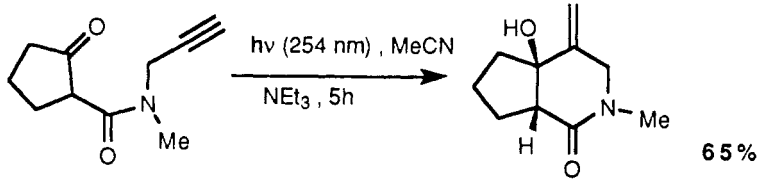

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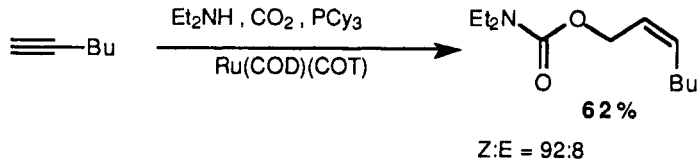

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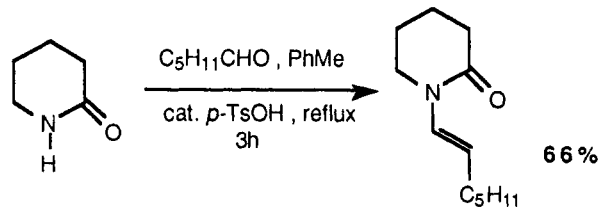

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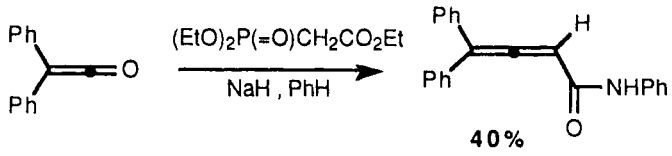
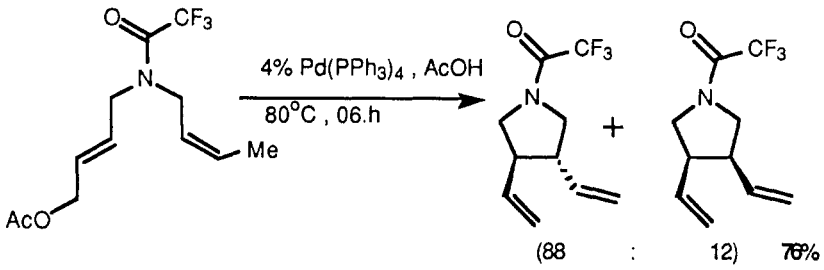


Fillion, H.; Hseine, A.; Péra, M.-H. *Synth. Commun.*, ***1987***, *17*, 929.



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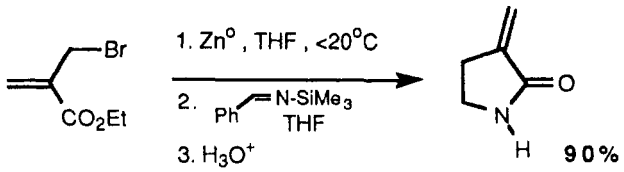

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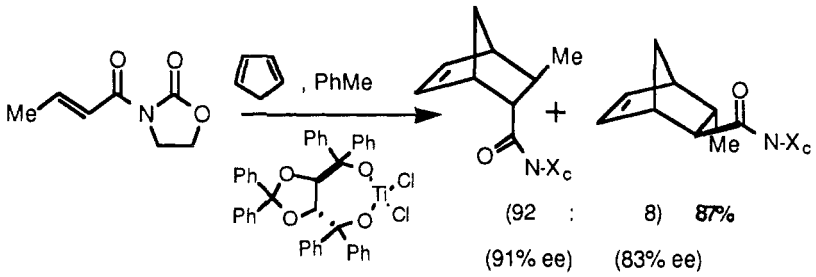

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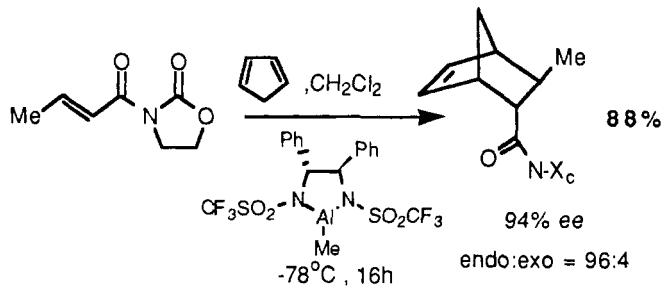

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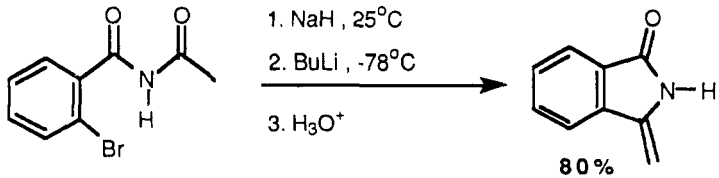
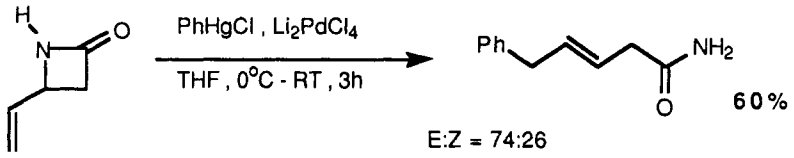


Hendi, M.S.; Natalie Jr., K.J.; Hendi, S.B.; Campbell, J.A.; Greenwood, T.D.; Wolfe, J.F. *Tetrahedron Lett.*, ***1989***, *30*, 275.



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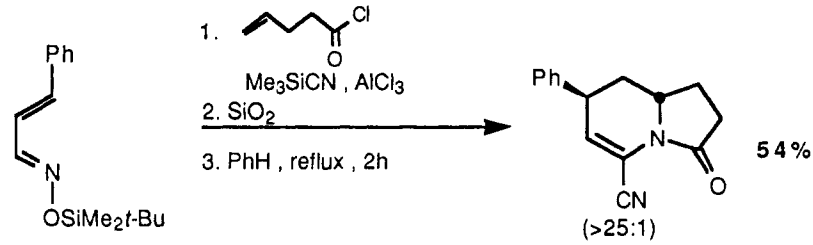

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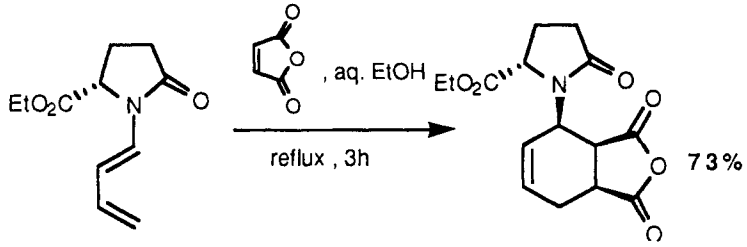

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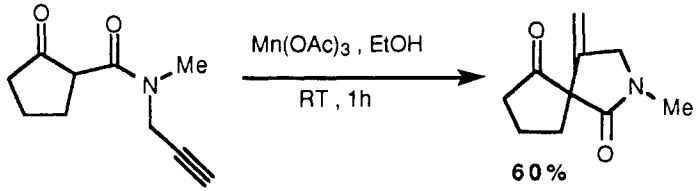

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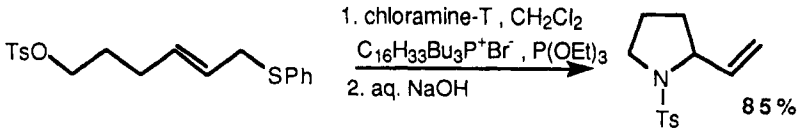
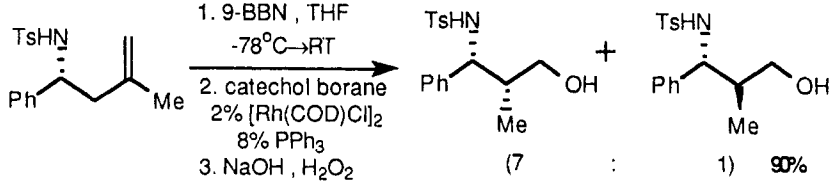


Dolle, R.E.; Li, C.-S.; Shaw, A.N. *Tetrahedron Lett.*, ***1989***, *30*, 4723.



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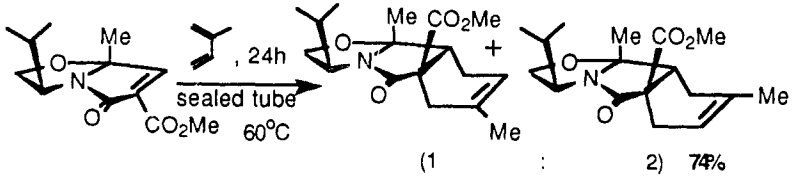

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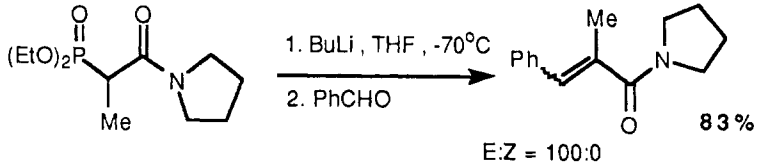

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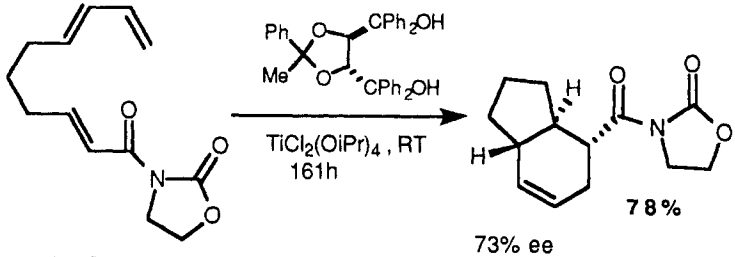
Tay, M.K.; About-Jaudet, E.; Collignon, N.; Savignac, P. *Tetrahedron*, ***1989***, *45*, 4415.

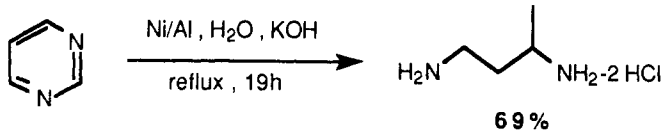


73% ee

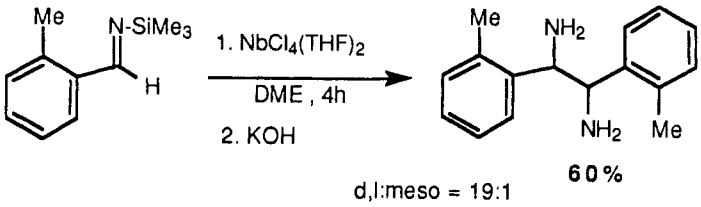
Iwasawa, N.; Sugimori, J.; Kawase, Y.; Narasaka, K. *Chem. Lett.*, ***1989***, 1947.

Also via Alkenyl Acids: Section 322 (Carboxylic Acid -Alkene)

SECTION 350: AMINE - AMINE



Lunn, G. *J. Org. Chem.*, ***1987***, *52*, 1043.



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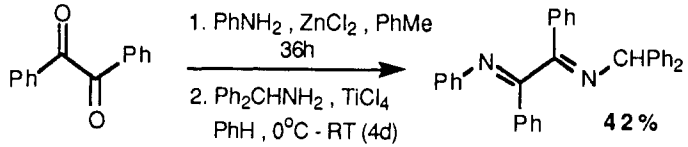

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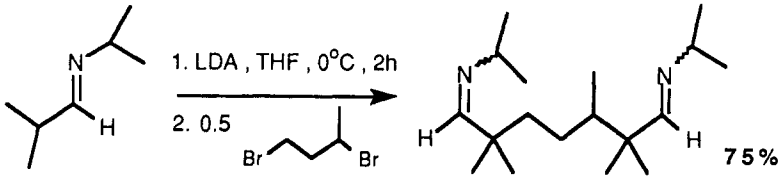
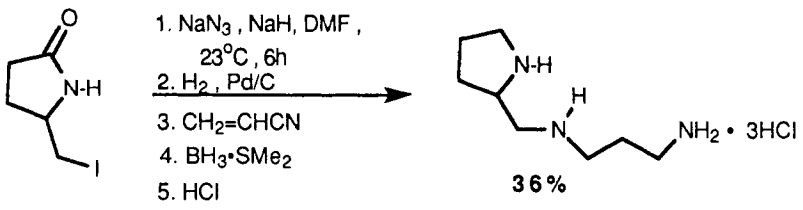
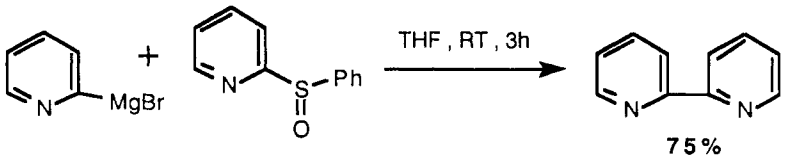


Sulmon, P.; DeKimpe, N.; Schamp, N. *Org. Prep. Proceed. Int.*, ***1987***, *19*, 17.



Knapp, S.; Levorse, A.T. *Tetrahedron Lett.*, ***1987***, *28*, 3213.



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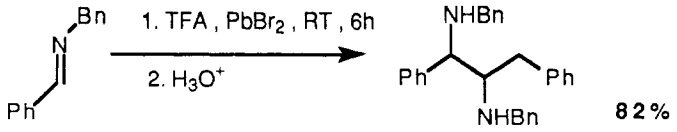

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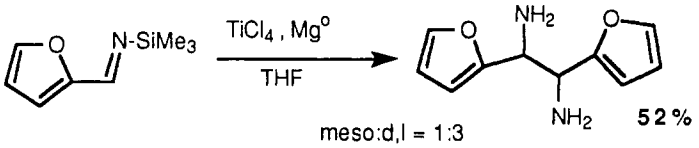

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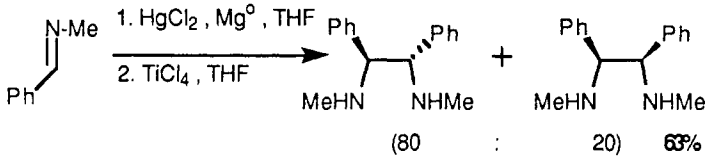
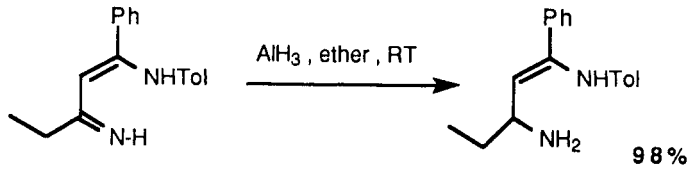


Mangeney, P.; Tejero, T.; Alexakis, A.; Grosjean, F.; Normant, J. *Synthesis*, ***1988***, 255.



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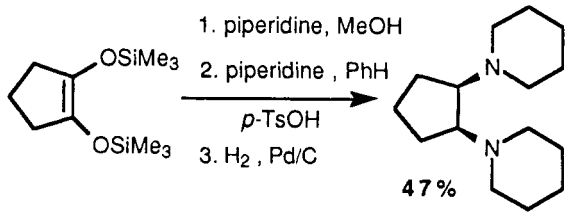
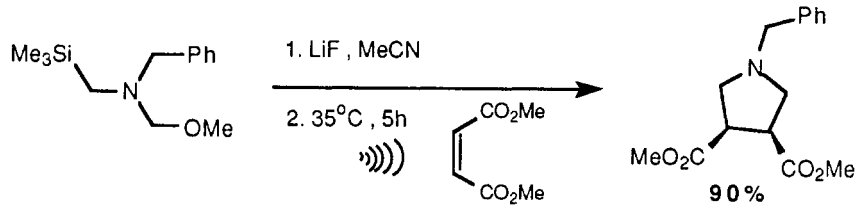


Fraenkel, G.; Gallucci, J.; Rosenzweig, H.S. *J. Org. Chem.*, ***1989***, *54*, 677.

SECTION 351: AMINE - ESTER



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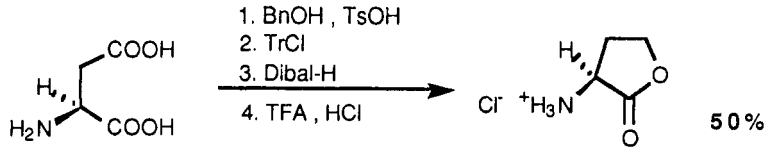
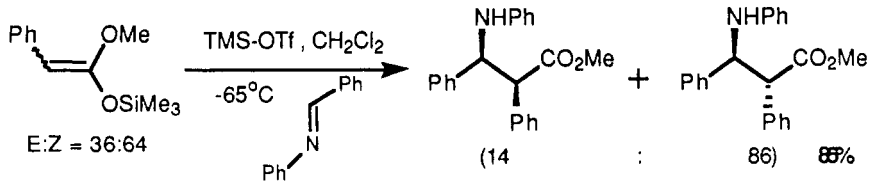
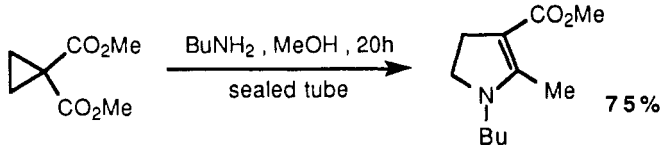


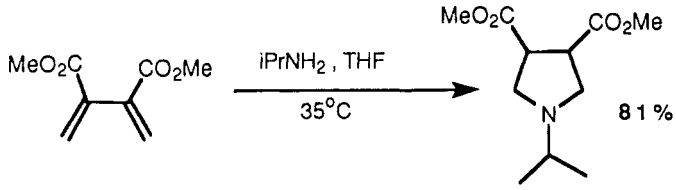
Baldwin, J.E.; North, M.; Flinn, A. *Tetrahedron Lett.*, ***1987***, *28*, 3167.



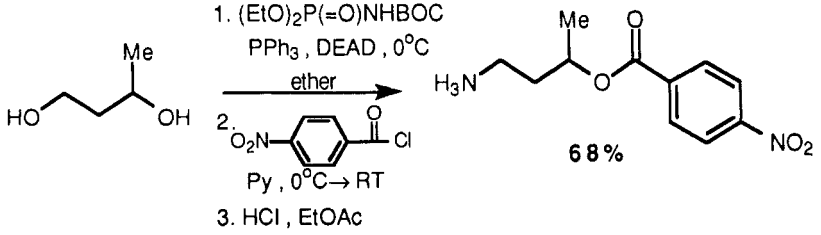
Guanti, G.; Narisano, E.; Banfi, L. *Tetrahedron Lett.*, ***1987***, *28*, 4331, 4335.



Celerier, J.P.; Haddad, M.; Jacoby, D.; Lhommet, G. *Tetrahedron Lett.*, ***1987***, *28*, 6597.



Tarnchampoo, B.; Thebtaranonth, C.; Thebtaranonth, Y. *Tetrahedron Lett.*, ***1987***, *28*, 6675.



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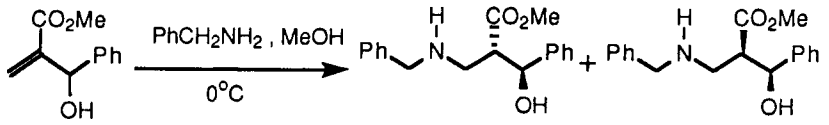
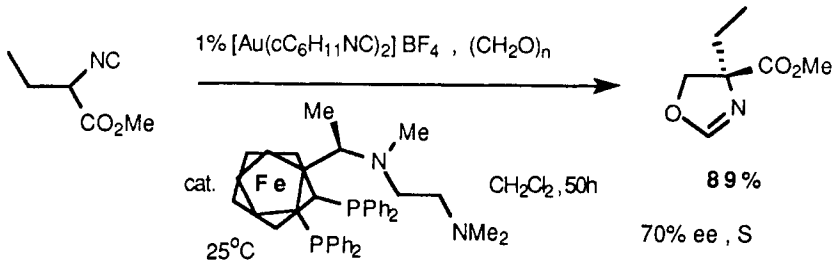
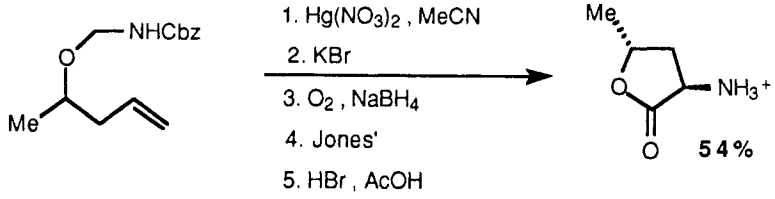


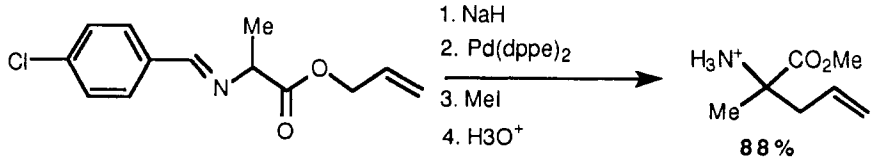
Perlmutter, P.; Mabone, M. *Tetrahedron Lett.*, ***1988***, *29*, 949.



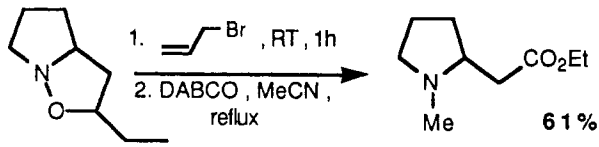
Ito, Y.; Sawamura, M.; Shirakawa, E.; Hayashizaki, K.; Hayashi, T. *Tetrahedron Lett.*, ***1988***, *29*, 239.



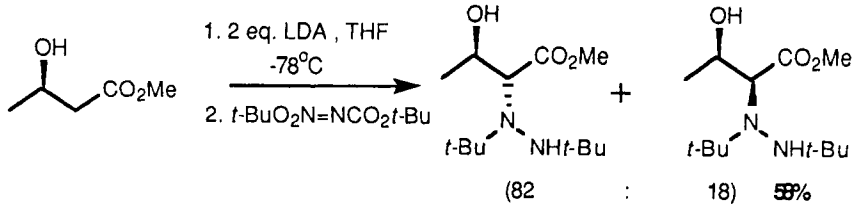
Harding, K.E.; Marman, T.H.; Nam, D. *Tetrahedron Lett.*, ***1988***, *29*, 1627.



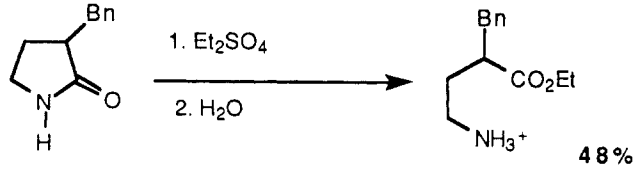
van der Werf, A.; Kellogg, R.M. *Tetrahedron Lett.*, ***1988***, *29*, 4981.



Murahashi, S.; Kodera, Y.; Hosomi, T. *Tetrahedron Lett.*, ***1988***, *29*, 5949.



Genet, J.P.; Juge, S.; Mallart, S. *Tetrahedron Lett.*, ***1988***, *29*, 6765.



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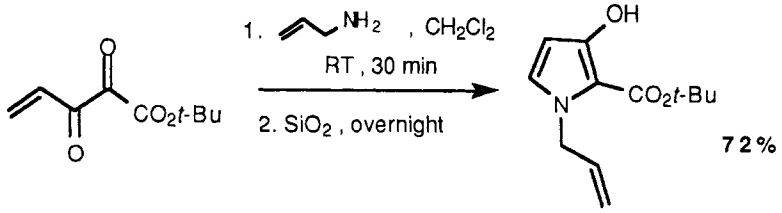
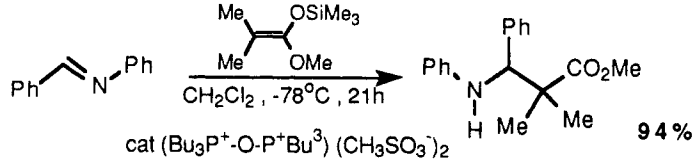


Wasserman, H.H.; Cook, J.D.; Fukuyama, J.M.; Rotello, V.M. *Tetrahedron Lett.*, ***1989***, *30*, 1721.



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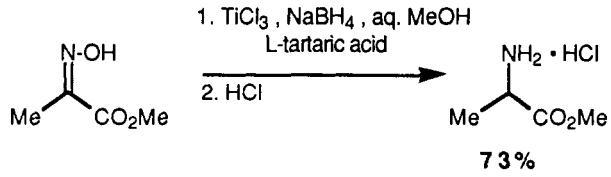
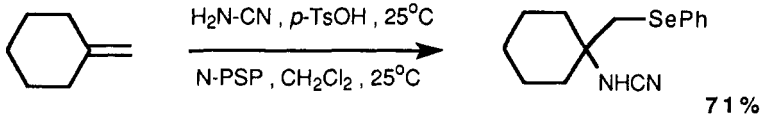
Mukaiyama, T.; Kashiwagi, K.; Matsui, S. *Chem. Lett.*, ***1989***, 1397.



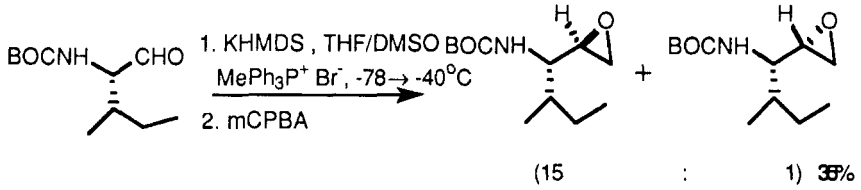
Hoffman, C.; Tanke, R.S.; Miller, M.J. *J. Org. Chem.*, ***1989***, *54*, 3750.

Related Methods: Section 315 (Carboxylic Acid - Amide)
Section 316 (Carboxylic Acid - Amine)
Section 344 (Amide - Ester)

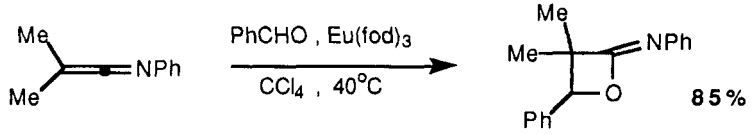
SECTION 352: AMINE - ETHER, EPOXIDE, THIOETHER



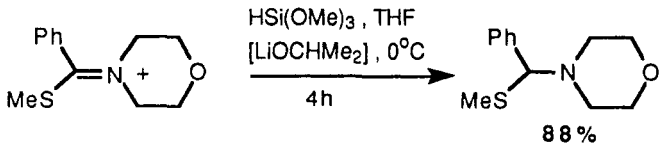
Hernández, R.; León, E.I.; Salazar, J.A.; Suárez, E. *J. Chem. Soc., Chem. Commun.*, ***1987***, 312.



Luly, J.R.; Dellaria, J.F.; Plattner, J.J.; Soderquist, J.L. *J. Org. Chem.*, ***1987***, *52*, 1487.



Barbaro, G.; Battaglia, A.; Giorgianni, P. *Tetrahedron Lett.*, ***1987***, *28*, 2995.



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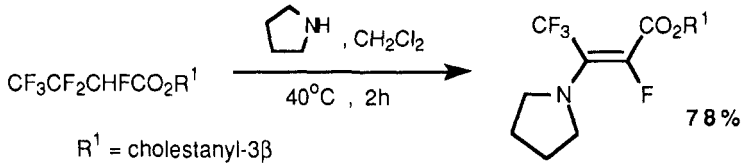
REVIEW:

"Chemistry of Lactam Acetals"

Anand, N.; Singh, J. *Tetrahedron*, ***1988***, *44*, 5975.

SECTION 353: AMINE - HALIDE, SULFONATE



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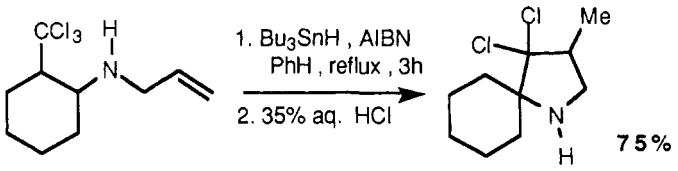

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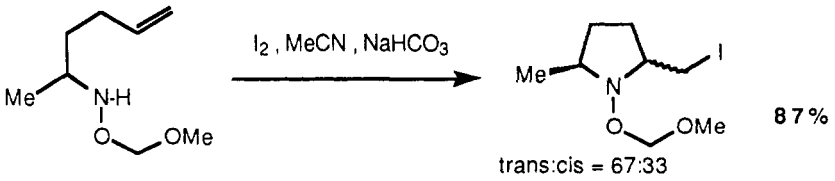

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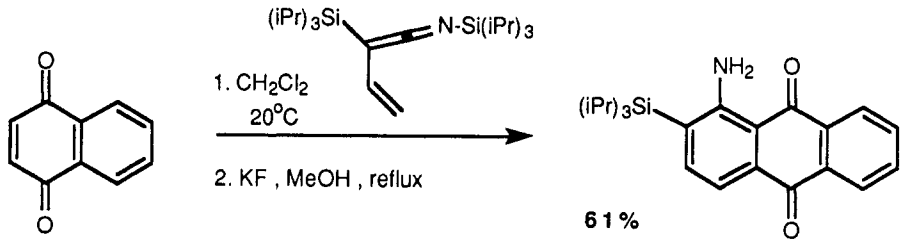

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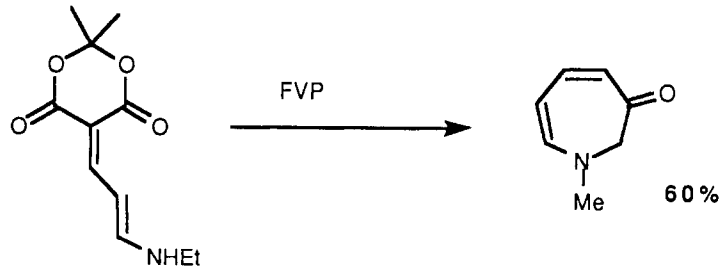

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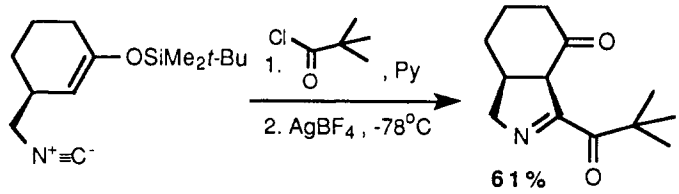

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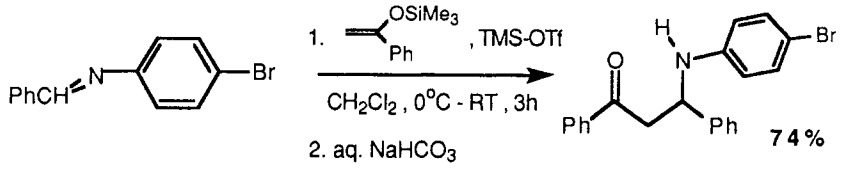

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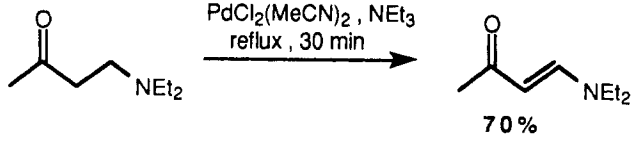

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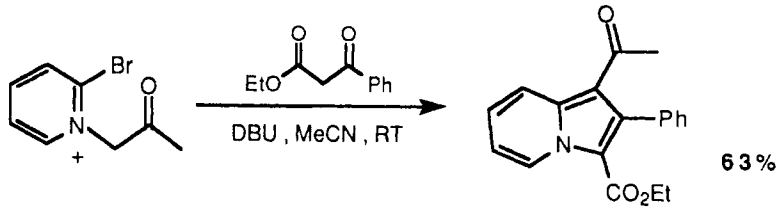

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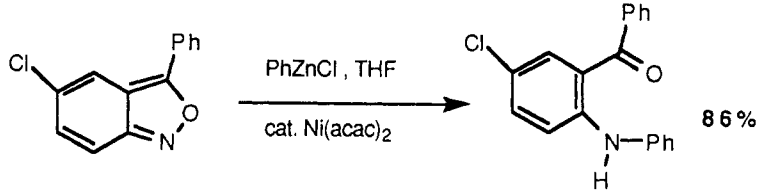

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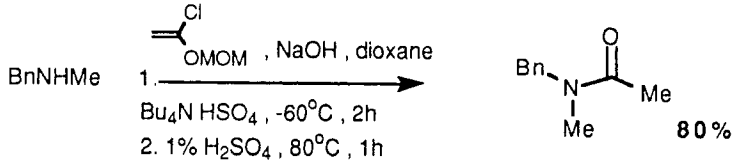

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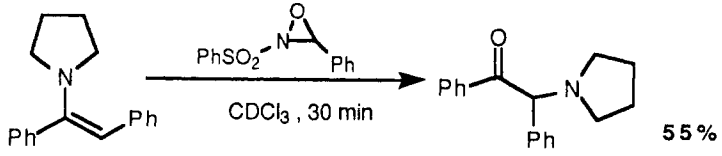

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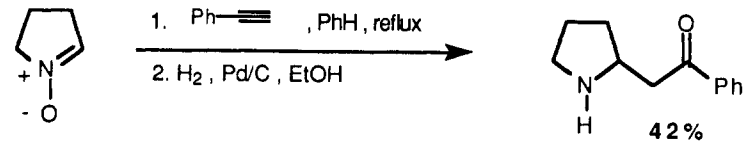

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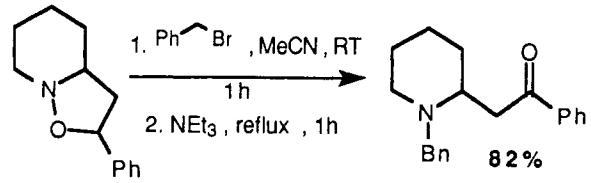

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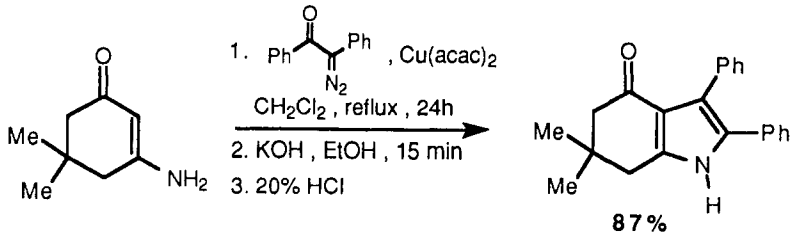

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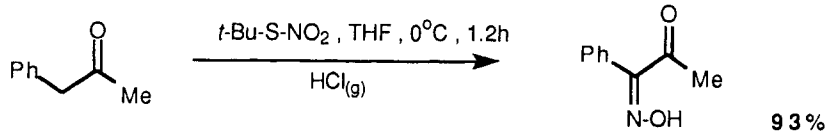

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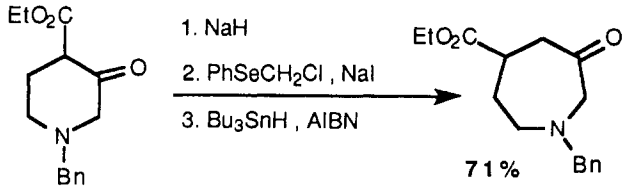

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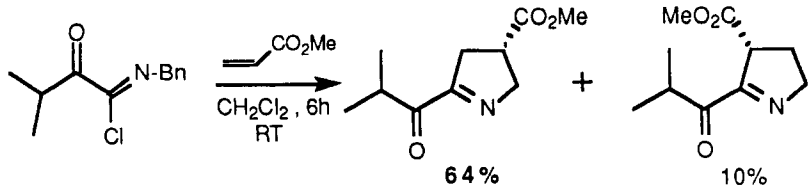

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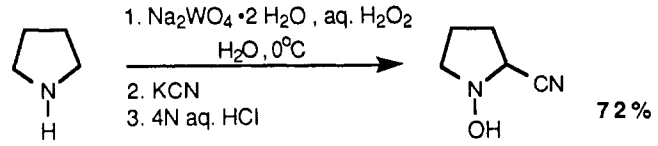

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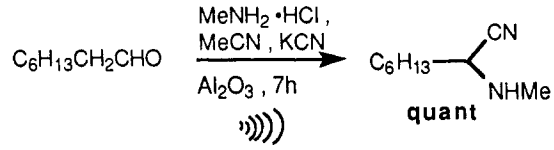

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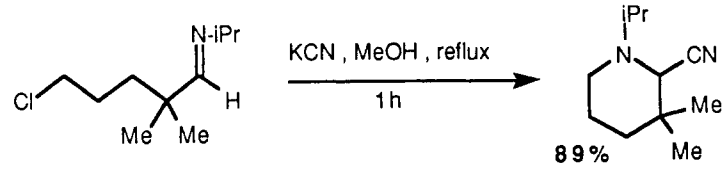

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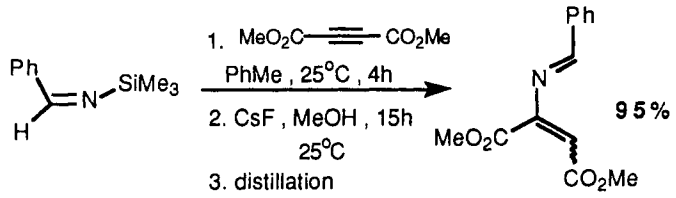

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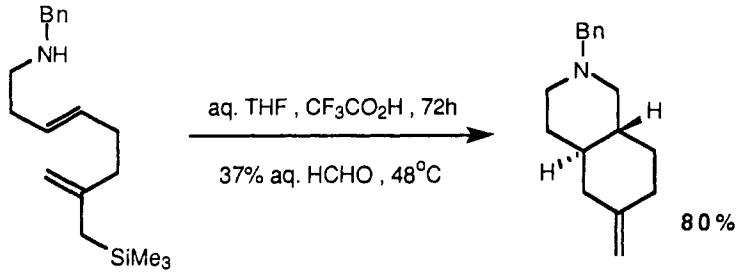

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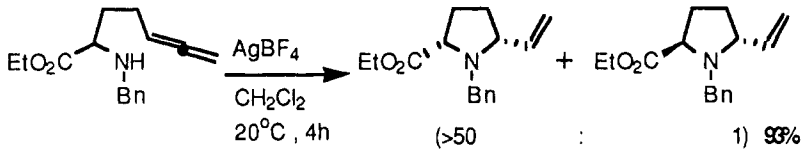

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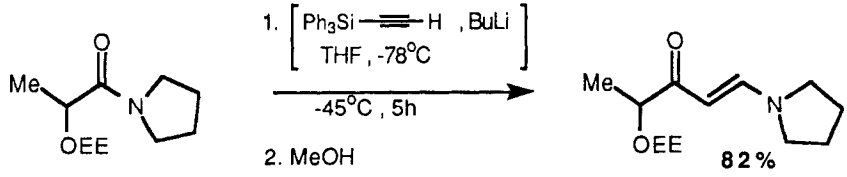

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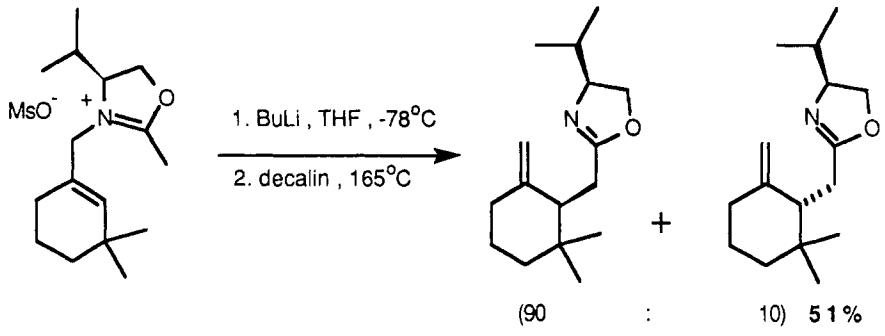

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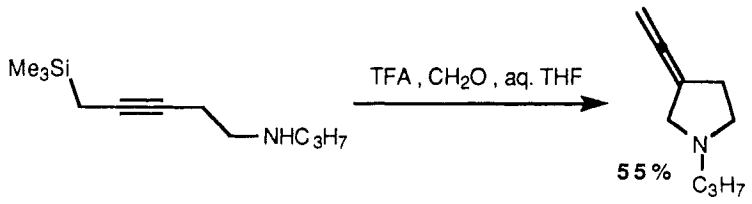

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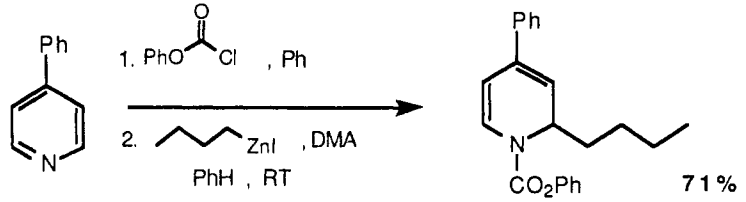

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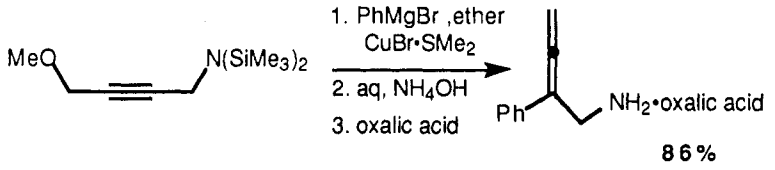

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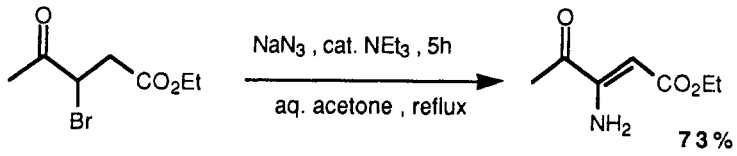

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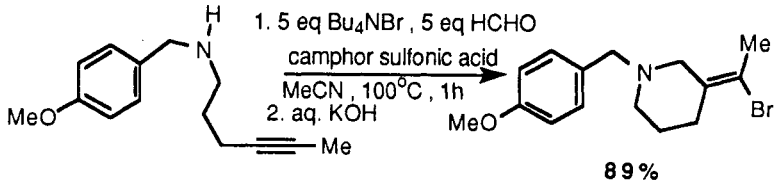

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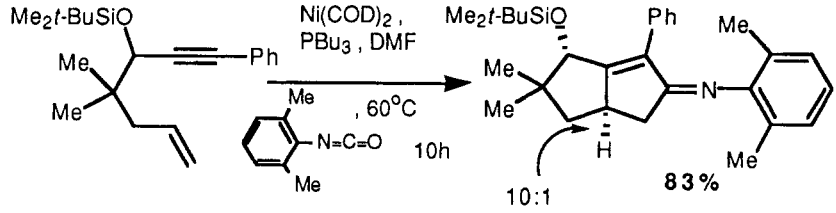

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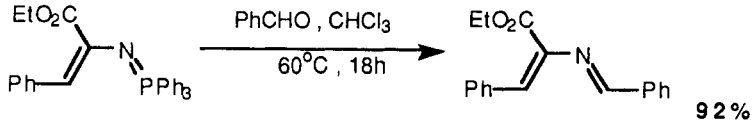

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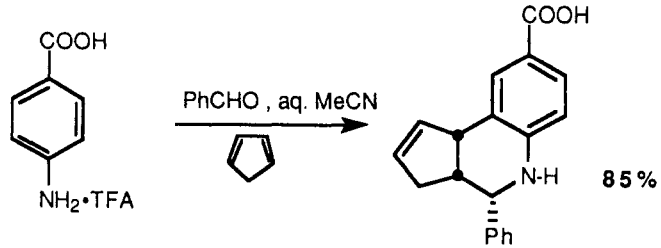

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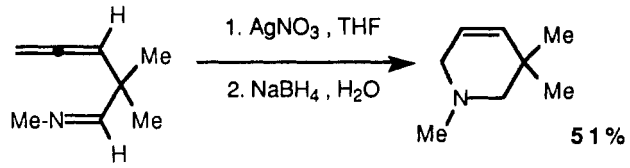

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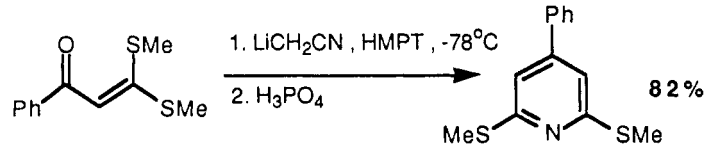

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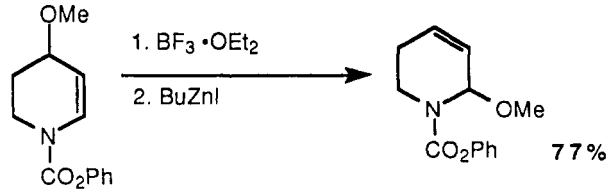

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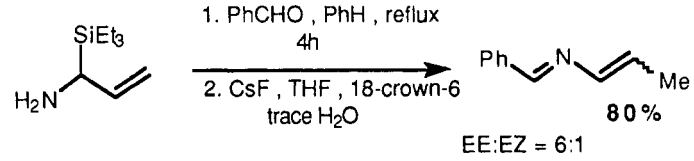

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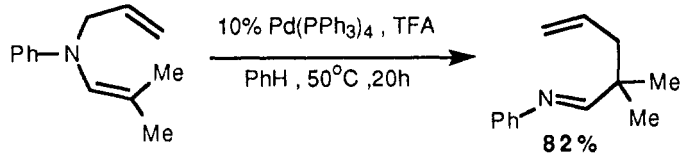

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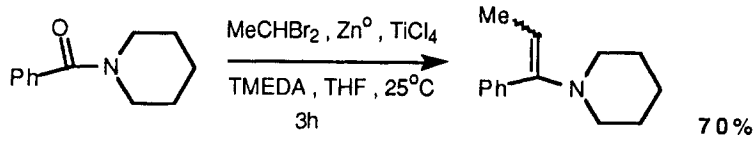

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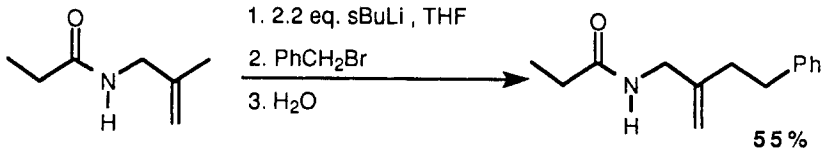

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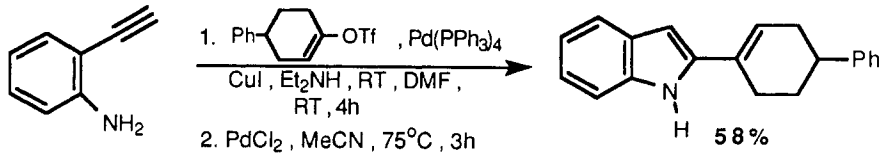

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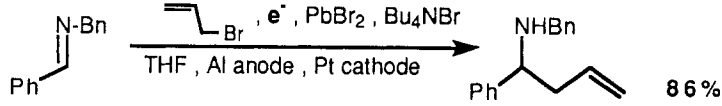

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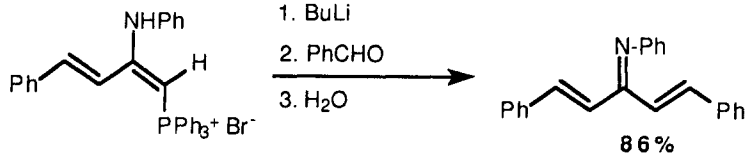

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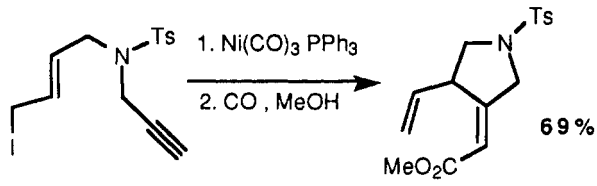

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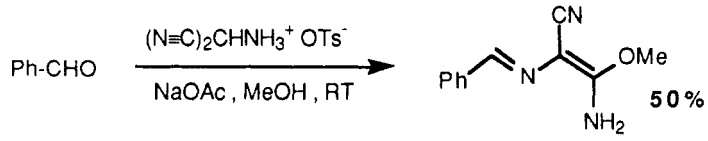

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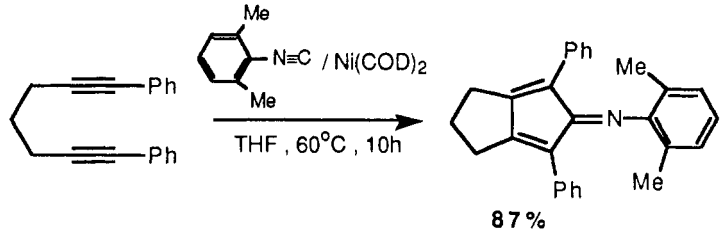

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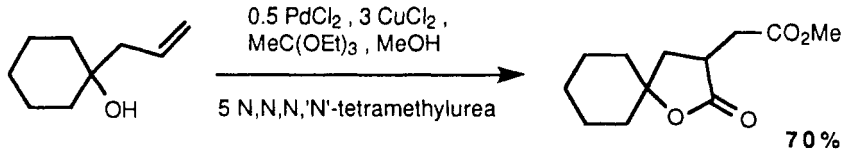
REVIEW:

"Synthesis of 1,4-Dihydropyridines by Cyclocondensation Reactions"
"Reactions of 1,4-Dihydropyridines"

Sausiņš, A.; Duburs, G. *Heterocycles*, ***1988***, *27*, 269, 291.

SECTION 357: ESTER - ESTER



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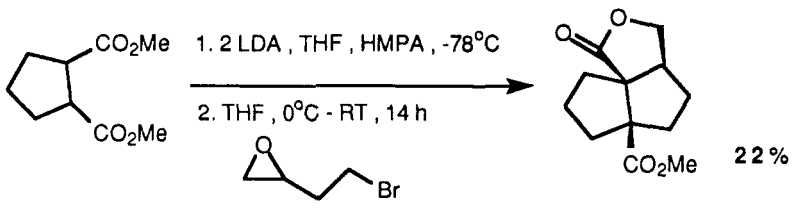
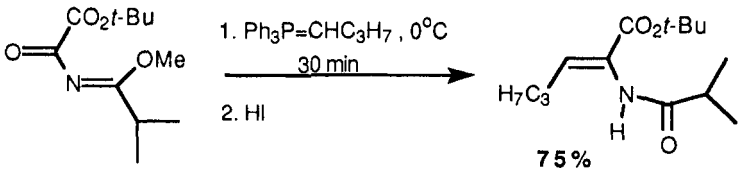


Garratt, P.J.; Porter, J.R. *Tetrahedron Lett.*, ***1987***, *28*, 351.



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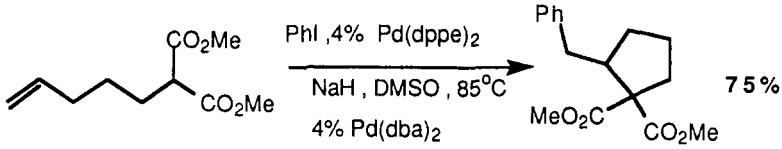
Bazureau, J.P.; LeRoux, J.; LeCorre, M. *Tetrahedron Lett.*, ***1988***, *29*, 1921.



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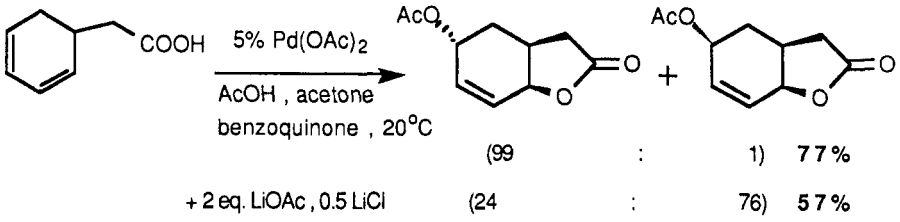

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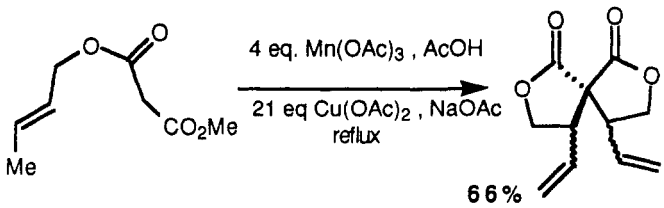


Oumar-Mahamat, H.; Moustrou, C.; Surzur, J.-M.; Bertrand, M.P. *J. Org. Chem.*, ***1989***, *54*, 5684.

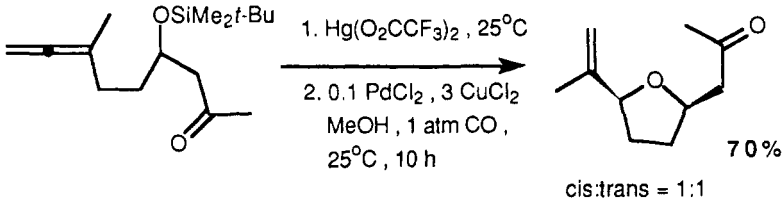
REVIEW:

"The Chemistry of Methane Tricarboxylic Esters: A Review"

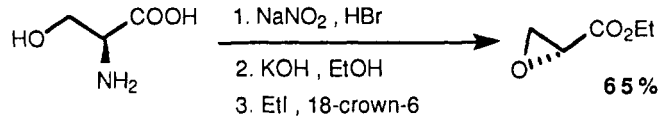
Newkome, G.R.; Baker, G.R. *Org. Prep. Proceed. Int.*, ***1986***, *18*, 119.

Also via Dicarboxylic Acids:	Section 312 (Carboxylic Acids - Carboxylic Acids)
Hydroxy-esters	Section 327 (Alcohol - Ester)
Diols	Section 323 (Alcohol - Alcohol)

SECTION 358: ESTER - ETHER, EPOXIDE, THIOETHER



Walkup, R.D.; Park, G. *Tetrahedron Lett.*, ***1987***, *28*, 1023.



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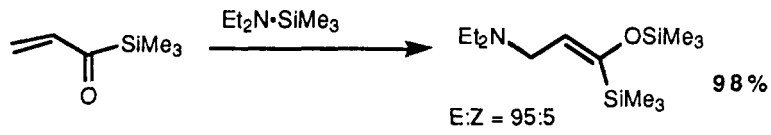
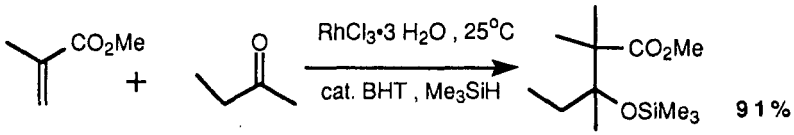
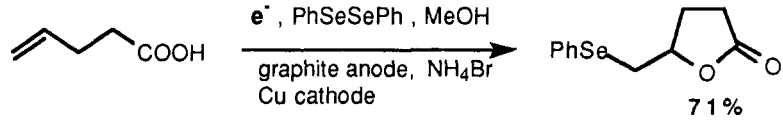


Ricci, A.; Degl'Innocenti, A.; Borselli, G.; Reginato, G. *Tetrahedron Lett.*, ***1987***, *28*, 4093.

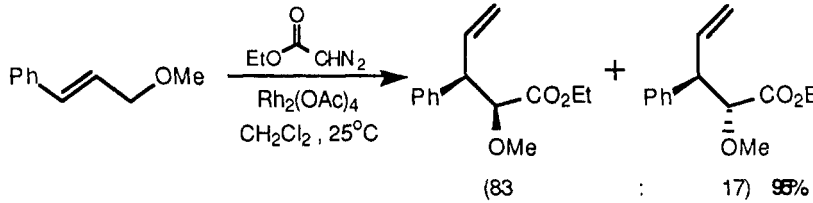


BHT = 2,6-di-*t*-butyl-4-methylphenol

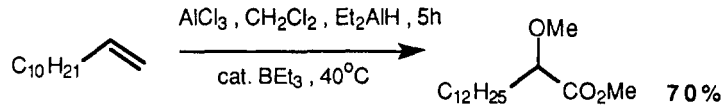
Revis, A.; Hilty, T.K. *Tetrahedron Lett.*, ***1987***, *28*, 4809.



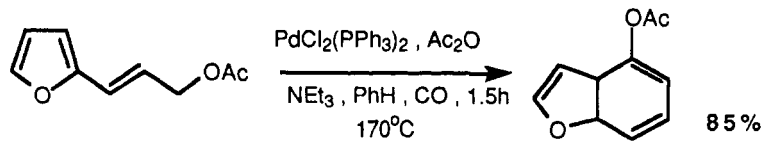
Konstantinović, S.; Vukićević, R.; Mihailović, M.L. *Tetrahedron Lett.*, ***1987***, *28*, 6511.



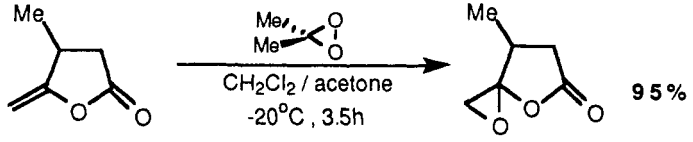
Doyle, M.P.; Bagheri, V.; Harn, N.K. *Tetrahedron Lett.*, ***1988***, *29*, 5119.



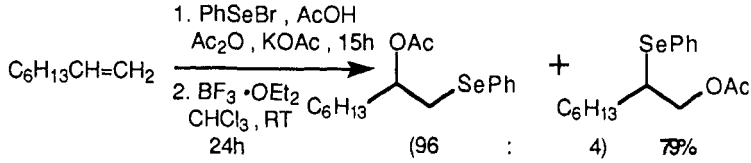
Maruoka, K.; Shinoda, K.; Yamamoto, H. *Synth. Commun.*, ***1988***, *18*, 1029.



Iwasaki, M.; Li, J.; Kobayashi, Y.; Matsuzaka, H.; Ishii, Y.; Hidai, M. *Tetrahedron Lett.*, ***1989***, *30*, 95.

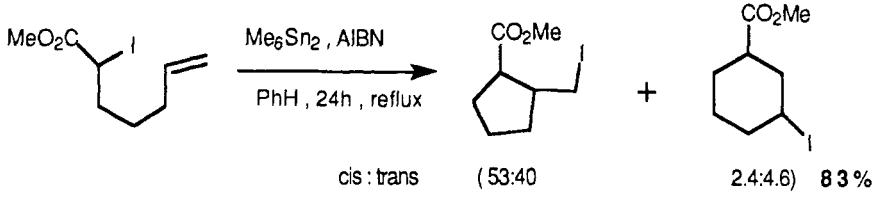


Adam, W.; Hadjiarapoglou, L.; Jäger, V.; Seidel, B. *Tetrahedron Lett.*, ***1989***, *30*, 4223.

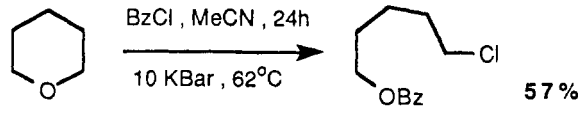


Engman, L. *J. Org. Chem.*, ***1989***, *54*, 884.

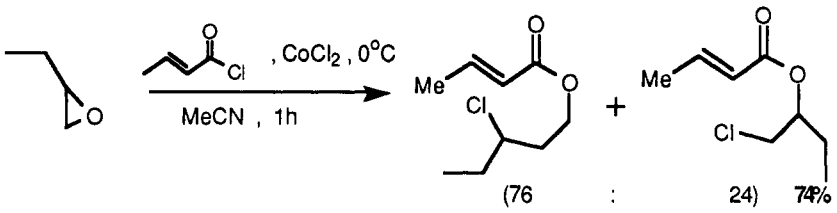
SECTION 359: ESTER - HALIDE, SULFONATE



Curran, D.P.; Chang, C.-T. *Tetrahedron Lett.*, ***1987***, *28*, 2477.



Kotsuki, H.; Ichikawa, Y.; Nishizawa, H. *Chem. Lett.*, ***1988***, 673.



Iqbal, J.; Aminkhan, M.; Srivastava, P.R. *Tetrahedron Lett.*, ***1988***, *29*, 4985.
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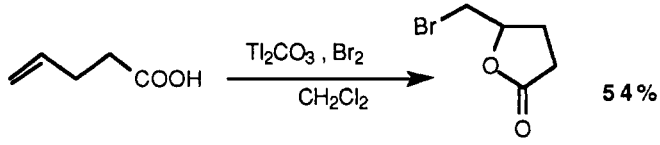
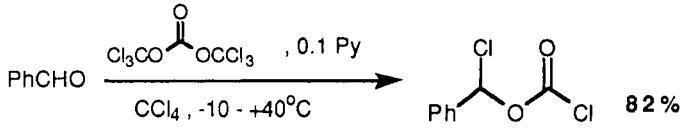
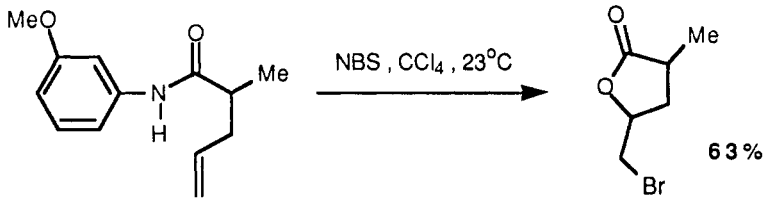


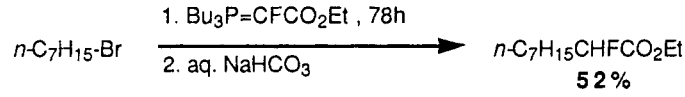
Cambie, R.C.; Rutledge, P.S.; Somerville, R.F.; Woodgate, P.D. *Synthesis*, ***1988***, 1009.



Coghlan, M.J.; Caley, B.A. *Tetrahedron Lett.*, ***1989***, *30*, 2033.

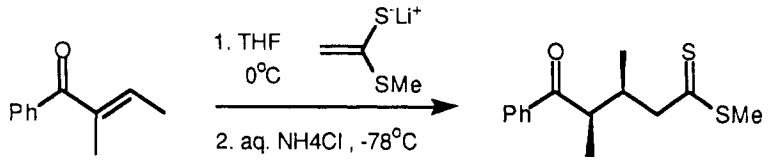


Balko, T.W.; Brinkmeyer, R.S.; Terando, N.H. *Tetrahedron Lett.*, ***1989***, *30*, 2045.



Thenappan, A.; Burton, D.J. *Tetrahedron Lett.*, ***1989***, *30*, 3641.

SECTION 360: ESTER - KETONE



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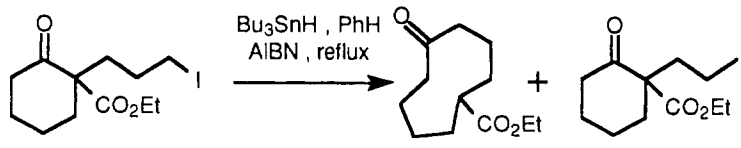
Berrada, S.; Metzner, P. *Tetrahedron Lett.*, ***1987***, *28*, 409.



Dowd, P.; Choi, S.-C. *J. Am. Chem. Soc.*, ***1987***, *109*, 6548.
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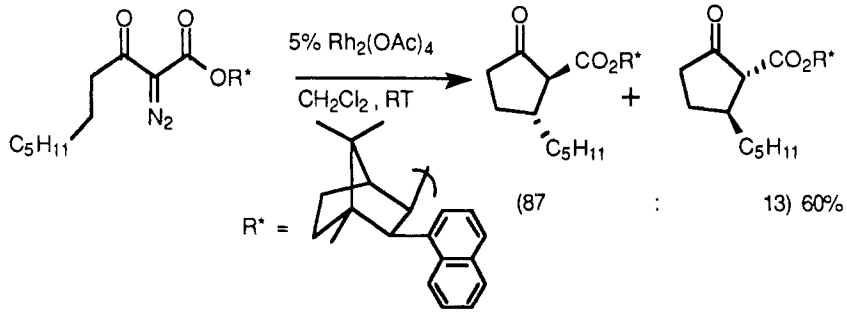
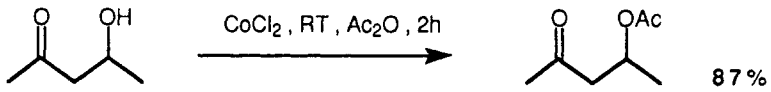
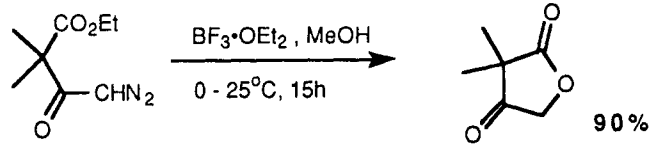


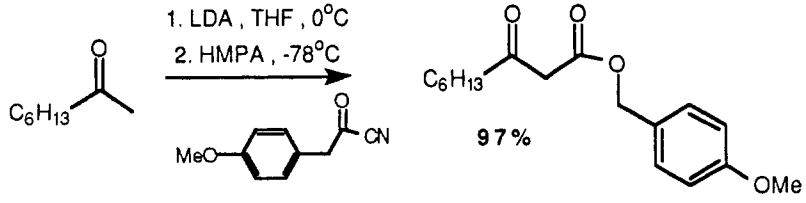
Taber, D.F.; Raman, K.; Gaul, M.D. *J. Org. Chem.*, ***1987***, *52*, 28.



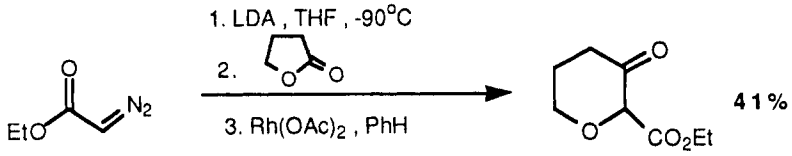
Ahmad, S.; Iqbal, J. *J. Chem. Soc., Chem. Commun.*, ***1987***, 114.



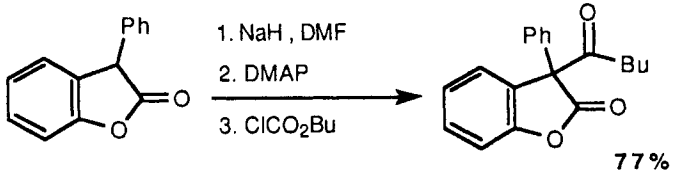
Miller, R.D.; Theis, W. *Tetrahedron Lett.*, ***1987***, *28*, 1039.



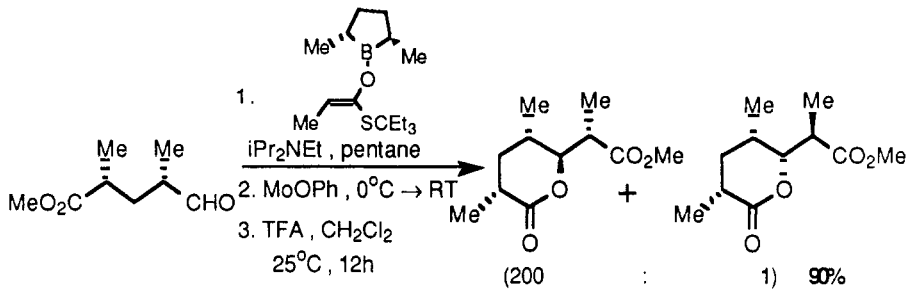
Henegar, K.E.; Winkler, J.D. *Tetrahedron Lett.*, ***1987***, *28*, 1051.



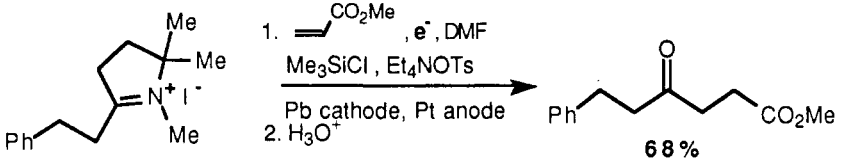
Moody, C.J.; Taylor, R.J. *Tetrahedron Lett.*, ***1987***, *28*, 5351.



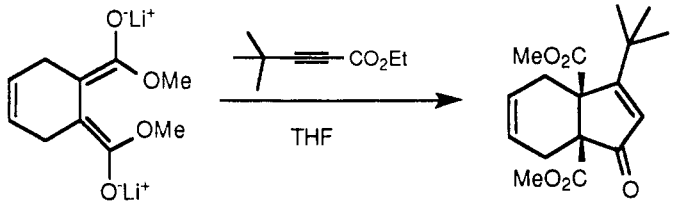
Black, T.H.; Arrivo, S.M.; Schumm, J.S.; Knobeloch, J.M. *J. Org. Chem.*, ***1987***, *52*, 5425.



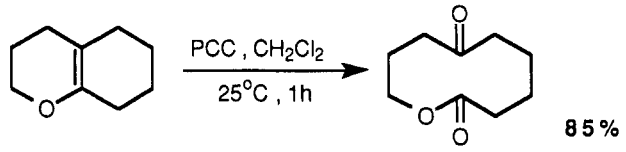
Short, R.P.; Masamune, S. *J. Org. Chem.*, ***1987***, *52*, 2841.



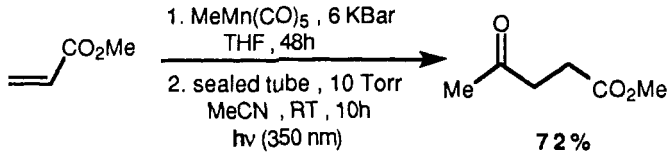
Shono, T.; Kashimura, S.; Yamaguchi, Y.; Kuwata, F. *Tetrahedron Lett.*, ***1987***, *28*, 4411.



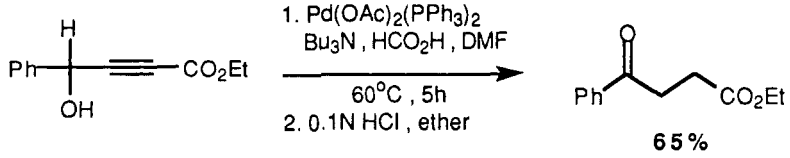
Corey, E.J.; Su, W. *Tetrahedron Lett.*, ***1987***, *28*, 5241.



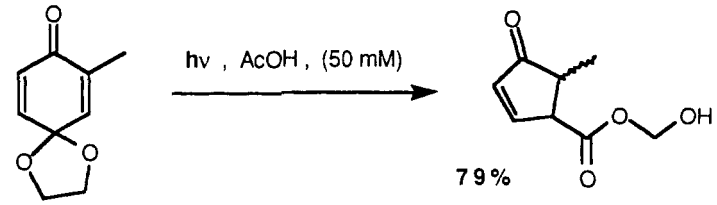
Baskaran, S.; Islam, I.; Baghavan, M.; Chandrasekaran, S. *Chem. Lett.*, ***1987***, 1175.



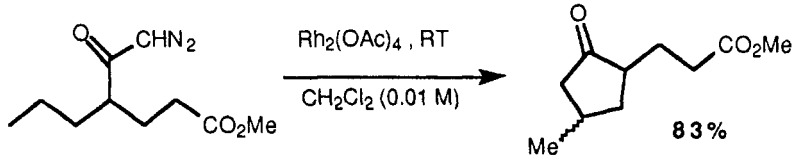
DeShong, P.; Sidler, D.R.; Rybczynski, P.J.; Slough, G.A.; Rheingold, A.L. *J. Am. Chem. Soc.*, ***1988***, *110*, 2575.



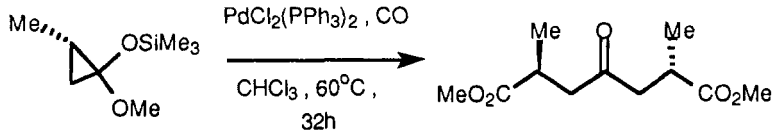
Arcadi, A.; Cacchi, S.; Marinelli, F.; Misiti, D. *Tetrahedron Lett.*, ***1988***, *29*, 1457.



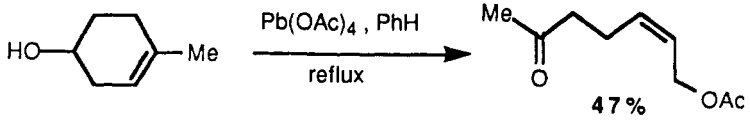
Pirrung, M.C.; Nunn, D.S. *Tetrahedron Lett.*, ***1988***, *29*, 163.



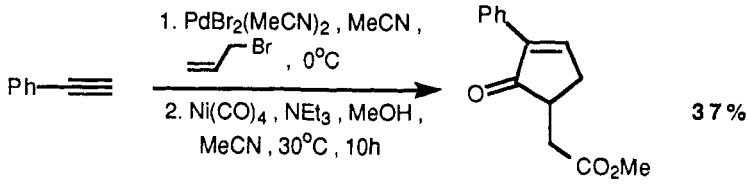
Stork, G.; Nakatani, K. *Tetrahedron Lett.*, ***1988***, *29*, 2283



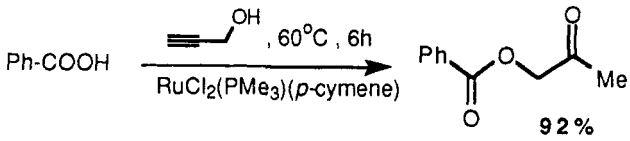
Aoki, S.; Nakamura, E.; Kawajima, I. *Tetrahedron Lett.*, ***1988***, *29*, 1541.



Ramaiah, P.; Rao, A.S. *Tetrahedron Lett.*, ***1988***, *29*, 2119.



Camps, F.; Coll, J.; Llebaria, A.; Moretó, J.M. *Tetrahedron Lett.*, ***1988***, *29*, 5811.



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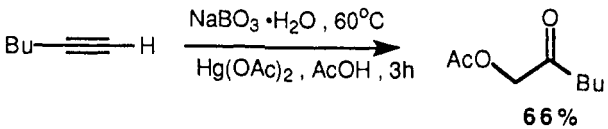
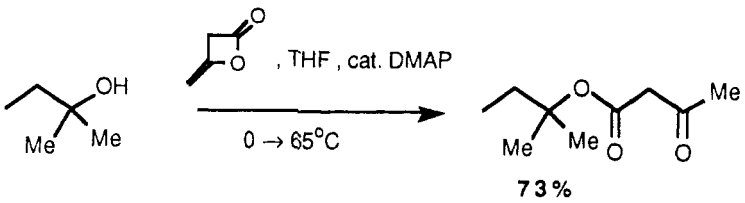


Reed, K.L.; Gupton, J.T.; McFarlane, K.L *Synth. Commun.*, ***1989***, *19*, 2595.



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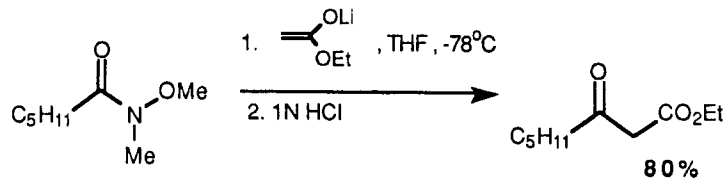
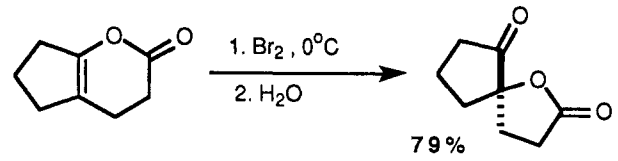


Turner, J.A.; Jacks, W.S. *J. Org. Chem.*, ***1989***, *54*, 4229.



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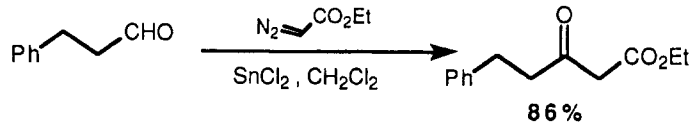

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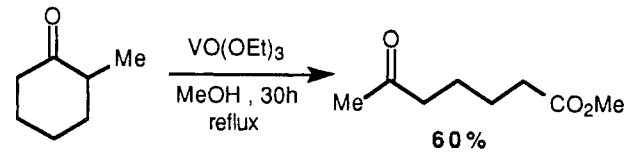


Hirao, T.; Mori, M.; Oshiro, Y. *Bull. Chem. Soc., Jpn.*, ***1989***, *62*, 2399.

REVIEW:

"Preparation and Reactions of 4-Oxocarbonyl Compounds"

Miyakoshi, T. *Org. Prep. Proceed. Int.*, ***1989***, *21*, 661.

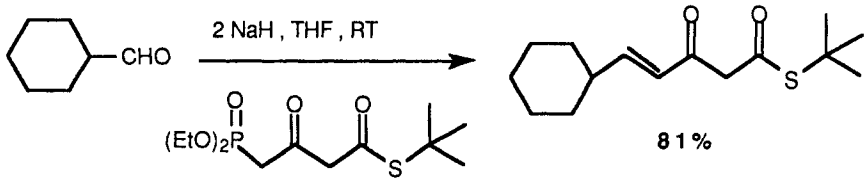
Also via Ketoacids — Section 320 (Carboxylic Acid - Ketone)
Hydroxyketones — Section 330 (Alcohol - Ketone)

SECTION 361: ESTER - NITRILE

NO ADDITIONAL EXAMPLES

SECTION 362: ESTER - ALKENE

This section contains syntheses of enol esters and esters of unsaturated acids as well as ester molecules bearing a remote alkenyl unit.



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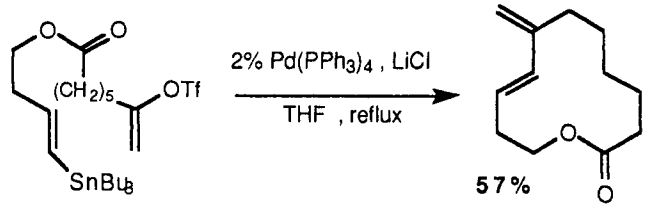

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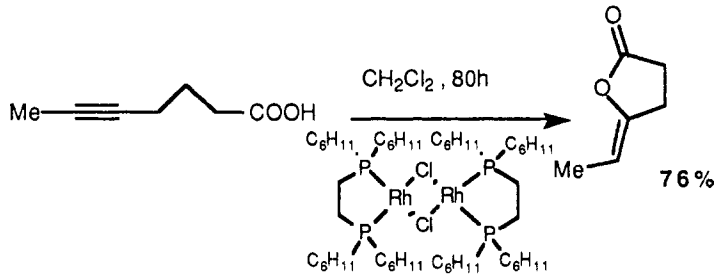

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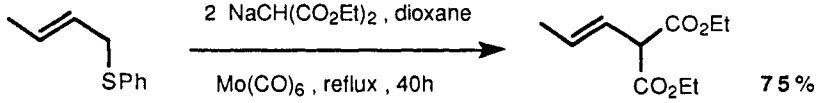

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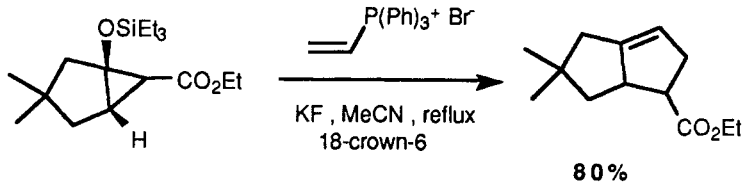
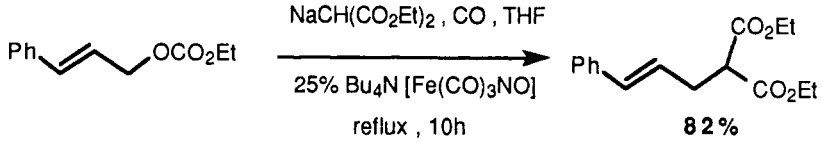


Marino, J.P.; Laborde, E. *J. Org. Chem.*, ***1987***, *52*, 1.



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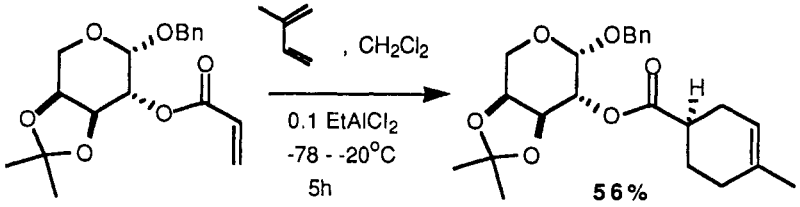

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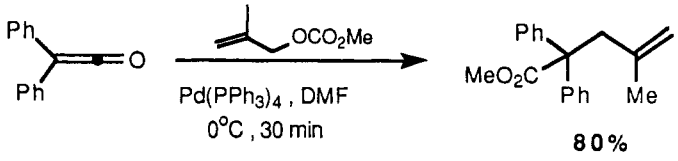

allylic acetates react to form substituted 1,3-dienes

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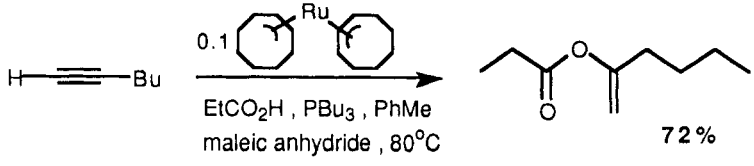

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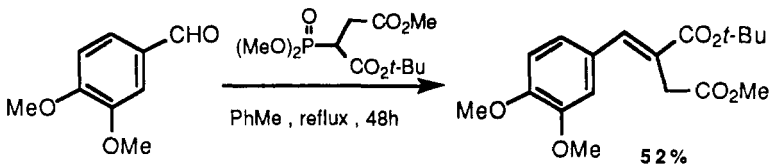

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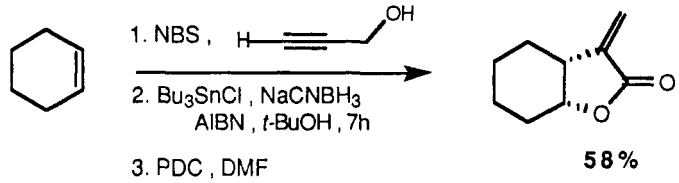

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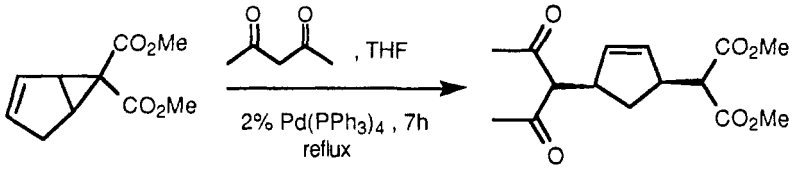

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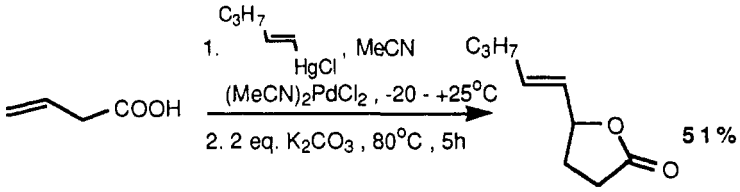

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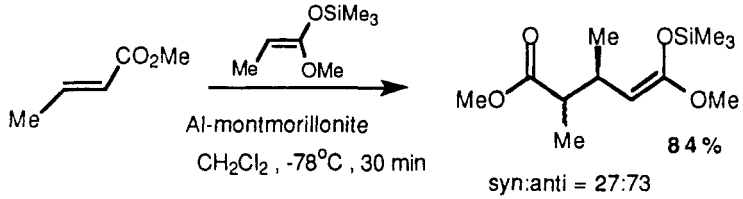

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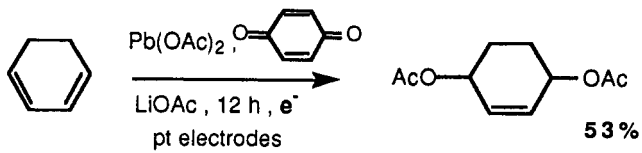

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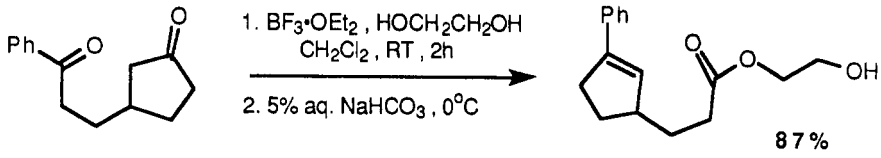

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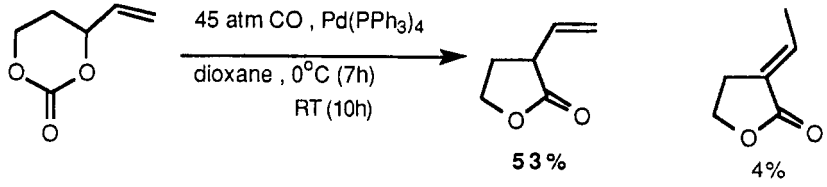

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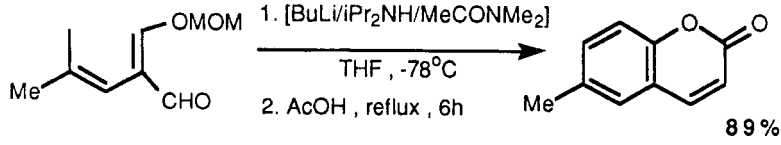

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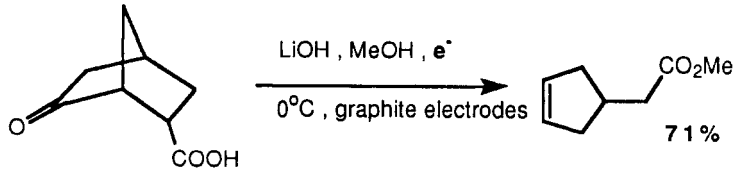

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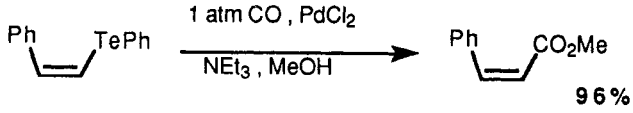

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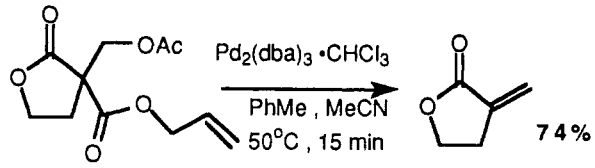

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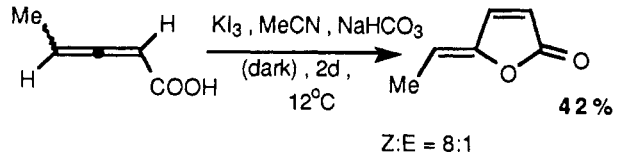

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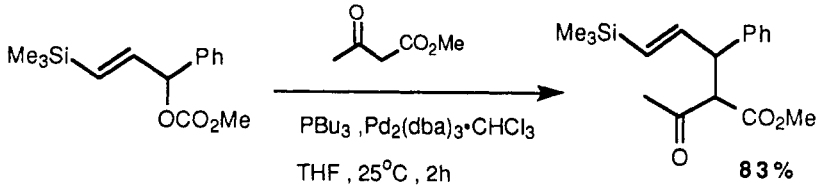

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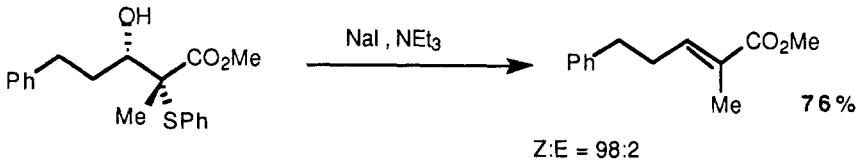

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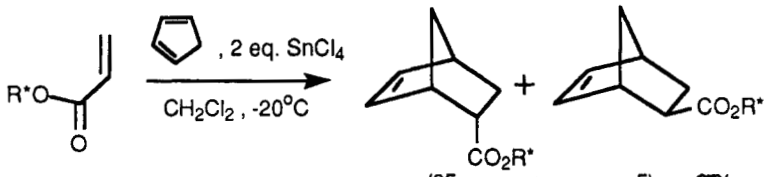

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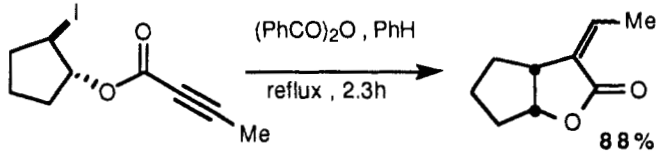

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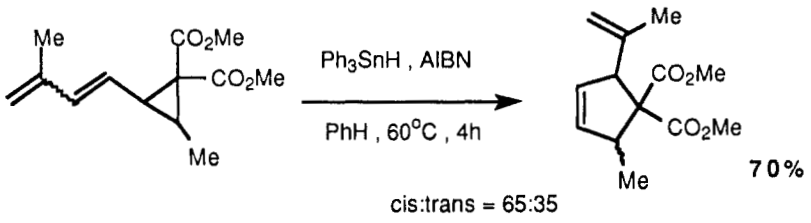

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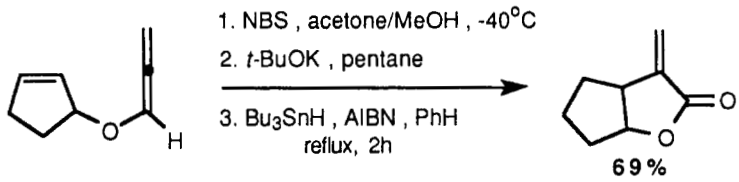

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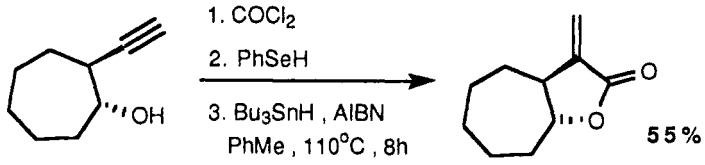

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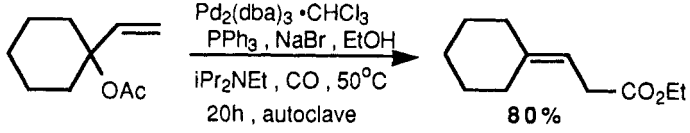

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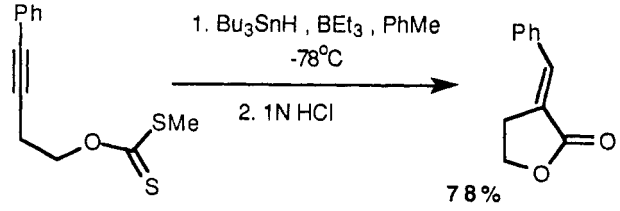

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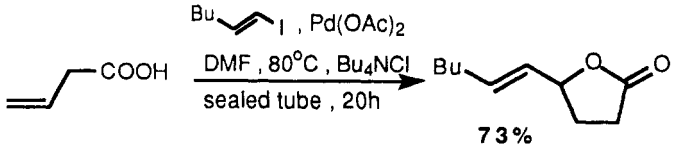

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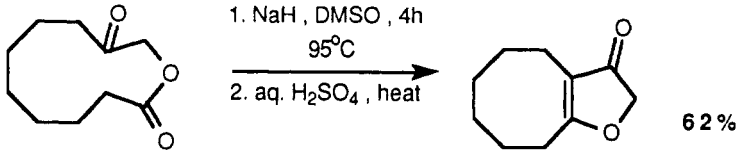

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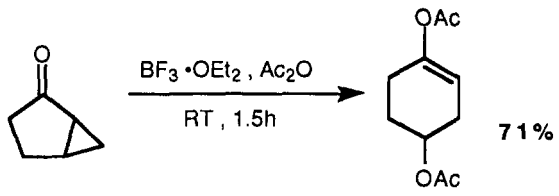

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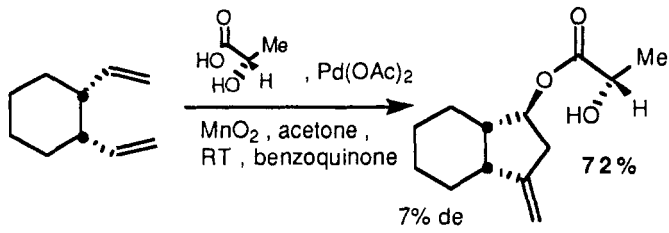

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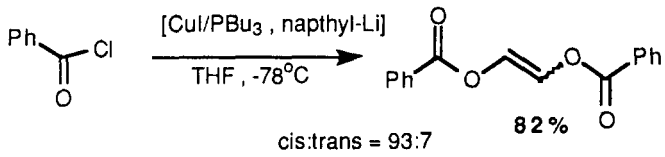
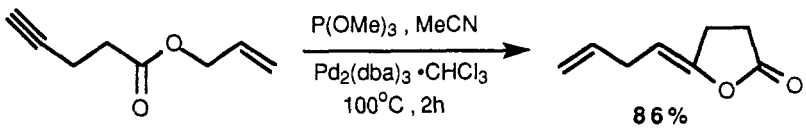


Wu, T.-C.; Riecke, R.D. *J. Org. Chem.*, ***1988***, *53*, 2381.



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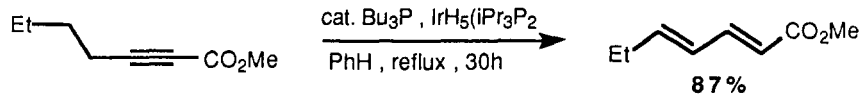

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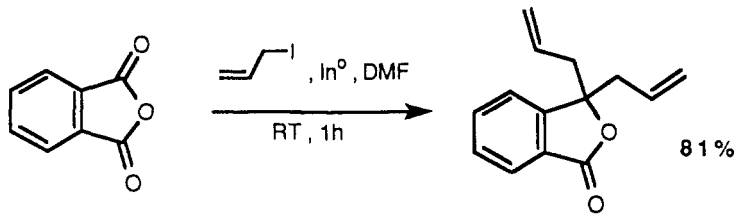

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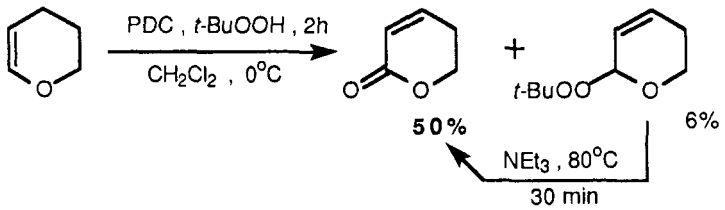

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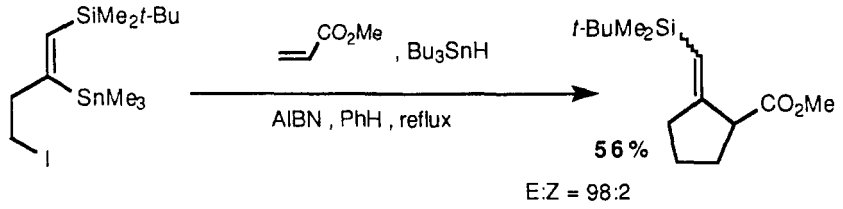

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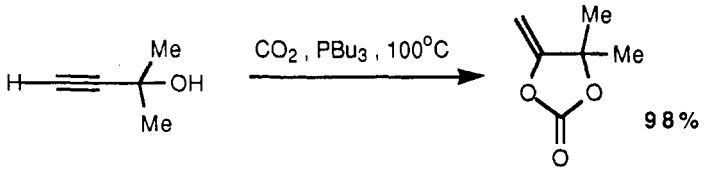

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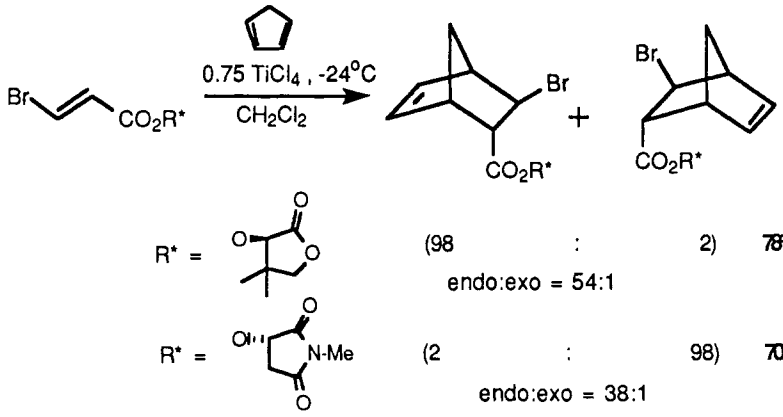

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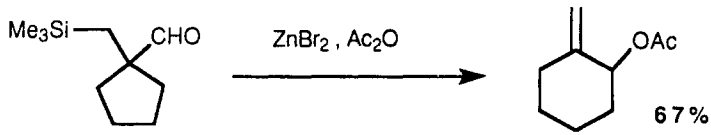

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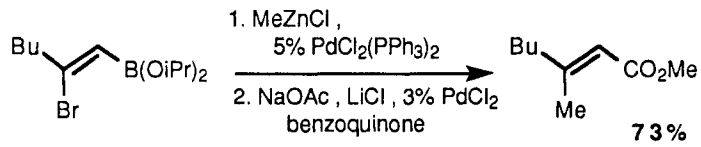

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REVIEW:

"Nucleophilic Addition Reactions with Cationic Iron π-Alkyne and Related Complexes"

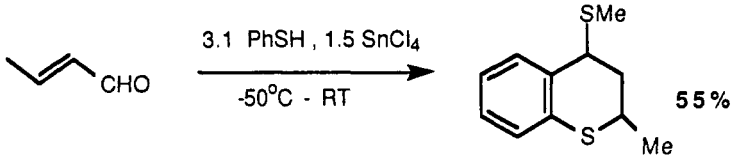
Reger, D.L. *Acc. Chem. Res.*, ***1988***, *21*, 229.

Related Methods: Section 60A (Protection of Aldehydes).
Section 180A (Protection of Ketones).

Also via Acetylenic Esters: Section 306 (Alkyne - Ester).
Alkenyl Acids: Section 322 (Carboxylic Acid - Alkene).
β-Hydroxy-esters: Section 327 (Alcohol - Ester).

SECTION 363: ETHER, EPOXIDE, THIOETHER - ETHER, EPOXIDE, THIOETHER

See Section 60A (Protection of Aldehydes) and Section 180A (Protection of Ketones) for reactions involving formation of Acetals and Ketals.



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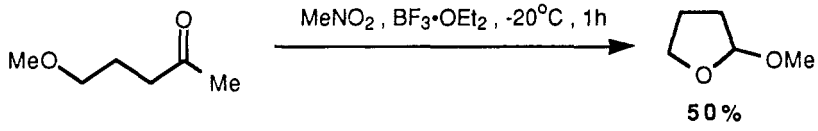

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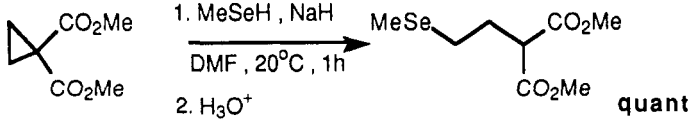

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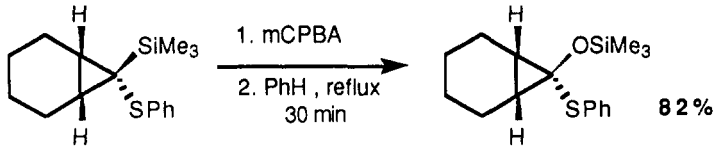

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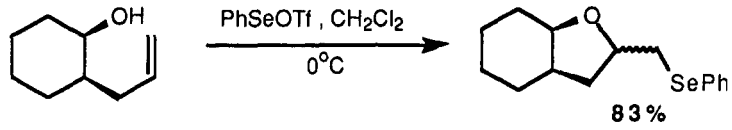

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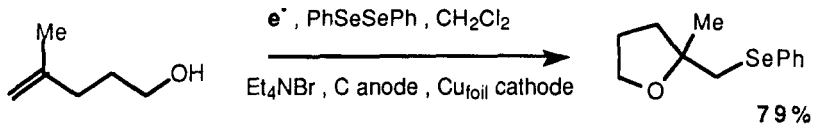

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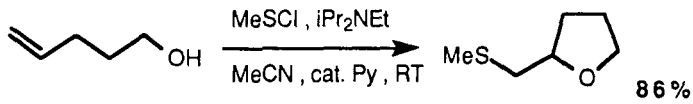

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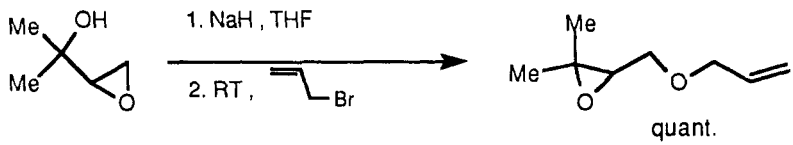

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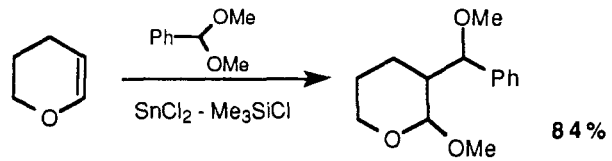

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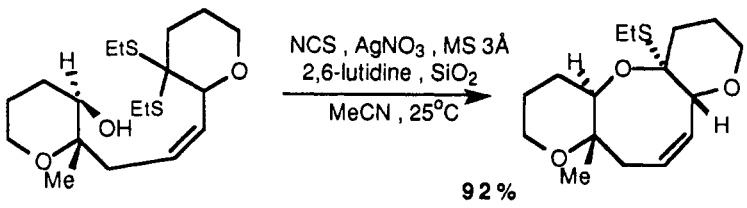

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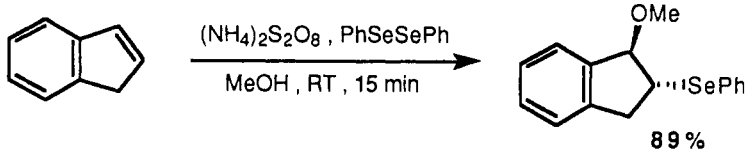

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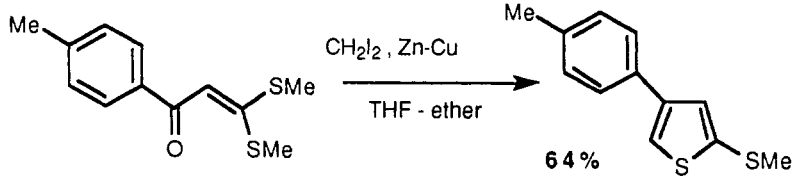

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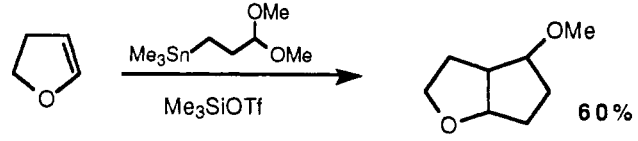

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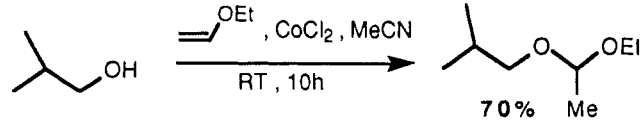

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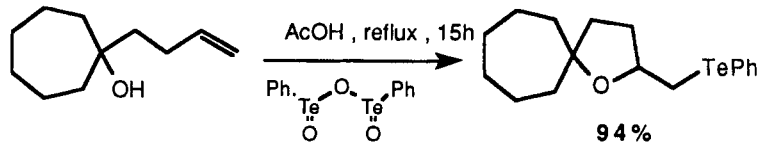

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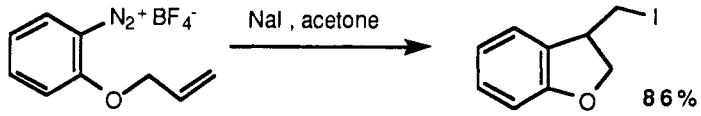
"Chemistry of Spiroketals"

Perron, F.; Albizati, K.F. *Chem. Rev.*, ***1989***, *89*, 1617.

SECTION 364: ETHER, EPOXIDE, THIOETHER - HALIDE, SULFONATE



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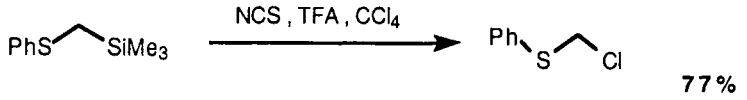

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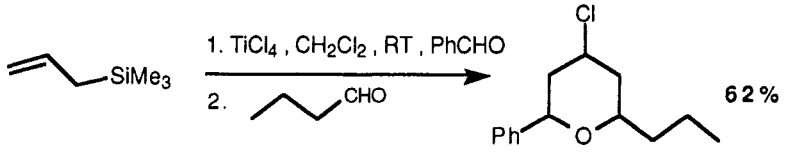

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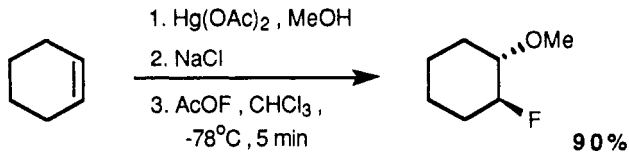

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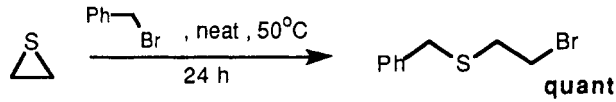

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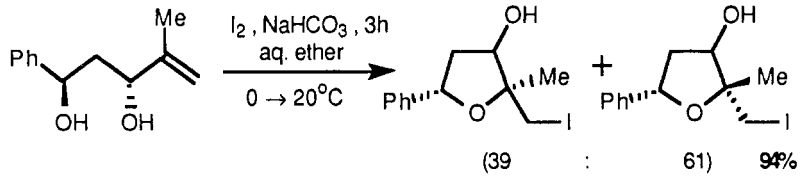

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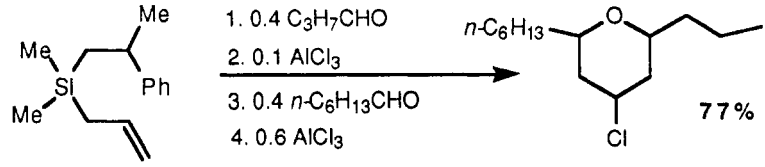

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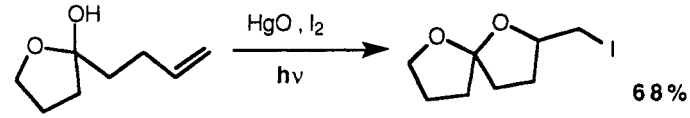

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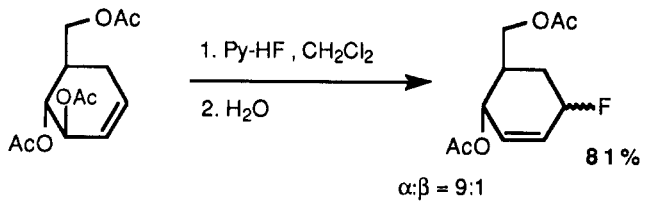

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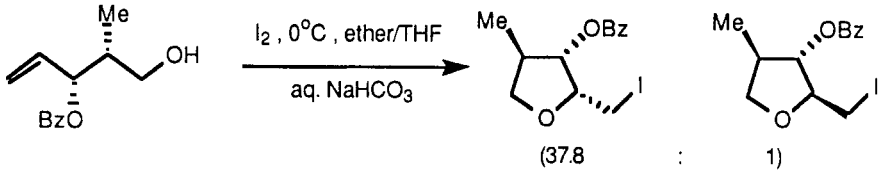

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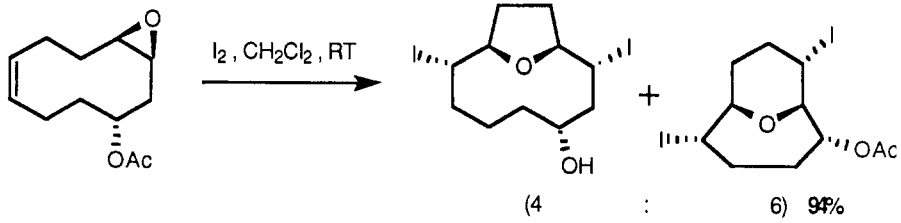

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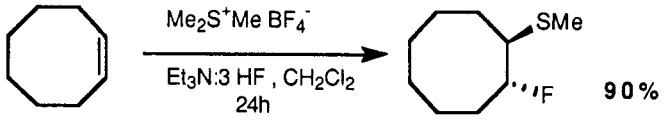

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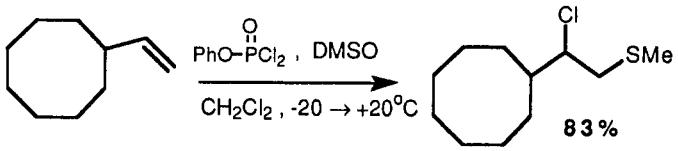
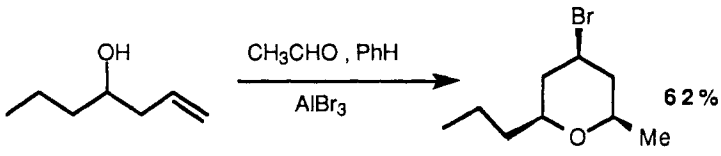


Liu, H.-J.; Nyangulu, J.M. *Tetrahedron Lett.*, ***1988***, *29*, 5467.



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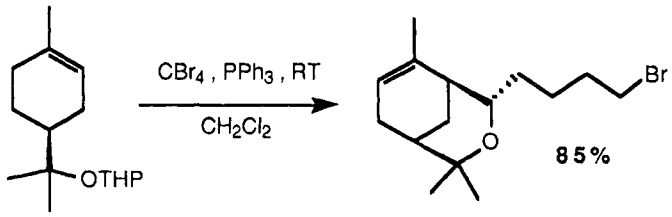

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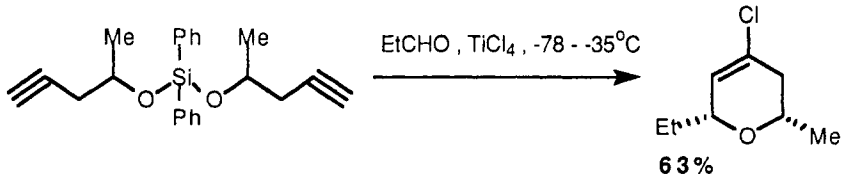

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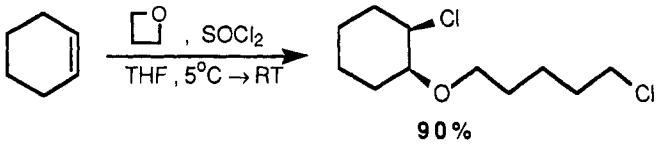

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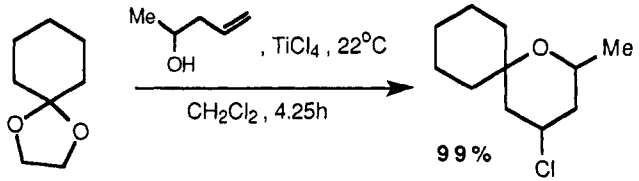

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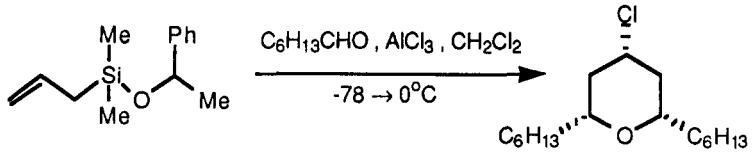
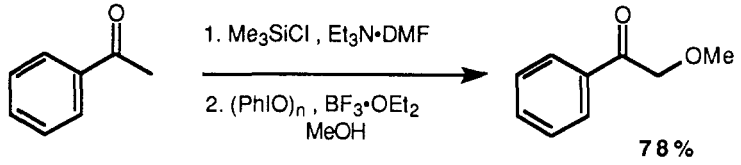


Wei, Z.Y.; Wang, D.; Li, J.S.; Chan, T.H. *J. Org. Chem.*, ***1989***, *54*, 5768.

SECTION 365: ETHER, EPOXIDE, THIOETHER - KETONE



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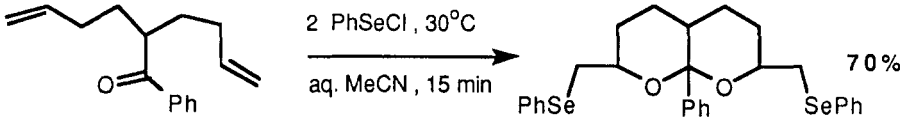

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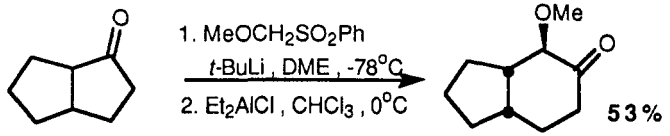

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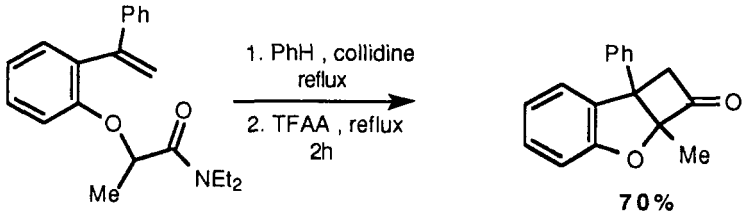

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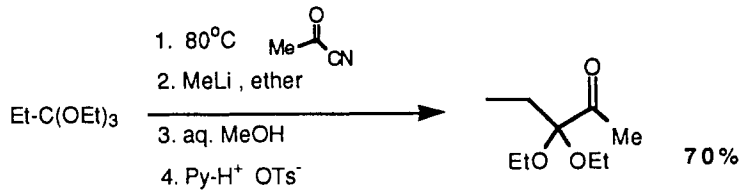
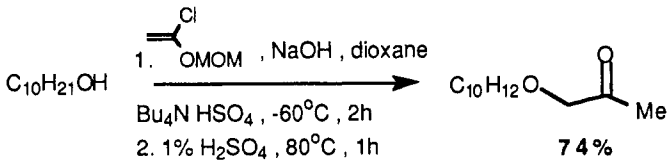


Babler, J.H.; Marcuccilli, C.J. *Tetrahedron Lett.*, ***1987***, *28*, 4657.



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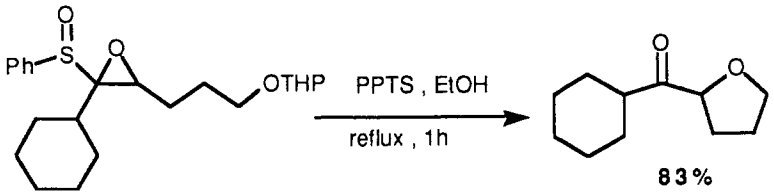

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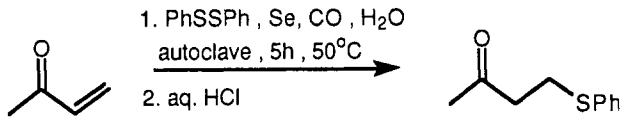

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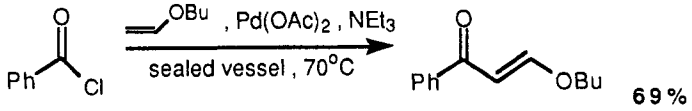
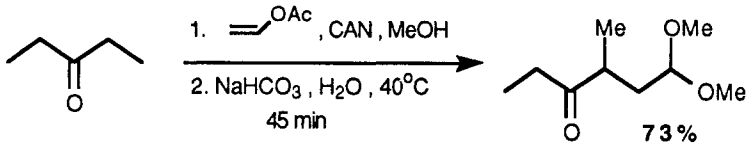


Andersson, C.-M.; Hallberg, A. *Tetrahedron Lett.*, ***1987***, *28*, 4215.



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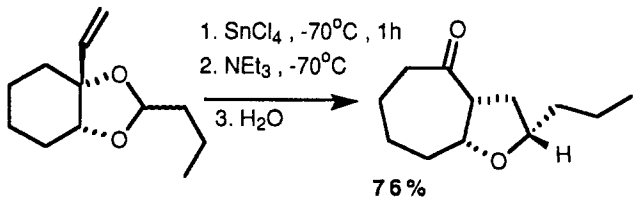
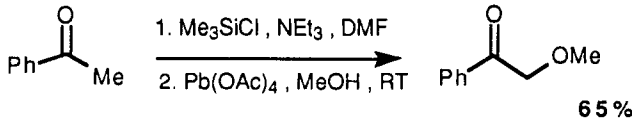


Herrinton, P.M.; Hopkins, M.H.; Mishra, P.; Brown, M.J.; Overman, L.E. *J. Org. Chem.*, ***1987***, *52*, 3711.



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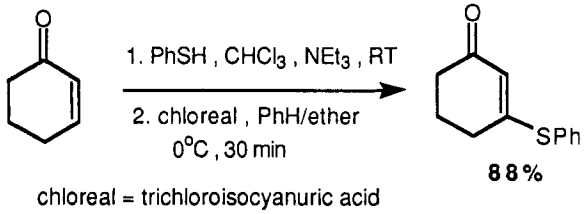

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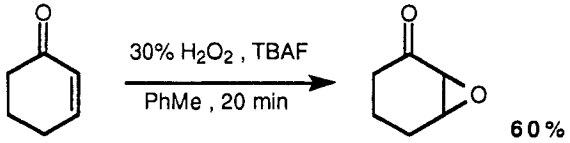

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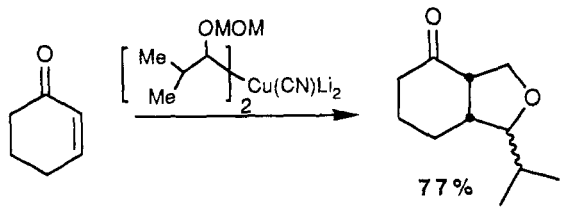

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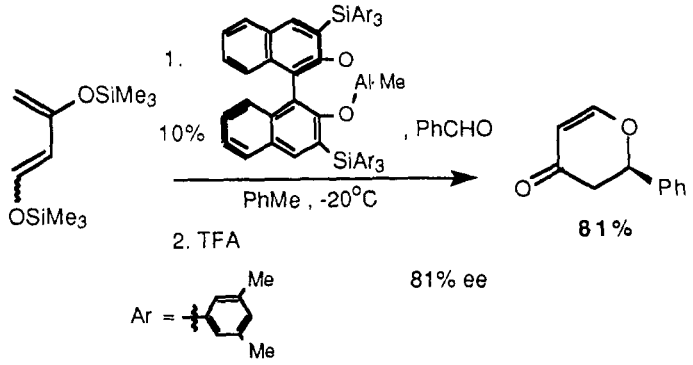

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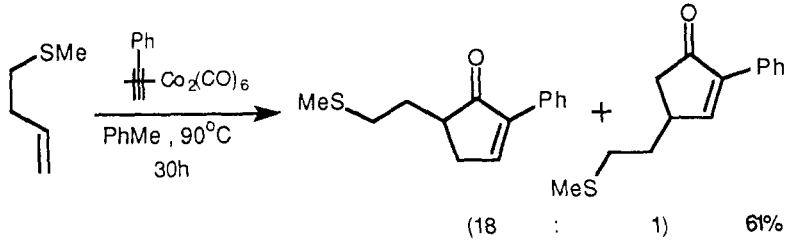

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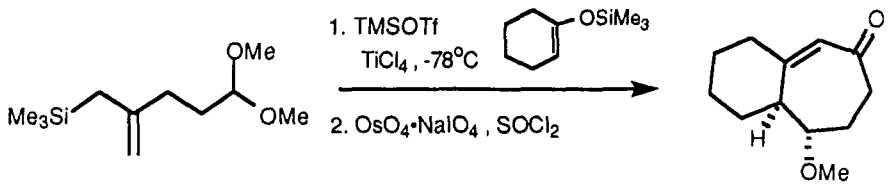

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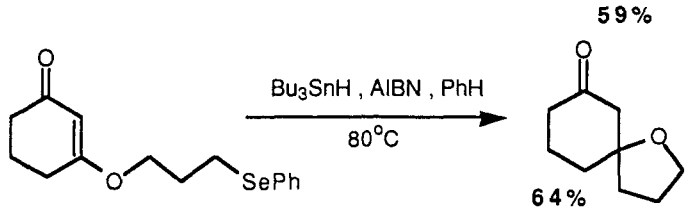

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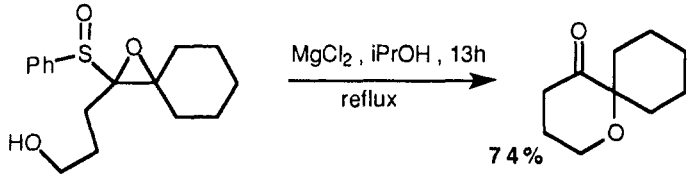

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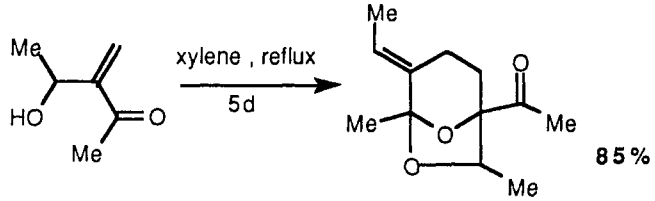

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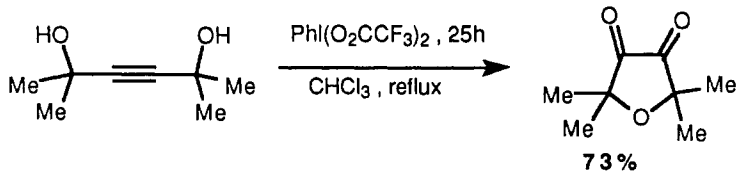

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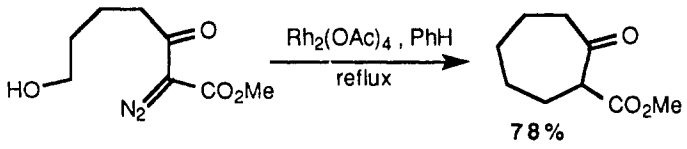

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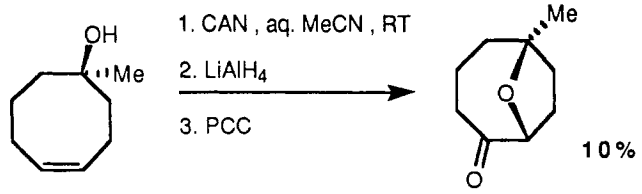
Moody, C.J.; Taylor, R.J. *J. Chem. Soc., Perkin Trans. I,* ***1989***, 721.



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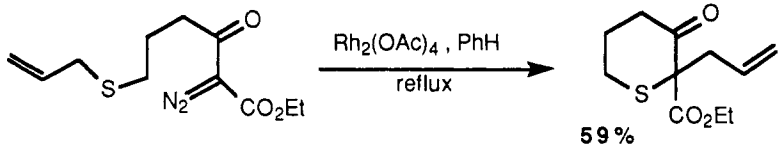

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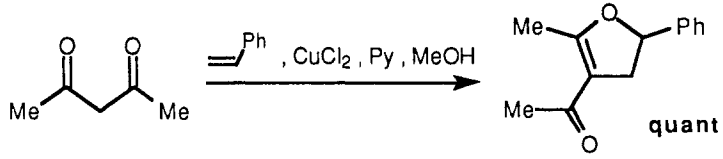

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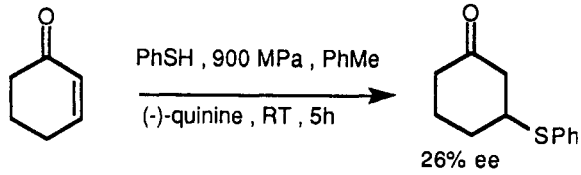

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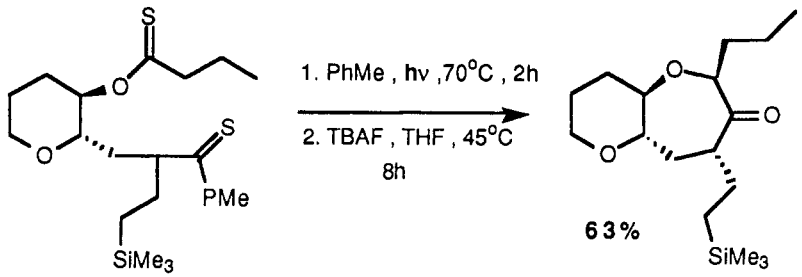

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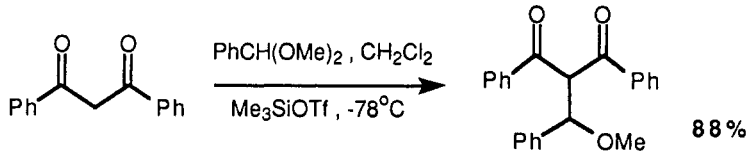

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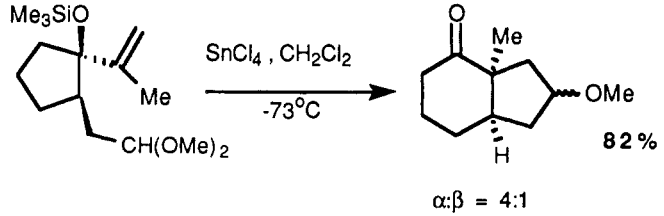

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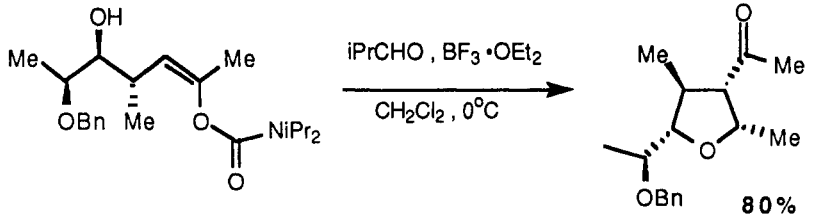

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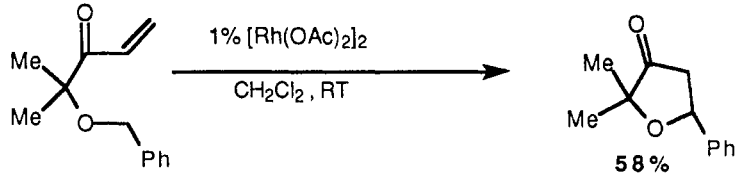

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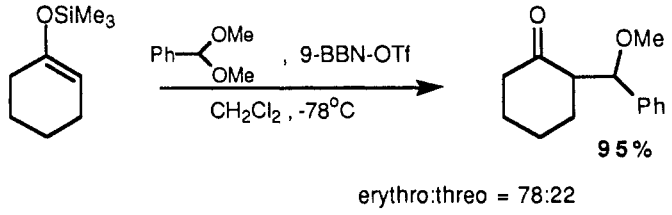

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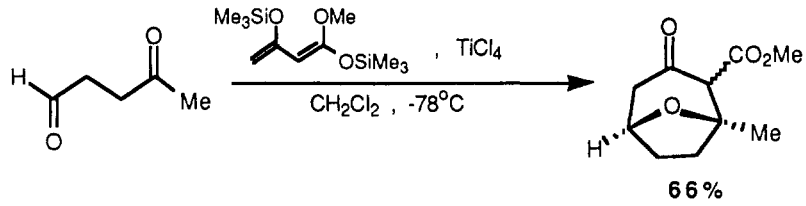

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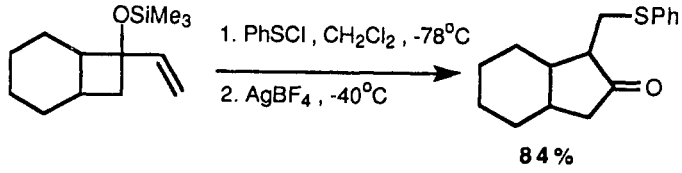

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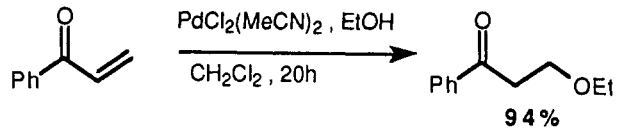

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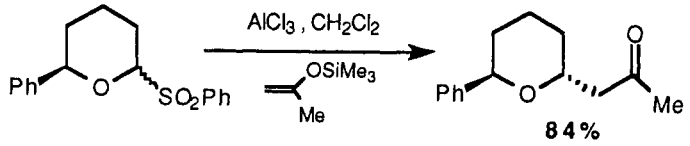

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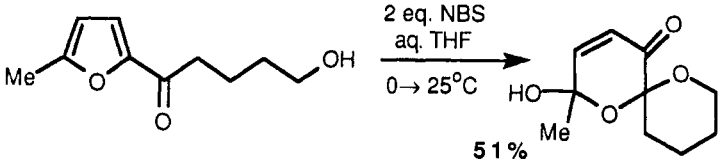
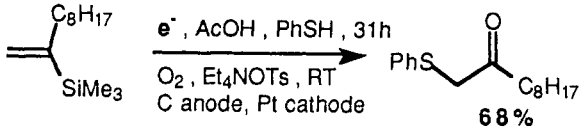


Perron, F.; Albizati, K.F. *J. Org. Chem.*, ***1989***, *54*, 2044.



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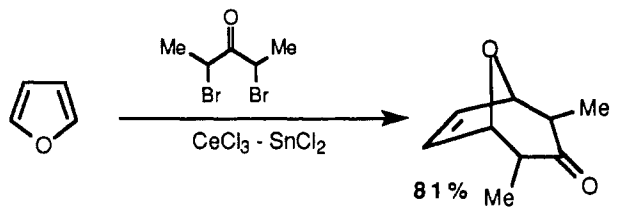

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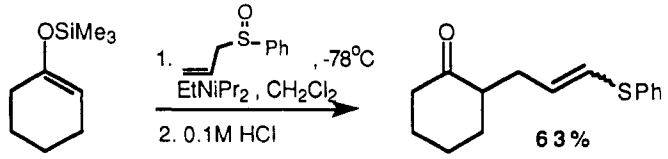
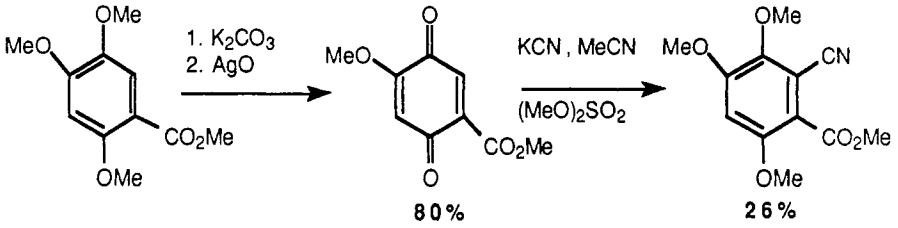


Hunter, R.; Carlton, L.; Cirillo, P.F.; Michael, J.P.; Simon, C.D.; Walter, D.S. *J. Chem. Soc., Perkin Trans. I*, ***1989***, 1631.

SECTION 366: ETHER, EPOXIDE, THIOETHER - NITRILE



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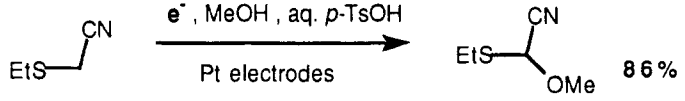
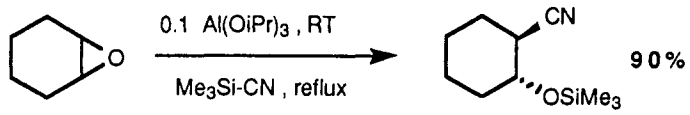


Kimura, M.; Koie, K.; Matsubara, S.; Sawaki, Y.; Iwamura, H. *J. Chem. Soc., Chem. Commun.*, ***1987***, 122.



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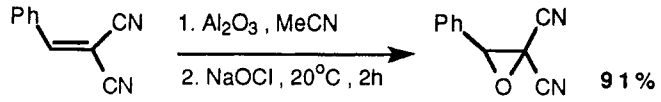

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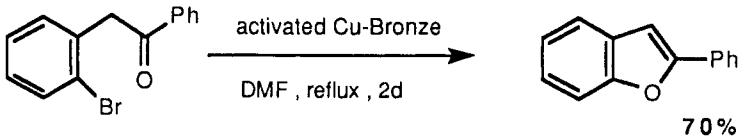
SECTION 367: ETHER, EPOXIDE, THIOETHER - ALKENE

Enol ethers are found in this section as well as alkenyl ethers.



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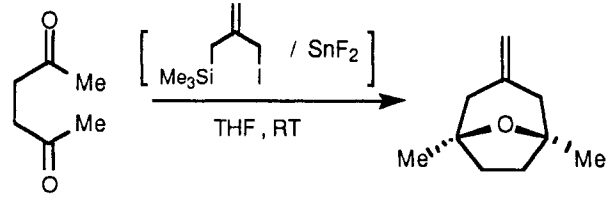

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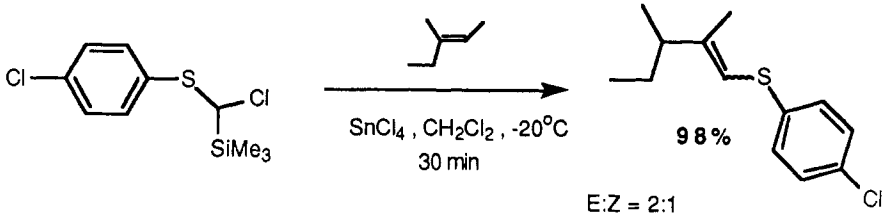

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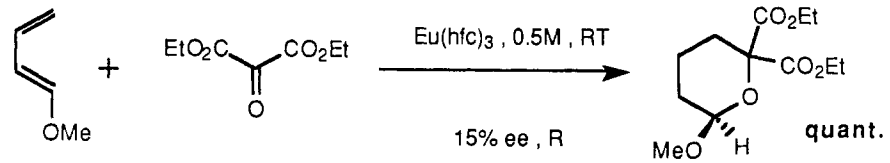

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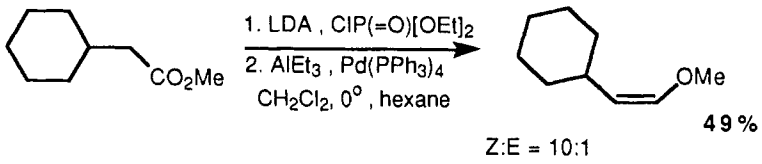

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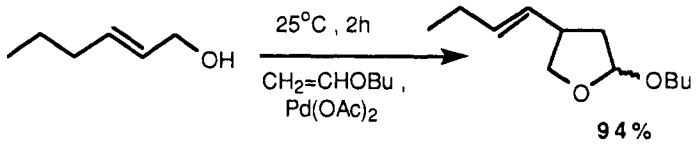

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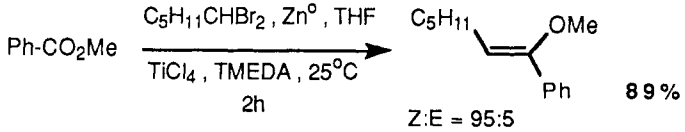

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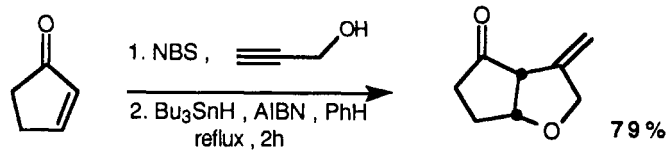

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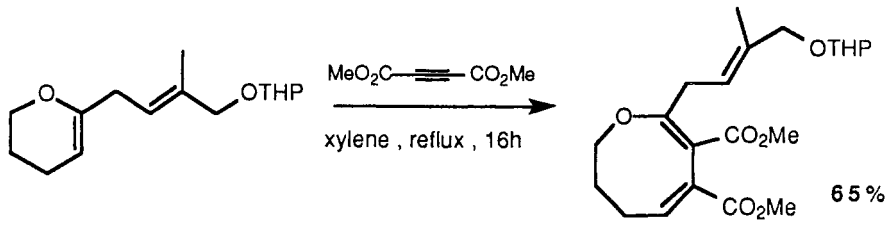

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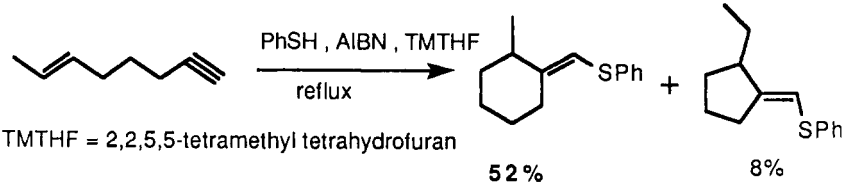

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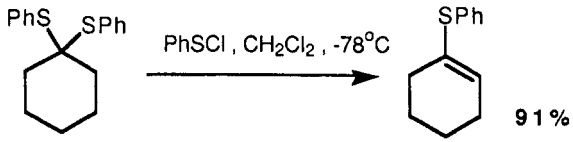

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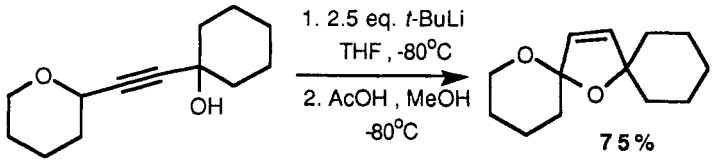
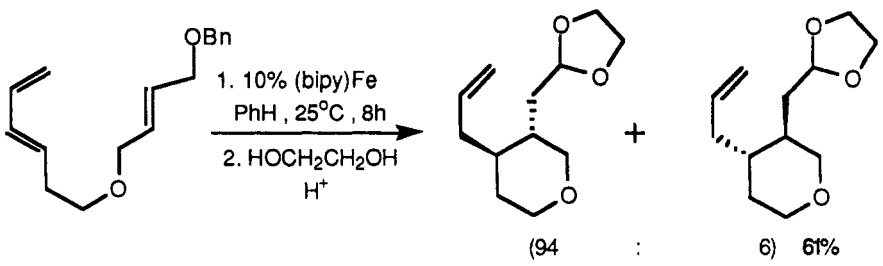
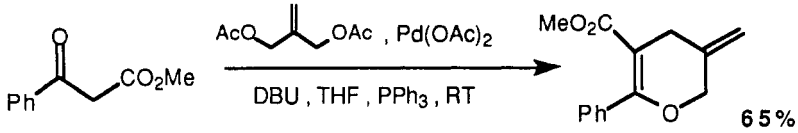


Whitby, R.; Kocieński, P. *Tetrahedron Lett.*, ***1987***, *28*, 3619.



Takacs, J.M.; Anderson, L.G.; Creswell, M.W.; Takacs, B.E. *Tetrahedron Lett.*, ***1987***, *28*, 5627.



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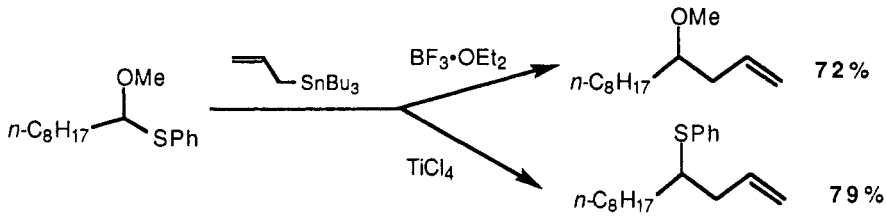

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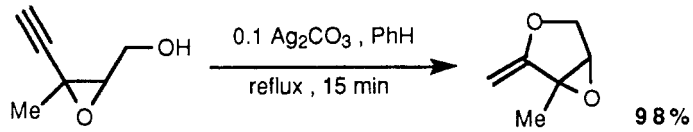
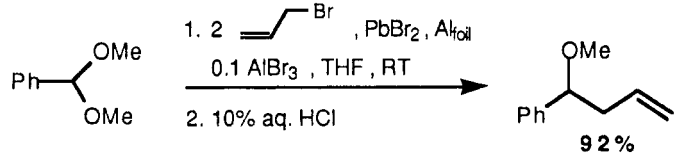
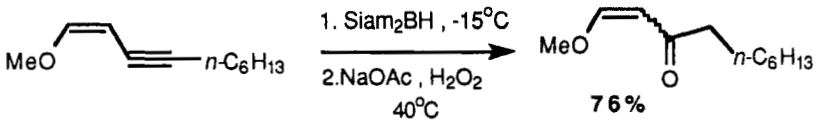


Pale, P.; Chuche, J. *Tetrahedron Lett.*, ***1987***, *28*, 6447.



Tanaka, H.; Yamashita, S.; Ikemoto, Y.; Torii, S. *Tetrahedron Lett.*, ***1988***, *29*, 1721.



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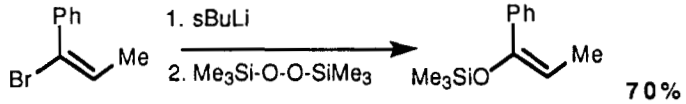

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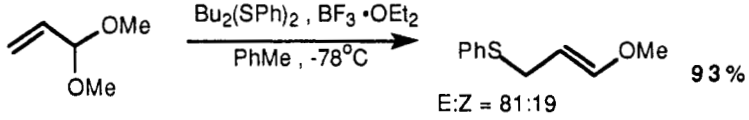
Davis, F.A.; Sankar Lal, G.; Wei, J. *Tetrahedron Lett.*, ***1988***, *29*, 4269.



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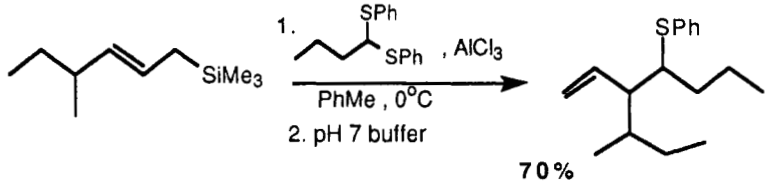

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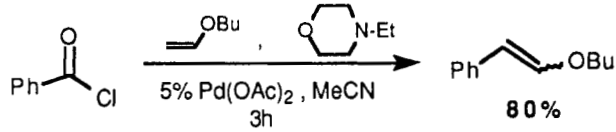

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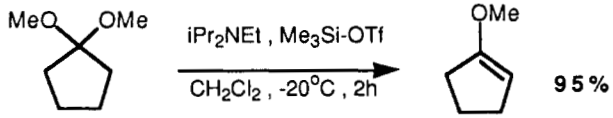
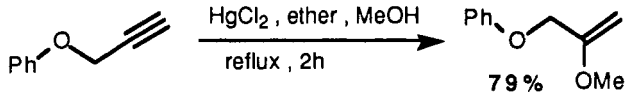


Gassman, P.G.; Burns, S.J. *J. Org. Chem.*, ***1988***, *53*, 5574.



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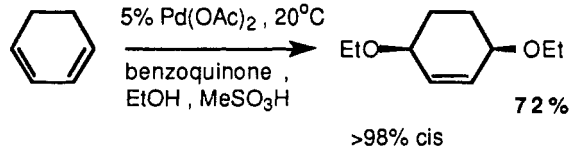

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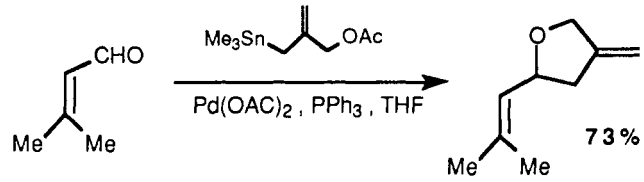

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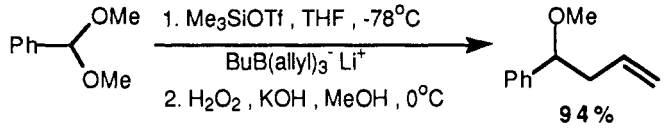
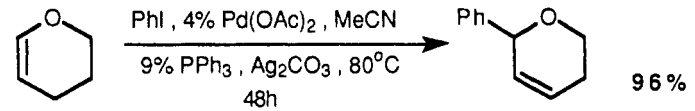


Hunter, R.; Tomlinson, G.D. *Tetrahedron Lett., **1989**, 30,* 2013.



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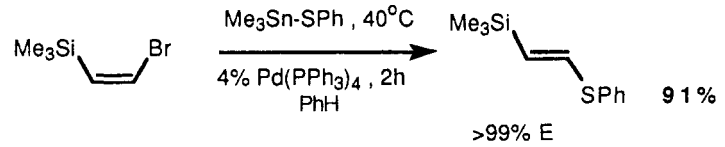

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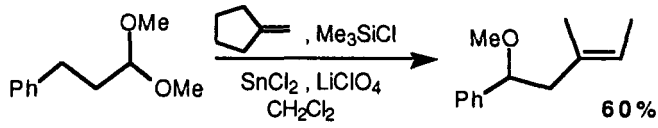

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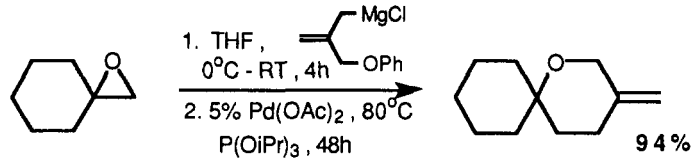
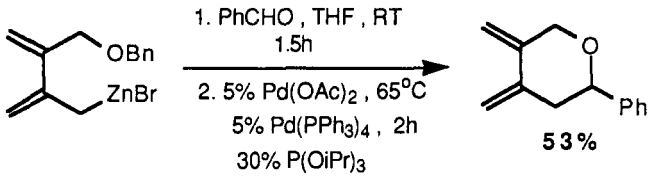
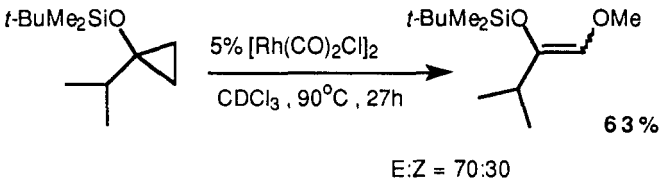


van der Louw, J.; Out, G.J.J.; van der Baan, J.L.; de Kanter, F.J.J.; Bickelhaupt, F.; Klumpp, G.W. *Tetrahedron Lett.*, ***1989***, *30*, 4863.



van der Louw, J.; Slagt, M.; van der Baan, J.L.; Bickelhaupt, F.; Klumpp, G.W. *Tetrahedron Lett.*, ***1989***, *30*, 5497.
van der Louw, J.; van der Baan, J.L.; Stichter,H.; Out, G.J.J.; Bickelhaupt, F.; Klumpp, G.W. *Tetrahedron Lett.*, ***1988***, *29*, 3579.



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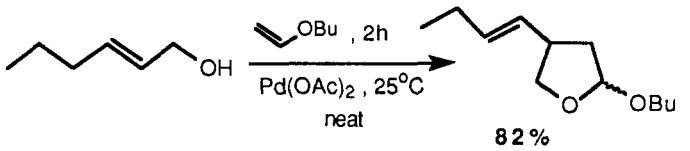

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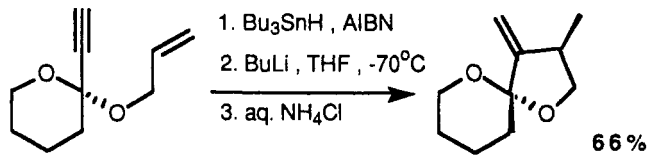

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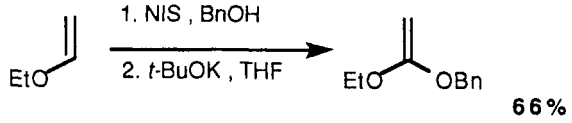
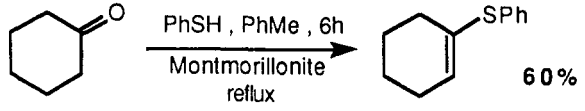


Middleton, D.S.; Simpkins, N.S. *Synth. Commun.*, ***1989***, *19*, 21.



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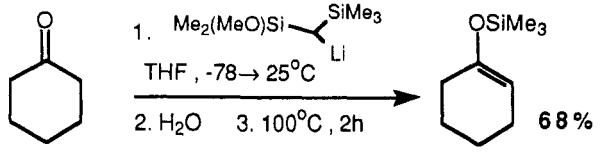
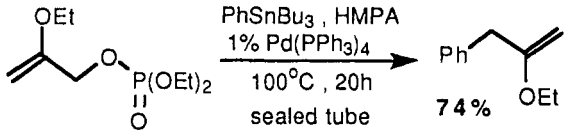


Bates, T.F.; Thomas, R.D. *J. Org. Chem.*, ***1989***, *54*, 1784.

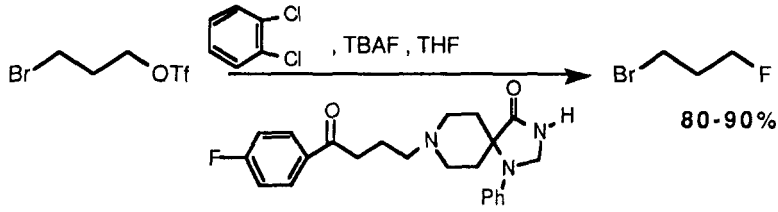


Kosugi, M.; Miyajima, Y.; Nakanishi, H.; Sano, H.; Migita, T. *Bull. Chem. Soc., Jpn.*, ***1989***, *62*, 3383.

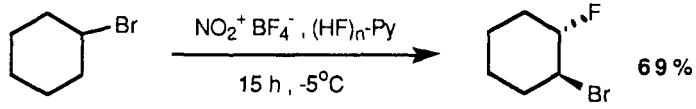
Related Methods: Section 180A (Protection of Ketones)

SECTION 368: ETHER, EPOXIDE, THIOETHER - HALIDE, SULFONATE

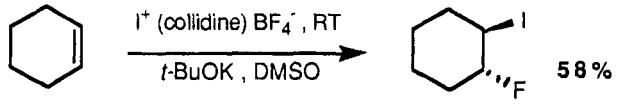
Halocyclopropanations are found in Section 74F (Alkyls from Alkenes).



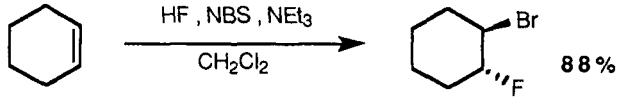
Chi, D.Y.; Kibourn, M.R.; Katzenellenbogen, J.A.; Welch, M.J. *J. Org. Chem.*, ***1987***, *52*, 658.



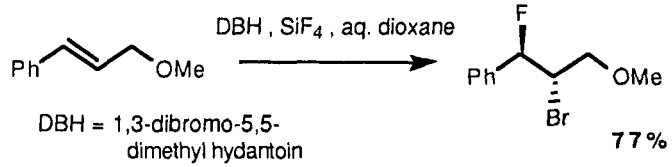
Hashimoto, T.; Surya Prakash, G.K.; Shih, J.G.; Olah, G.A. *J. Org. Chem.*, ***1987***, *52*, 931.



Evans, R.D.; Schauble, J.H. *Synthesis*, ***1987***, 551.



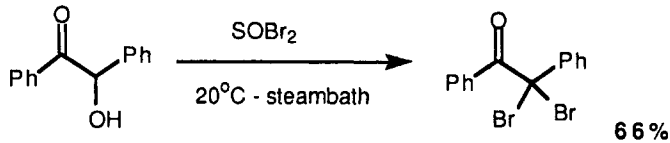
Alvernhe, G.; Laurent, A.; Haufe, G. *Synthesis*, ***1987***, 562.



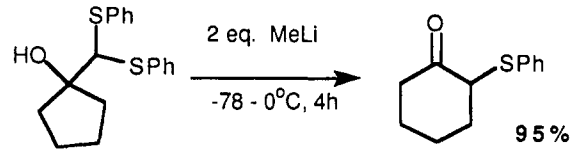
DBH = 1,3-dibromo-5,5-dimethyl hydantoin

Shimizu, M.; Nakahara, Y.; Yoihioka, H. *J. Chem. Soc., Chem. Commun.*, ***1989***, 1881.

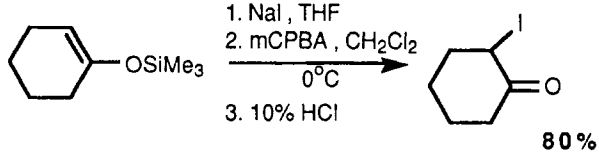
SECTION 369: HALIDE, SULFONATE - KETONE



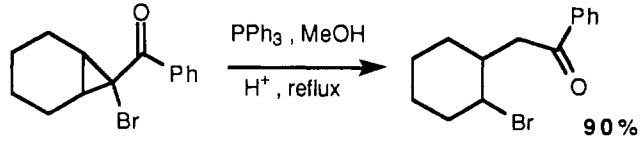
Saraf, S.D.; Al-Omran, F. *Org. Prep. Proceed. Int.*, ***1987***, *19*, 455.



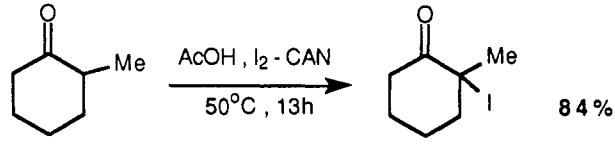
Abraham, W.D.; Bhupathy, M.; Cohen, T. *Tetrahedron Lett.*, ***1987***, *28*, 2203.



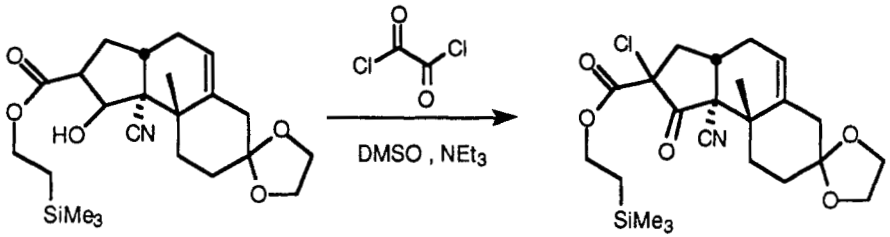
Sha, C.-K.; Young, J.-J.; Jean, T.-S. *J. Org. Chem.*, ***1987***, *52*, 3919.



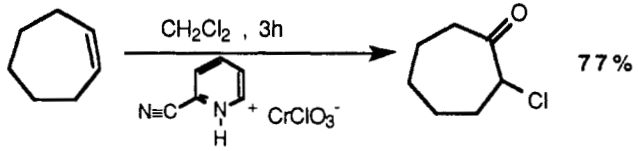
Kulinkovich, O.G.; Tishcenko, I.G.; Sviridov, S.V. *J. Org. Chem., U.S.S.R.*, ***1987***, *23*, 885.



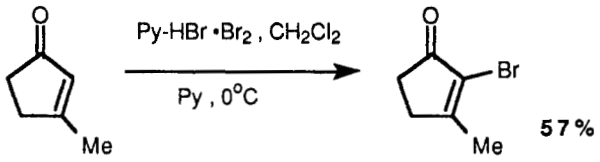
Horiuchi, C.A.; Kiji, S. *Chem. Lett.*, ***1988***, 31.



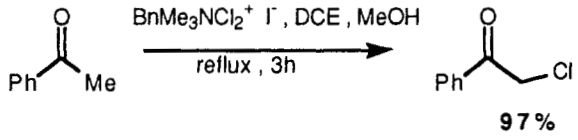
Smith III, A.B.; Leenay, T.L. *Tetrahedron Lett.*, ***1988***, *29*, 49.



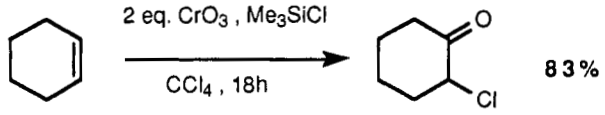
Guerrero, A.F.; Kim, H.; Schlecht, M.F. *Tetrahedron Lett.*, ***1988***, *29*, 6707.



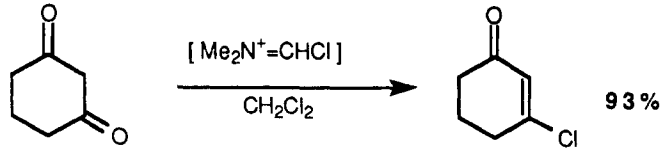
Dauben, W.G.; Warshawsky, A.M. *Synth. Commun.*, ***1988***, *18*, 1323.



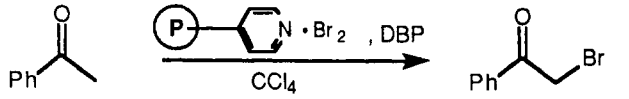
Kajigaeshi, S.; Kakinami, T.; Moriwaki, M.; Fujisaki, S.; Maeno, K.; Okamoto, T. *Synthesis*, ***1988***, 545.



Lee, J.G.; Ha, D.S. *Tetrahedron Lett.*, ***1989***, *30*, 193.

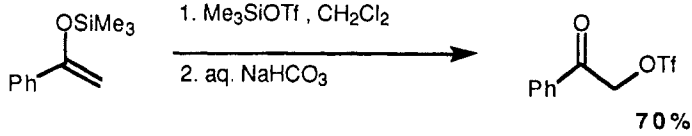


Mewshaw, R.E. *Tetrahedron Lett.*, ***1989***, *30*, 3753.



DBP = dibenzoyl peroxide

Sket, B.; Zupan, M. *Synth. Commun.*, ***1989***, *19*, 2481.

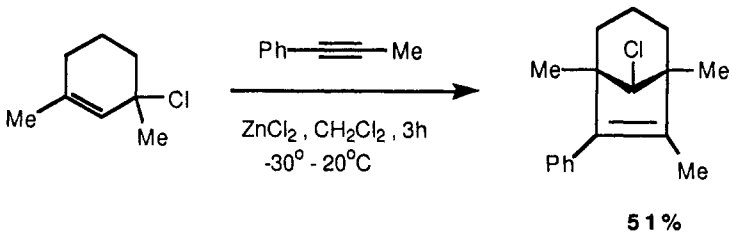


Moriarty, R.M.; Epa, W.R.; Penmasta, R.; Awasthi, A.K. *Tetrahedron Lett.*, ***1989***, *30*, 667.

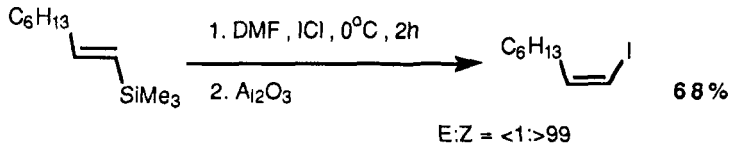
SECTION 370: HALIDE, SULFONATE - NITRILE

NO ADDITIONAL EXAMPLES

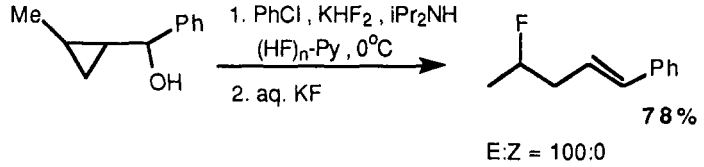
SECTION 371: HALIDE, SULFONATE - ALKENE



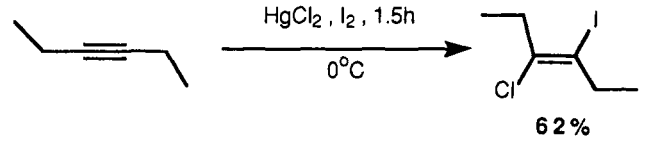
Gray, B.D.; McMillan, C.M.; Miller, A.; Moore, M. *Tetrahedron Lett.*, ***1987***, *28*, 235.



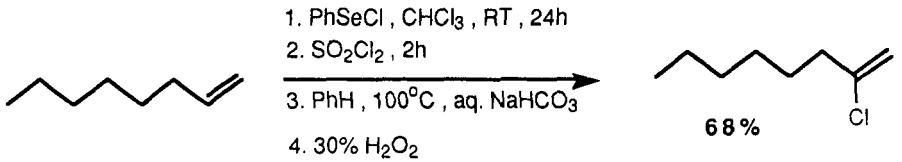
Tamao, K.; Akita, M.; Maeda, K.; Kumada, M. *J. Org. Chem.*, ***1987***, *52*, 1100.



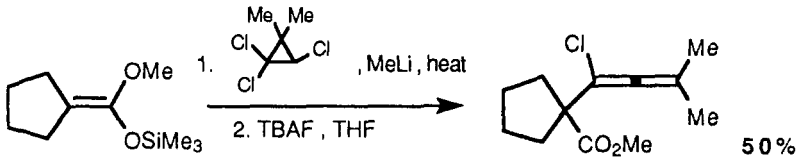
Kanemoto, S.; Shimizu, M.; Yoshioka, H. *Tetrahedron Lett.*, ***1987***, *28*, 663.



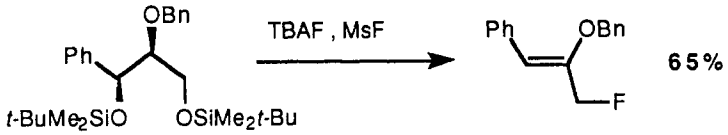
Barluenga, J.; Martínez-Gallo, J.M.; Nájera, C.; Yus, M. *J. Chem. Soc., Perkin Trans I*, ***1987***, 1017.



Engman, L. *Tetrahedron Lett.*, ***1987***, *28*, 1463.



Slougui, N.; Rousseau, G. *Tetrahedron Lett.*, ***1987***, *28*, 1651.



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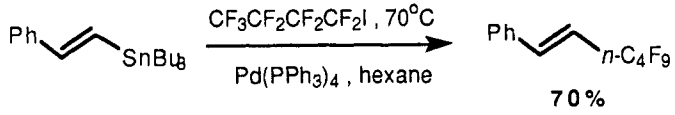
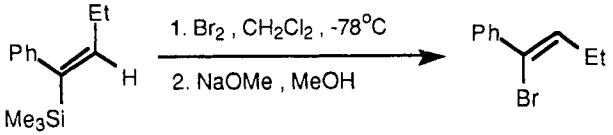
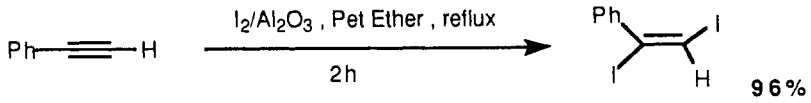


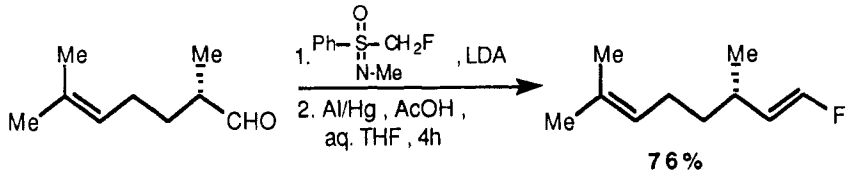
Matsubara, S.; Mitani, M.; Utimoto, K. *Tetrahedron Lett.*, ***1987***, *28*, 5857.



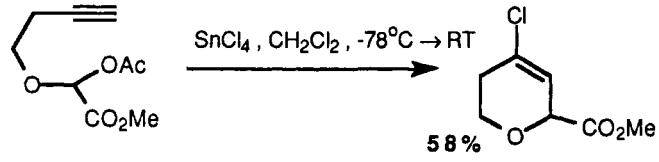
Oliva, A.; Molinari, A. *Synth. Commun.*, ***1987***, *17*, 837.



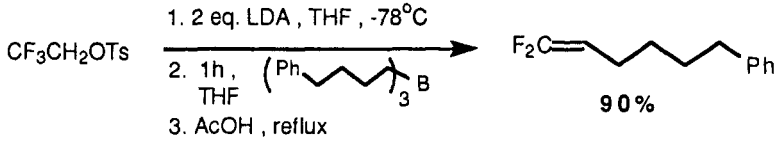
Larson, S.; Luidhardt, T.; Kabalka, G.W.; Pagni, R.M. *Tetrahedron Lett.*, ***1988***, *29*, 35.
Hondrogiannis, G.; Lee, L.C.; Kabalka, G.W.; Pagni, R.M. *Tetrahedron Lett.*, ***1989***, *30*, 2069.



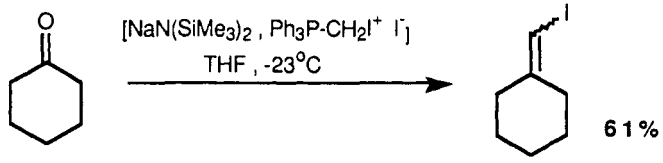
Boys, M.L.; Collington, E.W.; Finch, H.; Swanson, S.; Whitehead, J.F. *Tetrahedron Lett.*, ***1988***, *29*, 3365.



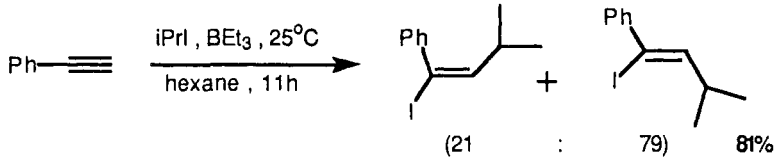
Lolkema, L.D.M.; Hiemstra, H.; Mooiweer, H.H.; Speckamp, W.N. *Tetrahedron Lett.*, ***1988***, *29*, 6365.



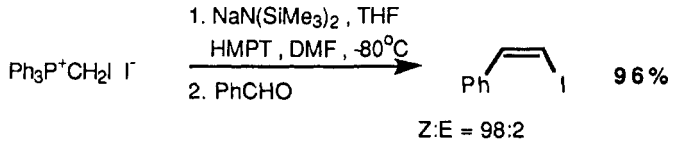
Ichikawa, J.; Sonoda, T.; Kobayashi, H. *Tetrahedron Lett.*, ***1989***, *30*, 1641.



Stork, G.; Zhao, K. *Tetrahedron Lett.*, ***1989***, *30*, 2173.



Ichnose, Y.; Matsunaga, S.; Fugami, K.; Oshima, K.; Utimoto, K. *Tetrahedron Lett.*, ***1989***, *30*, 3155.
Takeyama, Y.; Ichinose, Y.; Oshima, K.; Utimoto, K. *Tetrahedron Lett.*, ***1989***, *30*, 3159.



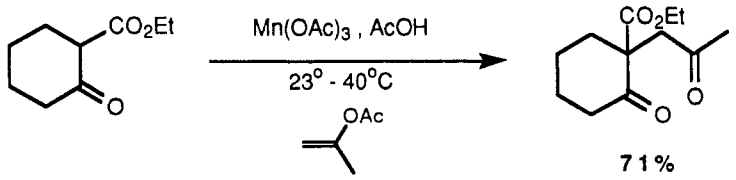
Bestmann, H.J.; Rippel, H.C.; Dostalek, R. *Tetrahedron Lett.*, ***1989***, *30*, 5261.

REVIEW:

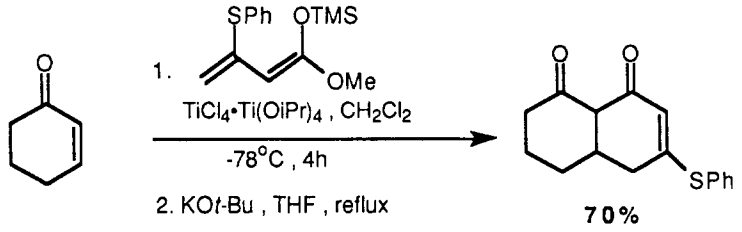
"The Design and Applications of Free Radical Chain Reactions in Organic Synthesis"

Curran, D.P. *Synthesis,* ***1988***, 417, 489.

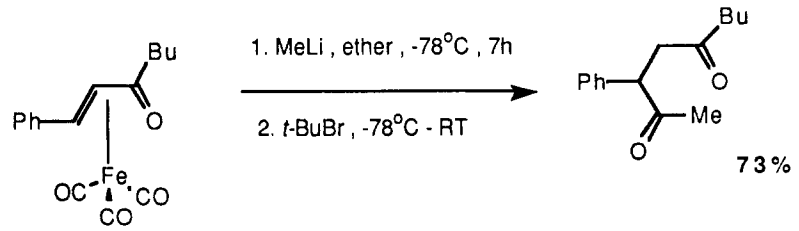
SECTION 372: KETONE - KETONE



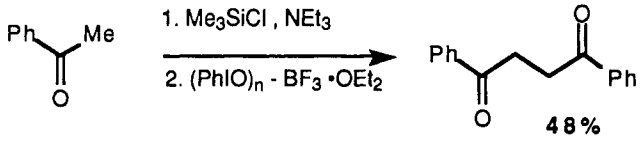
Corey, E.J.; Ghosh, A.K. *Tetrahedron Lett.,* ***1987***,.*28*, 175.



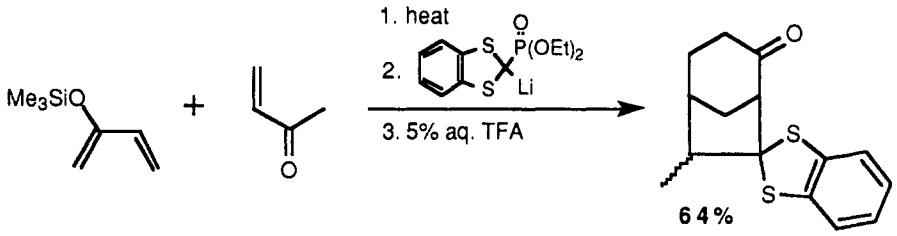
Chan, T.H.; Prasad, C.V.C. *J. Org. Chem.,* ***1987***, *52*, 120.



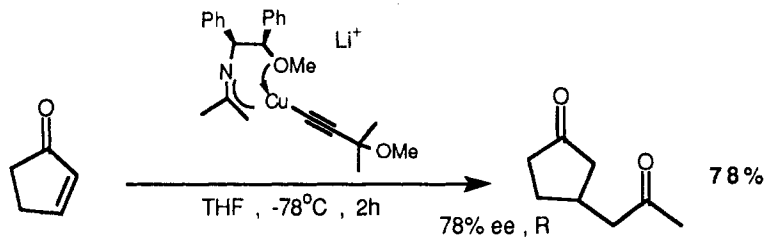
Thomas, S.E. *J. Chem. Soc., Chem. Commun.,* ***1987***, 226.



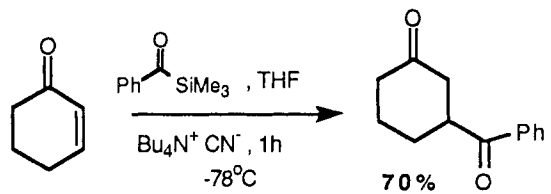
Moriarty, R.; Prakash, O.; Duncan, M.P. *J. Chem. Soc., Perkin Trans. I*, ***1987***, 559.



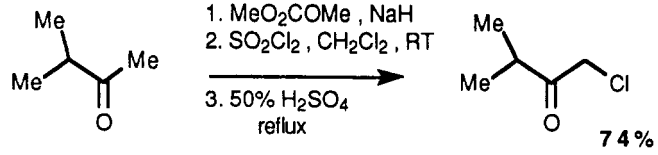
Rigby, J.H.; Kotnis, A.S. *Tetrahedron Lett.*, ***1987***, *28*, 4943.



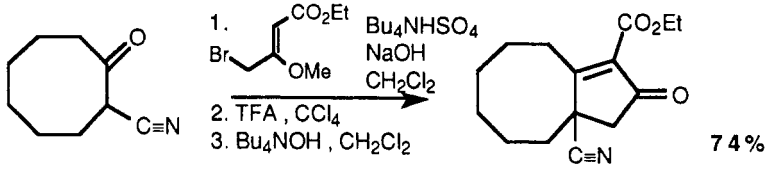
Yamamoto, K.; Kanoh, M.; Yamamoto, N.; Tsuji, T. *Tetrahedron Lett.*, ***1987***, *28*, 6347.



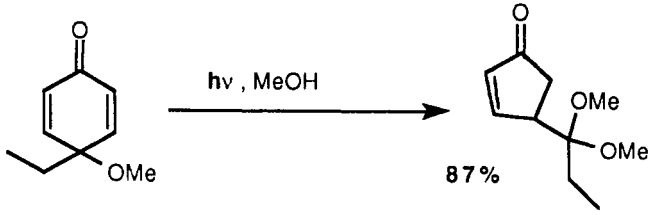
Degl'Innocenti, A.; Ricci, A.; Mordini, A.; Reginato, G.; Colotta, V. *Gazz. Chim. Ital.*, ***1987***, *117*, 645.



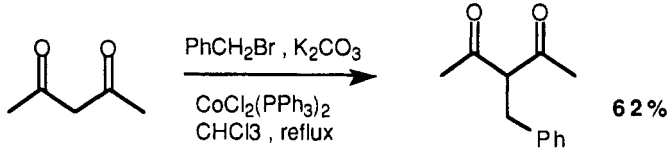
DeKimpe, N.; De Cock, W.; Schamp, N. *Synthesis*, ***1987***, 188.



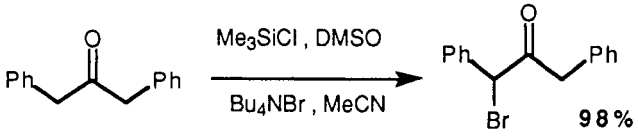
Ognyanov, V.I.; Hesse, M. *Helv. Chim. Acta*, ***1987***, *70*, 1393.



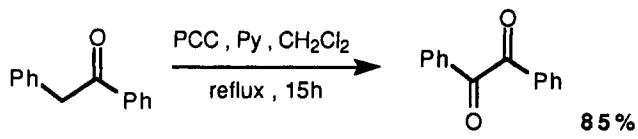
Taveras Jr., A.G. *Tetrahedron Lett.*, ***1988***, *29*, 1103.



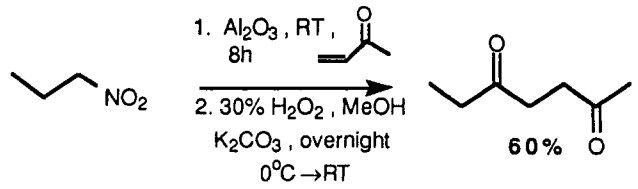
González, A.; Marquet, J.; Moreno-Mañas, M. *Tetrahedron Lett.*, ***1988***, *29*, 1469.



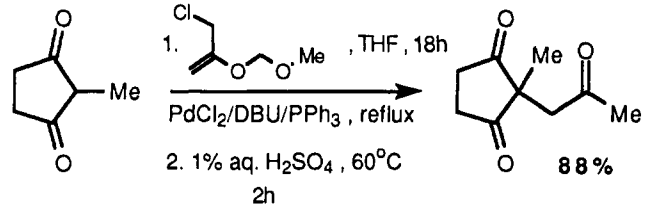
Fraser, R.R.; Kong, F. *Synth. Commun.*, ***1988***, *18*, 1071.



Bonadies, F.; Bonini, C. *Synth. Commun.*, ***1988***, *18*, 1573.



Ballini, R.; Petrini, M.; Marcantoni, E.; Rosini, G. *Synthesis,* ***1988***, 231.



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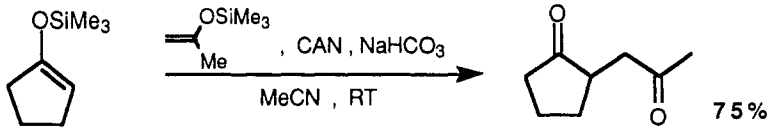

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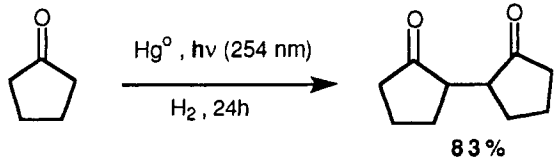

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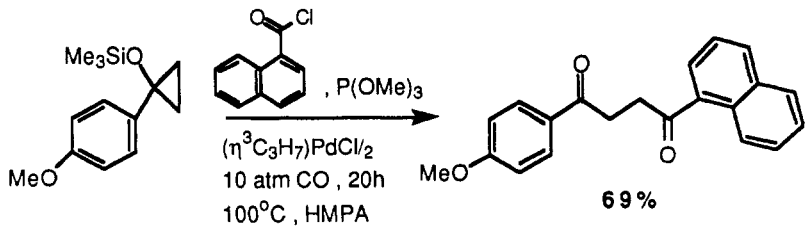
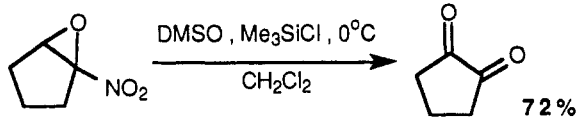


Aoki, S.; Fujimaura, T.; Nakamura, E.; Kuwahima, I. *Tetrahedron Lett.*, ***1989***, *30*, 6541.



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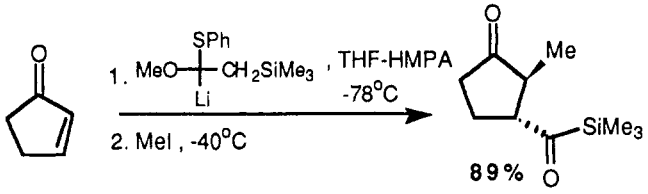

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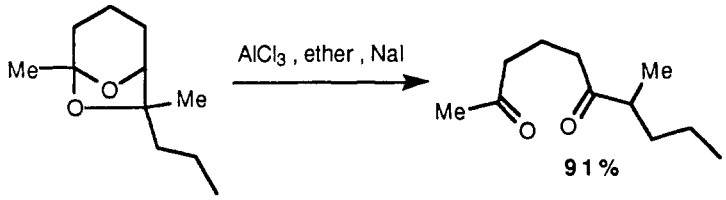

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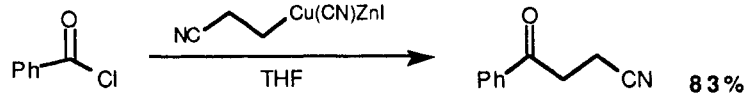
SECTION 373: KETONE - NITRILE



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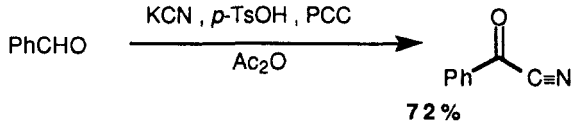


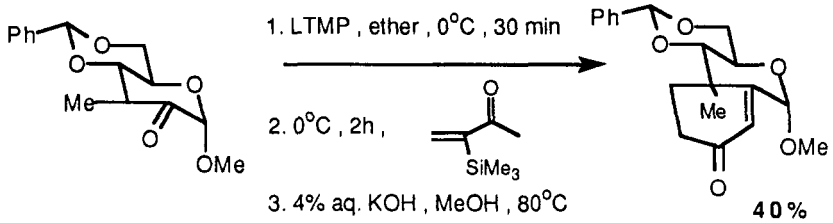
Kang, S.-K.; Sohn, H.-K.; Kim, S.-G. *Org. Prep. Proceed. Int.*, ***1989***, *21*, 383.

SECTION 374: KETONE - ALKENE

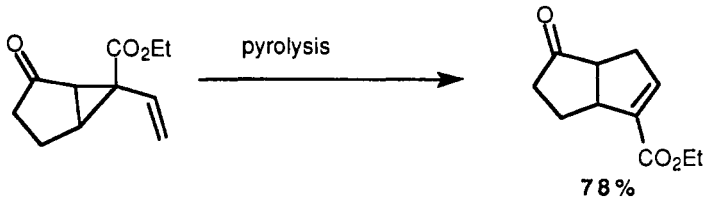
For the oxidation of allylic alcohols to alkene ketones, see Section 168 (Ketones from Alcohols and Phenols)

For the oxidation of allylic methylene groups (C=C-CH_2 → C=C-C=O), see Section 170 (Ketones from Alkyls and Methylenes).

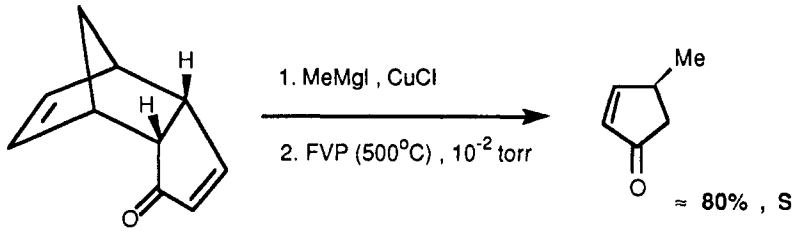
For the alkylation of alkene ketones, also see Section 177 (Ketones from Ketones) and for conjugate alkylations see Section 74E (Alkyls form Alkenes).



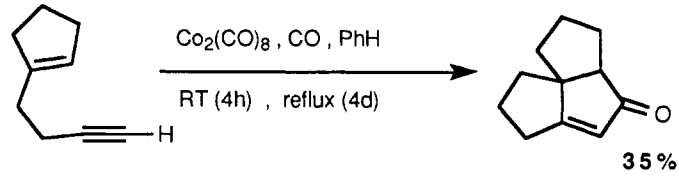
Bonnert, R.V.; Jinkins, P.R. *J. Chem. Soc., Chem. Commun.*, ***1987***, 6.



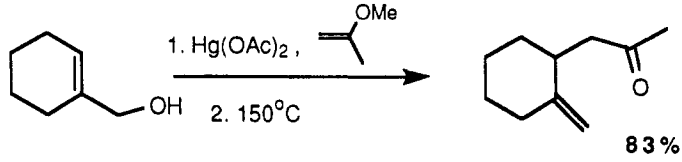
Fleming, A.; Sinari-Zingde, G.; Natchus, M.; Hudlicky, T. *Tetrahedron Lett.*, ***1987***,.*28*, 167.



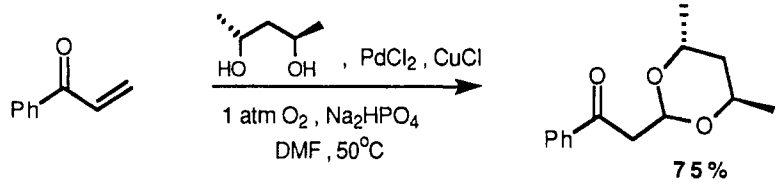
Klunder, A.J.H.; Huizinga, W.B.; Sessink, P.J.M. Zwanenburg, B. *Tetrahedron Lett.*, ***1987***, *28*, 357.



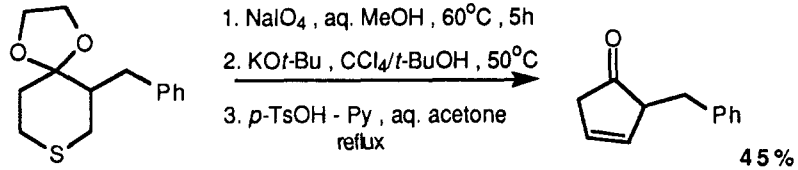
Schore, N.E.; Knudsen, M.J. *J. Org. Chem.*, ***1987***, *52*, 569.



McKenzie, T.G. *Org. Prep. Proceed. Int.*, ***1987***, *19*, 435.



Hosokawa, T.; Ohta, T.; Kanayama, S.; Murahashi, S. *J. Org. Chem.*, ***1987***, *52*, 1758.



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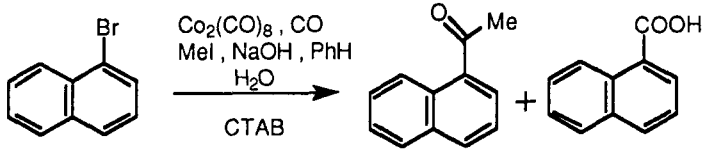
Matsuyama, H.; Miyazawa, Y.; Takei, Y.; Kobayashi, M. *J. Org. Chem.*, ***1987***, *52*, 1703.



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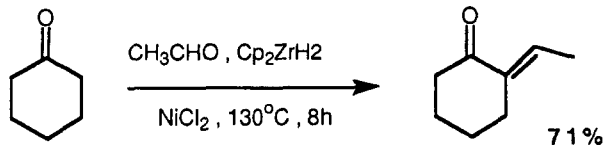

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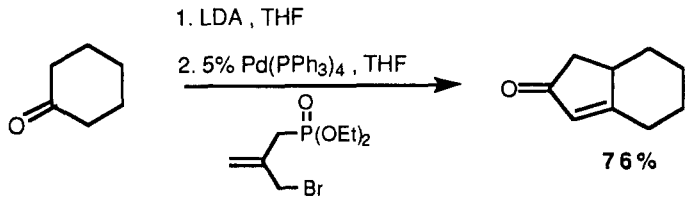

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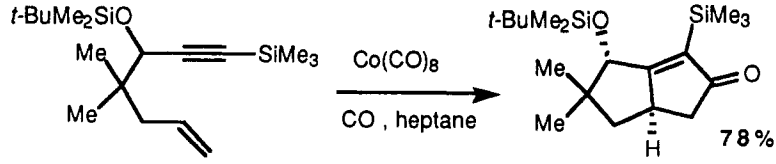
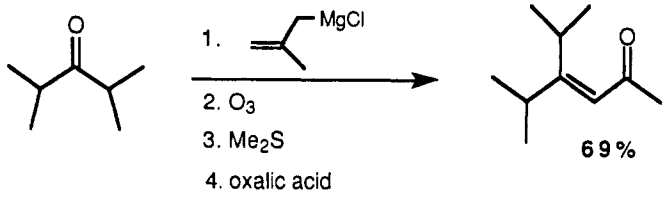


Magnus, P.; Principe, L.M.; Slater, M.J. *J. Org. Chem.*, ***1987***, *52*, 1483.



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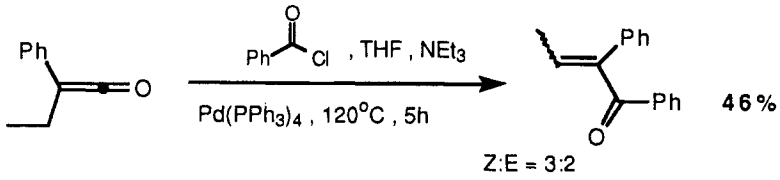

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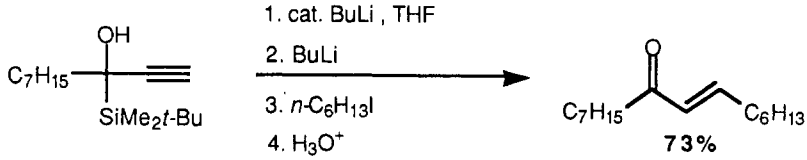
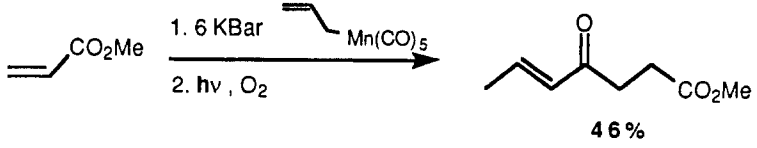


Matsuoka, R.; Horiguchi, Y.; Kawajima, I. *Tetrahedron Lett.*, ***1987***, *28*, 1299.



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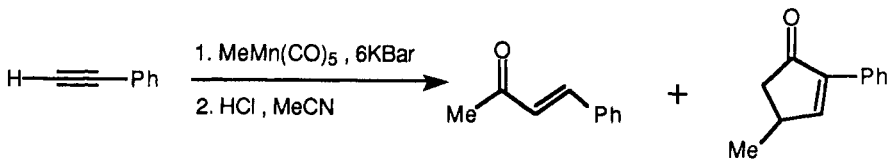

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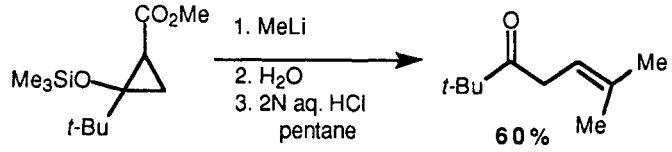
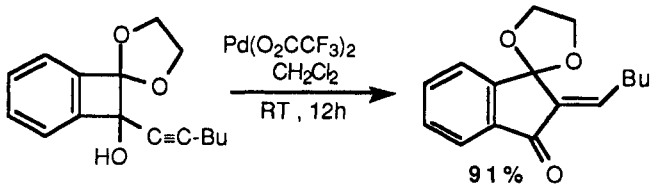


Bretsch, W.; Reißig, H.-U. *Liebigs. Ann. Chem.*, ***1987***, 175.



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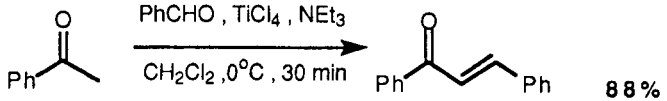
Liebeskind, L.S.; Mitchell, D.; Foster, B.S. *J. Am. Chem. Soc.*, ***1987***, *109*, 7908.



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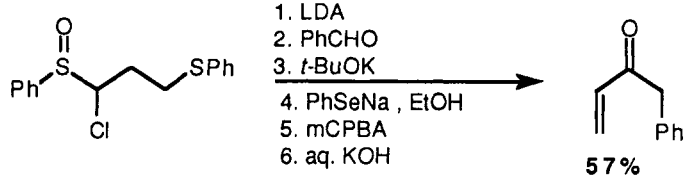

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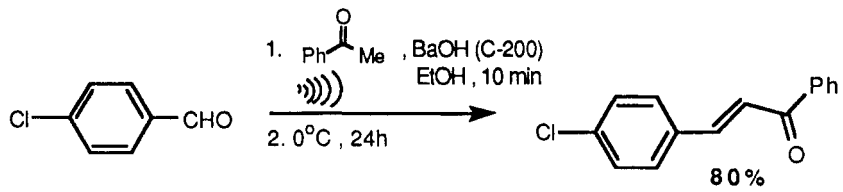
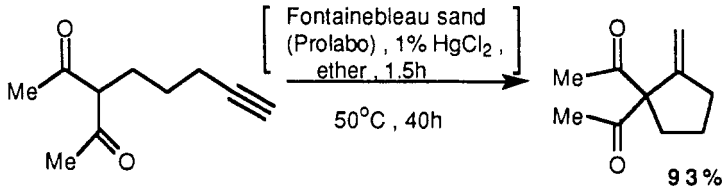


Fuentes, A.; Marinas, J.M.; Sinisterra, J.V. *Tetrahedron Lett.*, ***1987***, *28*, 4541.



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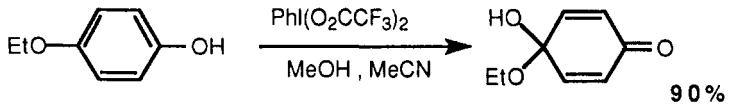
Boaventura, M.-A.; Drouin, J. *Synth. Commun.*, ***1987***, *17*, 975.



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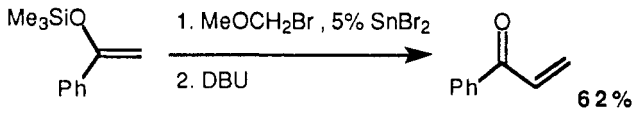
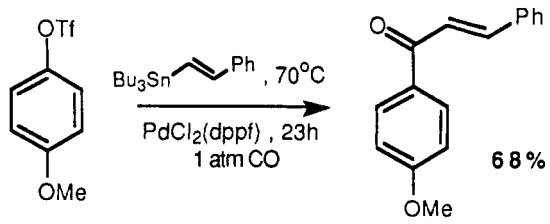
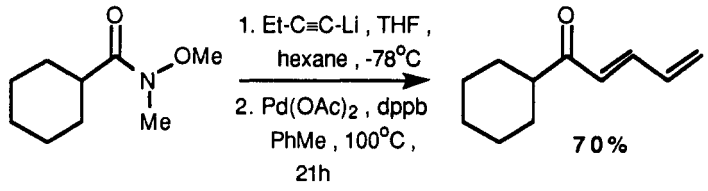


Hayashi, M.; Mukaiyama, T. *Chem. Lett.*, ***1987***, 1283.



Echavarren, A.M.; Stille, J.K. *J. Am. Chem. Soc.*, ***1988***, *110*, 1557.



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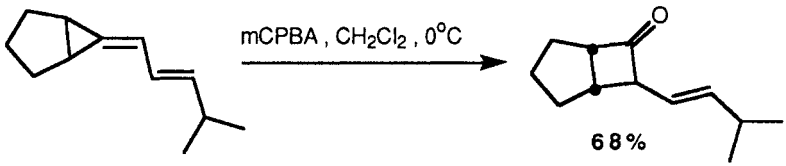

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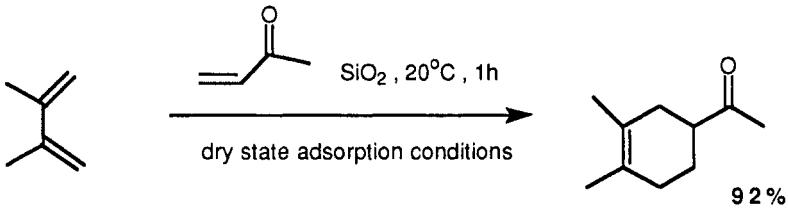
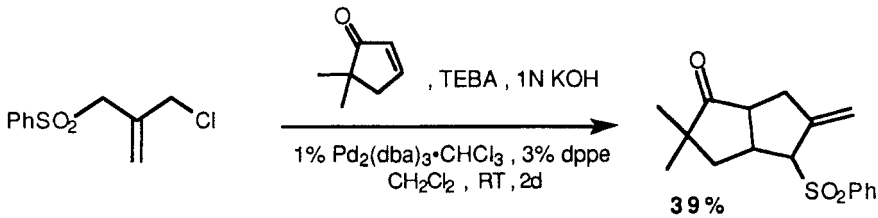
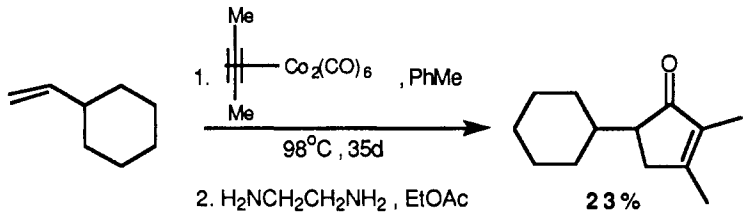
McCullough, D.W.; Cohen, T. *Tetrahedron Lett.*, ***1988***, *29*, 27.



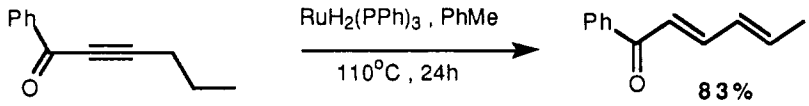
Veselovsky, V.V.; Gybin, A.S.; Lozanova, A.V.; Moiseenkov, A.M.; Smit, W.A.; Caple, R. *Tetrahedron Lett.*, ***1988***, *29*, 175.



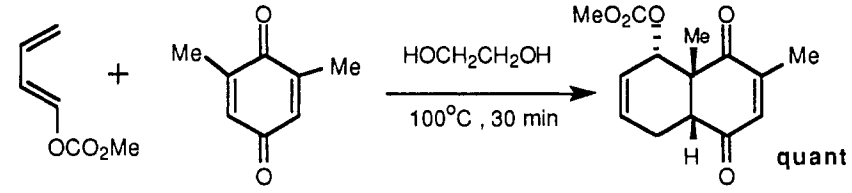
Breuilles, P.; Uguen, D. *Tetrahedron Lett.*, ***1988***, *29*, 201.



Krafft, M.E. *Tetrahedron Lett.*, ***1988***, *29*, 999.



Ma, D.; Lin, Y.; Lu, X.; Yu, Y. *Tetrahedron Lett.*, ***1988***, *29*, 1045.



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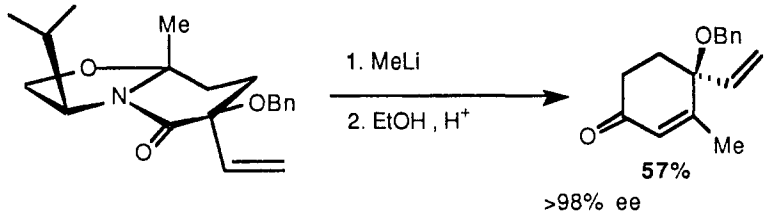

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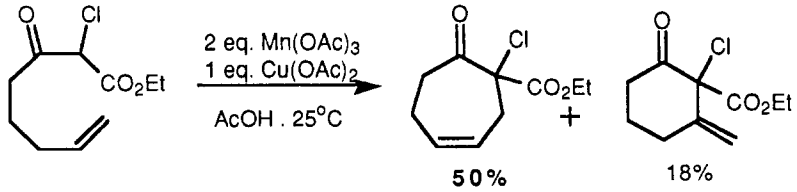

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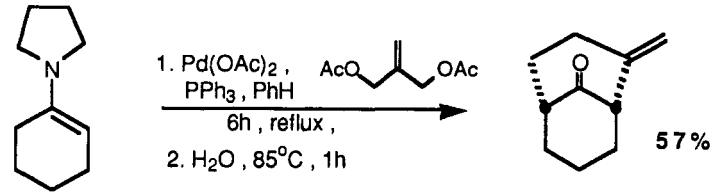

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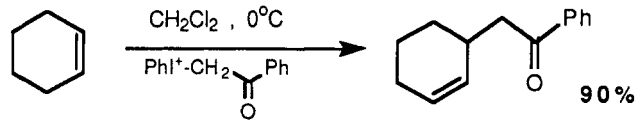

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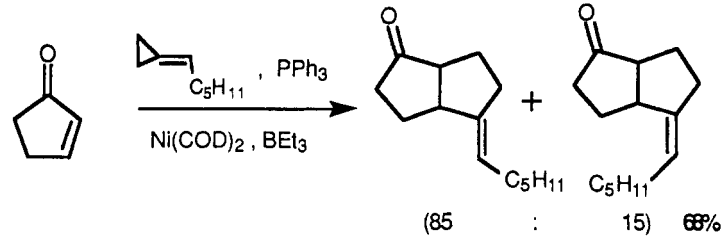

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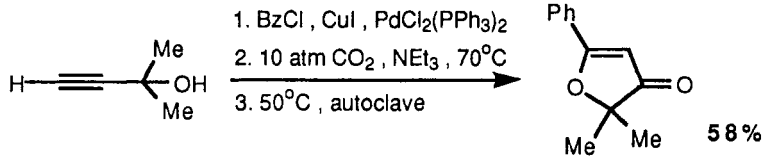

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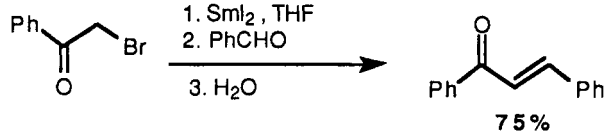

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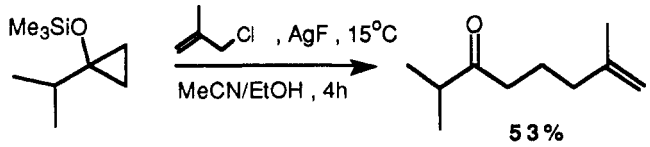

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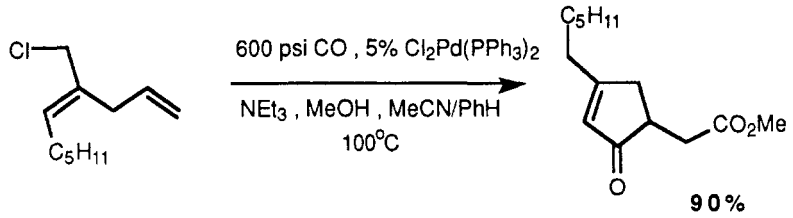

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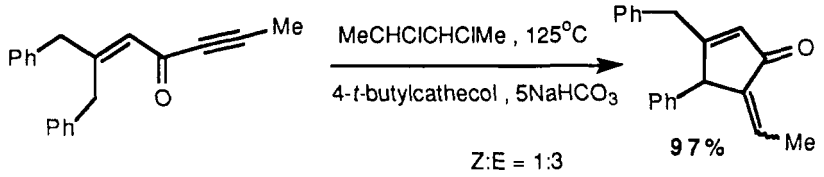

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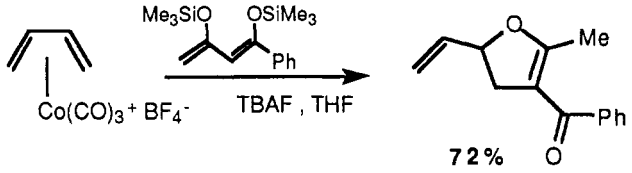

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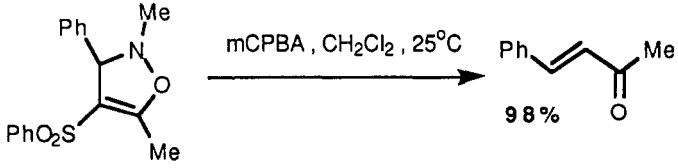

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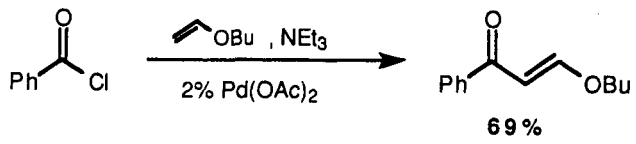

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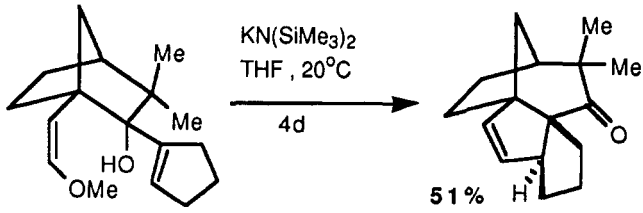

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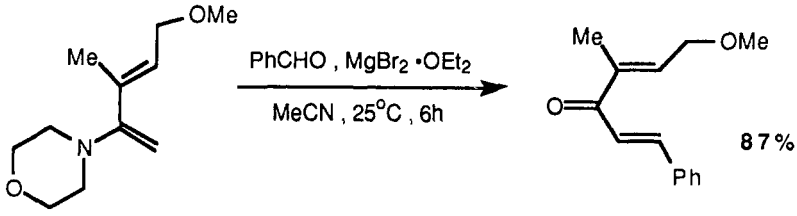

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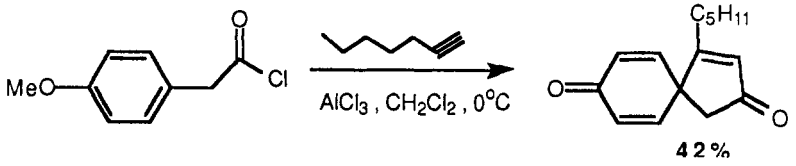

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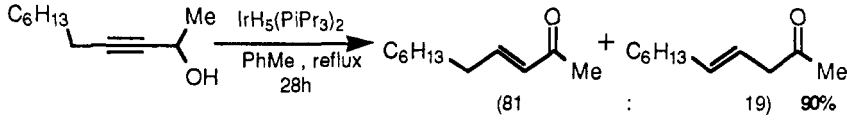

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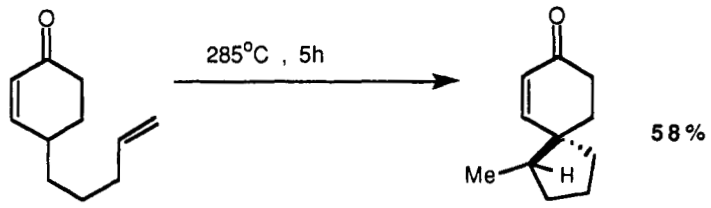

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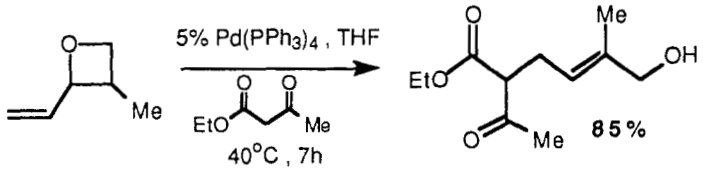

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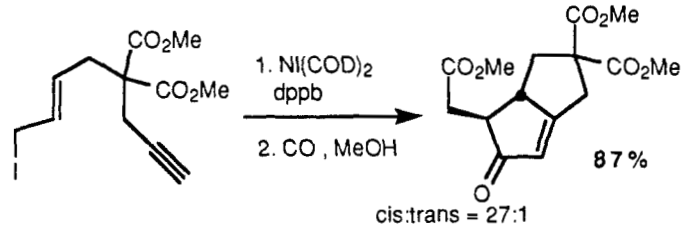

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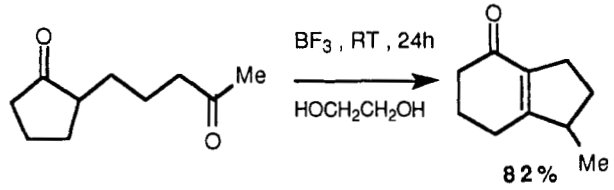

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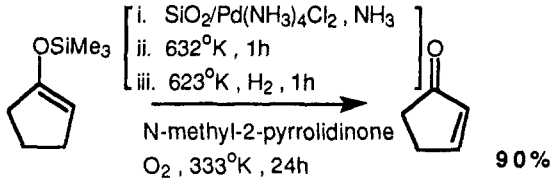

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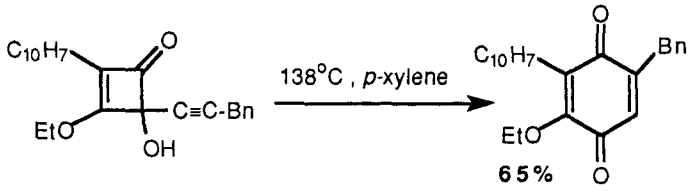
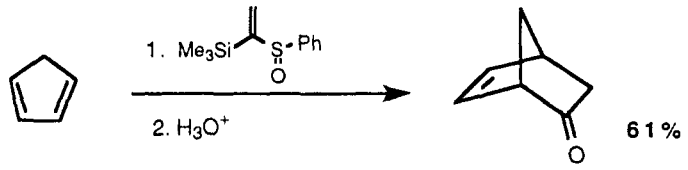


Foland, L.D.; Karlsson, J.O.; Pelrri, S.T.; Schwabe, R.; Xy, S.L.; Patil, S.; Moore, H.W. *J. Am. Chem. Soc.*, ***1989***, *111*, 975.



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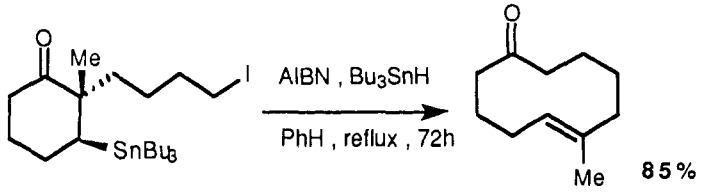

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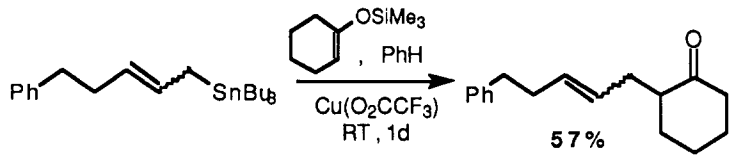

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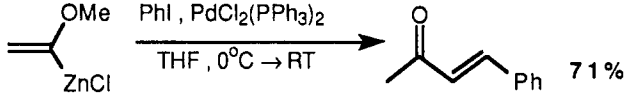

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REVIEW:

"New Synthetic Reactions of Allyl Alkyl Carbonates, Allyl β-Keto Carboxylates and Allyl Vinylic Carbonates Catalyzed by Palladium Complexes"

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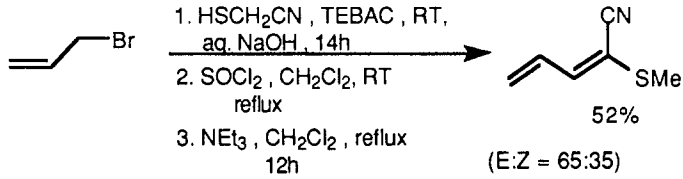
SECTION 375: NITRILE - NITRILE

NO ADDITIONAL EXAMPLES

SECTION 376: NITRILE - ALKENE



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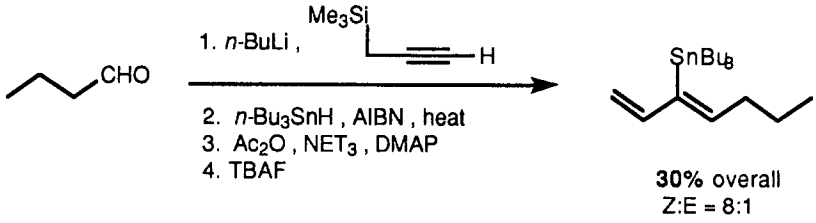
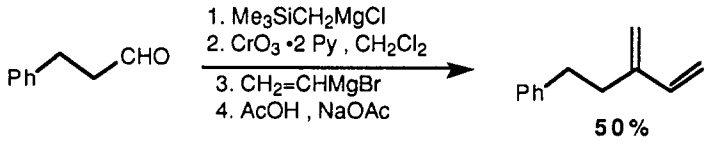
SECTION 377: ALKENE - ALKENE



Nativi, C. Taddei, M. *Tetrahedron Lett.*, ***1987***, *28*, 347.



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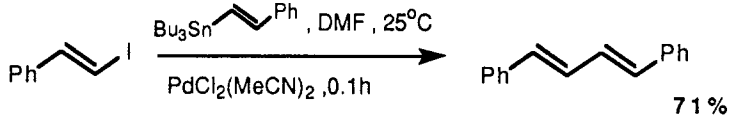

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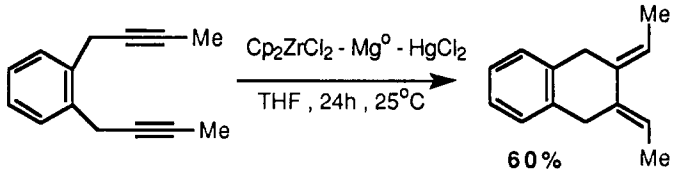

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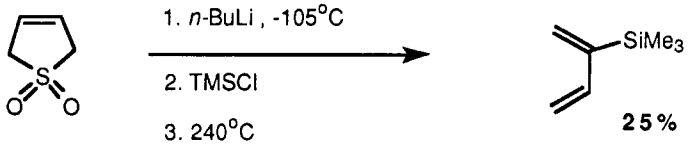

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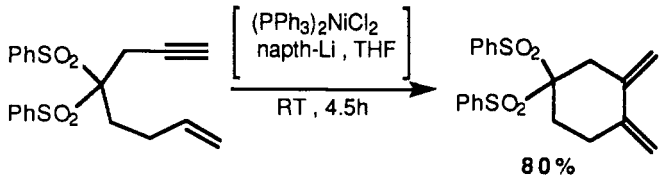

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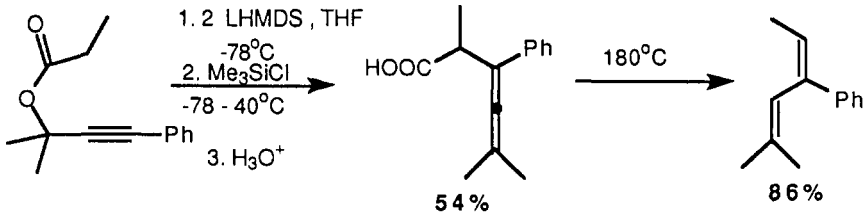

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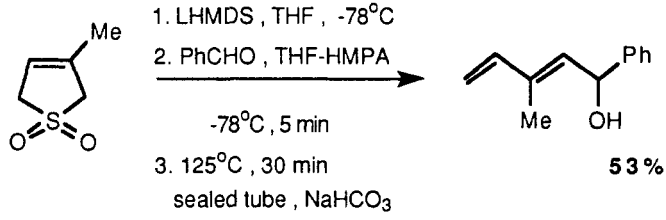

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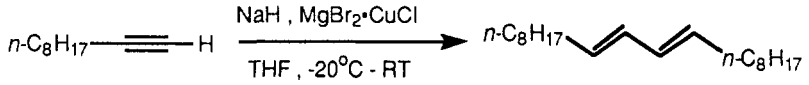

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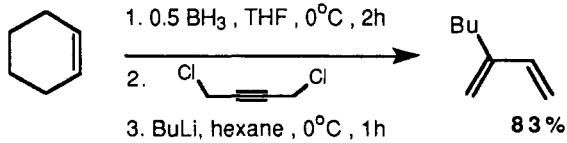
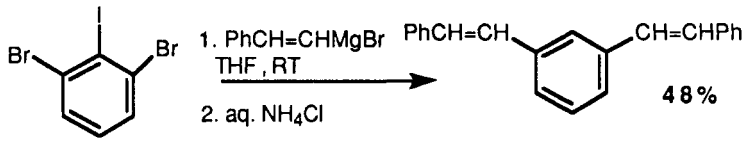


Arase, A.; Hoshi, M. *J. Chem. Soc., Chem. Commun.*, ***1987***, 531.



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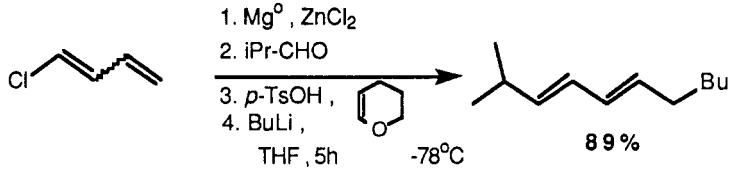

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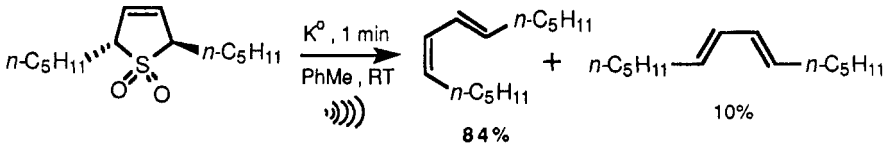

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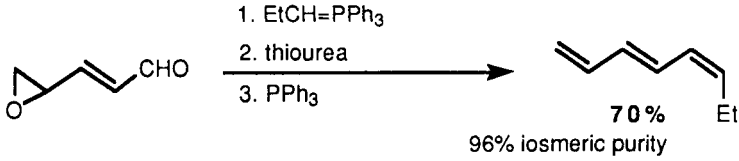

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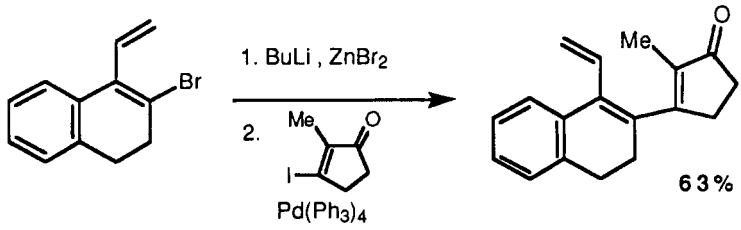

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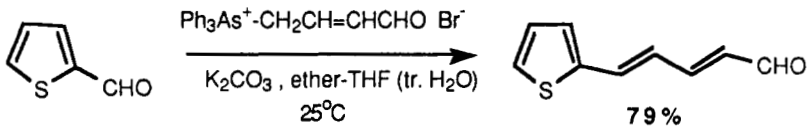

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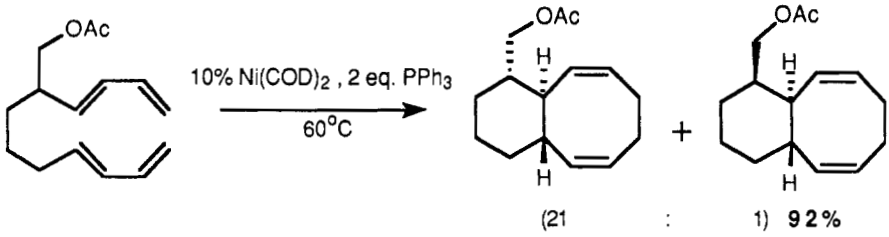

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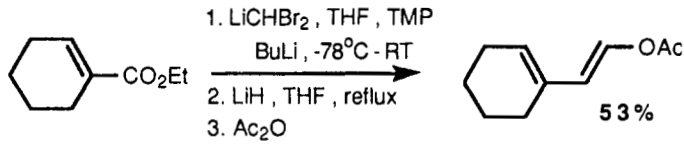

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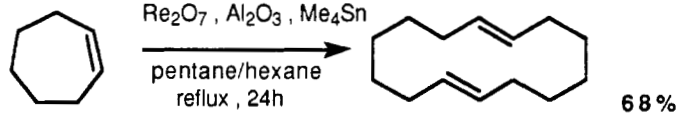

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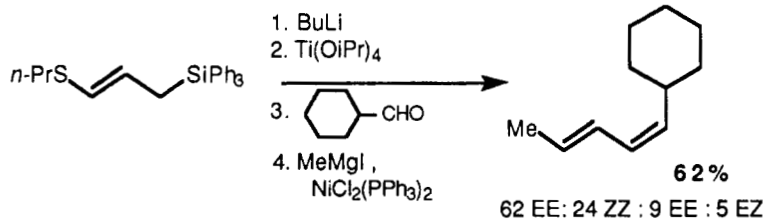

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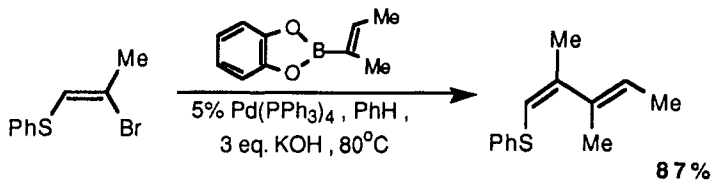

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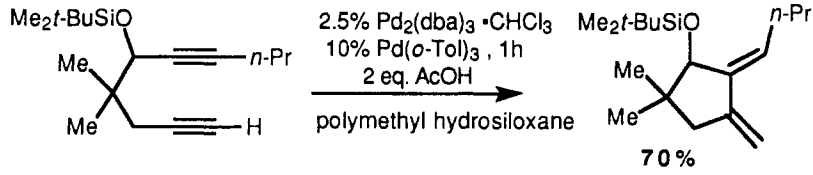

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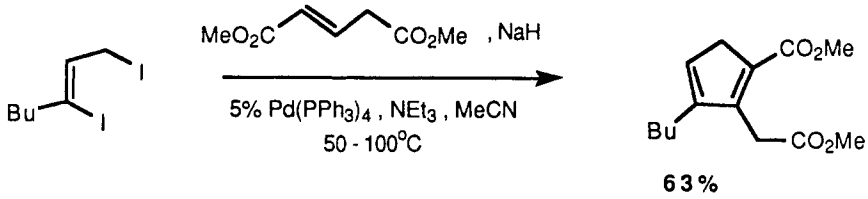

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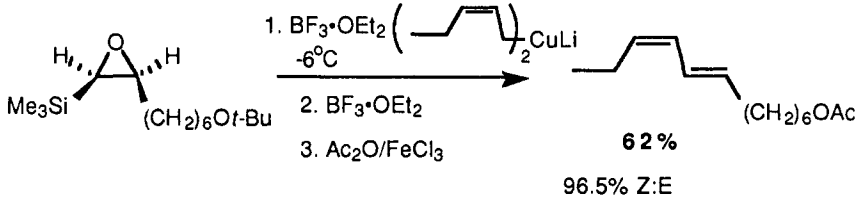

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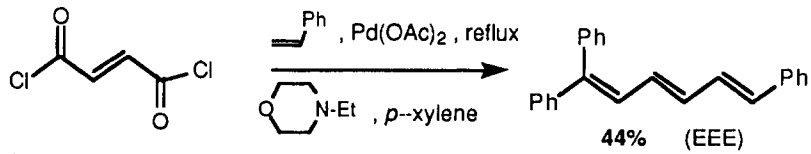

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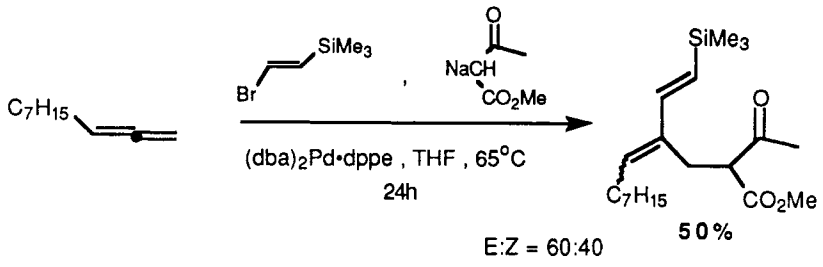

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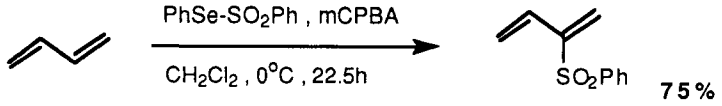

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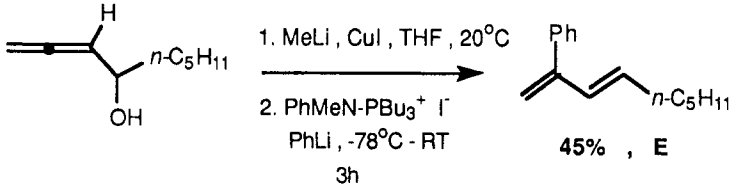

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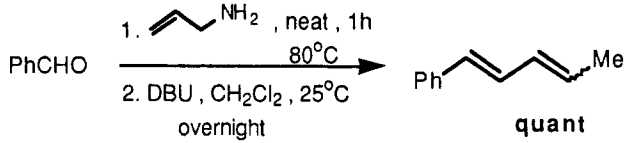

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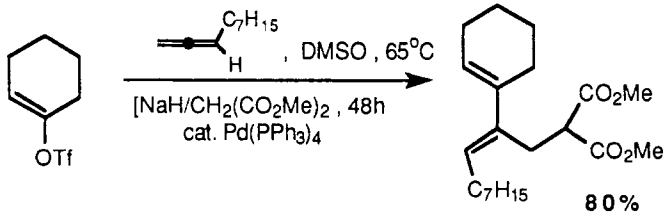

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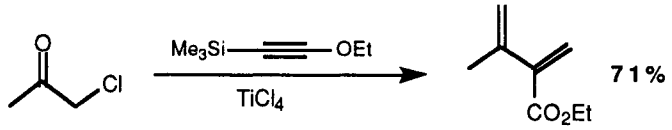

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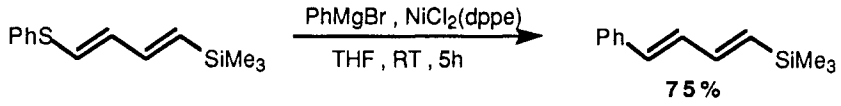

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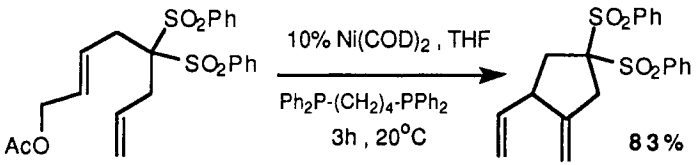

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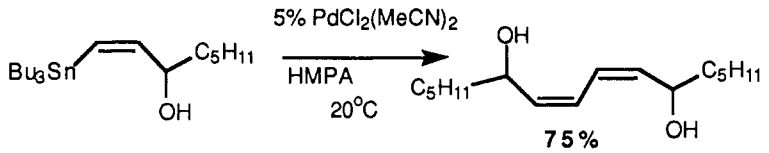

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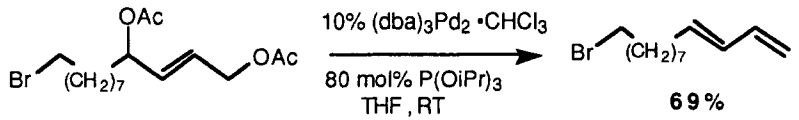

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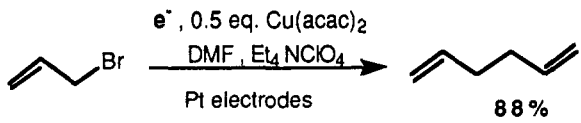

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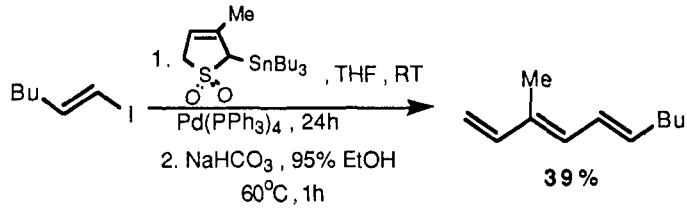

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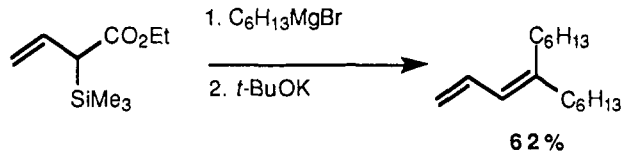

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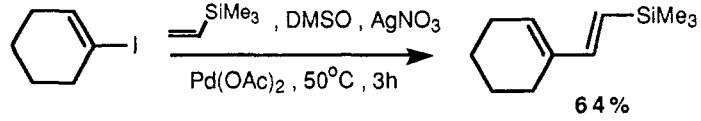

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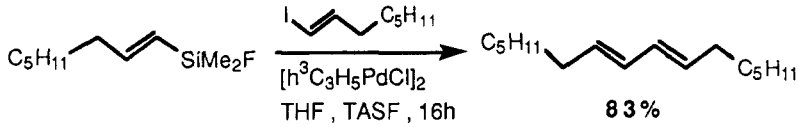

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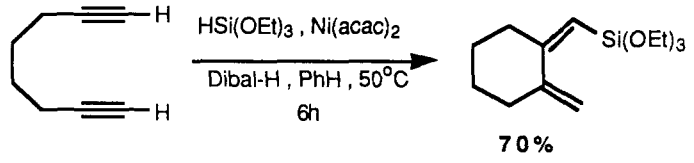

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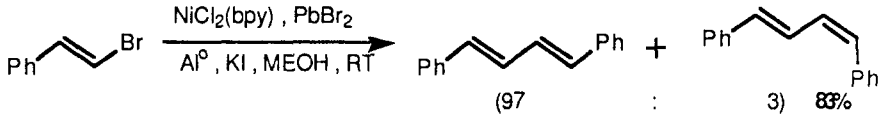

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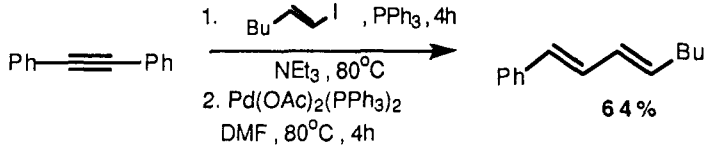

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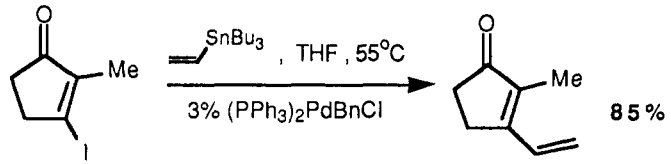

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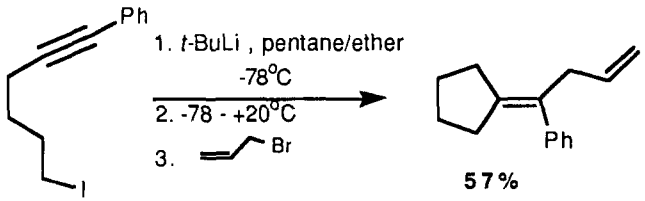

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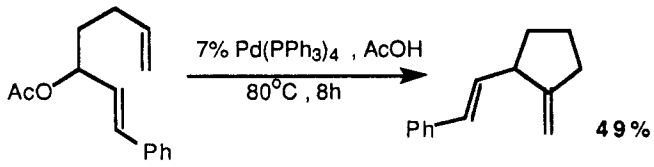

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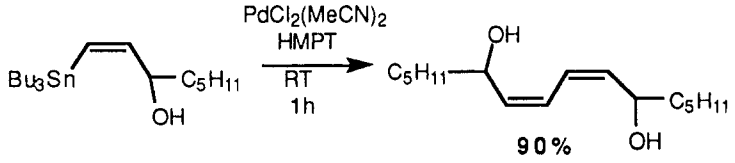

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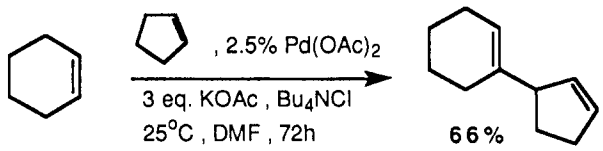

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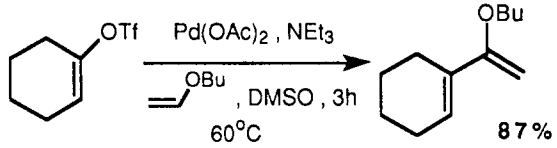

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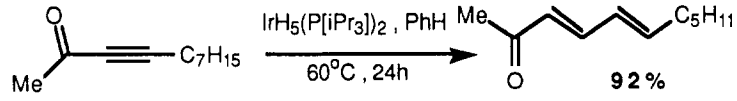

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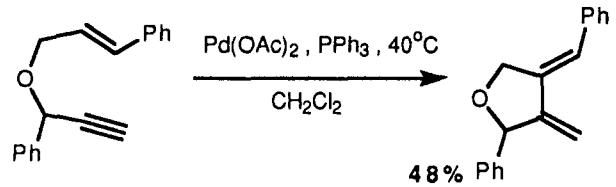

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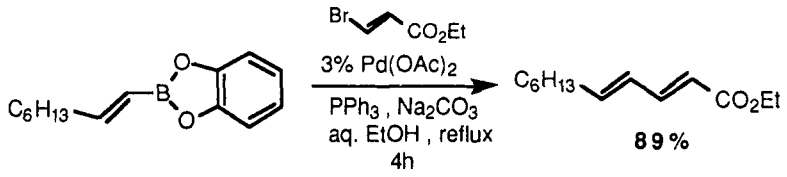

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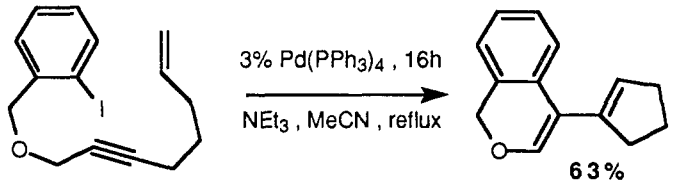

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REVIEWS:

"Camphor Derivatives as Chiral Auxiliaries in Asymmetric Synthesis"

Oppolzer, W. *Tetrahedron*, ***1987***, *43*, 1969.

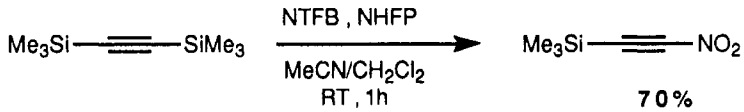
"Orthoquinodimethanes"

Charlton, J.L.; Alauddin, M.M. *Tetrahedron*, ***1987***, *43*, 2873.

"Retro-Diels-Alder Strategy in Natural Product Synthesis"

Ichihara, A. *Synthesis*, ***1987***, 207.

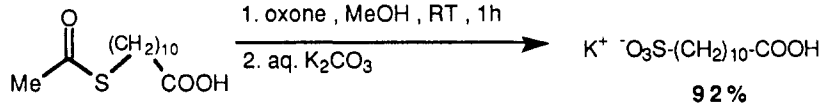
SECTION 378: OXIDES - ALKYNES



NTFB = nitronium tetrafluoroborate
NHFP = nitronium hexafluorophosphate

Schmitt, R.J.; Battaro, J.C.; Malhotra, R.; Bedford, C.D. *J. Org. Chem.*, ***1987***, *52*, 2294.

SECTION 379: OXIDES - ACID DERIVATIVES



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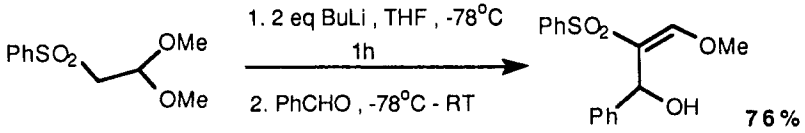
SECTION 380: OXIDES - ALCOHOLS, THIOLS



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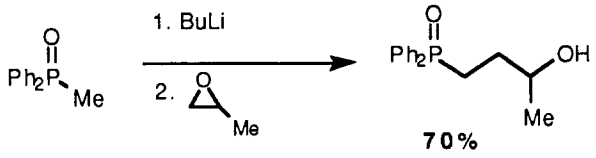

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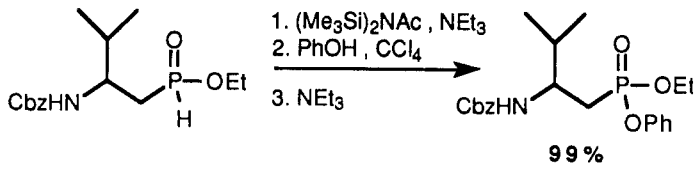
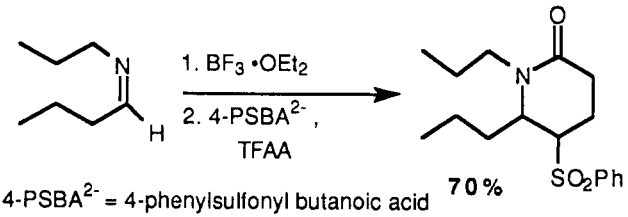
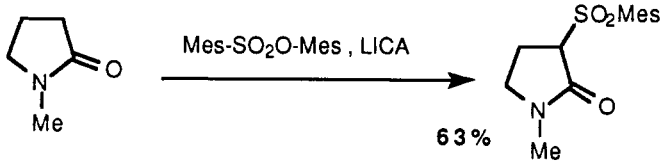
SECTION 381: OXIDES - AMIDES



Sampson, N.S.; Bartlett, P.A. *J. Org. Chem.*, ***1988***, *53*, 4500.

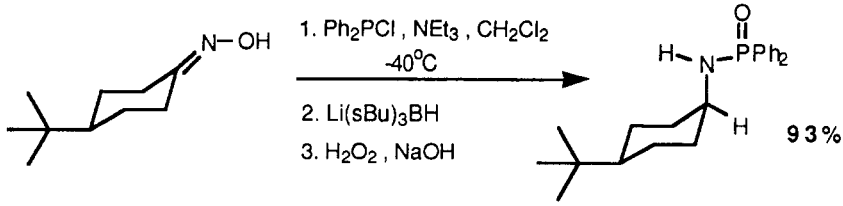


Thompson, C.M.; Green, D.L.C.; Kubas, R. *J. Org. Chem.*, ***1988***, *53*, 5389.

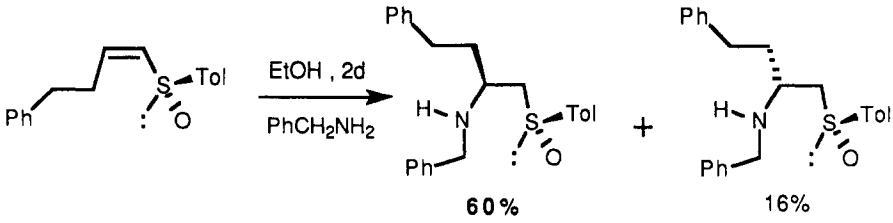


Stewart, J.D.; Pinnick, H.W. *Heterocycles*, ***1987***, *25*, 213.

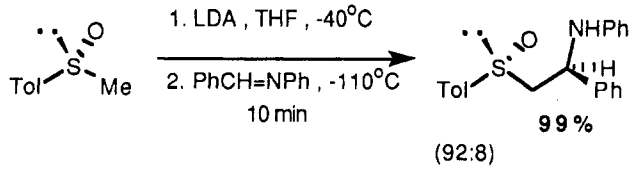
SECTION 382: OXIDES - AMINES



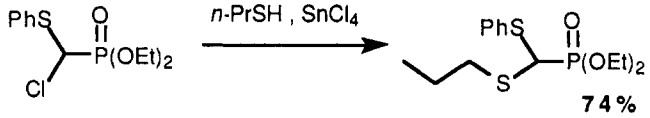
Hutchins, R.O.; Rutledge, M.C. *Tetrahedron Lett.*, ***1987***, *28*, 5619.



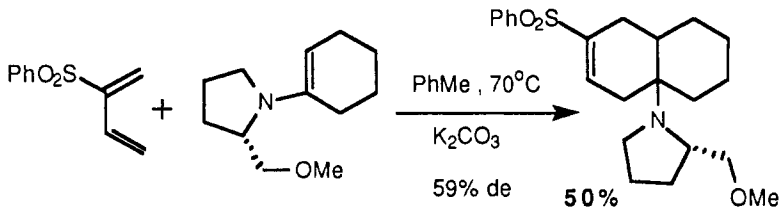
Pyne, S.G.; Griffith, R.; Edwards, M. *Tetrahedron Lett.*, ***1988***, *29*, 2089.



Ronan, B.; Marchalin, S.; Samuel, O.; Kagan, H.B. *Tetrahedron Lett.*, ***1988***, *29*, 6101.

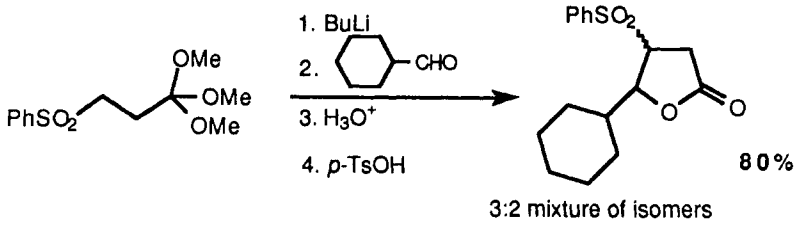


Kim, T.H.; Oh, D.Y. *Synth. Commun.*, ***1988***, *18*, 1611.



Bäckvall, J.-E.; Rise, F. *Tetrahedron Lett.*, ***1989***, *30*, 5347.

SECTION 383: OXIDES - ESTERS



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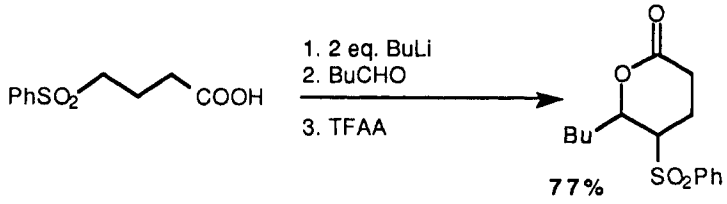
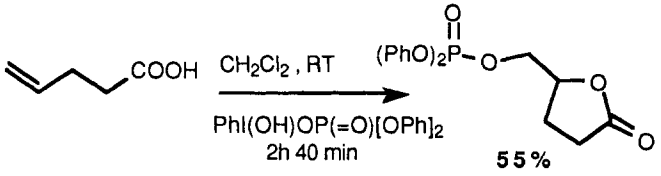
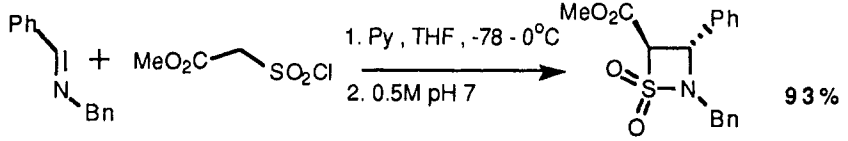


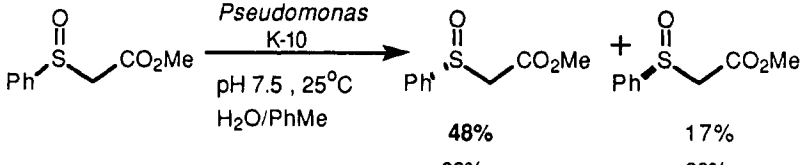
Thompson, C.M. *Tetrahedron Lett.*, ***1987***, *28*, 4243.



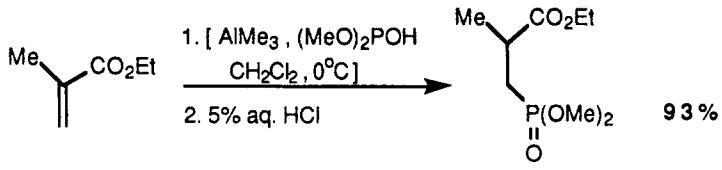
Koser, G.F.; Lodaya, J.S.; Ray III, D.G.; Kokil, P.B. *J. Am. Chem. Soc.*, ***1988***, *110*, 2987.



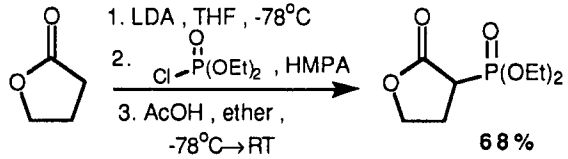
Szymonifka, M.J.; Heck, J.V. *Tetrahedron Lett.*, ***1989***, *30*, 2869; 2873.



Burgess, K.; Henderson, I. *Tetrahedron Lett.*, ***1989***, *30*, 3633.

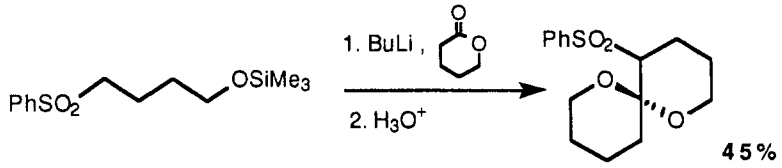


Green, K. *Tetrahedron Lett.*, ***1989***, *30*, 4807.

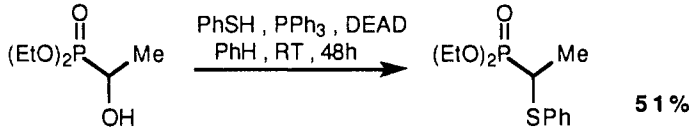


Jackson, J.A.; Hammond, G.B.; Wiemer, D.F. *J. Org. Chem.*, ***1989***, *54*, 4750.

SECTION 384: OXIDES - ETHERS, EPOXIDES, THIOETHERS

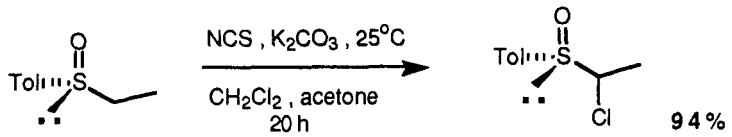


Brimble, M.A.; Officer, D.L.; Williams, G.M. *Tetrahedron Lett.*, ***1988***, *29*, 3609.



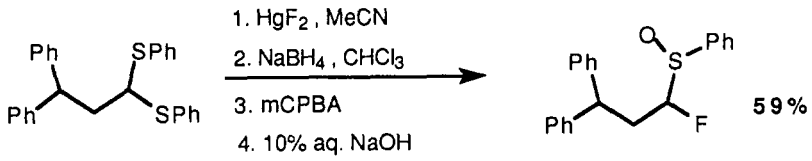
Gajada, T. *Synthesis*, ***1988***, 327.

SECTION 385: OXIDES - HALIDES, SULFONATES

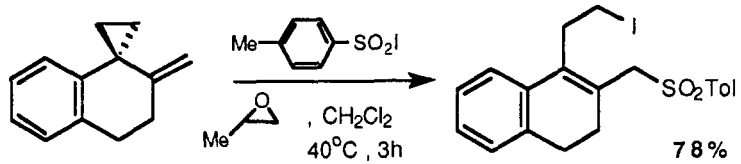


94% ee at sulfur

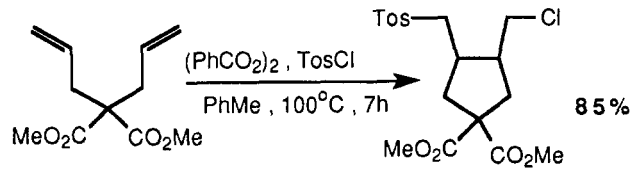
Satoh, T.; Oohara, T.; Ueda, Y.; Yamakawa, K. *Tetrahedron Lett.*, ***1988***, *29*, 313.



Purrington, S.T.; Pittman, J.H. *Tetrahedron Lett.*, ***1987***, *28*, 3901.



de C. Alpoim, M.C.M.; Morris, A.D.; Motherwell, W.B.; O'Shea, D.M. *Tetrahedron Lett.*, ***1988***, *29*, 4173.



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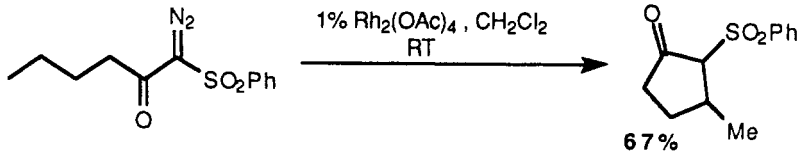
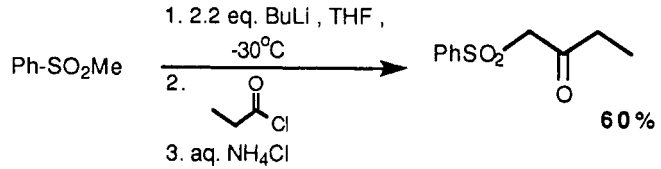
Chuang, C.-P.; Ngoi, T.K.J. *Tetrahedron Lett.*, ***1989***, *30*, 6369.

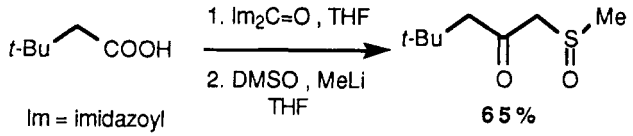
SECTION 386: OXIDES - KETONES



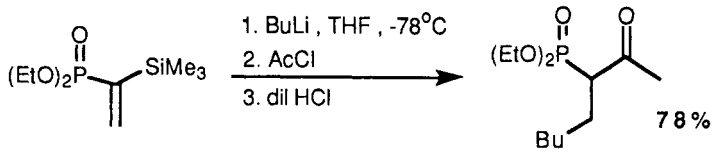
Monteiro, H.J. *Tetrahedron Lett.*, ***1987***, *28*, 3459.



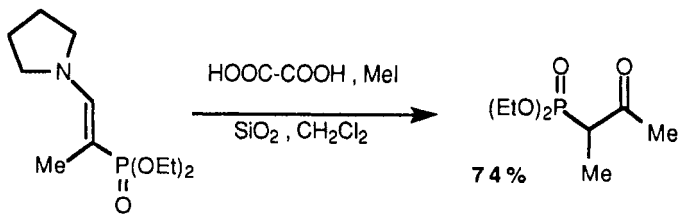
Thomsen, M.W.; Handwerker, B.M.; Katz, S.A.; Belser, R.B. *J. Org. Chem.*, ***1988***, *53*, 906.



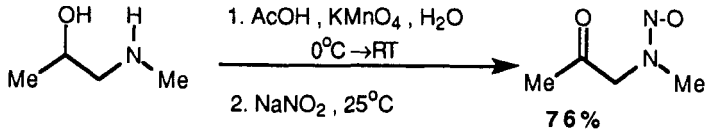
Ibarra, C.A.; Rodríguez, R.C.; Fernández Monreal, M.C.; García Navarro, F.J.; Martín Tesorero, J. *J. Org. Chem.*, ***1989***, *54*, 5620.



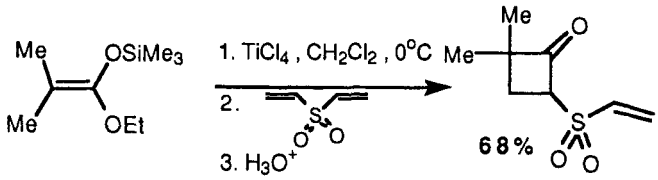
Hong, S.; Chang, K.; Ku, B.; Oh, D.Y. *Tetrahedron Lett.*, ***1989***, *30*, 3307.



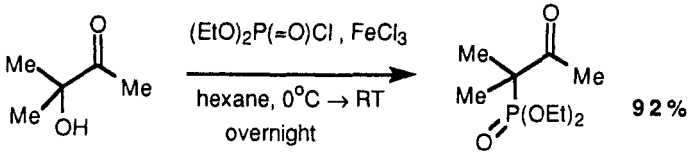
Boeckman Jr., R.K.; Walters, M.A.; Koyano, H. *Tetrahedron Lett.*, ***1989***, *30*, 4787.



Pei, H.-J.; Farnsworth, D.W.; Saavedra, J.E. *Synth. Commun.*, ***1989***, *19*, 207.

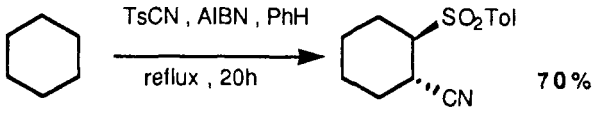


Ali, S.M.; Tanimoto, S. *J. Org. Chem.*, ***1989***, *54*, 2247.

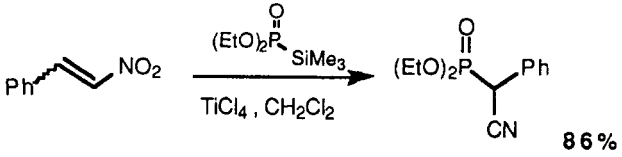


Roussis, V.; Wiemer, D.F. *J. Org. Chem.*, ***1989***, *54*, 627.

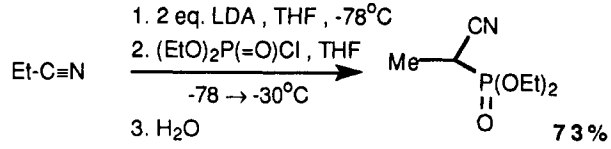
SECTION 387: OXIDES - NITRILES



Fang, J.-M.; Chen, M.-Y. *Tetrahedron Lett.*, ***1987***, *28*, 2853.

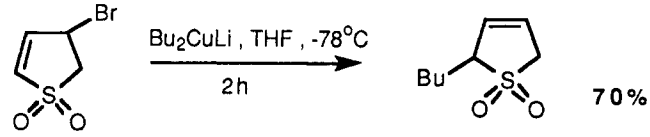


Kim, D.Y.; Oh, D.Y. *Synth. Commun.*, ***1987***, *17*, 953.

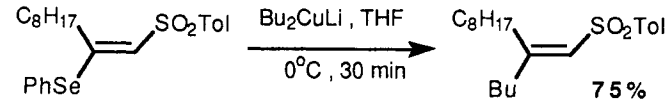


Kandil, A.A.; Porter, T.M.; Slessor, K.N. *Synthesis, **1987**,* 411.

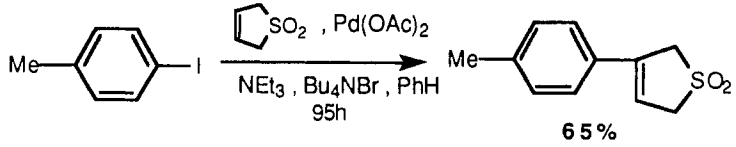
SECTION 388: OXIDES - ALKENES



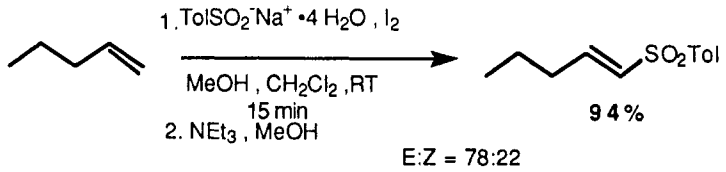
Chou, T.; Hung, S.C.; Tso, H.-H. *J. Org. Chem., **1987**, 52,* 3394.



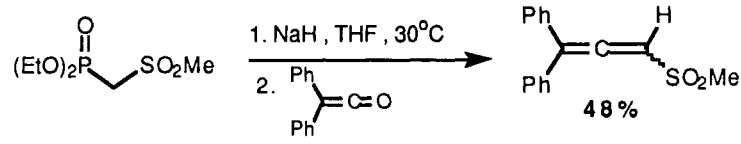
Back, T.G.; Collins, S.; Krishna, M.V.; Law, K.-W. *J. Org. Chem., **1987**, 52,* 4258.



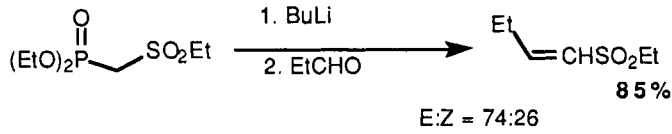
Harrington, P.J.; DiFiore, K.A. *Tetrahedron Lett., **1987**, 28,* 495.



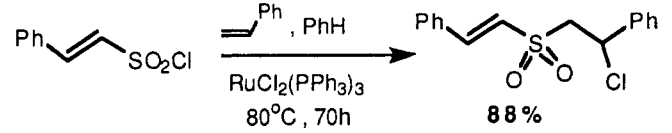
Inomata, K.; Sasaoka, S.; Kobayashi, T.; Tanaka, Y.; Igarashi, S.; Ohtani, T.; Kinoshita, H.; Kotake, H. *Bull. Chem. Soc., Jpn., **1987**, 60,* 1767.



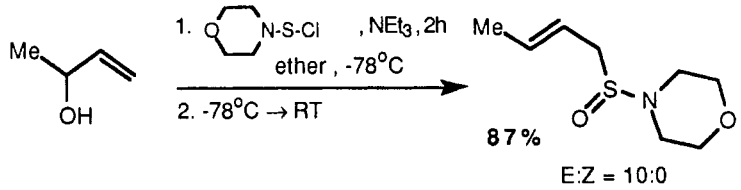
Fillion, H.; Hseine, A.; Pera, M.-H.; Dufaud, V.; Refouvelet, B. *Synthesis*, ***1987***, 708.



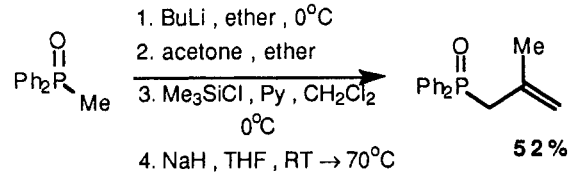
Carretero, J.C.; Demillequand, M., M.; Ghosez, L. *Tetrahedron* , ***1987***, *43*, 5125.



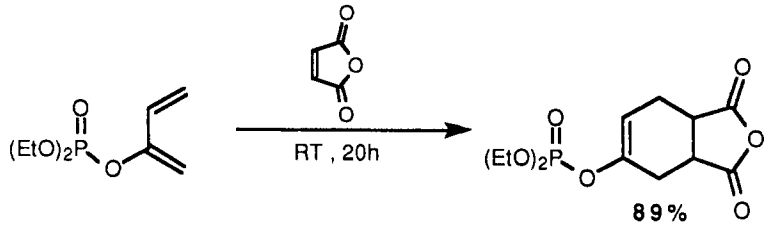
Kameyama, M.; Shimezawa, H.; Satoh, T.; Kamigata, N. *Bull. Chem. Soc., Jpn.*, ***1988***, *61*, 1231.



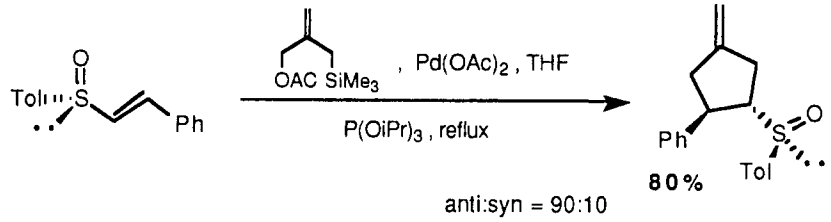
Baudin, J.-B.; Julia, S.A. *Tetrahedron Lett.*, ***1988***, *29*, 3251, 3255.



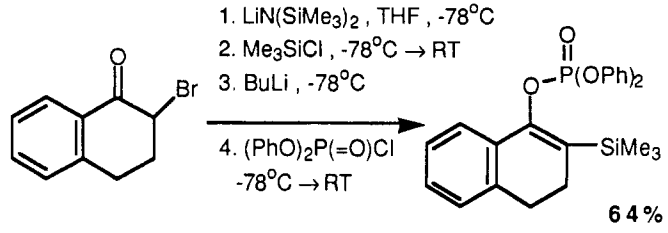
Santelli-Rouvier, C. *Synthesis*, ***1988***, 64.



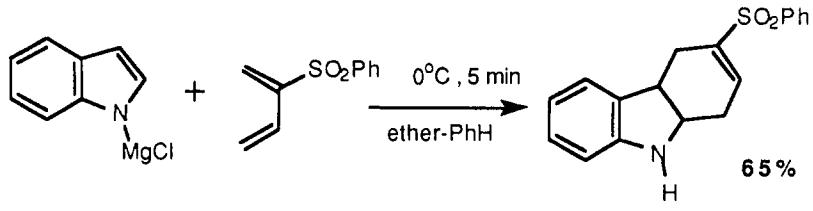
Calogeropoulou, T.; Wiemer, D.F. *J. Org. Chem.*, ***1988***, *53*, 2295.



Chaigne, F.; Gotteland, J.-P.; Malacria, M. *Tetrahedron Lett.*, ***1989***, *30*, 1803.



Koerwitz , F.L.; Hammond, G.B.; Wiemer, D.F. *J. Org. Chem.*, ***1989***, *54*, 738 , 743.



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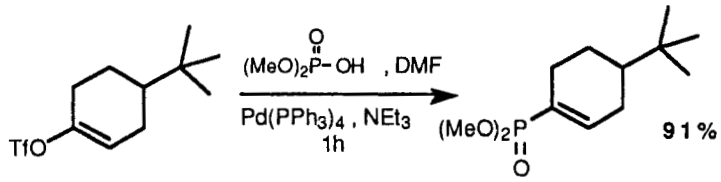

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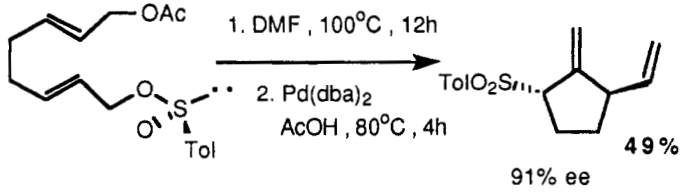

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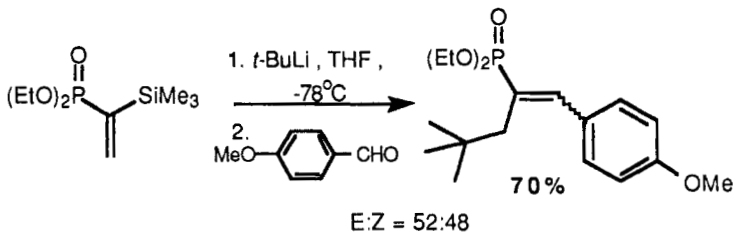

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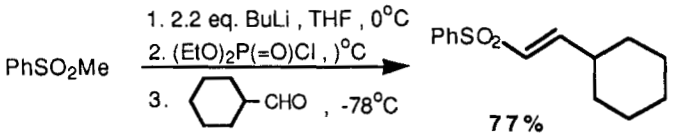

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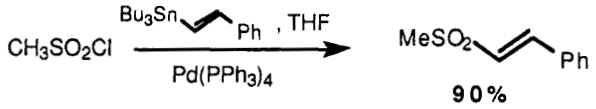

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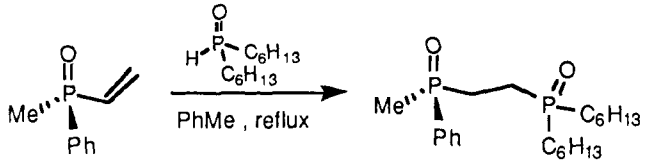

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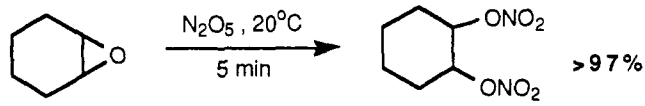

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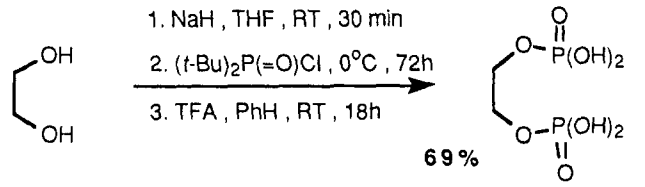

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