

Chapter- 07

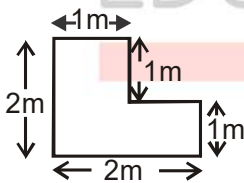
SYSTEM OF PARTICLE AND ROTATIONAL MOTION

Very Short Answer Type Questions

01. In which conditions do the C.M and C.G of a body coincide?
02. Mention example in which C.M of a body lies outside it.
03. Does the position of C.M. in a body change with change in reference Co-ordinate system?
04. Give the relation between the torque and angular momentum?
05. Give the physical significance of the moment of inertia?
06. If earth expands to double its radius with the same mass, what will be the duration of day and night?
07. Why are spokes fitted in a cycle wheel?
08. What will be a momentum of C.M if no external force acts on the body?
09. What will be the nature of the motion of the centre of mass of an isolated system?
10. Distinguish between the centre of gravity of a body and its centre of mass.
11. Why does a flywheel have most of its mass concentrated at the rim?
12. A dancer spinning on ice folds his arm. What will happen?

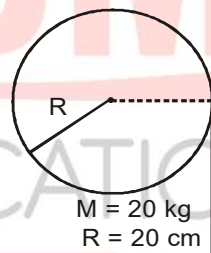
Short questions (2 & 3 Marks):

13. Find the centre of mass of a uniform L-shaped lamina with dimensions as shown. The mass of the lamina is 3 kg.



14. Find the torque of a force $(7\hat{i}+3\hat{j}-5\hat{k})\text{N}$ about the origin. The force acts on a particle whose position vector is $(\hat{i}-\hat{j}+\hat{k})\text{m}$
15. A solid cylinder of mass 20 kg rotates about its axis with angular speed 100 rad s^{-1} . The radius of the cylinder is 0.25m. What is the kinetic energy associated with the rotation of the cylinder?
16. Obtain an expression for the position vector of the centre of mass of a system consisting of two particles.
17. State and prove the principle of conservation of angular momentum.
18. Define a couple. Show that moment of a couple does not depend on the choice of origin.
19. State the theorem of a parallel axis of a moment of inertia.

20. State the theorem of the perpendicular axis of a moment of inertia
21. A metallic disc is melted and recast in the form of a solid sphere. What will happen to the moment of inertia about the axis of symmetry?
22. What is the kinetic energy of rolling? What is the acceleration of a body rolling down an inclined plane without slipping?
23. From a uniform disk of radius R , a circular hole of the radius $\frac{R}{2}$ is cut out. The centre of the hole is at $\frac{R}{2}$ from the centre of the original disc. Locate the centre of gravity of the resulting flat body.
24. Derive the expression of torque. A cord of negligible mass is wound around the rim of a flywheel of mass 20 kg and radius 20 cm. A steady pull of 25N is applied on the cord as shown in fig. The flywheel is mounted on a horizontal axle with frictionless bearings.
- (a) Compute the angular acceleration of the wheel.
- (b) Find the work done by the pull; when 2m of the cord is unwound.
- (c) Find also the kinetic energy of the wheel at this point.
- Assume that the wheel starts from rest.
- (d) Compare answer to parts (b) and (c).



25. A body rolls from rest without slipping along an inclined plane. Obtain the expression for (i) Linear acceleration of C.M (ii) Angular acceleration of rotation about C.M (iii) Time taken by the body to reach the bottom of incline (iv) The linear speed of the centre of mass and angular speed of rotation about C.M, when the body reaches the bottom of incline (v) The minimum coefficient of static friction needed for the motion.
26. Derive an expression for moment of inertia of a uniform circular disc about a diameter and tangent of the disc.
27. Derive the equations (i) $\omega = \omega_0 + \alpha t$
- (ii) $\theta = \omega_0 t + \frac{1}{2} \alpha t^2$
- (iii) $\omega^2 - \omega_0^2 = 2\alpha\theta$
28. Two particles of masses 100gm and 300gm have position co-ordinates (2, 5, 13) and (-6, 4, -2) respectively. Find the position co-ordinates of centre of mass.

29. Find the C.M of a uniform semicircular wire of radius R.
30. Find the C.M of a uniform straight rod of length 'L'.
31. A solid sphere rolls without slipping down two different inclined planes of same heights but different angles of inclination.
- (a) Will it reach the bottom with the same speed in each case?
- (b) Will it take longer to roll down one plane than the other?
- (c) If so, which one and why?
32. The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds.
- (i) What is its angular acceleration, assuming the acceleration to be uniform?
- (ii) How many revolutions does the engine make during this time?
33. Three bodies, a ring, a solid cylinder and a solid sphere roll down the same inclined plane without slipping. They start from rest. The radii of the bodies are identical. Which of the bodies reaches the ground with maximum velocity?
34. If the ice on the polar caps of the earth melts, how will it affect the duration of the day? Explain.

5 Marks questions.

35. Derive the expression for moment of inertia of a thin rod about an axis perpendicular to its length and passing through its centre.
36. What is meant by the moment of inertia, a radius of gyration, angular momentum, angular impulse, rotational kinetic energy and areal velocity?
37. (a) A uniform disc rolls from rest without slipping along an inclined plane. Obtain the expression for
- (i) Linear acceleration of C.M and Angular acceleration of rotation about C.M
- (ii) Frictional force between body and incline
- (b) If a body with a linear speed v at the foot of an incline can roll up to a height equal to $\frac{3v^2}{4g}$, then identify the shape of the body.

