# NDA-CDS 1 2025

# GS

LIVE

# PHYSICS

## ROTATIONAL MOTION

# MCQS


NAVJYOTI SIR

SSBCrack EXAMS

# 31 Jan 2025 Live Classes Schedule

| | | |
|---|---|---|
| 9:00AM | 31 JANUARY 2025 DAILY DEFENCE UPDATES | DIVYANSHU SIR |
| 10:00AM | 31 JANUARY 2025 DAILY CURRENT AFFAIRS | RUBY MA'AM |

## AFCAT 1 2025 LIVE CLASSES

| | | |
|---|---|---|
| 12:30PM | REASONING - SYLLOGISM | RUBY MA'AM |
| 3:00PM | STATIC GK - IMPORTANT INTERNATIONAL GROUPS | DIVYANSHU SIR |
| 4:30PM | ENGLISH - ANTONYMS - CLASS 3 | ANURADHA MA'AM |
| 5:30PM | MATHS - NUMBER SYSTEM - CLASS 2 | NAVJYOTI SIR |

## NDA 1 2025 LIVE CLASSES

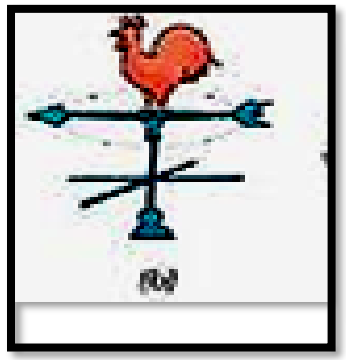
| | | |
|---|---|---|
| 10:00AM | MATHS - VECTOR ALGEBRA | NAVJYOTI SIR |
| 11:30AM | MODERN HISTORY - CLASS 3 | RUBY MA'AM |
| 1:00PM | PHYSICS - ROTATIONAL MOTION | NAVJYOTI SIR |
| 4:30PM | ENGLISH - ANTONYMS - CLASS 3 | ANURADHA MA'AM |

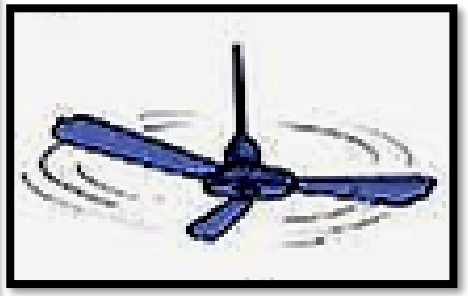
## CDS 1 2025 LIVE CLASSES

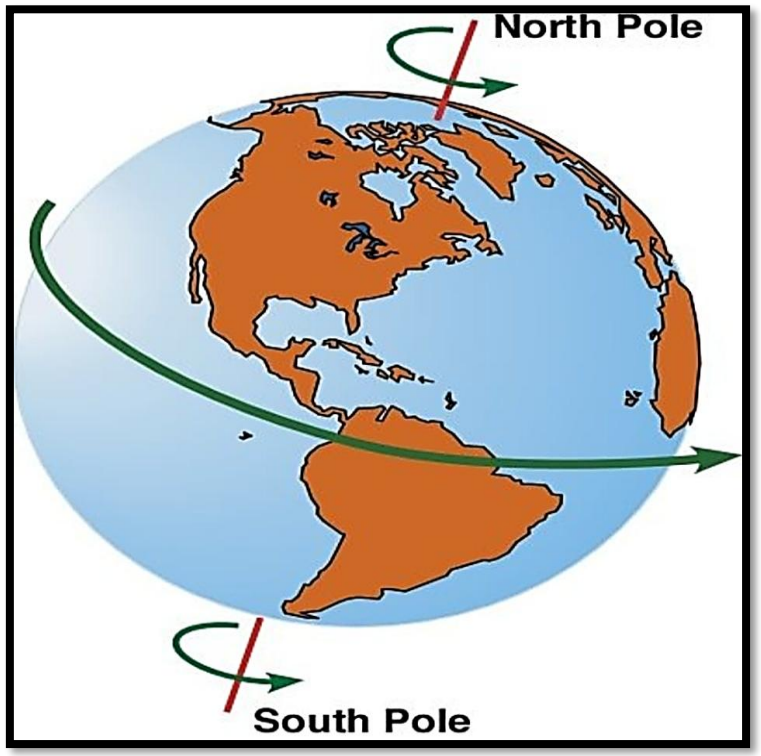
| | | |
|---|---|---|
| 11:30AM | MODERN HISTORY - CLASS 3 | RUBY MA'AM |
| 1:00PM | PHYSICS - ROTATIONAL MOTION | NAVJYOTI SIR |
| 4:30PM | ENGLISH - ANTONYMS - CLASS 3 | ANURADHA MA'AM |
| 5:30PM | MATHS - NUMBER SYSTEM - CLASS 2 | NAVJYOTI SIR |



# SYSTEM OF PARTICLES AND ROTATIONAL MOTION - MCQS








A solid disc and a solid sphere have the same mass and same radius. Which one has the higher moment of inertia about its centre of mass ?

(a) The disc

(b) The sphere

(c) Both have the same moment of inertia

(d) The information provided is not sufficient to answer the question

M – Mass R – Radius,

| disc | sphere |
| --- | --- |
| $\frac{1}{2}MR^2$ | $\frac{2}{5}MR^2$ |
| (0.5) | (0.4) |

$(0.5) > (0.4)$

A solid disc and a solid sphere have the same mass and same radius. Which one has the higher moment of inertia about its centre of mass ?

(a) The disc

(b) The sphere

(c) Both have the same moment of inertia

(d) The information provided is not sufficient to answer the question

**Answer : A**

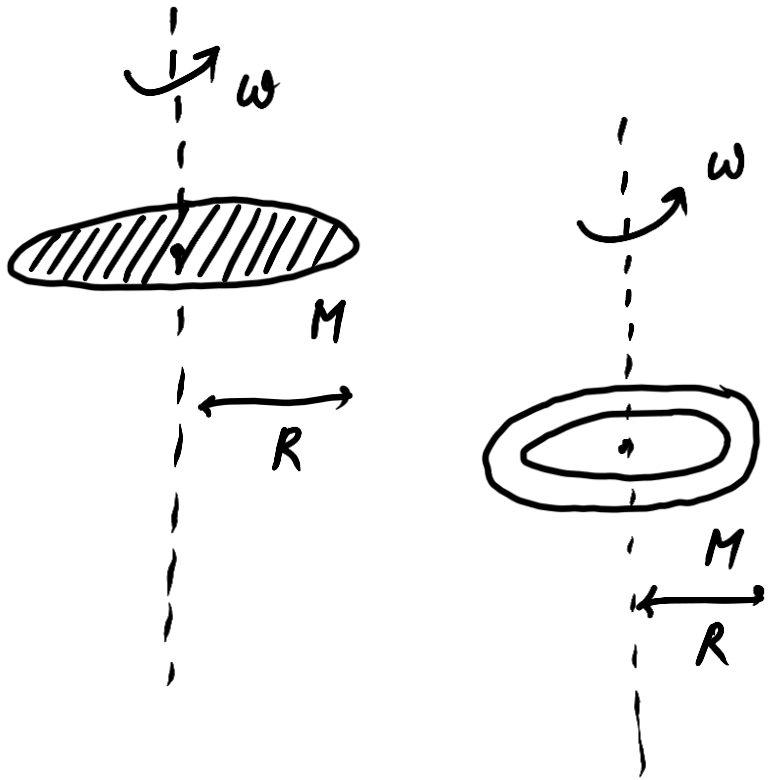
A thin disc and a thin ring, both have mass M and radius R. Both rotate about axes through their center of mass and are perpendicular to their surfaces at the same angular velocity. Which of the following is true ?

(a) The ring has higher kinetic energy

(b) The disc has higher kinetic energy

(c) The ring and the disc have the same kinetic energy

(d) Kinetic energies of both the bodies are zero since they are not in linear motion




(kinetic energy) = (KE)$_{translational}$ + (KE)$_{rotational}$

KE

$= 0 + \frac{1}{2} I\omega^2$

$\frac{1}{2} I\omega^2$

more $I$ ⇒ more kinetic energy

disc

$I = \frac{1}{2} MR^2$

ring

$I = MR^2$

$I_{ring} > I_{disc}$

$(KE)_{ring} > (KE)_{disc}$

A thin disc and a thin ring, both have mass M and radius R. Both rotate about axes through their center of mass and are perpendicular to their surfaces at the same angular velocity. Which of the following is true ?

(a) The ring has higher kinetic energy

(b) The disc has higher kinetic energy

(c) The ring and the disc have the same kinetic energy

(d) Kinetic energies of both the bodies are zero since they are not in linear motion

**Answer : A**

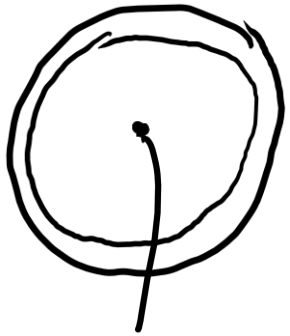
**For which of the following does the centre of mass lie outside the body ?**

(a) A pencil

(b) A shotput

(c) A dice

(d) A bangle



centre of mass – lieing outside

**For which of the following does the centre of mass lie outside the body ?**

(a) A pencil

(b) A shotput

(c) A dice

**(d) A bangle**

**When a torque acting on a system is zero, then which of the following should not change?**

(A) linear velocity

(b) angular momentum

(c) angular displacement

(d) force acting on the body

Force ⟶ momentum

Torque ⟶ angular momentum,

**When a torque acting on a system is zero, then which of the following should not change?**

(A) linear velocity

**(b) angular momentum**

(c) angular displacement

(d) force acting on the body

**Two rings have their moments of inertia in the ratio 2 : 1 and their diameters are in the ratio 2 : 1. The ratio of their masses will be**

(a) 2 : 1

(b) 1 : 2

(c) 1 : 4

(d) 1 : 1

$$\frac{I_1}{I_2} = \frac{2}{1}$$

$$\frac{M_1 R_1^2}{M_2 R_2^2} = \frac{2}{1}$$

$$\frac{M_1}{M_2} = \frac{2}{1}\frac{R_2^2}{R_1^2}$$

$$\frac{M_1}{M_2} = \frac{2}{1}\left(\frac{R_2}{R_1}\right)^2$$

$$= \frac{2}{1}\left(\frac{1}{2}\right)^2$$

$$= \frac{2}{1}\left(\frac{1}{4}\right)$$

$$\frac{M_1}{M_2} = \frac{1}{2} = 1:2$$

$$\frac{2R_1}{2R_2} = \frac{2}{1}$$

$$\frac{R_1}{R_2} = \frac{2}{1}$$

$$\frac{R_2}{R_1} = \frac{1}{2}$$

**Two rings have their moments of inertia in the ratio 2 : 1 and their diameters are in the ratio 2 : 1. The ratio of their masses will be**

(a) 2 : 1

**(b) 1 : 2**

(c) 1 : 4

(d) 1 : 1

**Angular acceleration is produced in a body when a …… acts on it.**

A. Moment of Inertia

B. Velocity

C. Torque

D. None of the Above

**Angular acceleration is produced in a body when a …… acts on it.**

A. Moment of Inertia

B. Velocity

**C. Torque**

D. None of the Above

**The rotational energy of a body with a given angular speed depends on its**

(a) mass only

(b) material only

(c) size only

(d) mass as well as the distribution of its mass about the axis of rotation ✓

Rot. energy $= (KE)_{rot} = \frac{1}{2} I\omega^2$

$I = MR^2$ (M: mass)

**The rotational energy of a body with a given angular speed depends on its**

(a) mass only

(b) material only

(c) size only

**(d) mass as well as the distribution of its mass about the axis of rotation**

**The combination of rotational motion and the translational motion of a rigid body is known as _____.**

A. Frictional motion

B. Axis motion

C. Angular motion

D. Rolling motion

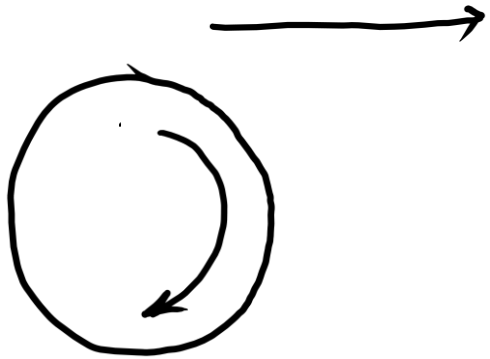
**The combination of rotational motion and the translational motion of a rigid body is known as _____.**

A. Frictional motion

B. Axis motion

C. Angular motion

**D. Rolling motion**



A body in rotational motion possesses rotational kinetic energy given by _____.

a. $KE = \frac{1}{2} I^2 \omega$

b. $KE = \frac{1}{2} I \omega^2$

c. $KE = 2I^2 \omega$

d. $KE = I\omega$

A body in rotational motion possesses rotational kinetic energy given by _____.

a. $KE = \frac{1}{2}I^2\omega$

b. $KE = \frac{1}{2}I\omega^2$

c. $KE = 2I^2\omega$

d. $KE = I\omega$

**Answer: (B)**

**Moment of inertia, of a spinning body about an axis, doesn't depend on which of the following factors?**

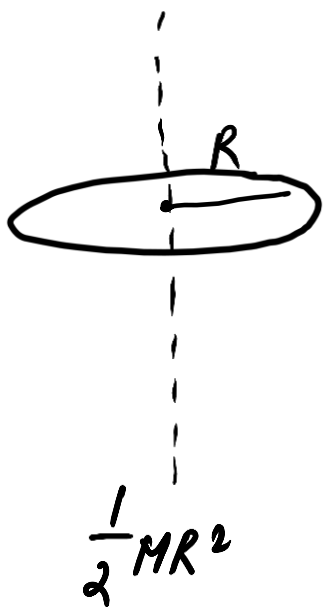
a) Distribution of mass around axis

b) Orientation of axis

c) Mass

d) Angular velocity

$I = MR^2$



**Moment of inertia, of a spinning body about an axis, doesn't depend on which of the following factors?**

a) Distribution of mass around axis

b) Orientation of axis

c) Mass

**d) Angular velocity**

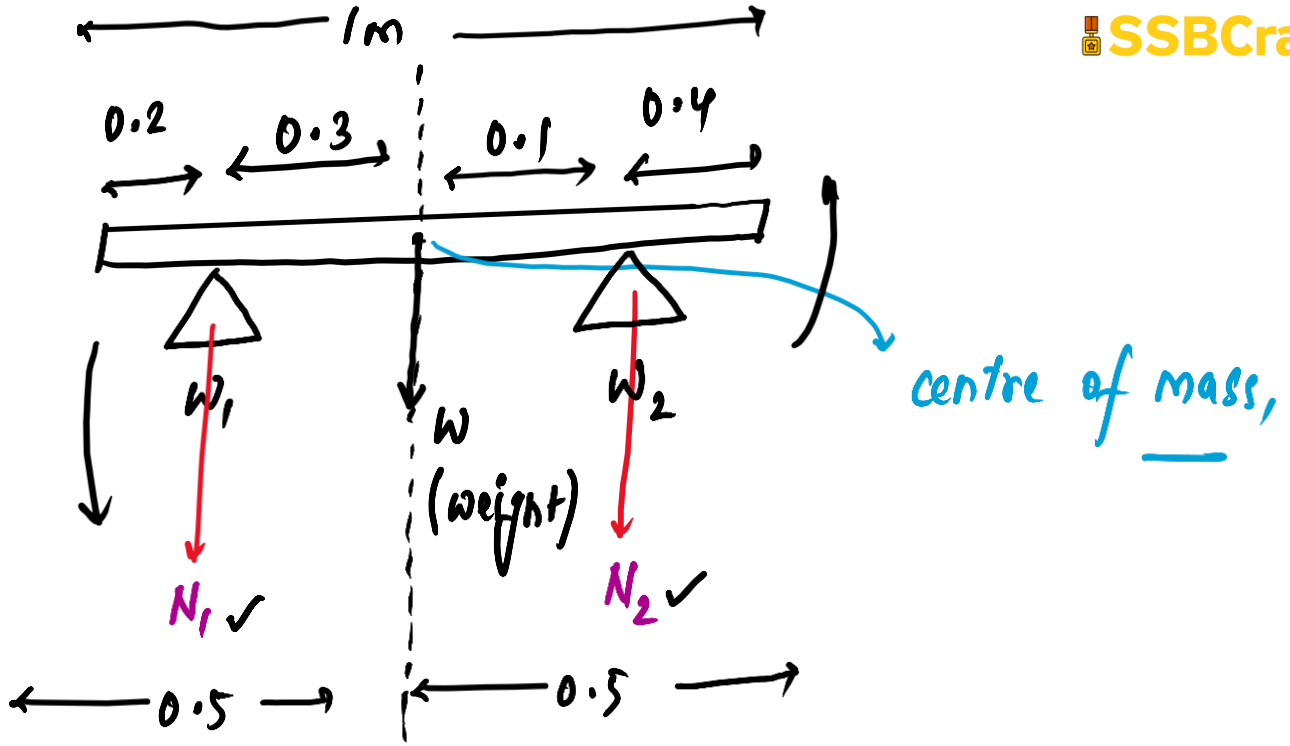
A uniform meter scale of mass 0·24 kg is made of steel. It is kept on two wedges, $W_1$ and $W_2$, in a horizontal position. $W_1$ is at a distance of 0·2 m from one of its ends, while $W_2$ is at distance of 0·4 m from the other end. If the force on the scale is $N_1$ due to $W_1$ and $N_2$ due to $W_2$, then : (take $g = 10{\cdot}0\ m\ s^{-2}$)

(a) $N_1 = 1{\cdot}6$ N and $N_2 = 0{\cdot}8$ N

(b) $N_1 = 0{\cdot}8$ N and $N_2 = 1{\cdot}6$ N

(c) $N_1 = 0{\cdot}6$ N and $N_2 = 1{\cdot}8$ N ✓

(d) $N_1 = 1{\cdot}8$ N and $N_2 = 0{\cdot}6$ N




Torque due to $W_1$ + Torque due to $W_2$ = 0

$(0.3) \times N_1 + (-0.1 \times N_2) = 0$

$3N_1 = N_2$ ✓

$$\begin{cases} N_1 + N_2 = W \\ N_1 + N_2 = (0.24)(10) \\ N_1 + N_2 = 2{\cdot}4 \end{cases}$$

A uniform meter scale of mass 0·24 kg is made of steel. It is kept on two wedges, $W_1$ and $W_2$, in a horizontal position. $W_1$ is at a distance of 0·2 m from one of its ends, while $W_2$ is at distance of 0·4 m from the other end. If the force on the scale is $N_1$ due to $W_1$ and $N_2$ due to $W_2$, then : (take $g = 10{\cdot}0\ m\ s^{-2}$)

(a) $N_1 = 1{\cdot}6$ N and $N_2 = 0{\cdot}8$ N

(b) $N_1 = 0{\cdot}8$ N and $N_2 = 1{\cdot}6$ N

(c) $N_1 = 0{\cdot}6$ N and $N_2 = 1{\cdot}8$ N

(d) $N_1 = 1{\cdot}8$ N and $N_2 = 0{\cdot}6$ N

**Answer: (C)**

A particle performing uniform circular motion has angular momentum $L$. If its angular frequency is doubled and its kinetic energy halved, then the new angular momentum is

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

$$L = I\omega$$

Kinetic energy, $K = \frac{1}{2} I\omega^2$

$$K = \frac{1}{2}(I\omega)\omega$$

$$K = \left(\frac{1}{2} L\omega\right)$$

$$L = \frac{2K}{\omega}$$

$$L' = \frac{2\left(\frac{1}{2}K\right)}{2\omega}$$

$$L' = \frac{2K}{\omega}\left(\frac{\frac{1}{2}}{2}\right)$$

$$= \frac{2K}{\omega}\left(\frac{1}{4}\right) = L\left(\frac{1}{4}\right) = \frac{L}{4}$$

A particle performing uniform circular motion has angular momentum $L$. If its angular frequency is doubled and its kinetic energy halved, then the new angular momentum is

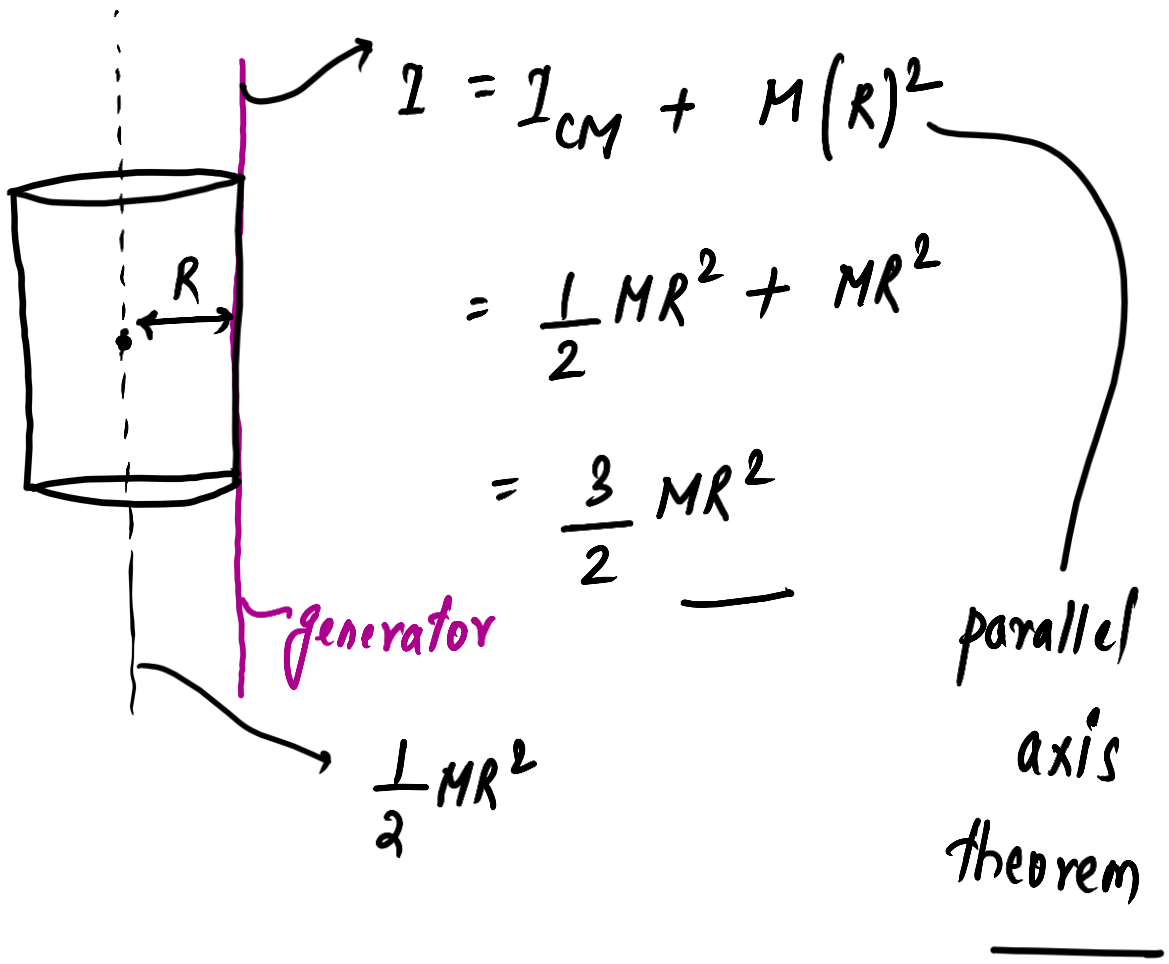
(a) $\frac{L}{4}$ (b) $2L$ (c) $4L$ (d) $\frac{L}{2}$

**Answer: (A)**

A solid cylinder has mass $M$, length $L$ and radius $R$. The moment of inertia of this cylinder about a generator is

(a) $M\left(\frac{L^2}{12}+\frac{R^2}{4}\right)$ (b) $\frac{ML^2}{4}$

(c) $\frac{1}{2}MR^2$ (d) $\frac{3}{2}MR^2$



A solid cylinder has mass $M$, length $L$ and radius $R$. The moment of inertia of this cylinder about a generator is

(a) $M\left(\frac{L^2}{12}+\frac{R^2}{4}\right)$ (b) $\frac{ML^2}{4}$

(c) $\frac{1}{2}MR^2$ (d) $\frac{3}{2}MR^2$

**Answer: (D)**

A wheel of mass 10 kg has a moment of inertia of 160 kg-m$^2$ about its own axis, the radius of gyration will be

(a) 10 m (b) 8 m (c) 6 m (d) 4 m

$I = MR^2$ → radius of gyration,

$$R^2 = \frac{I}{M} = \frac{160\ kg.m^2}{10\ kg} = 16\ m^2$$

$R = 4\ m$

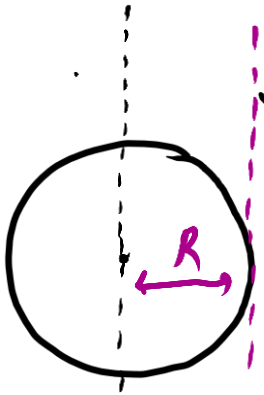
A wheel of mass 10 kg has a moment of inertia of 160 kg-$m^2$ about its own axis, the radius of gyration will be

(a) 10 m (b) 8 m (c) 6 m (d) 4 m

**Answer: (D)**

A sphere of mass 10kg and radius 0.5 m rotates about a tangent. The moment of inertia of the solid sphere is

(a) 5 kg-m$^2$ (b) 2.7 kg-m$^2$
(c) 3.5 kg-m$^2$ (d) 4.5 kg-m$^2$




parallel axis theorem,

$I = \frac{2}{5}MR^2 + M(R)^2$

$= \frac{7}{5}MR^2$

$\frac{7}{5} \times (10) \times (0.5)^2$

$14 \times 0.5 \times 0.5$

$7 \times 0.5 = 3.5 \text{ kg m}^2$

$I_{CM} = \frac{2}{5}MR^2$

A sphere of mass 10kg and radius 0.5 m rotates about a tangent. The moment of inertia of the solid sphere is

(a) 5 kg-$m^2$
(b) 2.7 kg-$m^2$
(c) 3.5 kg-$m^2$
(d) 4.5 kg-$m^2$

**Answer: (C)**

Three masses are placed on the $X$-axis, 300 g at origin, 500 g at $x = 40$ cm and 400 g at $x = 70$ cm. The distance of mass from the origin is

centre of mass (CM)

(a) 40 cm (b) 45 cm (c) 50 cm (d) 30 cm

$$r_{CM} = \frac{m_1 r_1 + m_2 r_2 + m_3 r_3}{m_1 + m_2 + m_3} = \frac{\sum_{i=1}^{n} m_i r_i}{\sum_{i=1}^{n} m_i}$$

$$= \frac{300(0) + 500(40) + 400(70)}{300 + 500 + 400} = \frac{0 + 20000 + 28000}{1200} = \frac{48000}{1200} = 40\,\text{cm}$$

Three masses are placed on the $X$-axis, 300 g at origin, 500 g at $x = 40$ cm and 400 g at $x = 70$ cm. The distance of mass from the origin is

(a) 40 cm (b) 45 cm (c) 50 cm (d) 30 cm

**Answer: (A)**

# NDA-CDS 1 2025

# GS

LIVE

# PHYSICS

## GRAVITATION & HYDROSTATICS

# MCQS


NAVJYOTI SIR

SSBCrack EXAMS