



Indian Institute of Technology
End-semester Examination Autumn-2015
Preparatory Physics-PH00001

Full Marks: 50

Time: 3 Hours

Q. 1 (i) Derive moment of inertia of a uniform circular disc of mass M and radius R about a diameter. [5 Marks]

(ii) A uniform circular disc of mass 200gm and radius 4cm is rotated about one of its diameter at an angular speed 10 rad/s. Find the kinetic energy of the disc and its angular momentum about the axis of rotation. [5 Marks]

Q. 2 A particle executing simple harmonic motion has angular frequency 6.28s^{-1} and amplitude 10cm. Find (a) the time period (b) the maximum speed (c) the maximum acceleration (d) the speed when the displacement is 6cm from the mean position, (e) the speed at $t=1/6\text{s}$ assuming that the motion starts from rest at $t=0$. [5 Marks]

Q. 3 Two particles of equal mass go round a circle of radius R under the action of their mutual gravitational attraction. Find the speed of each particle. [5 Marks]

Q. 4 Derive Bernoulli's equation and explain its application in Torricelli's theorem and calculate the speed of efflux. [(6+4) Marks]

Q. 5 (i) Let 'u' be the initial velocity of a particle, i.e, its velocity at time $t=0$. The particle traverses a distance 'S' in time 't', by accelerating at a constant rate 'a'. And in the process it attains a final velocity 'v' at the end of time 't'. Derive the following equations of motion for the particle:

$$\begin{aligned}v &= u + at \\v^2 &= u^2 + 2aS \\S &= ut + \frac{1}{2} at^2\end{aligned}$$

[6 Marks]

(ii) A ball is projected horizontally with a velocity 5m/s. Find its position and velocity after 1/4 second. [4 Marks]

Q. 6 (i) A box is dragged along a horizontal surface by a constant force 'F' making an angle ' θ ' with the direction of motion. The other forces on the block are its weight 'W', upward normal force 'N' exerted by the surface, and the frictional force 'f'. What is the work done by each force when the box moves a distance 'S' along the surface in the direction of the applied force. [5 Marks]

[5 Marks]

(ii) An elevator and its load have a mass 800Kg. Find the tension T in the supporting cable when the elevator, originally moving downwards at 10m/s, is brought to rest with constant acceleration in a distance 25m. [5 Marks]

[5 Marks]