CHAPTER

Rotational Motion

07

MHT CET Physics

PHYSICS CIRCLE

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MHT CET WEIGHTAGE

197 Questions

MHT CET · all years



Moment of Inertia & Radius of Gyration	90	46%
Rotational KE, Work & Power	36	18%
Angular Momentum & its Conservation	23	12%
Rolling Motion	23	12%
Rotational Kinematics & Dynamics	16	8%
Torque, Couple & Equilibrium	9	5%

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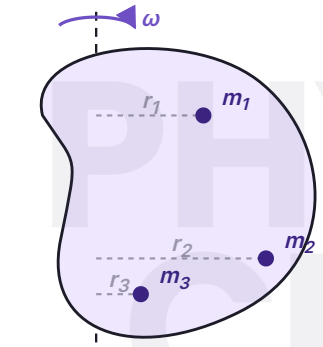
01 CONCEPT Moment of Inertia, Radius of Gyration & Standard Bodies

IN ONE LINE

Moment of inertia is the **rotational inertia** of a body: it tells how hard it is to start, stop or change its rotation about an axis.

7.1.1 Rotation about a fixed axis

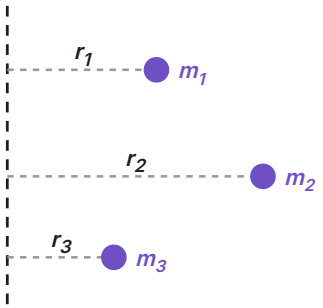
- **Rigid body**: the distance between any two particles never changes.
- In rotation about a fixed axis every particle moves in a circle centred on the axis.
- All particles have the **same θ, ω and α**.
- Their linear speeds differ: $v = r\omega$.



every particle: same ω, same α

7.1.2 I = Σ mr²

$$I = mr^2$$



$$I = m_1r_1^2 + m_2r_2^2 + m_3r_3^2$$

r = perpendicular distance from the axis

$$I = m_1r_1^2 + m_2r_2^2 + m_3r_3^2 + \dots$$

continuous body: $I = \int r^2\, dm$

- SI unit kg m²; dimensions $[ML^2T^0]$.
- Plays the role in rotation that mass plays in translation.
- Depends on the **mass**, its **distribution** and the **position of the axis**.
- Does not depend on ω, α, torque or angular momentum.
- It is neither a vector nor a scalar (it changes with the axis): a tensor.
- Same M and R: a hollow body has a larger I than a solid one (mass lies farther out).

7.1.3 About their centre of mass



Axis through the CM, ⊥ to the line joining them

$$r_1 = \frac{m_2 r}{m_1 + m_2} \cdot r_2 = \frac{m_1 r}{m_1 + m_2}$$

$$I = \mu r^2,\ \mu = \frac{m_1 m_2}{m_1 + m_2}$$

- μ is the **reduced mass**: $\mu < m_1$ and $\mu < m_2$.
- I about the CM is the least of all parallel axes.
- Used for diatomic molecules (H_2, HCl).

7.1.4 I = MK²

$$I = MK^2 \Rightarrow K = \sqrt{\frac{I}{M}}$$

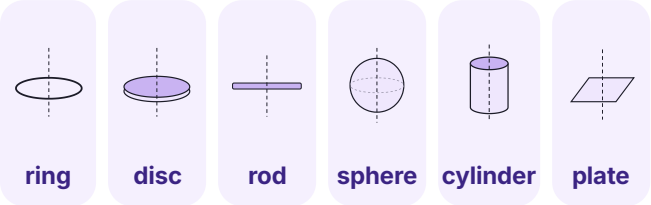
- K is the distance from the axis at which the whole mass can be put to give the same I.
- For n equal particles K is the root-mean-square distance:

$$K = \sqrt{\frac{r_1^2 + r_2^2 + \dots + r_n^2}{n}}$$

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- Depends on the shape, the mass distribution and the axis; not on the total mass.
- SI unit metre, dimensions [L].
- Disc about its axis: $K = \frac{R}{\sqrt{2}}$.

7.1.5 Learn these by heart



Body	Axis	I
Ring	⊥ plane, centre	MR^2
Ring	diameter	$\frac{1}{2}MR^2$
Disc	⊥ plane, centre	$\frac{1}{2}MR^2$
Disc	diameter	$\frac{1}{4}MR^2$
Annular disc	⊥ plane, centre	$\frac{M}{2}(R_1^2 + R_2^2)$
Annular disc	diameter	$\frac{M}{4}(R_1^2 + R_2^2)$
Solid cylinder	own axis	$\frac{1}{2}MR^2$
Thin hollow cylinder	own axis	MR^2
Thick hollow cylinder	own axis	$\frac{M}{2}(R_1^2 + R_2^2)$
Solid cylinder	⊥ axis through centre	$M(\frac{L^2}{12} + \frac{R^2}{4})$
Solid sphere	diameter	$\frac{2}{5}MR^2$
Spherical shell	diameter	$\frac{2}{3}MR^2$
Thin rod	⊥, through centre	$\frac{ML^2}{12}$
Thin rod	⊥, through one end	$\frac{ML^2}{3}$
Rectangular plate	⊥ plane, centre	$\frac{M(l^2 + b^2)}{12}$
Square plate	⊥ plane, centre	$\frac{Ma^2}{6}$

- Same M and R: $I_{ring} : I_{disc} = 2 : 1$; $K_{ring} : K_{disc} = \sqrt{2} : 1$.
- Same M and R: $I_{shell} > I_{solid\ sphere}$.
- Order of I (same M, R, about a diameter or own axis): ring = hollow cylinder > shell > disc = solid cylinder > solid sphere.

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Solved Examples 01 Mol & Standard Bodies

SOLVED 1 MHT CET 2026 · 20 May · Shift 1

At the corners of an equilateral triangle of side L, point masses, each of mass 2 kg, are placed. The moment of inertia of the system about an axis along any one side is (in kg m²)

(a) $\frac{3L^2}{4}$ (b) $\frac{L^2}{3}$
(c) $\frac{3L^2}{2}$ (d) $\frac{4L^2}{3}$

STEP 1 The two masses on the axis contribute nothing
STEP 2 Third mass is at the height of the triangle: $r = \frac{\sqrt{3}}{2}L$
STEP 3 $I = 2 \times \frac{3L^2}{4} = \mathbf{\frac{3L^2}{2}}$

Answer: **(c)**

SOLVED 2 MHT CET 2025 · 25 Apr · Shift 1

Four particles each of mass M are placed at the corners of a square of side L. The radius of gyration of the system about an axis perpendicular to the square and passing through its centre is

(a) $\frac{L}{2}$ (b) $\frac{L}{\sqrt{2}}$
(c) 2L (d) $\frac{L}{4}$

STEP 1 Each particle is at half the diagonal: $r = \frac{L}{\sqrt{2}}$
STEP 2 $I = 4M \times \frac{L^2}{2} = 2ML^2$
STEP 3 $k^2 = \frac{I}{4M} = \frac{L^2}{2} \Rightarrow k = \mathbf{\frac{L}{\sqrt{2}}}$

Answer: **(b)**

SOLVED 3 MHT CET 2026 · 17 Apr · Shift 1

Four point masses m, 2m, 3m and 4m are kept at the corners A, B, C and D respectively of a square ABCD of side b. The moment of inertia of the system about an axis perpendicular to the plane of the square and passing through the point D is

(a) $12mb^2$ (b) $10mb^2$
(c) $8mb^2$ (d) $5mb^2$

STEP 1 4m at D is on the axis. A and C are at distance b; B is at the diagonal $\sqrt{2}$ b
STEP 2 $I = m\,b^2 + 3m\,b^2 + 2m(\sqrt{2}\,b)^2$
STEP 3 $I = mb^2 + 3mb^2 + 4mb^2 = \mathbf{8mb^2}$

Answer: **(c)**

SOLVED 4 MHT CET 2021 · 24 Sep · Shift 1

Two identical particles each of mass m are separated by a distance d. The axis of rotation passes through the midpoint of d and is perpendicular to it. If K is the rotational kinetic energy of the system, then the angular frequency is

(a) $2d\sqrt{\frac{m}{K}}$ (b) $\frac{d}{2}\sqrt{\frac{K}{m}}$
(c) $\frac{2}{d}\sqrt{\frac{K}{m}}$ (d) $\frac{d}{4}\sqrt{\frac{m}{K}}$

STEP 1 $I = 2m(\frac{d}{2})^2 = \frac{md^2}{2}$
STEP 2 $K = \frac{1}{2}I\omega^2 = \frac{md^2\omega^2}{4}$
STEP 3 $\omega = \mathbf{\frac{2}{d}\sqrt{\frac{K}{m}}}$

Answer: **(c)**

SOLVED 5 MHT CET 2026 · 11 Apr · Shift 2

Let M and L be the mass and length of a thin uniform rod. In the first case, the axis of rotation passes through the centre and is perpendicular to the length of the rod. In the second case, the axis passes through one end and is perpendicular to the length. The ratio of the radius of gyration in the first case to the second case is

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) $\frac{1}{8}$ (d) $\frac{1}{6}$

STEP 1 $k_1^2 = \frac{L^2}{12}$ (centre), $k_2^2 = \frac{L^2}{3}$ (end)
STEP 2 $\frac{k_1^2}{k_2^2} = \frac{3}{12} = \frac{1}{4}$
STEP 3 $\frac{k_1}{k_2} = \mathbf{\frac{1}{2}}$

Answer: **(b)**

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Solved Examples 01 MoI & Standard Bodies (contd.)

SOLVED 6 MHT CET 2024 · 3 May · Shift 1

The ratio of the radius of gyration of a circular disc to that of a circular ring, each of the same mass and radius, about their respective axes is

(a) $\sqrt{2} : 1$ (b) $\sqrt{2} : \sqrt{3}$
(c) $\sqrt{3} : \sqrt{2}$ (d) $1 : \sqrt{2}$

STEP 1 Disc: $I = \frac{1}{2}MR^2 \Rightarrow k = \frac{R}{\sqrt{2}}$
STEP 2 Ring: $I = MR^2 \Rightarrow k = R$
STEP 3 $k_{disc} : k_{ring} = \mathbf{1 : \sqrt{2}}$

Answer: **(d)**

SOLVED 7 MHT CET 2026 · 17 Apr · Shift 2

The radius of gyration of a thin uniform circular disc about the axis passing through its centre and perpendicular to its plane is K_c. The radius of gyration of the same disc about a diameter is K_d. The ratio $K_d : K_c$ is

(a) $1 : 4$ (b) $1 : \sqrt{2}$
(c) $\sqrt{2} : 1$ (d) $2 : 1$

STEP 1 Centre axis: $I = \frac{1}{2}MR^2 \Rightarrow K_c = \frac{R}{\sqrt{2}}$
STEP 2 Diameter: $I = \frac{1}{4}MR^2 \Rightarrow K_d = \frac{R}{2}$
STEP 3 $K_d : K_c = \frac{1}{2} : \frac{1}{\sqrt{2}} = \mathbf{1 : \sqrt{2}}$

Answer: **(b)**

SOLVED 8 MHT CET 2024 · 2 May · Shift 1

An annular ring has mass 10 kg, and its inner and outer radii are 5 m and 10 m respectively. Its moment of inertia about an axis passing through its centre and perpendicular to its plane is

(a) 525 kg m² (b) 625 kg m²
(c) 525 g cm² (d) 625 g cm²

STEP 1 Annular disc: $I = \frac{M}{2}(R_1^2 + R_2^2)$
STEP 2 $I = \frac{10}{2}(25 + 100)$
STEP 3 $I = \mathbf{625\ kg\ m^2}$

Answer: **(b)**

SOLVED 9 MHT CET 2025 · 22 Apr · Shift 1

A solid sphere and a thin-walled hollow sphere have the same mass and are made of the same material. Which of them has the greater moment of inertia about its diameter? (I_h: hollow sphere, I_s: solid sphere)

(a) $I_s > I_h$ (b) $I_h \geq I_s$
(c) $I_h > I_s$ (d) $I_h = I_s$

STEP 1 Same mass of the same material: the hollow sphere is bigger ($R_h > R_s$)
STEP 2 Even for equal radii, $\frac{2}{3}MR^2 > \frac{2}{5}MR^2$
STEP 3 Mass lies farther from the axis $\Rightarrow \mathbf{I_h > I_s}$

Answer: **(c)**

SOLVED 10 MHT CET 2024 · 16 May · Shift 1

Two spheres of equal masses, one a thin spherical shell and the other a solid sphere, have the same moment of inertia about their respective diameters. The ratio of their radii is

(a) $3 : 5$ (b) $\sqrt{3} : \sqrt{5}$
(c) $\sqrt{3} : \sqrt{7}$ (d) $5 : 7$

STEP 1 $\frac{2}{3}MR_1^2 = \frac{2}{5}MR_2^2$
STEP 2 $\frac{R_1^2}{R_2^2} = \frac{3}{5}$
STEP 3 $R_{shell} : R_{solid} = \mathbf{\sqrt{3} : \sqrt{5}}$

Answer: **(b)**

SOLVED 11 NEET 2016 · Phase 2

A light rod of length l has two masses m_1 and m_2 attached to its two ends. The moment of inertia of the system about an axis perpendicular to the rod and passing through the centre of mass is

(a) $\frac{m_1 m_2}{m_1 + m_2} l^2$ (b) $\frac{m_1 + m_2}{m_1 m_2} l^2$
(c) $(m_1 + m_2) l^2$ (d) $\sqrt{(m_1 m_2)}\, l^2$

STEP 1 $r_1 = \frac{m_2 l}{m_1 + m_2}, r_2 = \frac{m_1 l}{m_1 + m_2}$
STEP 2 $I = m_1 r_1^2 + m_2 r_2^2$
STEP 3 $I = \mathbf{\frac{m_1 m_2}{m_1 + m_2} l^2 = \mu l^2}$

Answer: **(a)**

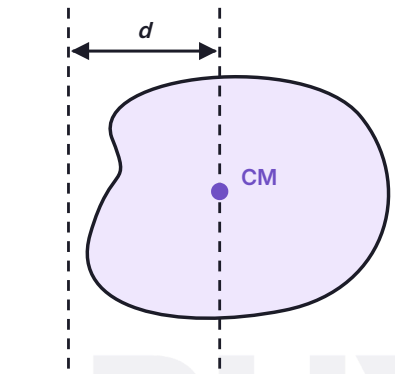
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02 CONCEPT Theorems of Parallel & Perpendicular Axes

IN ONE LINE

Know I about one axis; these two theorems give I about **any parallel axis** or about the **axis ⊥ to a plane body**.

7.2.1 Shifting the axis sideways



parallel axis CM axis

Two parallel axes, d apart

$$I = I_{cm} + Md^2$$

- I_{cm}: about the parallel axis through the centre of mass.
- d: distance between the two axes.
- Works for **every** body (1D, 2D or 3D).
- I is least about the axis through the CM.
- Used for I about a tangent of a ring, disc or sphere.

rod, axis at x from the centre: $I = M(\frac{L^2}{12} + x^2)$

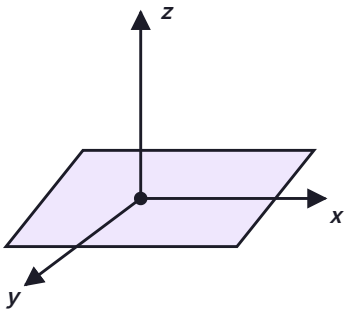
rod, one end: $\frac{ML^2}{12} + M(\frac{L}{2})^2 = \frac{ML^2}{3}$

disc, tangent ⊥ plane: $\frac{1}{2}MR^2 + MR^2 = \frac{3}{2}MR^2$

solid sphere, tangent: $\frac{2}{5}MR^2 + MR^2 = \frac{7}{5}MR^2$

square plate, corner (⊥ plane): $\frac{Ma^2}{6} + \frac{Ma^2}{2} = \frac{2}{3}Ma^2$

7.2.2 Only for plane laminas



$I_z = I_x + I_y$

x and y in the plane, z ⊥ to it

$$I_z = I_x + I_y$$

- Only for thin **plane** bodies: rings, discs, plates.
- x and y lie in the plane; z is ⊥ to it through their meeting point.
- Used to find I about a **diameter** of a ring or disc.

disc: $I_x = I_y = I_D \Rightarrow \frac{1}{2}MR^2 = 2I_D \Rightarrow I_D = \frac{1}{4}MR^2$

ring: $I_D = \frac{1}{2}MR^2$

- For a symmetric plane body (disc, square plate) I is the same about every in-plane axis through the centre, perpendicular or not.
- Square plate: every in-plane axis through the centre (sides or diagonals) has $I = \frac{Ma^2}{12}$.

7.2.3 Using both theorems

Body	tangent in plane	tangent ⊥ plane
Ring	$\frac{3}{2}MR^2$	$2MR^2$
Disc	$\frac{5}{4}MR^2$	$\frac{3}{2}MR^2$
Annular disc	$\frac{M}{4}(5R_2^2 + R_1^2)$	$\frac{M}{2}(3R_2^2 + R_1^2)$

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LEVEL-WISE WORKSHEET

Rotational Motion

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

171	20	6
questions	concepts	topics

CONTENTS

01	Moment of Inertia & Radius of Gyration	Q 1–56	56 Qs
02	Torque, Couple & Equilibrium of Rigid Bodies	Q 1–24	24 Qs
03	Rotational Kinematics & Dynamics	Q 1–27	27 Qs
04	Angular Momentum & its Conservation	Q 1–17	17 Qs
05	Rotational Kinetic Energy, Work & Power	Q 1–15	15 Qs
06	Rolling Motion	Q 1–32	32 Qs
	Answer key		

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TOPIC 01

Moment of Inertia & Radius of Gyration

56 PYQs · Easy 56 · Medium 0 · Difficult 0 | MHT CET 30 · NEET 14 · JEE 12

Concepts covered: Point masses & rigid systems (11) · Standard bodies & radius of gyration (11) · Parallel & perpendicular axis theorems (32) · Bending, recasting & scaling (2)

LEVEL 1 · EASY 56 questions

◆ Point masses & rigid systems 11 Qs

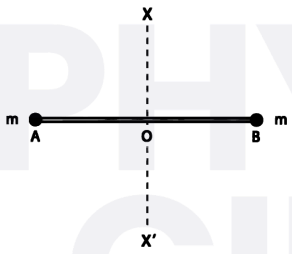
1. At the corners of an equilateral triangle of side L, point masses, each of mass 2 kg are placed. The moment of inertia of the system about an axis along any one side is (in kg–m^2)

MHT CET 2026 · 20 MAY · SHIFT 1

(a) $\frac{3L^2}{4}$ (b) $\frac{L^2}{3}$ (c) $\frac{3L^2}{2}$ (d) $\frac{4L^2}{3}$

2. The moment of inertia of two equal masses each of mass m at separation L connected by a rod of mass M about an axis passing through centre and perpendicular to the length of rod is

MHT CET 2026 · 13 MAY · SHIFT 1



(a) $\frac{(M+3m)L^2}{12}$ (b) $\frac{(M+6m)L^2}{12}$
(c) $\frac{ML^2}{4}$ (d) $\frac{ML^2}{12}$

3. Four particles each of mass M are placed at the corners of a square of side L. The radius of gyration of the system about an axis perpendicular to the square and passing through its centre is

MHT CET 2025 · 25 APR · SHIFT 1

(a) $\frac{L}{2}$ (b) $\frac{L}{\sqrt{2}}$ (c) 2 L (d) $\frac{L}{4}$

4. Four particles each of mass M are placed at the corners of a square of side L. The radius of gyration of the system about an axis perpendicular to the square and passing through its centre is

MHT CET 2025 · 19 APR · SHIFT 1

(a) L (b) $\frac{L}{2}$ (c) $\frac{L}{4}$ (d) $\frac{L}{\sqrt{2}}$

5. Three point masses, each of mass ' m ' are placed at the corners of an equilateral triangle of side ' L '. The moment of inertia of the system about an axis passing through one of the vertices and parallel to the side joining other two vertices will be

MHT CET 2024 · 16 MAY · SHIFT 2

(a) $\frac{3mL^2}{4}$ (b) $\frac{mL^2}{4}$ (c) $\frac{3mL^2}{2}$ (d) $\frac{mL^2}{2}$

6. Two identical particles each of mass 'm' are separated by a distance 'd'. The axis of rotation passes through the midpoint of 'd' and is perpendicular to the length d . If 'K' is the average rotational kinetic energy of the system, then the angular frequency is

MHT CET 2021 · 24 SEP · SHIFT 1

(a) $2\,d\sqrt{\frac{m}{K}}$ (b) $\frac{d}{2}\sqrt{\frac{K}{m}}$ (c) $\frac{2}{d}\sqrt{\frac{K}{m}}$ (d) $\frac{d}{4}\sqrt{\frac{m}{K}}$

7. Three point masses, each of mass m are placed at the corners of an equilateral triangle of side ℓ. The moment of inertia of the system about an axis passing through one of the vertices and parallel to the side joining other two vertices, will be

MHT CET 2020 · 19 OCT · SHIFT 2

(a) $\frac{3}{4}m\ell^2$ (b) $\frac{1}{4}m\ell^2$ (c) $\frac{3}{2}m\ell^2$ (d) $\frac{1}{2}m\ell^2$

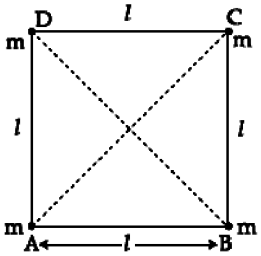
8. Three point masses each of mass ' m ' are kept at the corners of an equilateral triangle of side ' L '. The system rotates about the center of the triangle without any change in the separation of masses during rotation. The period of rotation is directly proportional to $\left(\cos 30^\circ = \sin 60^\circ = \frac{\sqrt{3}}{2}\right)$

MHT CET 2019 · 2 MAY · SHIFT 2

(a) $\sqrt{L}$ (b) $L^{3/2}$ (c) L (d) L^{-2}

9. Four equal masses, m each are placed at the corners of a square of length (l) as shown in the figure. The moment of inertia of the system about an axis passing through A and parallel to DB would be:

JEE MAIN 2021 · 16 MAR · SHIFT 1



(a) $\sqrt{}$ 3 ml2 (b) 2 ml2
(c) ml2 (d) 3 ml2

10. Four point masses, each of value m, are placed at the corners of a square $ABCD$ of side l. The moment of inertia of this system about an axis passing through A and parallel to BD is

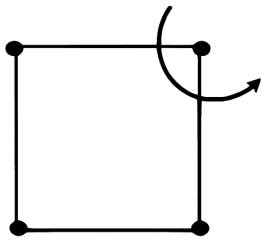
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(a) $2ml^2$ (b) $\sqrt{3}ml^2$ (c) $3ml^2$ (d) ml^2

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11. Four particles each of mass 1 kg are placed at four corners of a square of side 2 m. Moment of inertia of system about an axis perpendicular to its plane and passing through one of its vertex is _____ kgm^2.

JEE MAIN 2024 · 27 JAN · SHIFT 1 ***(Numerical)***



◆ Standard bodies & radius of gyration 11 Qs

12. Let M and L be the mass and length of thin uniform rod respectively. In first case, axis of rotation is passing through centre and perpendicular to length of rod. In second case axis of rotation is passing through one end and perpendicular to length of rod. The ratio of radius of gyration in first case to second case is

MHT CET 2026 · 11 APR · SHIFT 2

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) $\frac{1}{8}$ (d) $\frac{1}{6}$

13. A solid sphere and thin walled hollow sphere have same mass and same material. Which of them have greater moment of inertia about their diameter?

[I_h = moment of inertia of hollow sphere about an axis coinciding with its diameter, I_s = moment of inertia of solid sphere about an axis coinciding with its diameter]

MHT CET 2025 · 22 APR · SHIFT 1

(a) $I_s > I_h$ (b) $I_h \geqslant I_s$ (c) $I_h > I_s$ (d) $I_h = I_s$

14. Ratio of radius of gyration of a circular disc to that of circular ring each of same mass and radius around their respective axes is

MHT CET 2024 · 3 MAY · SHIFT 1

(a) $\sqrt{2} : 1$ (b) $\sqrt{2} : \sqrt{3}$ (c) $\sqrt{3} : \sqrt{2}$ (d) $1 : \sqrt{2}$

15. An annular ring has mass 10 kg and inner and outer radii are 5 m and 10 m respectively. Its moment of inertia about an axis passing through its centre and perpendicular to its plane is

MHT CET 2024 · 2 MAY · SHIFT 1

(a) $525\ \text{kgm}^2$ (b) $625\ \text{kgm}^2$
(c) $525\ \text{gcm}^2$ (d) $625\ \text{gcm}^2$

16. The moment of inertia of a uniform square plate about an axis perpendicular to its plane and passing through the centre is $\frac{Ma^2}{6}$, where 'M' is the mass and 'a' is the side of square plate. Moment of inertia of this plate about an axis perpendicular to its plane and passing through one of its corners is

MHT CET 2023 · 10 MAY · SHIFT 2

(a) $\frac{Ma^2}{6}$ (b) $\frac{2Ma^2}{3}$ (c) $\frac{Ma^2}{3}$ (d) $\frac{2Ma^2}{5}$

17. The ratio of radii of gyration of a circular ring and circular disc of the same mass and radius, about an axis passing through their centres and perpendicular to their planes is

MHT CET 2021 · 20 SEP · SHIFT 2

(a) $1 : \sqrt{2}$ (b) $2 : 1$ (c) $\sqrt{2} : 1$ (d) $3 : 2$

18. The ratio of radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of the thin hollow sphere of same mass and radius about its axis is :-

NEET 2023

(a) $5 : 3$ (b) $2 : 5$ (c) $\sqrt{5} : \sqrt{3}$ (d) $\sqrt{3} : \sqrt{5}$

19. The ratio of radii of gyration of a circular ring and a circular disc, of the same mass and radius, about an axis passing through their centres and perpendicular to their planes are

NEET 2013

(a) $1 : \sqrt{2}$ (b) 3: 2 (c) 2: 1 (d) $\sqrt{2} : 1$

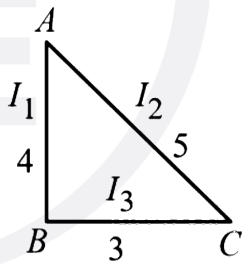
20. The ratio of the radii of gyration of a circular disc to that of a circular ring, each of same mass and radius, around their respective axes is

AIPMT 2008

(a) $\sqrt{2} : 1$ (b) $\sqrt{2} : \sqrt{3}$ (c) $\sqrt{3} : \sqrt{2}$ (d) $1 : \sqrt{2}$

21. For the adjoining diagram, the correct relation between I1, I2, and I3 is, (I-moment of inertia)

AIPMT 2000



(a) I1 > I2 (b) I2 > I1 (c) I3 > I1 (d) I3 > I2

22. Moment of inertia of a circular wire of mass M and radius R about its diameter is

AIEEE 2002

(a) $\frac{MR^2}{2}$ (b) MR^2 (c) $2MR^2$ (d) $\frac{MR^2}{4}$

◆ Parallel & perpendicular axis theorems 32 Qs

23. Moment of inertia of a disc of mass m and radius R about the centre of mass and perpendicular to plane is I_1 and moment of inertia of disc at a distance $\frac{2R}{3}$ from centre and perpendicular to plane is I_2 then I_1/I_2 is

MHT CET 2026 · 15 MAY · SHIFT 2

(a) $\frac{6}{17}$ (b) $\frac{9}{17}$ (c) $\frac{8}{9}$ (d) $\frac{5}{7}$

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24. The moment of inertia of a solid sphere about an axis passing through centre of gravity is $\frac{2MR^2}{5}$ where M is the mass and R is the radius. The radius of gyration about a parallel axis at a distance $2R$ from first axis is

MHT CET 2026 · 14 MAY · SHIFT 1

(a) $5R$ (b) $\sqrt{\frac{22}{5}}R$ (c) $\frac{5R}{2}$ (d) $\sqrt{\frac{12}{5}}R$

25. A solid sphere of radius R and mass M is rotating about its diameter. The moment of intertia of the solid sphere rotating about an axis at a distance $\frac{R}{3}$ from the centre and parallel to that diameter is

MHT CET 2026 · 17 APR · SHIFT 2

(a) $\frac{11}{15}MR^2$ (b) $\frac{13}{20}MR^2$ (c) $\frac{23}{45}MR^2$ (d) $\frac{47}{45}MR^2$

26. A Solid sphere has mass M and radius R. Its moment of inertia about a parallel axis passing through a point at a distance R/3 from its centre is

MHT CET 2026 · 16 APR · SHIFT 1

(a) $8MR^2/11$ (b) $11MR^2/15$
(c) $23MR^2/45$ (d) $13MR^2/20$

27. Moment of inertia of a disc of mass M and radius 'R' about any of its diameter is $MR^2/4$. The moment of inertia of this disc about an axis normal to the disc and passing through a point on its edge will be, $(x/2)MR^2$. The value of x is

MHT CET 2026 · 13 APR · SHIFT 2

(a) 1 (b) 3 (c) 5 (d) 7

28. The moment of inertia of a thin uniform rod of mass ' M ' and length ' L ', about an axis perpendicular to length of the rod and at a distance ' $L/4$ ' from one end is

MHT CET 2025 · 5 MAY · SHIFT 2

(a) $\frac{ML^2}{6}$ (b) $\frac{ML^2}{12}$ (c) $\frac{7ML^2}{24}$ (d) $\frac{7ML^2}{48}$

29. The moment of inertia of a solid sphere of mass ' m ' and radius ' R ' about its diametric axis is ' I '. Its moment of inertia about a tangent in the plane is

MHT CET 2025 · 25 APR · SHIFT 2

(a) 2.5 I (b) 3.0 I (c) 3.5 I (d) 4 I

30. The radius of gyration of a circular disc of radius R and mass m rotating about diameter as axis is

MHT CET 2024 · 15 MAY · SHIFT 2

(a) $R\sqrt{2}$ (b) $R/\sqrt{2}$ (c) $R/2$ (d) R

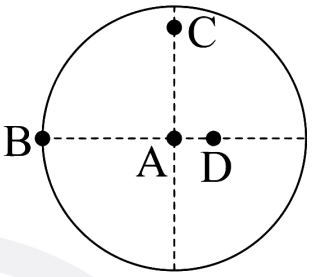
31. Moment of inertia of a disc about an axis passing through its centre and perpendicular to its plane is 'I'. The ratio of moment of inertia about a parallel axis tangential to its rim to that about a parallel axis passing through a point midway between the centre and the rim is

MHT CET 2024 · 11 MAY · SHIFT 2

(a) 2 : 1 (b) 3 : 1 (c) 4 : 1 (d) 6 : 1

32. The moment of inertia of uniform circular disc is maximum about an axis perpendicular to the disc and passing through point

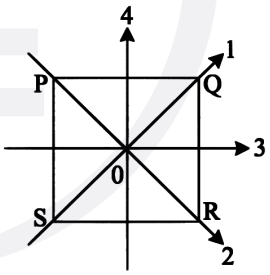
MHT CET 2024 · 10 MAY · SHIFT 1



(a) A (b) B (c) C (d) D

33. The moment of inertia of thin square plate PQRS of uniform thickness, about an axis passing through centre ' O ' and perpendicular to the plane of the plate is $(I_1, I_2, I_3, I_4$ are respectively the moments of inertia about axis $1, 2, 3, 4$ which are in the plane of the plate as shown in figure)

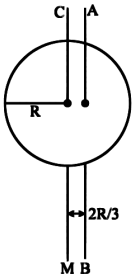
MHT CET 2024 · 9 MAY · SHIFT 1



(a) $I_1 + I_2 + I_3$ (b) $I_1 + I_3 + I_4$
(c) $I_1 + I_2 + I_3 + I_4$ (d) $I_1 + I_3$

34. I_1 is the moment of inertia of a circular disc about an axis passing through its centre and perpendicular to the plane of disc. I_2 is its moment of inertia about an axis AB perpendicular to plane and parallel to axis CM at a distance $\frac{2R}{3}$ from centre. The ratio of I_1 and I_2 is $x : 17$. The value of 'x' is (R = radius of the disc)

MHT CET 2023 · 12 MAY · SHIFT 1



(a) 9 (b) 12 (c) 15 (d) 17

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35. The moment of inertia of a thin uniform rod of mass 'M' and length 'L' about an axis passing through a point at a distance $\frac{L}{4}$ from one of its ends and perpendicular to the length of the rod is

MHT CET 2021 · 24 SEP · SHIFT 2

(a) $\frac{ML^2}{48}$ (b) $\frac{7ML^2}{48}$ (c) $\frac{5ML^2}{48}$ (d) $\frac{9ML^2}{48}$

36.

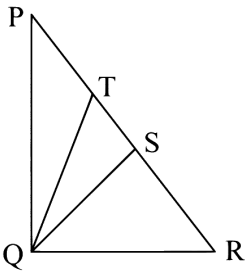


Figure shows triangular lamina which can rotate about different axes moment of inertia is maximum, about the axis

MHT CET 2021 · 23 SEP · SHIFT 1

(a) PR (b) QS (c) QR (d) PQ

37. A thin uniform rod has mass M and length L The moment of inertia about an axis perpendicular to it and passing through the point at a distance $\frac{L}{3}$ from one of its ends, will be

MHT CET 2020 · 16 OCT · SHIFT 2

(a) $\frac{ML^2}{12}$ (b) $\frac{7}{8}ML^2$ (c) $\frac{ML^2}{9}$ (d) $\frac{ML^2}{3}$

38. The moment of inertia of a thin rod about an axis passing through its mid point and perpendicular to the rod is 2400 g cm ^{2}. The length of the 400 g rod is nearly:

NEET 2024

(a) 8.5 cm (b) 17.5 cm (c) 20.7 cm (d) 72.0 cm

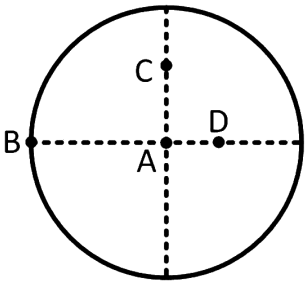
39. The ratio of the radius of gyration of a thin uniform disc about an axis passing through its centre and normal to its plane to the radius of gyration of the disc about its diameter is

NEET 2022 · PHASE 1

(a) 2: 1 (b) $\sqrt{2}$: 1 (c) 4: 1 (d) 1: $\sqrt{2}$

40. The moment of inertia of a uniform circular disc is maximum about an axis perpendicular to the disc and passing through

AIPMT 2012 · MAINS



(a) B (b) C (c) D (d) A

41. The moment of inertia of a thin uniform rod of mass M and length L about an axis passing through its midpoint and perpendicular to its length is $I\,0$. Its moment of inertia about an axis passing through one of its ends and perpendicular to its length is

AIPMT 2011 · PRELIMS

(a) $I_0 + ML^2/2$ (b) $I_0 + ML^2/4$
(c) $I_0 + 2ML^2$ (d) $I_0 + ML^2$

42. The moment of inertia of a uniform circular disc of radius R and mass M about an axis touching the disc at its diameter and normal to the disc

AIPMT 2006

(a) $_2^1$ MR2 (b) MR2 (c) $\frac{2}{5}MR^2$ (d) $\frac{3}{2}MR^2$

43. The moment of inertia of a uniform circular disc of radius R and mass M about an axis passing from the edge of the disc and normal to the disc is

AIPMT 2005

(a) MR2 (b) $_2^1$ MR2 (c) $_2^3$ MR2 (d) $_2^7$ MR2

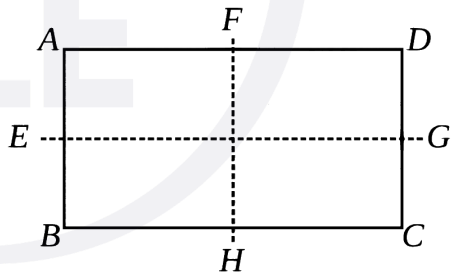
44. The moment of inertia of a disc of mass M and radius R about a tangent to its rim in its plane is

AIPMT 1999

(a) $\frac{2}{3}MR^2$ (b) $\frac{3}{2}MR^2$ (c) $\frac{4}{5}MR^2$ (d) $\frac{5}{4}MR^2$

45. In a rectangle $ABCD$ $(BC = 2AB)$. The moment of inertia is minimum along axis through

AIPMT 1993



(a) BC (b) BD (c) HF (d) EG

46. Moment of inertia of a uniform circular disc about a diameter is I. Its moment of inertia about an axis perpendicular to its plane and passing through a point on its rim will be

AIPMT 1990

(a) $5I$ (b) $3I$ (c) $6I$ (d) $4I$

47. The moment of inertia of a circular ring of mass M and diameter r about a tangential axis lying in the plane of the ring is:

JEE MAIN 2025 · 2 APR · SHIFT 2

(a) $\frac{3}{8}$Mr^2 (b) 2Mr^2 (c) $\frac{1}{2}$Mr^2 (d) $\frac{3}{2}$Mr^2

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48. Moment of inertia of a square plate of side l about the axis passing through one of the corner and perpendicular to the plane of square plate is given by:

JEE MAIN 2021 · 27 AUG · SHIFT 1

(a) $\frac{Ml^2}{6}$ (b) Ml^2 (c) $\frac{Ml^2}{12}$ (d) $\frac{2}{3}Ml^2$

49. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Moment of inertia of a circular disc of mass 'M' and radius 'R' about X, Y axes (passing through its plane) and Z-axis which is perpendicular to its plane were found to be Ix, Iy and Iz respectively. The respectively radii of gyration about all the three axes will be the same. Reason R: A rigid body making rotational motion has fixed mass and shape. In the light of the above statements, choose the most appropriate answer from the options given below:

JEE MAIN 2021 · 25 JUL · SHIFT 1

(a) Both A and R are correct but R is NOT the correct explanation of A.
(b) A is not correct but R is correct.
(c) A is correct but R is not correct.
(d) Both A and R are correct and R is the correct explanation of A.

50. The radius of gyration of a uniform rod of length l, about an axis passing through a point $\frac{l}{4}$ away from the centre of the rod, and perpendicular to it, is:

JEE MAIN 2020 · 7 JAN · SHIFT 1

(a) $\frac{1}{8}l$ (b) $\frac{1}{4}l$ (c) $\sqrt{\frac{7}{48}}l$ (d) $\sqrt{\frac{3}{8}}l$

51. Consider a uniform square plate of side $'a'$ and mass $'m'$. The moment of inertia of this plate about an axis perpendicular to its plane and passing through one of its corners is

AIEEE 2008

(a) $\frac{5}{6}ma^2$ (b) $\frac{1}{12}ma^2$ (c) $\frac{7}{12}ma^2$ (d) $\frac{2}{3}ma^2$

52. One solid sphere A and another hollow sphere B are of same mass and same outer radii. Their moment of inertia about their diameters are respectively I_A and I_B such that

AIEEE 2004

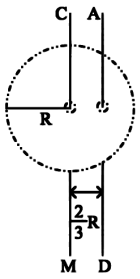
(a) $I_A < I_B$
(b) $I_A > I_B$
(c) $I_A = I_B$
(d) $\frac{}{I_B} = \frac{}{d_B}^{I_A\ d_A}$ where d_A and d_B are their densities.

53. Moment of inertia of a disc of mass 'M' and radius 'R' about any of its diameter is $\frac{MR^2}{4}$. The moment of inertia of this disc about an axis normal to the disc and passing through a point on its edge will be, $\frac{x}{2}$ MR^2. The value of x is _____.

JEE MAIN 2023 · 1 FEB · SHIFT 2 *(Numerical)*

54. I_{CM} is the moment of inertia of a circular disc about an axis (CM) passing through its center and perpendicular to the plane of disc. I_{AB} is its moment of inertia about an axis AB perpendicular to plane and parallel to axis CM at a distance $\frac{2}{3}$ R from center. Where R is the radius of the disc. The ratio of I_{AB} and I_{CM} is $x : 9$. The value of x is _____.

JEE MAIN 2023 · 25 JAN · SHIFT 1 *(Numerical)*



◆ Bending, recasting & scaling 2 Qs

55. If radius of the solid sphere is doubled by keeping its mass constant, the ratio of their moment of inertia about any of its diameter is

MHT CET 2019 · 2 MAY · SHIFT 1

(a) 1 : 8 (b) 2 : 5 (c) 2 : 3 (d) 1 : 4

56. A circular disc is to be made by using iron and aluminium so that it acquired maximum moment of inertia about geometrical axis. It is possible with

AIPMT 2002

(a) aluminium at interior and iron surround to it
(b) iron at interior and aluminium surround to it
(c) using iron and aluminium layers in alternate order
(d) sheet of iron is used at both external surface and aluminium sheet as internal layers.

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TOPIC 02

Torque, Couple & Equilibrium of Rigid Bodies

24 PYQs · Easy 24 · Medium 0 · Difficult 0 | MHT CET 8 · NEET 6 · JEE 10

Concepts covered: Torque as a vector (r × F) (16) · Couple & torque concepts (8)

LEVEL 1 · EASY 24 questions

◆ Torque as a vector (r × F) 16 Qs

1. A force of $3\hat{i}+2\hat{j}-\hat{k}$ N acts on a particle with position vector $\hat{i}+\hat{j}-\hat{k}$ m. The magnitude of torque of given force is

MHT CET 2026 · 19 APR · SHIFT 2

(a) $\sqrt{5}$ N m (b) $\sqrt{8}$ N m
(c) $\sqrt{6}$ N m (d) $\sqrt{10}$ N m

2. If force $\vec{F}=-3\hat{i}+\hat{j}+5\hat{k}$ acts along $\vec{r}=7\hat{i}+3\hat{j}+\hat{k}$ then the torque acting at that point is

MHT CET 2025 · 22 APR · SHIFT 1

(a) $(14\hat{i}-38\hat{j}+16\hat{k})$ (b) $(-14\hat{i}+34\hat{j}-16\hat{k})$
(c) $(21\hat{i}+4\hat{j}+4\hat{k})$ (d) $(4\hat{i}+4\hat{j}+6\hat{k})$

3. If $\vec{F}=(5\hat{i}-10\hat{j})$ and $\vec{r}=(4\hat{i}-3\hat{j})$, then the torque acting on the object will be

MHT CET 2025 · 19 APR · SHIFT 1

(a) $\hat{i}-2\hat{j}$ (b) $2\hat{i}-\hat{j}$ (c) $25\hat{k}$ (d) $-25\hat{k}$

4. Find the torque about the origin when a force of 3 $\hat{j}$ N acts on a particle whose position vector is 2 $\hat{k}$ m.

NEET 2020 · PHASE 1

(a) 6 $\hat{j}$ N m (b) – 6 $\hat{i}$ N m
(c) 6 $\hat{k}$ N m (d) 6 $\hat{i}$ N m

5. The moment of the force, $\vec{F}=4\hat{i}+5\hat{j}-6\hat{k}$ at (2, 0, –3), about the point (2, –2, –2), is given by

NEET 2018

(a) $-8\hat{i}-4\hat{j}-7\hat{k}$ (b) $-4\hat{i}-\hat{j}-8\hat{k}$
(c) $-7\hat{i}-8\hat{j}-4\hat{k}$ (d) $-7\hat{i}-4\hat{j}-8\hat{k}$

6. If $\vec{F}$ is the force acting on a particle having position vector $\vec{r}$ and $\vec{\tau}$ be the torque of this force about the origin, then

AIPMT 2009

(a) $\vec{r}.\vec{\tau}>0$ and $\vec{F}.\vec{\tau}<0$ (b) $\vec{r}.\vec{\tau}=0$ and $\vec{F}.\vec{\tau}=0$
(c) $\vec{r}.\vec{\tau}=0$ and $\vec{F}.\vec{\tau}\neq 0$ (d) $\vec{r}.\vec{\tau}\neq 0$ and $\vec{F}.\vec{\tau}=0$

7. Find the torque of a force $\vec{F}=-3\hat{i}+\hat{j}+5\hat{k}$ acting at the point $\vec{r}=7\hat{i}+3\hat{j}+\hat{k}$.

AIPMT 1997

(a) $-21\hat{i}+4\hat{j}+4\hat{k}$ (b) $-14\hat{i}+34\hat{j}-16\hat{k}$
(c) $14\hat{i}-38\hat{j}+16\hat{k}$ (d) $4\hat{i}+4\hat{j}+6\hat{k}$

8. What is the torque of the force $\vec{F}=2\hat{i}-3\hat{j}+4\hat{k}$ N acting at the point $\vec{r}=3\hat{i}+2\hat{j}+3\hat{k}$ m about origin?

AIPMT 1995

(a) $-6\hat{i}+6\hat{j}-12\hat{k}$ (b) $-17\hat{i}+6\hat{j}+13\hat{k}$
(c) $6\hat{i}-6\hat{j}+12\hat{k}$ (d) $17\hat{i}-6\hat{j}-13\hat{k}$

9. The torque due to the force $(2\hat{i}+\hat{j}+2\hat{k})$ about the origin, acting on a particle whose position vector is $(\hat{i}+j+\hat{k})$, would be

JEE MAIN 2025 · 22 JAN · SHIFT 2

(a) $\hat{j}+\hat{k}$ (b) $\hat{i}-\hat{k}$
(c) $\hat{i}-\hat{j}+\hat{k}$ (d) $\hat{i}+\hat{k}$

10. The torque of a force $5\hat{i}+3j-\hat{7k}$ about the origin is τ. If the force acts on a particle whose position vector is $2\hat{i}+2j+\hat{k}$, then the value of τ will be

JEE MAIN 2022 · 29 JUL · SHIFT 2

(a) $11\hat{i}+19\hat{j}-4\hat{k}$ (b) $-11\hat{i}+9\hat{j}-16\hat{k}$
(c) $-17\hat{i}+19\hat{j}-4\hat{k}$ (d) $17\hat{i}+9\hat{j}+16\hat{k}$

11. If force $\vec{F}=3\hat{i}+4\hat{j}-2\hat{k}$ acts on a particle position vector $2\hat{i}+\hat{j}+2\hat{k}$ then, the torque about the origin will be:

JEE MAIN 2022 · 25 JUN · SHIFT 1

(a) $3\hat{i}+4\hat{j}-2\hat{k}$ (b) $-10\hat{i}+10\hat{j}+5\hat{k}$
(c) $10\hat{i}+5\hat{j}-10\hat{k}$ (d) $10\hat{i}+\hat{j}-5\hat{k}$

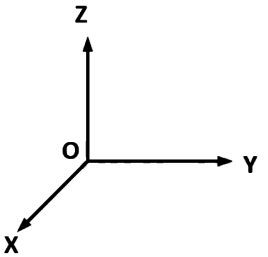
12. The magnitude of torque on a particle of mass 1 kg is 2.5 Nm about the origin. If the force acting on it is 1 N, and the distance of the particle from the origin is 5m, the angle between the force and the position vector is (in radians):

JEE MAIN 2019 · 11 JAN · SHIFT 2

(a) $\frac{\pi}{8}$ (b) $\frac{\pi}{6}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{3}$

13. A force of $-F\hat{k}$ acts on O, the origin of the coordinate system. The torque about the point $(1,-1)$ is

AIEEE 2006



(a) $F\left(\hat{i}-\hat{j}\right)$ (b) $-F\left(\hat{i}+\hat{j}\right)$
(c) $F\left(\hat{i}+\hat{j}\right)$ (d) $-F\left(\hat{i}-\hat{j}\right)$

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14. Let $\vec{F}$ be the force acting on a particle having position vector $\vec{r}$, and $\vec{\tau}$ be the torque of this force about the origin. Then

AIEEE 2003

(a) $\vec{r}\cdot\vec{\tau}=0$ and $F.\tau\neq 0$

(b) $\vec{r}\cdot\vec{\tau}\neq 0$ and $F.\tau=0$

(c) $\vec{r}\cdot\vec{\tau}\neq 0$ and $F.\tau\neq 0$

(d) $\vec{r}\cdot\vec{\tau}=0$ and $F.\tau=0$

15. The coordinates of a particle with respect to origin in a given reference frame is (1, 1, 1) meters. If a force of $\vec{F}=\hat{i}-\hat{j}+\hat{k}$ acts on the particle, then the magnitude of torque (with respect to origin) in z- direction is _____.

JEE MAIN 2025 · 29 JAN · SHIFT 1 *(Numerical)*

16. A force $\vec{F}=\left(\hat{i}+2\hat{j}+3\hat{k}\right)$ N acts at a point $\left(4\hat{i}+3\hat{j}-\hat{k}\right)$ m. Then the magnitude of torque about the point $\left(\hat{i}+2\hat{j}+\hat{k}\right)$ m will be $\sqrt{x}$ N m.

The value of x is _____.

JEE MAIN 2020 · 5 SEP · SHIFT 1 *(Numerical)*

◆ Couple & torque concepts 8 Qs

17. In the case of rotational dynamics, which of the following statements is correct? { S = linear displacement, α = angular acceleration, r = radius vector, a = linear acceleration, L = angular momentum, p = linear momentum, θ = angular displacement}

1. $S=r\times\theta, a=r\times\alpha, L=p\times r$
2. $S=\theta\times r, a=\alpha\times r, L=r\times p$
3. $S=r\cdot\theta, a=r\cdot\alpha, L=p\cdot r$
4. $S=\omega\times r, a=r\times p, L=r\times f$

MHT CET 2026 · 12 MAY · SHIFT 1

(a) 4 (b) 3 (c) 2 (d) 1

18. Which of the following sentence is true?

a. Moment of a couple is independent of the axis of rotation or the points of application of forces. b. Moment of a couple produces translational acceleration.

c. Moment of a couple can be balanced by single force.

d. Moment of a couple depends upon the axis of rotation or the points of application of forces.

MHT CET 2026 · 12 MAY · SHIFT 1

(a) d (b) c (c) b (d) a

19. In case of rotational dynamics, which one of the following statements is correct? [$\vec{\omega}$ = angular velocity, $\vec{\mathrm{v}}$ = linear velocity

$\vec{\mathbf{r}}$ = radius vector, $\vec{\alpha}$ = angular acceleration

$\vec{\mathrm{a}}$ = linear acceleration, $\vec{\mathrm{L}}$ = angular momentum

$\vec{\mathrm{p}}$ = linear momentum, $\bar{\tau}$ = torque,

$\vec{\mathrm{f}}$ = centripetal force]

MHT CET 2024 · 3 MAY · SHIFT 1

(a) $\vec{\mathbf{v}}=\vec{\mathbf{r}}\times\vec{\omega}, \vec{\boldsymbol{\alpha}}=\vec{\mathbf{r}}\times\vec{a}, \vec{L}=\vec{\mathrm{r}}\times\vec{\mathrm{p}}, \vec{\tau}=\vec{\mathrm{f}}\times\vec{\mathrm{r}}$

(b) $\vec{\mathrm{v}}=\vec{\omega}\times\vec{\mathrm{r}}, \vec{\alpha}=\vec{\mathrm{a}}\times\vec{\mathrm{r}}, \vec{\mathrm{L}}=\vec{\mathrm{p}}\times\vec{\mathrm{r}}, \vec{\tau}=\vec{\mathrm{r}}\times\vec{\mathrm{f}}$

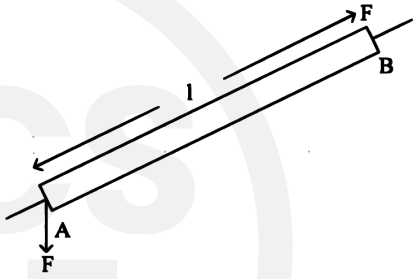
(c) $\vec{\mathrm{v}}=\vec{\omega}\times\vec{\mathrm{r}}, \vec{\alpha}=\vec{\mathrm{a}}\times\vec{\mathrm{r}}, \vec{\mathrm{L}}=\vec{\mathrm{r}}\times\vec{\mathrm{p}}, \vec{\tau}=\vec{\mathrm{r}}\times\vec{\mathrm{f}}$

(d) $\vec{\mathrm{v}}=\vec{\omega}\times\vec{\mathrm{r}}, \vec{\alpha}=\vec{\mathrm{a}}\times\vec{\mathrm{r}}, \vec{\mathrm{L}}=\vec{\mathrm{p}}\cdot\vec{\mathrm{r}}, \vec{\tau}=\vec{\mathrm{r}}\times\vec{\mathrm{f}}$

20. A rod l m long is acted upon by a couple as shown in the figure. The moment of couple is τ Nm. If the force acts at each end of the rod, then magnitude of each force is

$(\sin 30^\circ=\cos 60^\circ=0.5)$

MHT CET 2019 · 3 MAY · SHIFT 1



(a) $\frac{\tau}{l}$ (b) $\frac{l}{2\tau}$ (c) $\frac{2\tau}{l}$ (d) $\frac{2}{\tau}$

21. The dimensions of torque are same as that of

MHT CET 2019 · 2 MAY · SHIFT 1

(a) moment of force (b) pressure.

(c) acceleration (d) impulse

22. A couple produces

AIPMT 1997

(a) linear and rotational motion

(b) no motion

(c) purely linear motion

(d) purely rotational motion

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23. Which of the following are correct expression for torque acting on a body?

A. $\vec{\tau} = \vec{r} \times \vec{L}$

B. $\vec{\tau} = \frac{d}{dt}(\vec{r} \times \vec{p})$

C. $\vec{\tau} = \vec{r} \times \frac{d\vec{p}}{dt}$

D. $\vec{\tau} = I\vec{\alpha}$

E. $\vec{\tau} = \vec{r} \times \vec{F}$

($\vec{r}$ = position vector; $\vec{p}$ = linear momentum; $\vec{L}$ = angular momentum; $\vec{\alpha}$ = angular acceleration; I = moment of inertia; $\vec{F}$ = force; t = time)

Choose the correct answer from the options given below:

JEE MAIN 2025 · 4 APR · SHIFT 1

(a) A, B, D and E Only (b) C and D Only

(c) B, C, D and E Only (d) B, D and E Only

---

24. Given below are two statements: one is labelled as Assertion **A** and the other is labelled as Reason **R**

Assertion A: An electric fan continues to rotate for some time after the current is switched off. Reason R: Fan continues to rotate due to inertia of motion.

In the light of above statements, choose the most appropriate answer from the options given below.

JEE MAIN 2023 · 10 APR · SHIFT 2

(a) A is not correct but R is correct

(b) A is correct but R is not correct

(c) Both A and R are correct and R is the correct explanation of A

(d) Both A and R are correct but R is NOT the correct explanation of A

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TOPIC 03

Rotational Kinematics & Dynamics

27 PYQs · Easy 27 · Medium 0 · Difficult 0 | MHT CET 10 · NEET 12 · JEE 5

Concepts covered: Angular kinematics (10) · Torque = Iα (wheels & discs) (8) · Pulley, string & hanging mass (3) · Circular motion & rotating frames (6)

LEVEL 1 · EASY 27 questions

◆ Angular kinematics 10 Qs

1. A wheel is rotating at 600 rpm about its axis of rotation. When the power is cut off, it comes to rest in half a minute. Its angular retardation expressed in rad $/s^2$ is (retardation is uniform)

MHT CET 2026 · 11 APR · SHIFT 1

(a) $\frac{2\pi}{3}$ (b) $\frac{\pi}{4}$ (c) π (d) $\frac{\pi}{6}$

2. What is the linear velocity if angular velocity $\vec{\omega} = 3\hat{i} - 4\hat{j} + \hat{k}$ and radius $\vec{r} = (5\hat{i} - 6\hat{j} + 6\hat{k})$?

MHT CET 2025 · 23 APR · SHIFT 2

(a) $(-30\hat{i} - 13\hat{j} - 38\hat{k})$ (b) $(8\hat{i} - 10\hat{j} + 7\hat{k})$
(c) $(-18\hat{i} - 13\hat{j} + 2\hat{k})$ (d) $(-2\hat{i} - 2\hat{j} - 5\hat{k})$

3. A rigid body is rotating with angular velocity ' ω ' about an axis of rotation. Let v ' be the linear velocity of particle which is at perpendicular distance ' r ' from the axis of rotation. Then the relation $v = r\omega$ ' implies that

MHT CET 2019 · 2 MAY · SHIFT 2

(a) ω does not depend on r (b) $\omega \propto \frac{1}{r}$
(c) $\omega \propto r$ (d) $\omega = 0$

4. The angular speed of a flywheel is increased from 600 rpm to 1200 rpm in 10 s. The number of revolutions completed by the flywheel during this time is:

NEET 2026

(a) 900 (b) 600 (c) 150 (d) 300

5. The angular speed of a fly wheel moving with uniform angular acceleration changes from 1200 rpm to 3120 rpm in 16 seconds. The angular acceleration in rad/s2 is

NEET 2022 · PHASE 1

(a) 2π (b) 4π (c) 12π (d) 104π

6. The angular speed of the wheel of a vehicle is increased from 360 rpm to 1200 rpm in 14 second. Its angular acceleration is,

NEET 2020 · PHASE 2

(a) 1 rad/s^2 (b) 2π rad/s^2
(c) 28π rad/s^2 (d) 120π rad/s^2

7. A wheel has angular acceleration of 3.0 rad/sec2 and an initial angular speed of 2.00 rad/sec. In a time of 2 sec it has rotated through an angle (in radian) of

AIPMT 2007

(a) 10 (b) 12 (c) 4 (d) 6

8. A fly wheel is accelerated uniformly from rest and rotates through 5 rad in the first second. The angle rotated by the fly wheel in the next second, will be:

JEE MAIN 2022 · 24 JUN · SHIFT 2

(a) 7.5 rad (b) 15 rad (c) 20 rad (d) 30 rad

9. A body rotating with an angular speed of 600 rpm is uniformly accelerated to 1800 rpm in 10 sec. The number of rotations made in the process is _____.

JEE MAIN 2021 · 20 JUL · SHIFT 2 *(Numerical)*

10. The angular speed of truck wheel is increased from 900 rpm to 2460 rpm in 26 seconds. The number of revolutions by the truck engine during this time is _____. (Assuming the acceleration to be uniform).

JEE MAIN 2021 · 17 MAR · SHIFT 1 *(Numerical)*

◆ Torque = Iα (wheels & discs) 8 Qs

11. A disc of radius 0.4 m and mass 1 kg rotates about an axis passing through its centre and perpendicular to its plane. The angular acceleration is 10 rad/s^2. The tangential force applied to the rim of the disc is

MHT CET 2026 · 13 APR · SHIFT 1

(a) 1 N (b) 2 N (c) 3 N (d) 4 N

12. A same torque is applied to a disc and a ring of equal mass and radii then

MHT CET 2025 · 26 APR · SHIFT 2

(a) the ring will rotate with greater angular frequency.
(b) both will rotate with same angular frequency.
(c) the disc will rotate with greater angular frequency.
(d) both will rotate with same angular velocity.

13. A disc of radius 0.4 metre and mass 1 kg rotates about an axis passing through its centre and perpendicular to its plane. The angular acceleration is 10 rad s^{-2}. The tangential force applied to the rim of the disc is

MHT CET 2021 · 20 SEP · SHIFT 2

(a) 2N (b) 3N (c) 4N (d) 5N

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14. A disc of radius 0.4 m and mass one kg rotates about an axis passing through its centre and perpendicular to its plane. The angular acceleration of the disc is 10 rad/s^2. The tangential force applied to the rim of the disc is

MHT CET 2021 · 20 SEP · SHIFT 1

(a) 4 N (b) 1 N (c) 2 N (d) 8 N

15. If there is a change of angular momentum from 1j-s to 4j-s in 4 s, then the torque

MHT CET 2020 · 16 OCT · SHIFT 1

(a) $\left(\frac{5}{4}\right)$J (b) $\left(\frac{3}{4}\right)$J (c) 1 J (d) $\left(\frac{4}{3}\right)$J

16. A constant torque of 100 N m turns a wheel of moment of inertia 300 kg m^2 about an axis passing through its centre. Starting from rest, its angular velocity after 3 s is :-

NEET 2023

(a) 1 rad/s (b) 5 rad/s (c) 10 rad/s (d) 15 rad/s

17. A wheel having moment of inertia 2 kg m2 about its vertical axis, rotates at the rate of 60 rpm about this axis. The torque which can stop the wheel's rotation in one minute would be

AIPMT 2004

(a) $\frac{2\pi}{15}$ N m (b) $\frac{\pi}{12}$ N m (c) $\frac{\pi}{15}$ N m (d) $\frac{\pi}{18}$ N m

18. A solid disc of radius 20 cm and mass 10 kg is rotating with an angular velocity of 600 rpm, about an axis normal to its circular plane and passing through its centre of mass. The retarding torque required to bring the disc at rest in 10 s is _____ $\pi \times 10^{-1}$ Nm.

JEE MAIN 2021 · 25 JUL · SHIFT 2 *(Numerical)*

◆ Pulley, string & hanging mass 3 Qs

19. A rope is wound around a solid cylinder of mass 1 kg and radius 0.4 m. What is the angular acceleration of cylinder, if the rope is pulled with a force of 25 N? (Cylinder is rotating about its own axis.)

MHT CET 2020 · 19 OCT · SHIFT 2

(a) 125 rad/s^2 (b) 10 rad/s^2
(c) 1 rad/s^2 (d) 50 rad/s^2

20. A rope is wound around a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30 N?

NEET 2017

(a) 0.25 rad s^{-2} (b) 25 rad s^{-2}
(c) 5 m s^{-2} (d) 25 m s^{-2}

21. A light rope is wound around a hollow cylinder of mass 5 kg and radius 70 cm. The rope is pulled with a force of 52.5 N. The angular acceleration of the cylinder will be _____ rad s^{-2}.

JEE MAIN 2023 · 13 APR · SHIFT 2 *(Numerical)*

◆ Circular motion & rotating frames 6 Qs

22. A particle moves along a circular path with decreasing speed. Hence

MHT CET 2023 · 11 MAY · SHIFT 1

(a) its resultant acceleration is towards the centre.
(b) it moves in a spiral path with decreasing radius.
(c) the direction of angular momentum remains constant.
(d) its angular momentum remains constant

23. A bob is whirled in a horizontal plane by means of a string with an initial speed of ω rpm. The tension in the string is T. If speed becomes 2ω while keeping the same radius, the tension in the string becomes:

NEET 2024

(a) T (b) $4T$ (c) $\frac{T}{4}$ (d) $\sqrt{2}T$

24. The angular acceleration of a body, moving along the circumference of a circle, is:

NEET 2023

(a) along the radius towards the centre
(b) along the tangent to its position
(c) along the axis of rotation
(d) along the radius, away from centre

25. Two particles A and B are moving in uniform circular motion in concentric circles of radii rA and rB with speed vA and vB respecitively. Their time period of rotation is the same. The ratio of angular speed of A to that of B will be:

NEET 2019

(a) vA: vB (b) 1: 1 (c) rB: rA (d) rA: rB

26. A car of mass m is moving on a level circular track of radius R. If μ_s represents the static friction between the road and tyres of the car, the maximum speed of the car in circular motion is given by

AIPMT 2012 · MAINS

(a) $\sqrt{\mu_s mRg}$ (b) $\sqrt{\frac{Rg}{\mu_s}}$
(c) $\sqrt{\frac{mRg}{\mu_s}}$ (d) $\sqrt{\mu_s Rg}$

27. A car of mass 1000 kg negotiates a banked curve of radius 90 m on a frictionless road. If the banking angle is 45°, the speed of the car is

AIPMT 2012 · PRELIMS

(a) 20 m s^{-1} (b) 30 m s^{-1}
(c) 5 m s^{-1} (d) 10 m s^{-1}

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TOPIC 04

Angular Momentum & its Conservation

17 PYQs · Easy 17 · Medium 0 · Difficult 0 | MHT CET 5 · NEET 7 · JEE 5

Concepts covered: Angular momentum of a particle (7) · L = Iω & torque-L relation (4) · Conservation: changing moment of inertia (5) · Conservation: discs coupled / masses added (1)

LEVEL 1 · EASY 17 questions

◆ Angular momentum of a particle 7 Qs

1. A mass 'M' is moving with constant velocity parallel to X-axis. Its angular momentum with respect to the origin is

MHT CET 2023 · 14 MAY · SHIFT 2

(a) constant (b) zero
(c) decreasing (d) increasing

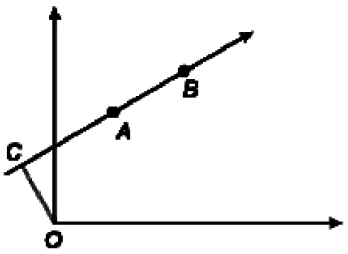
2. A particle with position vector $\vec{r}$ has a linear momentum $\vec{P}$. Which one of the following statements is true in respect of its angular momentum 'L' about the origin?

MHT CET 2021 · 22 SEP · SHIFT 2

(a) $\vec{L}$ acts along $\vec{P}$.
(b) L is maximum when $\vec{P}$ is perpendicular to $\vec{r}$.
(c) $\vec{L}$ acts along $\vec{r}$.
(d) L is maximum when $\vec{P}$ and $\vec{r}$ are parallel.

3. A particle of mass m moves in the XY plane with a velocity v along the straight line AB. If the angular momentum of the particle with respect to origin O is LA when it is at A and LB when it is at B, then

AIPMT 2007



(a) LA = LB
(b) the relationship between LA and LB depends upon the slope of the line AB
(c) LA < LB
(d) LA > LB.

4. When the position vector $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ changes sign as $-\vec{r}$, which one of the following vector will not flip under sign change?

JEE MAIN 2026 · 28 JAN · SHIFT 2

(a) Velocity (b) Linear momentum
(c) Acceleration (d) Angular momentum

5. Angular momentum of a single particle moving with constant speed along circular path:

JEE MAIN 2021 · 31 AUG · SHIFT 1

(a) changes in magnitude but remains same in the direction
(b) remains same in magnitude and direction
(c) remains same in magnitude but changes in the direction
(d) is zero

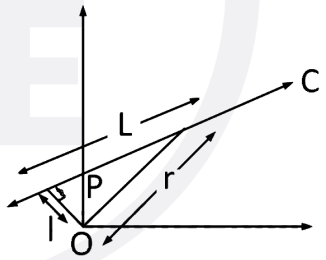
6. Angular momentum of the particle rotating with a central force is constant due to

AIEEE 2007

(a) constant torque
(b) constant force
(c) constant linear momentum
(d) zero torque

7. A particle of mass m moves along line PC with velocity v as shown. What is the angular momentum of the particle about P?

AIEEE 2002



(a) mvL (b) mvl (c) mvr (d) zero

◆ L = Iω & torque-L relation 4 Qs

8. A body of mass 'm' and radius of gyration 'K' has an angular momentum L. Its angular velocity is

MHT CET 2021 · 24 SEP · SHIFT 1

(a) $\frac{K^2}{mL}$ (b) $mK^2 L$ (c) $\frac{mK^2}{L}$ (d) $\frac{L}{mK^2}$

9. A body of mass 'm' and radius of gyration 'K' has an angular momentum 'L'. Then its angular velocity is

MHT CET 2021 · 23 SEP · SHIFT 2

(a) $\frac{L}{mK^2}$ (b) $\frac{mK^2}{L}$ (c) $\frac{K^2}{mL}$ (d) $mK^2 L$

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10. An automobile moves on a road with a speed of 54 km $h^{-}1$. The radius of its wheels is 0.45 m and the moment of inertia of the wheel about its axis of rotation is 3 kg m2. If the vehicle is brought to rest in 15 s, the magnitude of average torque transmitted by its brakes to the wheel is

AIPMT 2015

(a) 10.86 kg m2 s^{-2} (b) 2.86 kg m2 s^{-2}
(c) 6.66 kg m2 s^{-2} (d) 8.58 kg m2 s^{-2}

11. When a mass is rotating in a plane about a fixed point, its angular momentum is directed along

AIPMT 2012 · PRELIMS

(a) a line perpendicular to the plane of rotation
(b) the line making an angle of 45° to the plane of rotation
(c) the radius
(d) the tangent to the orbit

◆ Conservation: changing moment of inertia 5 Qs

12. The earth is assumed to be a sphere of radius ' R ' and mass ' M ' having period of rotation ' T '. The angular momentum of earth about its axis of rotation is

MHT CET 2024 · 3 MAY · SHIFT 2

(a) $\frac{2\pi MR^2}{5\,T}$ (b) $\frac{4\pi MR^2}{5\,T}$ (c) $\frac{MR^2\,T}{2\pi}$ (d) $\frac{MR^2\,T}{4\pi}$

13. The Sun rotates around its centre once in 27 days. What will be the period of revolution if the Sun were to expand to twice its present radius without any external influence? Assume the Sun to be a sphere of uniform density.

NEET 2025

(a) 115 days (b) 108 days (c) 100 days (d) 105 days

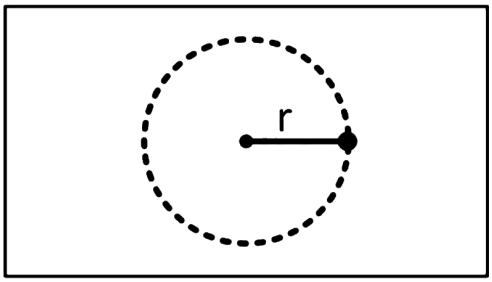
14. A solid sphere is rotating freely about its symmetry axis in free space. The radius of the sphere is increased keeping its mass same. Which of the following physical quantities would remain constant for the sphere?

NEET 2018

(a) Angular velocity
(b) Moment of inertia
(c) Rotational kinetic energy
(d) Angular momentum

15. A small mass attached to a string rotates on a frictionless table top as shown. If the tension in the string is increased by pulling the string causing the radius of the circular motion to decrease by a factor of 2, the kinetic energy of the mass will

AIPMT 2011 · MAINS



(a) decrease by a factor of 2
(b) remain constant
(c) increase by a factor of 2
(d) increase by a factor of 4

16. A solid sphere is rotating in free space. If the radius of the sphere is increased keeping mass same which one of the following will not be affected?

AIEEE 2004

(a) Angular velocity
(b) Angular momentum
(c) Moment of inertia
(d) Rotational kinetic energy

◆ Conservation: discs coupled / masses added 1 Q

17. A disc is rotating with angular speed ω. If a child sits on it, what is conserved

AIPMT 2002

(a) linear momentum (b) angular momentum
(c) kinetic energy (d) potential energy.

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TOPIC 05

Rotational Kinetic Energy, Work & Power

15 PYQs · Easy 15 · Medium 0 · Difficult 0 | MHT CET 9 · NEET 5 · JEE 1

Concepts covered: KE-L-I relations (8) · Work, power & flywheels (7)

LEVEL 1 · EASY 15 questions

◆ KE-L-I relations 8 Qs

1. A body is rotating about its own axis. Its rotational kinetic energy is 'x' and its angular momentum is 'y'. Hence its moment of inertia about its own axis is

MHT CET 2026 · 20 APR · SHIFT 1

(a) $\frac{x}{2y}$ (b) $\frac{y}{2x}$ (c) $\frac{x^2}{2y}$ (d) $\frac{y^2}{2x}$

2. A body is rotating about its own axis. Its rotational kinetic energy is ' x ' and its angular momentum is ' y '. Hence its moment of inertia about its own axis is

MHT CET 2025 · 21 APR · SHIFT 2

(a) $\frac{x^2}{2y}$ (b) $\frac{y^2}{2x}$ (c) $\frac{x}{2y}$ (d) $\frac{y}{2x}$

3. If the angular velocity of a body rotating about the given axis increases by 20%, then its kinetic energy of rotation will increase by

MHT CET 2024 · 15 MAY · SHIFT 1

(a) 20% (b) 30% (c) 44% (d) 66%

4. A rigid body rotates with an angular momentum L. If its rotational kinetic energy is made four times, its angular momentum will become

MHT CET 2023 · 13 MAY · SHIFT 1

(a) 4 L (b) 16 L (c) $\sqrt{2}$ L (d) 2 L

5. Two bodies have their moments of inertia I and 2I respectively about their axis of rotation. If their kinetic energies of rotation are equal, their angular momenta will be in the ratio

MHT CET 2023 · 11 MAY · SHIFT 2

(a) 1 : 2 (b) $\sqrt{2}$: 1 (c) 2 : 1 (d) 1 : $\sqrt{2}$

6. The moment of inertia of a body about the given axis, rotating with angular velocity 1 rad/s is numerically equal to 'P' times its rotational kinetic energy. The value of 'P' is

MHT CET 2021 · 23 SEP · SHIFT 2

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) 2 (d) 1

7. Two bodies have their moments of inertia I and 2I respectively about their axis of rotation. If their kinetic energies of rotation are equal, their angular velocity will be in the ratio

AIPMT 2005

(a) 2: 1 (b) 1: 2 (c) $\sqrt{2}$: 1 (d) 1 : $\sqrt{2}$

8. A ring of mass m and radius r rotates about an axis passing through its centre and perpendicular to its plane with angular velocity ω. Its kinetic energy is

AIPMT 1988

(a) $\frac{1}{2}mr^2\omega^2$ (b) $mr\omega^2$ (c) $mr^2\omega^2$ (d) $\frac{1}{2}mr\omega^2$

◆ Work, power & flywheels 7 Qs

9. The power (P) is supplied to rotating body having moment of inertia 'I' and angular acceleration 'α'. Its instantaneous angular velocity is

MHT CET 2026 · 15 APR · SHIFT 1

(a) $\frac{I}{P\alpha}$ (b) $\frac{\alpha}{PI}$ (c) $\frac{P\alpha}{I}$ (d) $\frac{P}{I\alpha}$

10. A flywheel rotating about a fixed axis has a kinetic energy of 500 joule, if its angular frequency is 5 Hz, then calculate the moment of inertia of the wheel about the axis of rotation. ($\pi^2 = 10$)

MHT CET 2026 · 11 APR · SHIFT 1

(a) 0.6 kg m^2 (b) 1 kg m^2
(c) 0.75 kg m^2 (d) 0.15 kg m^2

11. When a 12000 joule of work is done on a flywheel, its frequency of rotation increases from 10 Hz to 20 Hz. The moment of inertia of flywheel about its axis of rotation is $(\pi^2 = 10)$

MHT CET 2019 · 2 MAY · SHIFT 2

(a) 1 kgm^2 (b) 2 kgm^2
(c) 1.688 kgm^2 (d) 1.5 kgm^2

12. An energy of 484 J is spent in increasing the speed of a flywheel from 60 rpm to 360 rpm. The moment of inertia of the flywheel is:

NEET 2022 · PHASE 2

(a) 0.07 kg-m2 (b) 0.7 kg-m2
(c) 3.22 kg-m2 (d) 30.8 kg-m2

13. A fly wheel rotating about fixed axis has a kinetic energy of 360 joule when its angular speed is 30 radian/sec. The moment of inertia of the wheel about the axis of rotation is

AIPMT 1990

(a) 0.6 kg m^2 (b) 0.15 kg m^2
(c) 0.8 kg m^2 (d) 0.75 kg m^2

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14. The moment of inertia of a body about a given axis is $1.2\,\mathrm{kg\,m^2}$. Initially, the body is at rest. In order to produce a rotational kinetic energy of 1500 joule, an angular acceleration of 25 radian/sec2 must be applied about that axis for a duration of

AIPMT 1990

(a) 4 s (b) 2 s (c) 8 s (d) 10 s

15. Moment of inertia of a body about a given axis is 1.5 kg m2. Initially the body is at rest. In order to produce a rotational kinetic energy of 1200 J, the angular accleration of 20 rad/s2 must be applied about the axis for a duration of :-

JEE MAIN 2019 · 9 APR · SHIFT 2

(a) 2.5 s (b) 3 s (c) 5s (d) 2 s

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TOPIC 06

Rolling Motion

32 PYQs · Easy 32 · Medium 0 · Difficult 0 | MHT CET 11 · NEET 11 · JEE 10

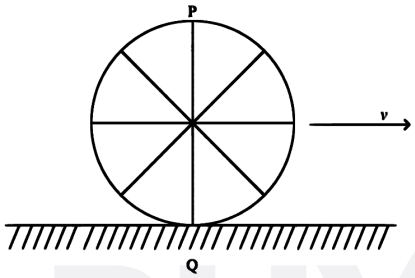
Concepts covered: Rolling kinematics (1) · KE split in rolling (14) · Rolling down an incline (16) · Friction, slipping & transition to rolling (1)

LEVEL 1 · EASY 32 questions

◆ Rolling kinematics 1 Q

1. A wheel of a bullock cart is rolling on a level road as shown in the figure below. If its linear speed is v in the direction shown, which one of the following options is correct (P and Q are any highest and lowest points on the wheel, respectively)?

NEET 2024



(a) Point P moves slower than point Q
(b) Point P moves faster than point Q
(c) Both the points P and Q move with equal speed
(d) Point P has zero speed

◆ KE split in rolling 14 Qs

2. A solid sphere rolls without slipping on an inclied plane at an angle θ. The ratio of total kinetic energy to its rotational kinetic energy is

MHT CET 2026 · 18 APR · SHIFT 2

(a) $\frac{5}{2}$ (b) $\frac{7}{2}$ (c) $\frac{5}{4}$ (d) $\frac{5}{7}$

3. The rotational kinetic energy and translational kinetic energy of a rolling body are same, the body is

MHT CET 2023 · 13 MAY · SHIFT 1

(a) disc (b) sphere (c) cylinder (d) ring

4. A solid sphere rolls without slipping on an inclined plane at an angle θ. The ratio of total kinetic energy to its rotational kinetic energy is

MHT CET 2023 · 9 MAY · SHIFT 1

(a) $\frac{7}{2}$ (b) $\frac{5}{2}$ (c) $\frac{7}{3}$ (d) $\frac{5}{4}$

5. A disc of radius 2 m and mass 100 kg rolls on a horizontal floor. Its centre of mass has speed of 20 cm/s. How much work is needed to stop it?

NEET 2019

(a) 1 J (b) 2 J (c) 3 J (d) 30 kJ

6. A solid sphere is in rolling motion. In rolling motion a body possesses translational kinetic energy (Kt) as well as rotational kinetic energy (Kr) simultaneously. The ratio Kt: (Kt + Kr) for the sphere is

NEET 2018

(a) 7: 10 (b) 5: 7 (c) 10: 7 (d) 2: 5

7. A solid spherical ball rolls on a table. Ratio of its rotational kinetic energy to total kinetic energy is

AIPMT 1994

(a) $\frac{1}{2}$ (b) $\frac{1}{6}$ (c) $\frac{7}{10}$ (d) $\frac{2}{7}$

8. If a sphere is rolling, the ratio of the translational energy to total kinetic energy is given by

AIPMT 1991

(a) 7 : 10 (b) 2 : 5 (c) 10 : 7 (d) 5 : 7

9. A solid sphere is rolling without slipping on a horizontal plane. The ratio of the linear kinetic energy of the centre of mass of the sphere and rotational kinetic energy is:

JEE MAIN 2025 · 24 JAN · SHIFT 2

(a) $\frac{3}{4}$ (b) $\frac{4}{3}$ (c) $\frac{5}{2}$ (d) $\frac{2}{5}$

10. A solid spherical ball is rolling on a frictionless horizontal plane surface about its axis of symmetry. The ratio of rotational kinetic energy of the ball to its total kinetic energy is

JEE MAIN 2022 · 26 JUN · SHIFT 2

(a) $\frac{2}{5}$ (b) $\frac{2}{7}$ (c) $\frac{1}{5}$ (d) $\frac{7}{10}$

11. A body rolls down an inclined plane without slipping. The kinetic energy of rotation is 50% of its translational kinetic energy. The body is:

JEE MAIN 2021 · 20 JUL · SHIFT 2

(a) Solid sphere (b) Solid cylinder
(c) Hollow cylinder (d) Ring

12. A uniform sphere of mass 500 g rolls without slipping on a plane horizontal surface with its centre moving at a speed of 5.00 cm/s. Its kinetic energy is:

JEE MAIN 2020 · 8 JAN · SHIFT 2

(a) 8.75 × 10–3 J (b) 1.13 × 10–3 J
(c) 8.75 × 10–4 J (d) 6.25 × 10–4 J

13. A hollow sphere is rolling on a plane surface about its axis of symmetry. The ratio of rotational kinetic energy to its total kinetic energy is $\frac{x}{5}$. The value of x is _____.

JEE MAIN 2024 · 5 APR · SHIFT 2 *(Numerical)*

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14. For a rolling spherical shell, the ratio of rotational kinetic energy and total kinetic energy is $\frac{x}{5}$. The value of x is _____.

JEE MAIN 2023 · 12 APR · SHIFT 1 *(Numerical)*

15. A solid sphere of mass 2 kg is making pure rolling on a horizontal surface with kinetic energy 2240 J. The velocity of centre of mass of the sphere will be _____ ms^{-1}.

JEE MAIN 2023 · 29 JAN · SHIFT 1 *(Numerical)*

◆ Rolling down an incline 16 Qs

16. A solid sphere at rests rolls down an inclined plane of vertical height h without sliding. Its speed on reaching the bottom of plane is (g = acceleration due to gravity)

MHT CET 2025 · 26 APR · SHIFT 2

(a) $\left(\frac{9gh}{11}\right)^{\frac{1}{2}}$ (b) $\left(\frac{10gh}{7}\right)^{\frac{1}{2}}$ (c) $\left(\frac{8gh}{7}\right)^{\frac{1}{2}}$ (d) $\left(\frac{6gh}{7}\right)^{\frac{1}{2}}$

17. A disc of mass ' m ' and radius ' r ' rolls down an inclined plane of height ' h '. When it reaches the bottom of the plane, its rotational kinetic energy is (g = acceleration due to gravity)

MHT CET 2025 · 20 APR · SHIFT 2

(a) $\frac{mgh}{3}$ (b) $\frac{mgh}{6}$ (c) $\frac{mgh}{2}$ (d) $\frac{mgh}{4}$

18. An inclined plane makes an angle 30° with the horizontal. A solid sphere rolling down an inclined plane from rest without slipping has linear acceleration (g = acceleration due gravity) ($\sin 30^\circ = 0.5$)

MHT CET 2025 · 20 APR · SHIFT 1

(a) $\frac{5g}{7}$ (b) $\frac{5g}{14}$ (c) $\frac{2g}{3}$ (d) $\frac{g}{3}$

19. An inclined plane makes an angle 30° with horizontal. A solid sphere rolls down from the top of the inclined plane from rest without slipping has a linear acceleration along the plane equal to (where g is acceleration due to gravity) (given $\sin 30^\circ = 0.5$)

MHT CET 2024 · 11 MAY · SHIFT 1

(a) $\frac{5g}{14}$ (b) $\frac{5g}{4}$ (c) $\frac{2g}{3}$ (d) $\frac{g}{3}$

20. A solid cylinder of mass ' M ' and radius ' R ' rolls down an inclined plane of height ' h '. When it reaches the foot of the plane, its rotational kinetic energy is (g = acceleration due to gravity)

MHT CET 2024 · 4 MAY · SHIFT 2

(a) $\frac{Mgh}{3}$ (b) $\frac{Mgh}{6}$ (c) $\frac{Mgh}{4}$ (d) $\frac{Mgh}{2}$

21. An inclined plane makes an angle of 30° with the horizontal. A solid sphere rolling down this inclined plane from rest without slipping has a linear acceleration (g = acceleration due to gravity, $\sin 30^\circ = 0.5$)

MHT CET 2024 · 2 MAY · SHIFT 2

(a) $\frac{2g}{3}$ (b) $\frac{5g}{14}$ (c) $\frac{g}{3}$ (d) $\frac{5g}{7}$

22. A solid cylinder of radius r and mass M rolls down an inclined plane of height h. When it reaches the bottom of the plane, then its rotational kinetic energy is (g = acceleration due to gravity)

MHT CET 2020 · 16 OCT · SHIFT 1

(a) $\frac{Mgh}{4}$ (b) $\frac{Mgh}{2}$ (c) Mgh (d) $\frac{Mgh}{3}$

23. A solid sphere rolls down from top of inclined plane, 7 m high, without slipping. Its linear speed at the foot of plane is $\left(g = 10\ m/s^2\right)$

MHT CET 2019 · 3 MAY · SHIFT 1

(a) $\sqrt{70}\ m/s$ (b) $\sqrt{\frac{140}{3}}\ m/s$

(c) $\sqrt{\frac{280}{3}}\ m/s$ (d) $\sqrt{100}\ m/s$

24. The ratio of the accelerations for a solid sphere (mass m and radius R) rolling down an incline of angle θ without slipping and slipping down the incline without rolling is

AIPMT 2014

(a) 5: 7 (b) 2: 3 (c) 2: 5 (d) 7: 5

25. A solid cylinder and a hollow cylinder, both of the same mass and same external diameter are released from the same height at the same time on an inclined plane. Both roll down without slipping. Which one will reach the bottom first?

AIPMT 2010 · MAINS

(a) Both together only when angle of inclination of plane is 45°
(b) Both together
(c) Hollow cylinder
(d) Solid cylinder

26. A solid cylinder of mass M and radius R rolls without slipping down an inclined plane of length L and height h. What is the speed of its centre of mass when the cylinder reaches its bottom?

AIPMT 2003

(a) $\sqrt{2gh}$ (b) $\sqrt{\frac{3}{4}gh}$ (c) $\sqrt{\frac{4}{3}gh}$ (d) $\sqrt{4gh}$

27. The speed of a homogenous solid sphere after rolling down an inclined plane of vertical height h form rest without sliding is

AIPMT 1992

(a) $\sqrt{\frac{10}{7}gh}$ (b) $\sqrt{gh}$ (c) $\sqrt{\frac{6}{5}gh}$ (d) $\sqrt{\frac{4}{3}gh}$

28. A solid cylinder of mass M and radius R rolls without slipping down an inclined plane of length L and height h. What is the speed of its centre of mass when the cylinder reaches its bottom?

AIPMT 1989

(a) $\sqrt{2gh}$ (b) $\sqrt{\frac{3}{4}gh}$ (c) $\sqrt{\frac{4}{3}gh}$ (d) $\sqrt{4gh}$

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29. A solid sphere, a hollow sphere and a ring are released from top of an inclined plane (frictionless) so that they slide down the plane. Then maximum acceleration down the plane is for (no rolling)

AIEEE 2002

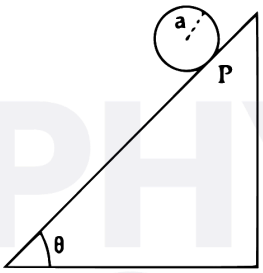
(a) solid sphere (b) hollow sphere
(c) ring (d) all same

30. A cylinder is rolling down on an inclined plane of inclination 60°. Its acceleration during rolling down will be $\frac{x}{\sqrt{3}} m/s^2$, where $x =$ _____ (use $g = 10\ m/s^2$).

JEE MAIN 2024 · 29 JAN · SHIFT 1 *(Numerical)*

31. A solid disc of radius 'a' and mass 'm' rolls down without slipping on an inclined plane making an angle θ with the horizontal. The acceleration of the disc will be $\frac{2}{b}$ g sinθ where b is _____. (Round off to the Nearest Integer) (g = acceleration due to gravity, θ = angle as shown in figure)

JEE MAIN 2021 · 16 MAR · SHIFT 2 *(Numerical)*



◆ Friction, slipping & transition to rolling 1 Q

32. A drum of radius R and mass M, rolls down without slipping along an inclined plane of angle θ. The frictional force

AIPMT 2005

(a) dissipates energy as heat
(b) decreases the rotational motion
(c) decreases the rotational and translation motion
(d) converts translational energy to rotational energy.

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ANSWER KEY

Shaded by level: **Easy**

01 Moment of Inertia & Radius of Gyration

1. (c)	2. (b)	3. (b)	4. (d)	5. (c)	6. (c)	7. (c)	8. (a)	9. (d)	10. (c)
11. 16	12. (b)	13. (c)	14. (d)	15. (b)	16. (b)	17. (c)	18. (d)	19. (d)	20. (d)
21. (b)	22. (a)	23. (b)	24. (b)	25. (c)	26. (c)	27. (b)	28. (d)	29. (c)	30. (c)
31. (a)	32. (b)	33. (d)	34. (a)	35. (b)	36. (c)	37. (c)	38. (a)	39. (b)	40. (a)
41. (b)	42. (d)	43. (c)	44. (d)	45. (d)	46. (c)	47. (a)	48. (d)	49. (b)	50. (c)
51. (d)	52. (a)	53. 3	54. 17	55. (d)	56. (a)				

02 Torque, Couple & Equilibrium of Rigid Bodies

1. (c)	2. (a)	3. (d)	4. (b)	5. (d)	6. (b)	7. (c)	8. (d)	9. (b)	10. (c)
11. (b)	12. (b)	13. (b)	14. (d)	15. 2	16. 195	17. (c)	18. (d)	19. (c)	20. (c)
21. (a)	22. (d)	23. (c)	24. (c)						

03 Rotational Kinematics & Dynamics

1. (a)	2. (c)	3. (a)	4. (c)	5. (b)	6. (b)	7. (a)	8. (b)	9. 200	10. 728
11. (b)	12. (c)	13. (a)	14. (c)	15. (b)	16. (a)	17. (c)	18. 4	19. (a)	20. (b)
21. 15	22. (c)	23. (b)	24. (c)	25. (b)	26. (d)	27. (b)			

04 Angular Momentum & its Conservation

1. (a)	2. (b)	3. (a)	4. (d)	5. (b)	6. (d)	7. (d)	8. (d)	9. (a)	10. (c)
11. (a)	12. (b)	13. (b)	14. (d)	15. (d)	16. (b)	17. (b)			

05 Rotational Kinetic Energy, Work & Power

1. (d)	2. (b)	3. (c)	4. (d)	5. (d)	6. (c)	7. (c)	8. (a)	9. (d)	10. (b)
11. (b)	12. (b)	13. (c)	14. (b)	15. (d)					

06 Rolling Motion

1. (b)	2. (b)	3. (d)	4. (a)	5. (c)	6. (b)	7. (d)	8. (d)	9. (c)	10. (b)
11. (b)	12. (c)	13. 2	14. 2	15. 40	16. (b)	17. (a)	18. (b)	19. (a)	20. (a)
21. (b)	22. (d)	23. (d)	24. (a)	25. (d)	26. (c)	27. (a)	28. (c)	29. (d)	30. 10
31. 3	32. (d)								

Note: *"Bonus" = no option is correct as the question is printed (dropped in the official key). Numerical questions show the numerical answer.*

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