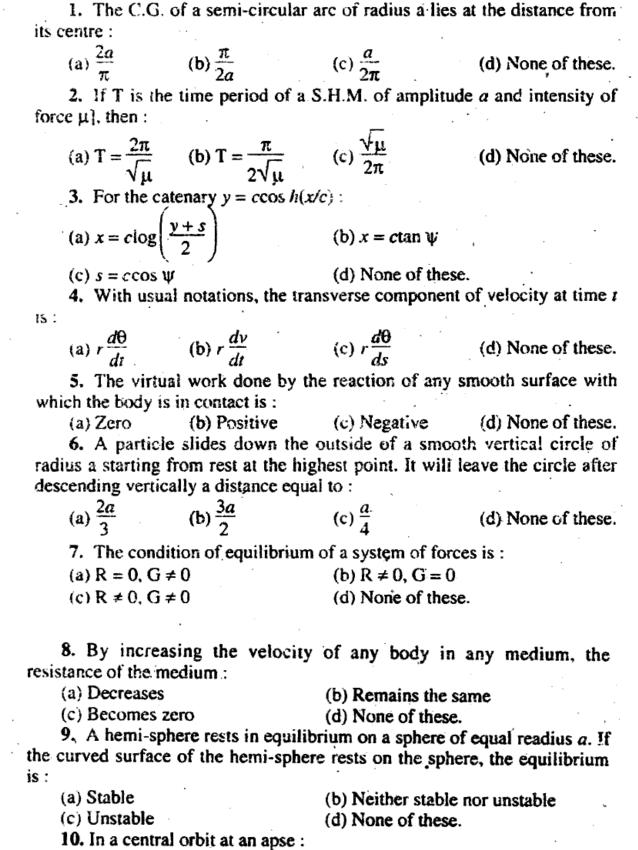
Paper III: Mechanics

Section—A

 $1 \times 10 = 10/0.5 \times 10 = 5$



(c) p = 2r

(d) None of these.

(b) $p = r^2$

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1. Find the C.G. of the arc of the curve $x^{2/3} + y^{2/3} = a^{2/3}$ lying in the first qudrant.

Or

The law of motion in a straight line is given by $s = \frac{1}{2}vt$, prove that the

The law of motion in a straight line is given by $s = \frac{1}{2} vt$, prove that the acceleration is constant.

2. With usual notations, for a common catenary obtain the formula:

$$x = c \log (\sec \psi + \tan \psi)$$

The velocities of a particle along and perpendicular to the radius vector are λr and $\mu\theta$. Find the equation of the path.

3. Explain the Principle of Virtual work.

Or

Oг

A heavy particle is tied to one end of a light inextensible string whose other end is attached to a fixed point. It is projected horizontally with a given velocity u from its vertical position of equilibrium. Obtain equations of motion of the particle along the tangent and normal.

4. A hemisphere rests in equilibrium on a sphere of equal radius, show that the equilibrium is unstable when the curved surface of the hemisphere rests on the sphere.

Or

A particle is falling from rest under gravity in a resisting medium whose resistance varies as the square of the velocity. Obtain the velocity of the particle at any position.

5. Forces P, Q, R act along three straight lines.

$$y = b$$
, $z = -c$: $z = c$, $x = -a$ and $y = a$, $y = -b$.

Show that they will have a single resultant, if:

$$\frac{a}{P} + \frac{b}{O} + \frac{c}{R} = 0$$

A particle describes the curve $r^n = a^n \cos n\theta$ under a force to the pole. Find the law of force.

Section—C
$$15 \times 3 = 45/6 \times 2 = 12/7 \times 1 = 7$$

- 1. A particle slides down the arc of a smooth cycloid whose axis is vertical and vertex downwards. Discuss the motion.
- 2. A particle moves in a plane with acceleration which is always directed to a fixed point O in the plane. Obtain differential equation of the path in polar form and pedal form.
- 3. The end links of a uniform chain slide along a fixed rough horizontal rod. Prove that the ratio of the maximum span to the length of the chain is

$$\mu \log \left[\frac{1 + \sqrt{(1 + \mu)^2}}{\mu} \right]$$

where μ is the coefficient of friction.

- 4. A heavy particle moves in a smooth sphere; if the velocity be that due to the level of the centre, prove that reaction of the surface will vary as the depth below the centre.
 - 5. Find the condition that the straight line

$$\frac{x-f}{l} = \frac{y-g}{m} = \frac{z-h}{n}$$

may be a null line for the system of forces (x, y, z; L, M, N).