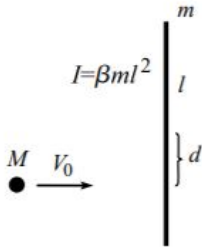


**Physics I**  
**ISI B.Math**  
**HW set 5**  
**Total Marks :40**

1. If a particle is projected vertically upward to height  $h$  above a point on Earth at a northern latitude  $\lambda$ , show that it strikes the ground at a point  $\frac{4}{3}\omega \cos \lambda \sqrt{8h^3/g}$  to the west. (Neglect air resistance and consider only small vertical heights).(10)
2. Consider a thin homogeneous plate that lies in the  $x_1 - x_2$  plane. Show that the inertia takes the form (10)

$$\{\mathbf{I}\} = \begin{Bmatrix} A & -C & 0 \\ -C & B & 0 \\ 0 & 0 & A + B \end{Bmatrix}$$

3. A uniform ball of mass  $M$  and radius  $a$  is pivoted so that it can turn freely about one of its diameters which is fixed in a vertical position. A beetle of mass  $m$  can crawl on the surface of the ball. Initially the ball is rotating with angular speed  $\Omega$  with the beetle at the north pole. The beetle then walks ( in any manner) to the equator of the ball and sits down. What is the angular speed of the ball now ?(10)



4. A ball of mass  $M$  collides with a stick with moment of inertia  $I = \beta m l^2$  (relative to its centre which is the CM). The ball is initially travelling with a speed  $V_0$  perpendicular to the stick. The ball strikes the stick at a distance  $d$  from the centre. The collision is elastic. Find the resulting translational and rotational speeds of the stick, and also the resulting speed of the ball . (3 + 3 + 4)