Chapter- 07

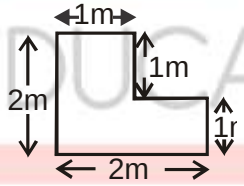
System of Particle and Rotational Motion

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. Give the relation between the torque and angular momentum?
04. Give the physical significance of the moment of inertia?
05. If earth expands to double its radius with the same mass, what will be the duration of day and night?
06. What will be a momentum of C.M if no external force acts on the body?
07. What will be the nature of the motion of the centre of mass of an isolated system?
08. A dancer spinning on ice folds his arm. What will happen?

Short questions (2 & 3 Marks):

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



10. Find the torque of a force $\left(7\hat{i}+3\hat{j}-5\hat{k}\right)N$ about the origin. The force acts on a particle whose position vector is. $\left(\hat{i}-\hat{j}+\hat{k}\right)m$

11. 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?
12. Obtain an expression for the position vector of the centre of mass of a system consisting of two particles.
13. State and prove the principle of conservation of angular momentum.
14. Define a couple. Show that moment of a couple does not depend on the choice of origin.
15. State the theorem of a parallel axis of moment of inertia.
16. State the theorem of the perpendicular axis of moment of inertia
17. 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?

18. 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.

19. Derive the equations (i) $\omega = \omega_0 + \alpha t$

(ii) $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

(iii) $\omega^2 - \omega_0^2 = 2\alpha\theta$

20. 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.

21. Find the C.M of a uniform straight rod of length 'L'.

22. 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?

23. 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?

5 Marks questions.

24. Obtain the relations in case of a rigid body rotating about an axis.

(i) Work is done; $W = \int_{\theta_1}^{\theta_2} \tau d\theta$

(ii) Power at any instant ; P = τω

(iii)Angular momentum ; L = Iω

(iv) Net torque ; τ = Iα

(v) K.E. of rotation; K = (1/2) Iω^2

25. 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.

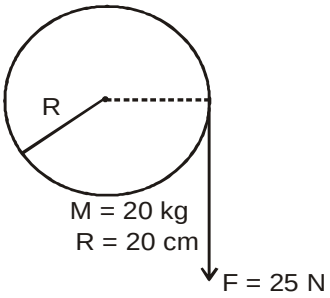
(a) Compute the angular acceleration of the wheel.

(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).



26. (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) The 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.