

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

SECOND YEAR [2014-17]

B.A./B.Sc. THIRD SEMESTER (July – December) 2015

Mid-Semester Examination, September 2015

Date : 17/09/2015

PHYSICS (General)

Time : 12 noon – 1 pm

Paper : III

Full Marks : 25

Group – A

(Answer any three questions)

1. Derive expressions for tangential component and normal component of acceleration of a particle moving in a curved path in two dimension. What is meant by the radius of curvature at a point on its path. [4+1]
2. An xyz coordinate system is rotating with respect to an XYZ coordinate system having the same origin and assumed to be fixed in space. The angular velocity of the xyz system relative to the XYZ system is given by $\vec{\omega} = 2t\hat{i} - t^2\hat{j} + (2t + 4)\hat{k}$, where t is the time. The position vector of a particle at time t as observed in the xyz system is given by $\vec{r} = (t^2 + 1)\hat{i} - bt\hat{j} + 4t^3\hat{k}$. Find (a) the apparent velocity, (b) the true velocity, (c) the apparent acceleration and (d) the true acceleration of the particle at t = 1. [1+1+1+2]
3. a) What do you mean by central force? Write the mathematical expression for the central force. [2]
b) Show that the central force is conservative. [3]
4. a) Find the magnitude and direction of angular momentum relative to the origin if two identical particles of mass M moves in a circle of radius R, 180° out of phase at an angular speed ω about the Z-axis in a plane parallel to a distance h above the XY-plane. [3]
b) Discuss the advantage of centre of mass frame over the lab-frame of reference. [2]
5. a) The ballistic pendulum was used to measure the speeds of bullet before electronic timing devices were developed. It consists of a large block of wood of mass $M = 5.4$ kg, hanging from two long cords. Bullet of mass $m = 9.5$ gm is fired into the block coming quickly to rest. The block and the bullet then swing upward, their centre of mass rising a vertical distance $h = 6.3$ cm before the pendulum comes momentarily at the end of its arc. What is the speed of the bullet just prior to the collision? [3]
b) Prove that the kinetic energy of a system of particles consist of two parts i.e. kinetic energy obtained as if all the masses concentrated at the centre of mass and kinetic energy of motion about the centre of mass. [2]

Group – B

(Answer any two questions)

6. What is Newton's ring? Show how the interference pattern occurs in Newton's ring. Find out the condition of dark and bright fringes in a Newton's ring pattern. [1+2+2]
7. What is zone plate? Show how a zone plate acts as a convex lens. [1+4]
8. In a single slit diffraction pattern, find out the condition for principle maxima, minima and secondary maxima. [1+2+2]