PH 203 – Classical Mechanics
Lecturer: Dr. M. K. Nandy
B.Tech. Engineering Physics, 3rd Sem, Aug-Nov 2023
Home Work Exercises-1.

1. A bead of mass m can move without friction on a circular ring of radius R. The ring is fixed in a vertical plae (see Fig. 1). The bead is released from rest from point A.

   (a) Find $\vec{p}(\theta)$ from $\vec{F} = \frac{d\vec{p}}{dt}$.

   (b) Find $\vec{L}(\theta)$ from $\vec{\tau} = \frac{d\vec{L}}{dt}$.

   (c) Verify $\vec{L} = \vec{r} \times \vec{p}$ for arbitrary θ.

   (d) Find W from $W_{AB} = \int_A^B \vec{F} \cdot d\vec{r}$.

   (e) Apply work-energy theorem and find the velocity of the bead at B and C.

   (f) Find the time period of the bead. Compare it with simple pendulum.

   You may use

$$\int_0^1 \frac{dz}{\sqrt{1-z^n}} = \frac{\sqrt{\pi}}{n} \frac{\Gamma(1/n)}{\Gamma(1/2+1/n)}$$

   where

$$\Gamma(y) = \int_0^\infty x^{y-1} e^{-x} dx$$

$$\Gamma(n+1) = n\Gamma(n) = n!$$

$$\Gamma(1/4) = 0.62561, \quad \Gamma(3/4) = 1.22542$$

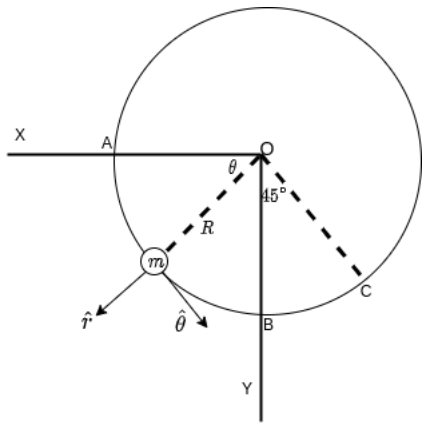

Figure 1: Q. 1

2. The ring in Fig. 1 is of mass M. Remove the bead and rotate the ring about the Y axis with angular velocity $\vec{\omega} = -\omega\hat{j}$.

   (a) Find $\vec{L}$ from $\vec{L} = \sum_i \vec{r}_i \times \vec{p}_i$.

   (b) Hence find the moment of inertia about the Y axis.