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Note:-

1. All Questions are compulsory.
2. Numbers on the right indicate full marks.

Section A

Q.1 Select and Write the correct answer.

(4)

1. A thin uniform disc of radius R , thickness t and density ρ is capable of rotating about transverse axis through its centre. What is the M.I of the disc about the given axis of rotation?
A) $\frac{\pi t \rho R^4}{2}$ B) $\frac{\pi \rho R^3}{2}$
C) $\frac{\pi t \rho R}{2}$ D) $\frac{\pi t \rho R^2}{2}$
2. A uniform hollow sphere and a uniform solid sphere have the same mass and same radius. Ratio of radius of gyration of the hollow sphere to that of the solid sphere about their diameter is
A) $\sqrt{3} : \sqrt{5}$ B) $\sqrt{3} : 6\sqrt{2}$
C) $\sqrt{5} : \sqrt{3}$ D) $5 : 3$
3. In a certain unit, the radius of gyration of a uniform disc about its central and transverse axis is $\sqrt{2.5}$. Its radius of gyration about a tangent in its plane (in the same unit) must be
A) $\sqrt{5}$ B) 2.5
C) $2\sqrt{2.5}$ D) $\sqrt{12.5}$
4. What is the M.I. of metre stick which has mass 300 g about an axis at right angles to the stick and located at 30 cm mark?
A) $3.7 \times 10^5 \text{ g cm}^2$ B) $3.7 \times 10^4 \text{ g cm}^2$
C) $3.7 \times 10^3 \text{ g cm}^2$ D) $3.7 \times 10^2 \text{ g cm}^2$

Q.2 Answer the following.

(3)

1. A particle moves in a circular path with decreasing speed, what happens to the angular momentum?
2. What is the moment of inertia of a (i) ring (ii) disc (iii) solid sphere about its diameter?
3. Do we need a banked road for a two wheeler? Explain.

Section B

Attempt any Four

- Q.3 If friction is zero, can a vehicle move on the road? Why are we not considering the friction in deriving the expression for the banking angle? **(2)**
- Q.4 What is vertical circular motion? Show that the motion of an object revolving in vertical circle is non uniform circular motion. **(2)**

- Q.5 A particle moves in a circular path with decreasing speed, what happens to the angular momentum? (2)
- Q.6 Write S. I. unit of angular velocity. State the rule concerned with direction of angular velocity. (2)
- Q.7 A particle is performing U.C.M. along a circle of radius r . In half period of revolution, what is its displacement and corresponding distance? $\pi/1$ (2)
- Q.8 The moments of inertia of two rotating bodies A and B about the same axis are I_A and I_B ($I_A > I_B$) and their angular momentum are equal. Which has greater rotational kinetic energy? (2)

Section C
Attempt any Two

- Q.9 Discuss the interlink between translational, rotational and total kinetic energies of a rigid object that rolls without slipping. (3)
- Q.10 We have mentioned about static friction between road and the tyres. Why is it static? What about the kinetic friction between road and the tyres? (3)
- Q.11 Two particles, each of mass m and speed v , travel in opposite directions along parallel lines separated by a distance d . Show that the angular momentum vector of the two-particle system is the same whatever be the point about which the angular momentum is taken. (3)

Section D
Attempt any One

- Q.12 How can right hand thumb rule gives Directions of angular velocity. (4)
Calculate the torque applied on a grindstone having a speed of 150 rpm. 10 sec after starting from rest. The moment of inertia of grindstone is 6 kg m^2 .
- Q.13 State and Derive parallel axes theorem. (4)