



College of Natural Science
Department of Physics
Classical Mechanics –II assignment

Part I *Conceptual questions*

1. Describe briefly the difference between elastic and inelastic collisions.
2. Define the following terms
 - i. Polarization
 - ii. Rigid bodies
 - iii. Wave interference
 - iv. Molecular vibration
 - v. Center of mass
 - vi. Virtual work

Part II *Solve the following problems by showing all the necessary steps.*

1. Find the center of mass of a hemispherical shell of constant density and inner radius r_1 and r_2 .
2. Consider two particles of equal mass m . The forces on the particles are $F_1=0$ and $F_2 = F_0i$. If the particles are initially at rest at the origin, what is the position, velocity and acceleration of the center of mass?
3. Even though the total force on a system of particles is zero, the net torque may not be zero. Show that the net torque has the same value in any coordinate system.

4. A particle of mass m_1 and velocity u_1 collides with a particle of mass m_2 at rest. The two particles stick together. What fraction of the original kinetic energy is lost in the collision?

5. A simple harmonic oscillator consists of a 100-g mass attached to a spring whose force constant is 10^4 dyne/cm. The mass is displaced 3cm and released from rest. Calculate
 - a) The natural frequency ν_0 and the period T_0 .
 - b) The total energy, and
 - c) The maximum speed.

6. Calculate the moments of inertia I_1 , I_2 and I_3 for a homogeneous sphere of radius R and mass M . (Choose the origin at the center of the sphere.)

7. A three-particle system consists of masses m_i and coordinates (x_1, x_2, x_3) as follows;

$$m_1 = 3m, (b, 0, b)$$

$$m_2 = 4m, (b, b, -b)$$

$$m_3 = 2m, (-b, b, 0)$$

Then, find

- i. the inertia tensor,
- ii. principal axes, and
- iii. principal moments of inertia.