PHYSICS

BOOKS - MTG PHYSICS (ENGLISH)

SYSTEM OF PARTICLES AND ROTATIONAL MOTIONS

Introduction

1. In a spinning top, axis moves around the vertical through its point of contact with the

ground sweeping out a cone. This movement of the axis of the top around the vertical is known as

A. a. rotation

B. b. translation

C. c. precession

D. d. rolling

Answer: c

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Centre Of Mass

1. The centre of mass of a body

A. lies always at the geometrical centre

B. lies always inside the body

C. lies always outside the body

D. may lie within or outside the body

Answer: d

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2. The position of the centre of mass of a cube of uniform mass density will be at

A. the centre of one face

B. the centre of the interaction of diagonals of one face.

C. the geometric centre of the cube

D. the edge of a cube

Answer: c

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3. The reduce mass of two particles having masses m and 2 m is

A. 2 m

B. 3 m

C. 2 m/3

D. m/2

Answer: c

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4. Three particles of masses $1kg, \frac{3}{2}kg,$ and $2kg$ are located the vertices of an equilateral triangle of side a. The x, y coordinates of the centre of mass are.

A. a. $\frac{5a}{9}, \frac{2a}{3\sqrt{3}}$

B. b. $\frac{2a}{3\sqrt{3}}, \frac{5a}{9}$

C. c. $\frac{5a}{9}, \frac{2a}{\sqrt{3}}$

D. d. $\frac{2a}{\sqrt{3}}, \frac{5a}{9}$

Answer: a

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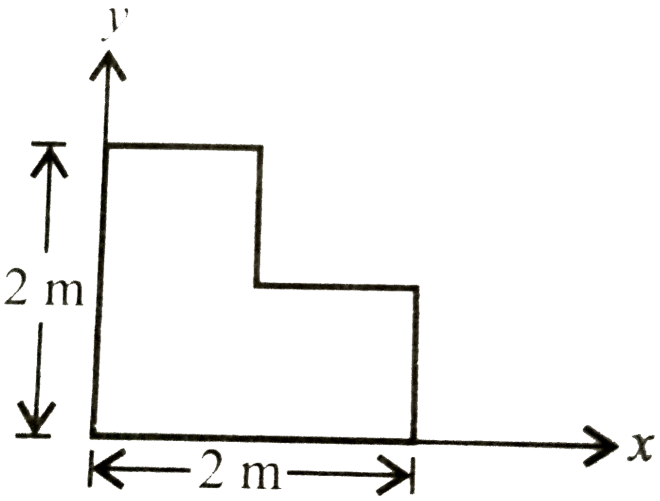
5. The x, y coordinates of the centre of mass of a uniform L-shaped lamina of mass 3 kg is



A. (5/6 m, 5/6 m)

B. (1 m, 1 m)

C. (6/5 m, 6/5 m)

D. (2 m, 2m)

Answer: a

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6. The centre of mass of a system of two particle of masses m_1 and m_2 is at a distance d_1 from mass m_1 and at a distance d_2 from mass m_2 such that.

A. $\frac{d_1}{d_2} = \frac{m_2}{m_1}$

B. $\frac{d_1}{d_2} = \frac{m_1}{m_2}$

C. $\frac{d_1}{d_2} = \frac{m_1}{m_1} + m_2$

D. $\frac{d_1}{d_2} = \frac{m_2}{m_1} + m_2$

Answer: a

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7. Centre of mass of three particles of masses $1kg, 2kg$ and $3kg$ lies at the point $(1, 2, 3)$ and centre of mass of another system of

particles $3kg$ and $2kg$ lies at the point $(-1, 3, -2)$. Where should we put a particle of mass $5kg$ so that the centre of mass of entire system lies at the centre of mass of first system ?

A. (0, 0, 0)

B. (1, 3, 2)

C. (-1, 2, 3)

D. (3, 1, 8)

Answer: d

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8. Two particles of masses 1 kg and 3 kg have position vectors $2\hat{i} + 3\hat{j} + 4\hat{k}$ and $-2\hat{i} + 3\hat{j} - 4\hat{k}$ respectively. The centre of mass has a position vector

A. $\hat{i} + 3\hat{j} - 2\hat{k}$

B. $-\hat{i} - 3\hat{j} - 2\hat{k}$

C. $-\hat{i} + 3\hat{j} + 2\hat{k}$

D. $-\hat{i} + 3\hat{j} - 2\hat{k}$

Answer: d

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Motion Of Centre Of Mass

1. When an expolsive shell travelling in a parabolic path under the effect of gravity explodes in the mid air, the centre of mass of the fragments will move.

A. a.vertically downwards

B. b.along the original parabolic path

C. c. vertically upwards and then vertically downwards

D. d. horizontallly followed by parabolic path

Answer: b

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2. The velocity of centre of mass of the system remains constant, if the total external force acting on the system is.

A. a. minimum

B. b. maximum

C. c. unity

D. d. zero

Answer: d

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3. Two particles of equal mass have velocities $v1 = 2ims^{-1}$ and $v2 = 2jms^{-1}$ First particle has an acceleration $a = (3i + 3j)ms^{-2}$ while the acceleration of the other particle is zero. The centre of mass of the two particles moves in a path of

A. a.straight line

B. b.parabola

C. c.circle

D. d.ellipse

Answer: a

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4. A child is standing at one end of a long trolley moving with a speed v on a smooth horizontal track. If the child starts running towards the other end of the trolley with a speed u, the centre of mass of the system (trolley + child) will move with a speed :

A. a. zero

B. b. (v + u)

C. c. (v - u)

D. d. v

Answer: d

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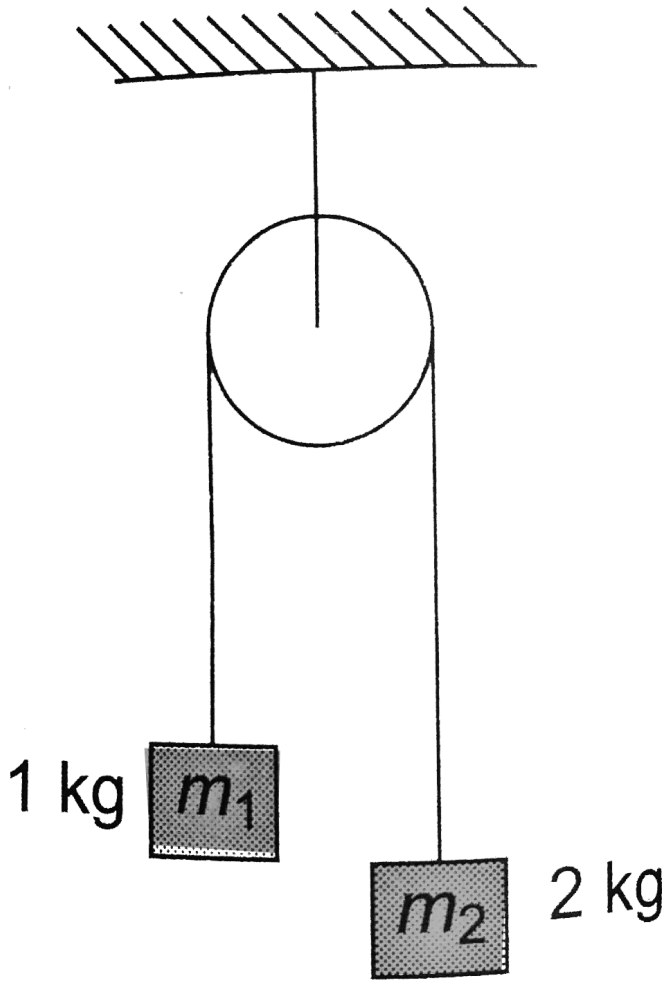
5. Two masses $m_1 = 1kg$ and $m_2 = 2kg$ are connected by a light inextensible string and suspended by means of a weightness pulley as shown in the figure. Assuming that both the

masses start from rest, the distance travelled by the centre of mass in two seconds is $(Takeg = 10ms^{-2}$.



A. a. 20/9 m

B. b. 40/9 m

C. c. 2/3 m

D. d. 1/3 m

Answer: a

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6. The correct relation between linear velocity $\vec{v}$ and angular velocity $\vec{\omega}$ of a particle is

A. $\vec{v} = \vec{r} \times \vec{\omega}$

B. $\vec{v} = \vec{\omega} \times \vec{r}$

C. $\vec{\omega} = \vec{r} \times \vec{v}$

D. $\vec{\omega} = \vec{v} \times \vec{r}$

Answer: b

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7. The direction of the angular velocity vector is along

A. the tangent to the circular path

B. the inward radius

C. the outward radius

D. the axis of rotation

Answer: d

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8. Which of the following statements is correct?

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9. What is the value of linear velocity, if $\vec{\omega} = 3\hat{i} - 4\hat{j} + \hat{k}$ and $\vec{r} = 5\hat{i} - 6\hat{j} + 6\hat{k}$?

A. $6\hat{i} + 2\hat{j} - 3\hat{k}$

B. $18\hat{i} + 3\hat{j} - 2\hat{k}$

C. $-18\hat{i} - 13\hat{j} + 2\hat{k}$

D. $6\hat{i} - 2\hat{j} + 8\hat{k}$

Answer: c

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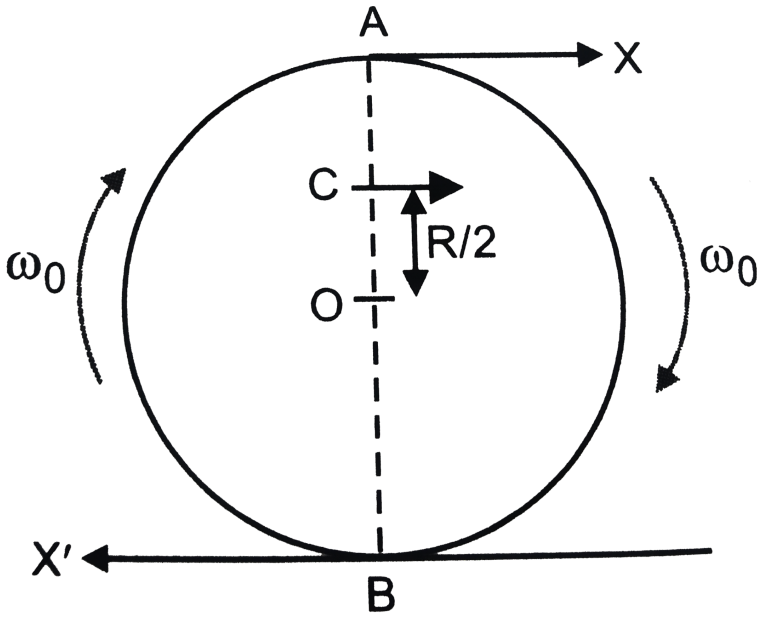
10. A disc rotating about its axis with angular speed ω_0 is placed lightly (without any translational pull) on a perfectly frictionless table. The radius of the disc is R. What are the linear velocities of the points A, B and C on the disc shown in Fig. Will the disc roll in the

direction indicated ?



A. $v_A > v_B > v_C$

B. $v_A < v_B < v_C$

C. $v_A = v_B < v_C$

D. $v_A = v_B > v_C$

Answer: d

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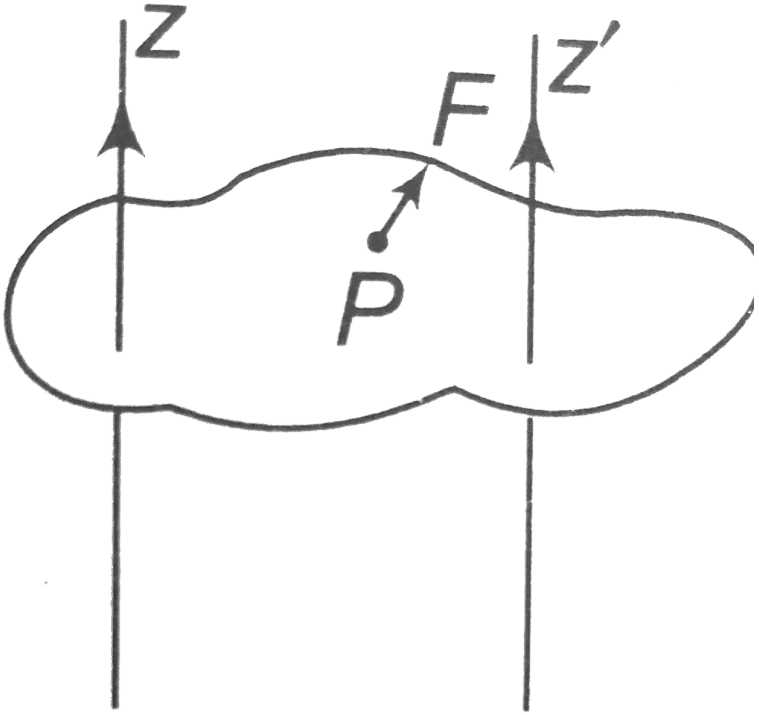
Torque And Angular Momentum

1. Figure shows a lamina in $x - y$ plane. Two axes z and z' pass perpendicular to its plane. A force F acts in the plane of lamina at point P as shown. Which of the following statements is incorrect ?

(The point P is closer to z'-axis than the z-

axis).



A. Torque τ caused by F about z axis is along $\hat{k}$.

B. Torque τ' caused by F about z' axis is along $-\hat{k}$.

C. Torque caused by F about z axis is greater in magnitude than that about z' axis.

D. Total torque is given by $\tau = \tau + \tau'$.

Answer: d

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2. When a torque acting upon a system is zero, which of the following will be constant ?

A. Force

B. Linear impulse

C. Linear momentum

D. Angular momentum

Answer: d

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3. Let $\vec{F}$ be a force acting on a particle having positon vector $\vec{r}$. $Let \vec{\tau}$ be the torque of this force about the origin then

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 $\vec{F} . \vec{\tau} = 0$

Answer: b

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

A. constant torque

B. constant force

C. constant linear momentum

D. zero torque

Answer: d

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

A. $2\hat{i}+12\hat{j}+10\hat{k}$

B. $2\hat{i}+10\hat{j}+12\hat{k}$

C. $2\hat{i}+10\hat{j}+10\hat{k}$

D. $10\hat{i}+2\hat{j}+\hat{k}$

Answer: a

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6. A disc is rotating with angular velocity ω. A force F acts at a point whose position vector with respect to the axis of rotation is r. The power associated with torque due to the force is given by

A. $\left(\overrightarrow{r} \times \overrightarrow{F}\right) . \overrightarrow{\omega}$

B. $\left(\overrightarrow{r} \times \overrightarrow{F}\right) \times \overrightarrow{\omega}$

C. $\overrightarrow{r} . \left(\overrightarrow{F} \times \overrightarrow{\omega}\right)$

D. $\overrightarrow{r} \times \left(\overrightarrow{F} . \overrightarrow{\omega}\right)$

Answer: a

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7. A mass M moving with a constant velocity parallel to the X-axis. Its angular momentum with respect to the origin

A. a. is zero

B. b. remains constant

C. c. goes on increasing

D. d. goes on decreasing

Answer: b

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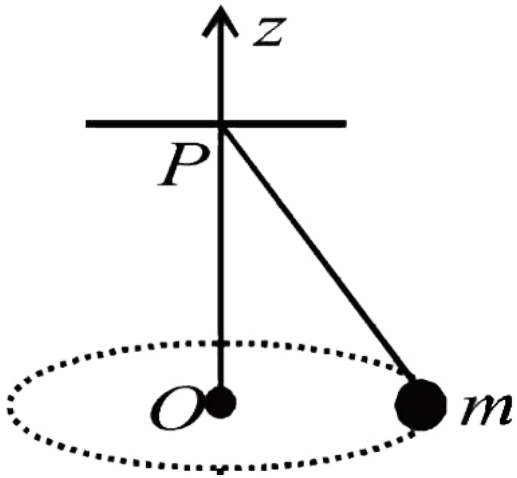
8. A small mass m is attached to a massless string whose other end is fixed at P as shown in the figure. The mass is undergoing circular motion in the x-y plane with centre at O and constant angular speed ω. If the angular momentum of the system. calculated about O and P are denoted. by $\vec{L}_O$ and $\vec{L}_P$

respectively, then.



A. $\overrightarrow{L}_O$ and $\overrightarrow{L}_P$ do not vary with time.

B. $\overrightarrow{L}_O$ varies with time while $\overrightarrow{L}_P$ remains constant

C. $\overrightarrow{L}_O$ remains constant while $\overrightarrow{L}_P$ varies with time

D. $\vec{L}_O$ and $\vec{L}_P$ both vary with time

Answer: c

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9. The position of a particle is given by $\vec{r} = \left(\hat{i} + 2\hat{j} - \hat{k}\right)$ and momentum $\vec{p} = \left(3\hat{i} + 4\hat{j} - 2\hat{k}\right)$. The angular momentum is perpendicular to the

A. x-axis

B. y-axis

C. z-axis

D. yz-plane

Answer: a

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10. The z component of the angular momentum of a particle whose position vector is

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11. Consider a particle of mass m having linear momentum $\vec{p}$ at position $\vec{r}$ relative to the origin O. Let $\vec{L}$ be the angular momentum of the particle with respect to the origin. Which of the following equations correctly relate(s) $\vec{r}$, $\vec{p}$ and $\vec{L}$?

A. $\frac{d\vec{L}}{dt} + \vec{r} \times \frac{d\vec{p}}{dt} = 0$

B. $\frac{d\vec{L}}{dt} + \frac{d\vec{r}}{dt} \times \vec{p} = 0$

C. $\frac{d\vec{L}}{dt} - \frac{d\vec{r}}{dt} \times \vec{p} = 0$

D. $\frac{d\vec{L}}{dt} - \vec{r} \times \frac{d\vec{p}}{dt} = 0$

Answer: d

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Equilibrium Of A Rigid Body

1. A rigid body is said to be in partial equilibrium, when it is in

A. a. translational equilibrium only

B. b. rotational equilibrium only

C. c. either (a) or (b)

D. d. neither (a) nor (b)

Answer: C

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2. Moment of couple is called

A. angular momentum

B. force

C. torque

D. impulse

Answer: C

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3. A couple produces: a) purely translational motion b) purely rotational motion c) both translational and rotational motion d) no motion

A. purely translational motion

B. purely rotational motion

C. both translational and rotational motion

D. no motion

Answer: B

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4. Which of the following statements is incorrect?

A. A pair of equal and opposite forces with different lines of action is known as couple.

B. A couple produces rotation without translation.

C. When we open the lid of a bottle by turning it, our fingers apply a couple to the lid.

D. Moment of a couple depends on the point about which we take the moment.

Answer: d

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5. Which of the following relations is correct?

A. Mechanical advantage = Effort/Load

B. Load arm $\times$ Effort = Effort arm $\times$ Load

C. Load arm $\times$ Load = Effort arm $\times$ Effort

D. None of these

Answer: c

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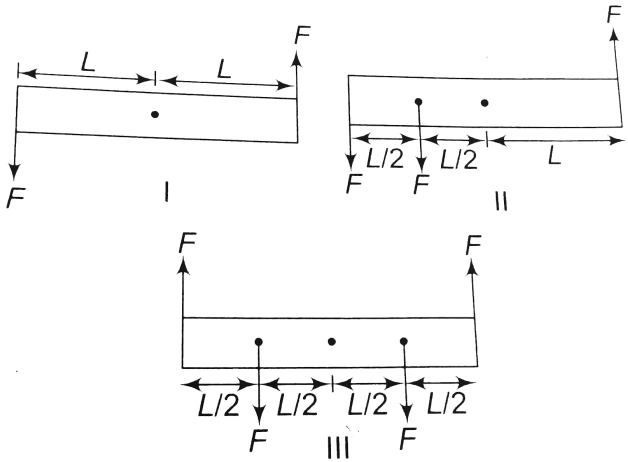
6. A rigid rod of length $2L$ is acted upon by some forces. All forces labelled F have the same magnitude. Which cases have a non-zero net torque acting on the rod about its centre ?



A. I and II only

B. II and III only

C. I and III only

D. The net torque is zero in all cases.

Answer: a

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7. (1) Centre of gravity (C.G.) of a body is the point at which the weight of the body acts,

(2) Centre of mass coincides with the centre of

gravity if the earth is assumed to have infinitely large radius,

(3) To evaluate the gravitational field intensity due to any body at an external point, the entire mass of the body can be considered to be concentrated at its C.G..,

(4) The radius of gyration of any body rotating about an axis is the length of the perpendicular dropped from the C.G. of the body to the axis. which one of the following pairs of statements is correct ?

A. (1) and (4)

B. (1) and (2)

C. (1) and (3)

D. (3) and (4)

Answer: a

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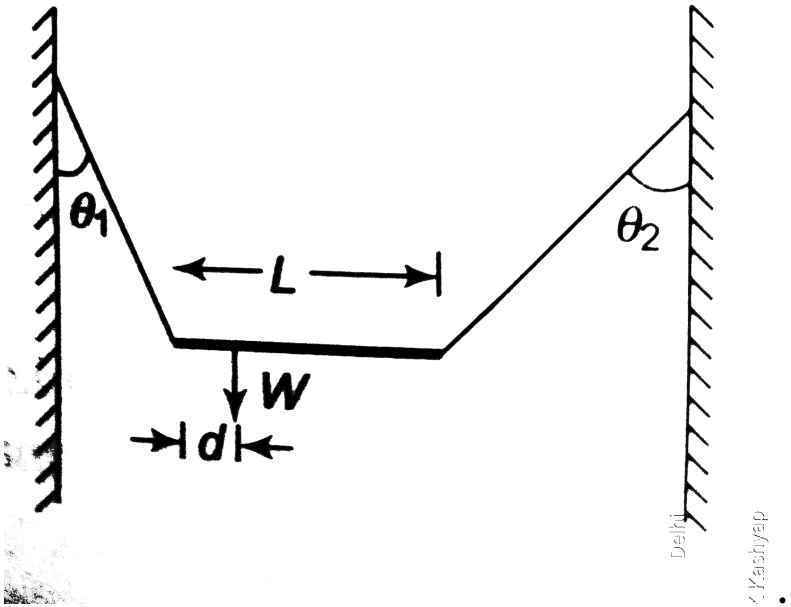
8. A non-uniform bar of weight W and weight L is suspended by two strings of neigligible weight as shown in figure. The angles made by the strings with the vertical are θ_1 and θ_2

respectively.

The distance d of the centre of gravity of the bar from left end is.



A. $L\left(\tan\theta_1 + \frac{\tan\theta_2}{\tan\theta_1}\right)$

B. $L\left(\frac{\tan\theta_1}{\tan\theta_1 +}\tan\theta_2\right)$

C. $L\left(\frac{\tan\theta_2}{\tan\theta_1 +}\tan\theta_2\right)$

D. $L\left(\tan\theta_1 + \frac{\tan\theta_2}{\tan\theta_2}\right)$

Answer: b

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9. A uniform rod of length $1m$ mass $4kg$ is supports on tow knife-edges placed$10cm$ from each end. A $60N$ weight is suspended at $30cm$ from one end. The reactions at the knife edges is.

A. a. 60 N, 40 N

B. b. 75 N, 25 N

C. c. 65 N, 35 N

D. d. 55 N, 45 N

Answer: c

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10. A car weighs $1800kg$. The distance between its front and back axles is $1.8m$. Its centre of gravity is $1.05m$ behind the front axle. Determine the force exerted by the level

ground on each front wheel and each back wheel.

A. 4000 N on each front wheel, 5000 N on each back wheel

B. 5000 N on each front wheel, 4000 N an each back wheel

C. 4500 N on each wheel, 4500 N on each back wheel

D. 3000 N on each front wheel, 6000 N on each back wheel

Answer: a

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11. A $3m$ along ladder weighing $20kg$ leans on a frictionless wall. Its feet rest on the floor $1m$ from the wall. Find the rection forces of the wall and the floor.

A. $25\sqrt{2}$ N, 203 N

B. $50\sqrt{2}$ N, 230 N

C. 203 N, $25\sqrt{2}$ N

D. $230N$, $50\sqrt{2}$ N

Answer: a

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12. A metre stick is balanced on a knife edge at its centre. When two coins, each of mass 5 g are put one on top of the other at the 12.0 cm mark, the stick is found to be balanced at 45.0 cm. What is the mass of the metre stick?

A. 56 g

B. 66 g

C. 76 g

D. 86 g

Answer: b

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13. A uniform cube of mass m and side a is placed on a frictionless horizontal surface. A vertical force F is applied to the edge as shown in Fig. Match the following (most

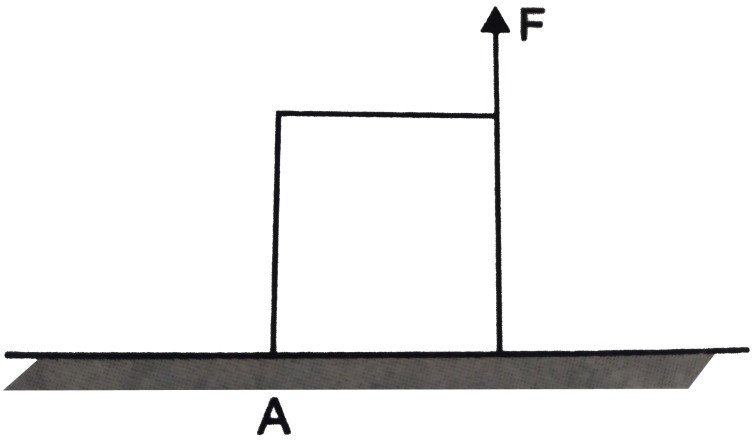
appropriate choice) :

(a)$mg/4 < F < mg/2$ (i) Cube will move up.

(b) $F > mg/2$ (ii) Cube will not exhibit motion.

(c) $F > mg$ (iii) Cube will begin to rotate and slip at A.

(d) $F = mg/4$ (iv) Normal reaction effectively at $a/3$ from A, no motion.



A. A-p, B-q, C-s, D-r

B. A-r, B-s, C-q, D-p

C. A-q, B-r, C-p, D-s

D. A-s, B-p, C-r, D-q

Answer: c

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Moment Of Inertia

1. Analogue of mass in rotational motion is.

A. moment of inertia

B. torque

C. radius of gyration

D. angular momentum

Answer: A

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2. Moment of inertia of body depends upon

A. mass of the body

B. axis of rotation of the body

C. shape and size of the body

D. all of these

Answer: D

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3. Which of the following has the highest moment of inertia when each of them has the same mass and the same radius ? a) A ring about any of its diameter. b) A disc about any of its diameter. c) A hollow sphere about any of its diameter. d) A solid sphere about any of its diameter

A. A ring about any of its diameter.

B. A disc about any of its diameter.

C. A hollow sphere about any of its diameter.

D. A solid sphere about any of its diameter.

Answer: C

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4. A person is standing on a rotating table with metal spheres in his hands. If he withdraws his hands to his chest, then the effect on his angular velocity will be. a)

increase b) decrease c) remain same d) can't say

A. increase

B. decrease

C. remain same

D. can't say

Answer: a

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5. A solid cylinder of mass M and radius R rotates about its axis with angular speed ω. Its rotational kinetic energy is

A. $\frac{1}{2}MR^2\omega^2$

B. $MR^2\omega^2$

C. $\frac{1}{4}MR^2\omega^2$

D. $\frac{1}{8}MR^2\omega^2$

Answer: C

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6. Match the Column I and Column II.,B

Column I		Column II	
(A)	For translational equilibrium	(p)	Mk^2
(B)	For rotational equilibrium	(q)	Angular acceleration
(C)	Moment of inertia of a body	(r)	$\sum \vec{F} = 0$
(D)	Torque is required to produce	(s)	$\sum \vec{\tau} = 0$

A. A-p, B-q, C-r, D-s

B. A-q, B-r, C-s. D-p

C. A-r, B-q, C-p, D-p

D. A-r, B-s, C-p, D-q

Answer: d

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7. The radius of gyration of an uniform rod of length l about an axis passing through one of its ends and perpendicular to its length is.

A. $\frac{l}{\sqrt{2}}$

B. $\frac{l}{3}$

C. $\frac{l}{\sqrt{3}}$

D. $\frac{l}{2}$

Answer: c

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Theorems Of Perpendicular And Parallel Axes

1. Two masses each of mass M are attached to the end of a rigid massless rod of length L. The moment of interia of the system about an axis passing centre of mass and perpendicular to its length is.

A. $ML^2/4$

B. $ML^2/2$

C. ML^2

D. $2ML^2$

Answer: B

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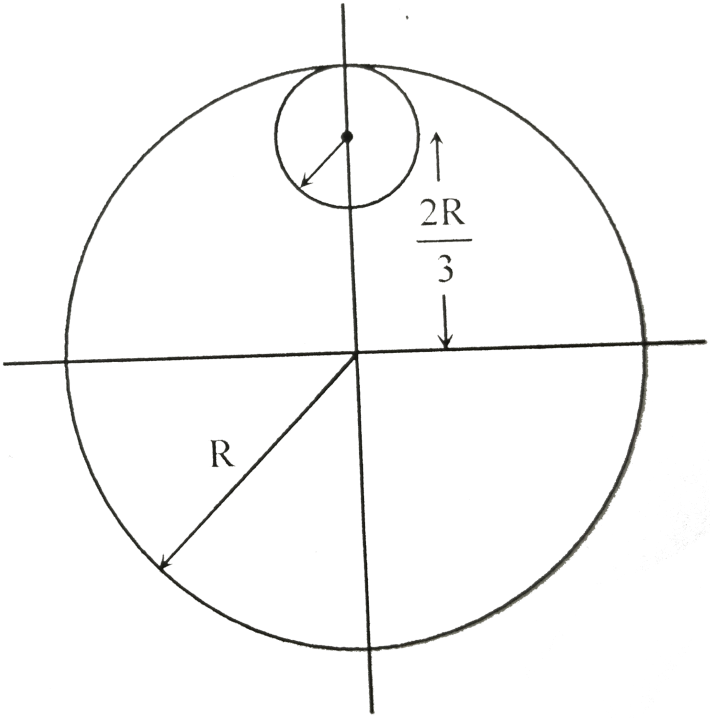
2. From a uniform circular disc of radius R and mass 9M, a small disc of radius $\frac{R}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and

passing through centre of disc is :



A. $4MR^2$

B. $\frac{40}{9}MR^2$

C. $40MR^2$

D. $\frac{37}{9}MR^2$

Answer: A

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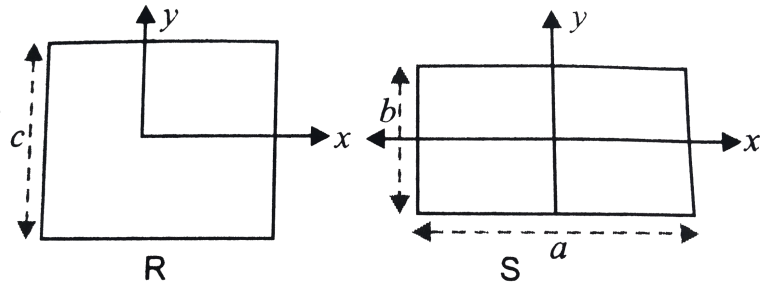
3. A uniform square plate $S(sidec)$ and a unifrom rectangular plate $R(sideb, a)$ have identical areas and mass [Fig.]

Show that

(i) $I_{xR}/I_{xS} < 1$, (ii) $I_{yR}/I_{yS} > 1$, (iii)

$I_{zR} / I_{zS} > 1.$



A. (i) only

B. (ii) only

C. Both (i) and (ii)

D. Neither (i) nor (ii)

Answer: c

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4. Find the moment of inertia of a sphere about a tangent to the sphere, while the mass of the sphere is M and the radius of the sphere is R.

A. $\frac{2}{5}MR^2$

B. $\frac{6}{5}MR^2$

C. $\frac{4}{5}MR^2$

D. $\frac{7}{5}MR^2$

Answer: D

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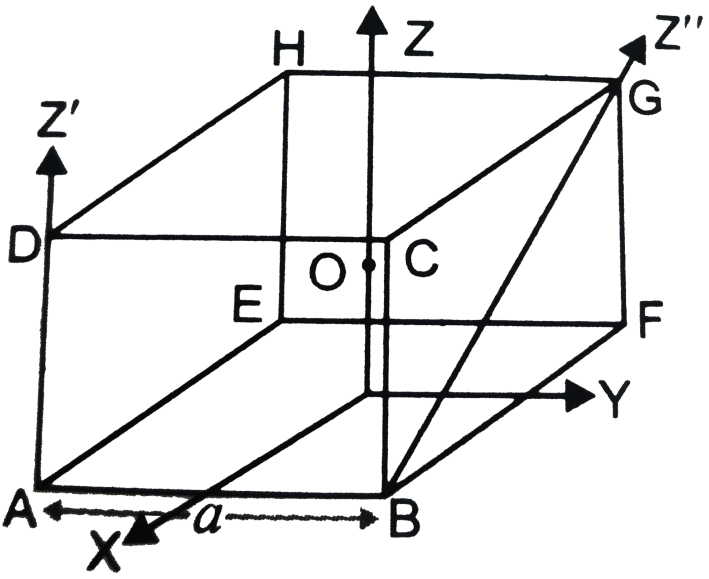
5. With reference to Fig. of a cube of edge a and mass m, state whether the following are true or false. (O is the centre of the cube.)



A. The moment of inertia of cube about z'

is $I_z' = I_z + \frac{ma^2}{2}$

B. The moment of inertia of cube about z''

is $I_z'' = I_z + \frac{ma^2}{2}$

C. $I_x = I_y$

D. None of these

Answer: b

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Kenematics Of Rotational Motion About A Fixed Axis

1. An athlete throws a discus from rest to a final angular velocity of $15rads^{-1}$ in $0.270s$ before releasing it. During acceleration, discuss moves a circular arc of radius $0.810m$. Acceleration of discus before it is released is.

A. $45ms^{-2}$

B. $182ms^{-2}$

C. $187ms^{-2}$

D. $192ms^{-2}$

Answer: a

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2. A flywheel rotating at 420 rpm slows down at a constant rate of $2radds^{-2}$. The time required to stop the flywheel is:

A. 22 s

B. 11 s

C. 44 s

D. 12 s

Answer: A

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3. The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds. The angular acceleration of the motor wheel is a) 2 π rads−2 b) 4 π rads−2 c) 6 π rads−2 d) 8 π rads−2

A. $2\pi rads^{-2}$

B. $4\pi rads^{-2}$

C. $6\pi rads^{-2}$

D. $8\pi rads^{-2}$

Answer: B

Watch Video Solution

Dynamics Of Rotational Motion About A Fixed Axis

1. An automobile engine develops 100 kilo $-$ watt, when rotating at a speed of $1800 rev / \min$. Find the torque developed by it.

A. $\frac{10^2}{6}\pi$ N m

B. $\frac{10^4}{6}\pi$ N m

C. $\frac{10^6}{6}\pi$ N m

D. $\frac{10^8}{6}\pi$ N m

Answer: b

Watch Video Solution

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2. A grindstone of moment of inertia $6kgm^2$ is found to have a speed of 150 rpm, $10\,\text{sec}$. After starting from rest. Torque applied is

A. 3π N m

B. 3 N

C. $\frac{\pi}{3}$ N m

D. 4π N m

Answer: a

Watch Video Solution

3. The instantaneous angular position of a point on a rotating wheel is given by the equation

$\theta(t) = 2t^3 - 6t^2$

The torque on the wheel becomes zero at a) t = 1 s b) t = 0.5 s c) t = 0.25 s d) t = 2 s

A. t = 1 s

B. t = 0.5 s

C. t = 0.25 s

D. t = 2 s

Answer: a

Watch Video Solution

4. A rope is wound round a hollow cylinder of mass $3kg$ and $radius 40cm$. If the rope is pulled with a force of $30N$, what is the angualr acceleration of the cylinder ?

A. $15rads^{-2}$

B. $20 rads^{-2}$

C. $25 rads^{-2}$

D. $30 rads^{-2}$

Answer: c

Watch Video Solution

5. In the question number 62, the linear acceleration of the rope is

A. $5 ms^{-2}$

B. $10ms^{-2}$

C. $15ms^{-2}$

D. $20ms^{-2}$

Answer: b

View Text Solution

6. A hollow cylinder of mass M and radius R is rotating about its axis of symmetry and a solid sphere of same mass and radius is rotating about an axis passing through its centre. It

torques of equal magnitude are applied to them, then the ratio of angular accelerations produced is a) 2/5 b) 5/2 c) 5/4 d) 4/5

A. 43587

B. 43501

C. 43560

D. 43589

Answer: a

Watch Video Solution

7. Too maintain a rotor at a uniform angular speed of $100 rads^{-1}$, an engine needs to transmit torque of 100 N m. The power of the engine is a) 10 kW b) 100 kW c)10 MW d) 100 MW

A. 10 kW

B. 100 kW

C. 10 MW

D. 100 MW

Answer: a

Watch Video Solution

8. A cord of negligible mass is wound round the rin of a flywheel of mass 20 kg and radius 20 cm. A steady pull of 25 N is applied on the cord. The work done by the pull when 2 m of the cord is unwound is a) 20 J b) 25 J c) 45 J d) 50 J

A. 20 J

B. 25 J

C. 45 J

D. 50 J

Answer: d

Watch Video Solution

9. In the question number 66, if wheel starts from rest, what is the kinetic energy of the wheel when 2 m of the cord is unwound?

A. 20 J

B. 25 J

C. 45 J

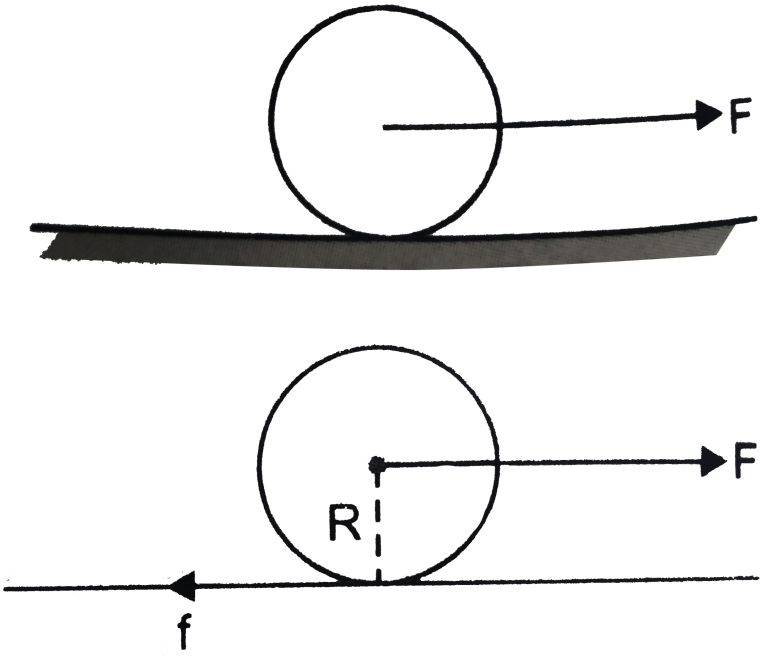
D. 50 J

Answer: d

View Text Solution

10. A unifrom disc of radius R, is resting on a table on its rim. The coefficient of friction between disc and table is μ Fig. Now the disc is pulled with a force F as shown in the Fig. What is the maximum value of F for which the

disc rolls without slipping ?



A. μMg

B. 2μMg

C. 3μMg

D. 4μMg

Answer: c

Watch Video Solution

Angular Momentum In Case Of Rotations About A Fixed Axis

1. Which of the following principles a circus acrobat employs in his performance? a) Conservation of energy b) Conservation of linear momentum c) Conservation of mass d) Conservation of angular momentum

A. Conservation of energy

B. Conservation of linear momentum

C. Conservation of mass

D. Conservation of angular momentum

Answer: d

Watch Video Solution

2. Total angular momentum of a rotating body remains constant, if the net torque acting on the body is

A. zero

B. maximum

C. minimum

D. unity

Answer: A

 Watch Video Solution

3. When a mass is rotating in a plane about a fixed point, its angular momentum is directed along: a) the radius b) the tangent the orbit c)

the line at angle of 45 degree to the plane of rotation d) the axis of rotation

A. the radius

B. the tangent the orbit

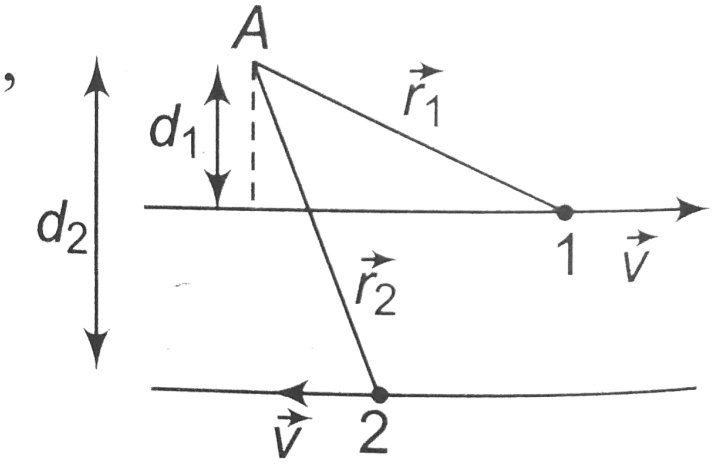
C. the line at angle of 45° to the plane of rotation

D. the axis of rotation

Answer: d

Watch Video Solution

4. Figure shows two identical particles 1 and 2, each of mass m, moving in opposite directions with same speed $\vec{V}$ along parallel lines. At a particular instant, $\vec{r}_1$ and $\vec{r}_2$ are their respective position vectors drawn from point A which is in the plane of the parallel lines. Which of the following is the correct statement ?



A. Angular momentum $\overrightarrow{L}_1$ of a particle 1

about A is $\overrightarrow{L}_1 = mv\overrightarrow{r}_1 \odot$

B. Angular momentum $\overrightarrow{L}_2$ of particle 2

about A is $\overrightarrow{L}_2 = mv\overrightarrow{r}_2 \odot$

C. Total angular momentum of the system

about A is $\overrightarrow{L} = mv\left(\overrightarrow{r}_1 + \overrightarrow{r}_2\right) \odot$

D. Total angular momentum of the system

about A is $\overrightarrow{L} = mv(d_2 - d_1) \otimes$

$\otimes$ represents a unit vector going into

the page, $\odot$ represent a unit vector coming out of the page

Answer: d

Watch Video Solution

5. An solid cylinder of mass $20kg$ and radius $20cm$ rotates about its axis with a angular speed $100rads^{-1}$. The angular momentum of the cylinder about its axis is: a) 40 J s b) 400 J s c) 20 J s d) 200 J s

A. 40 J s

B. 400 J s

C. 20 J s

D. 200 J s

Answer: A

Watch Video Solution

6. 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.

A. $\frac{1}{2}$

B. $\sqrt{2}$

C. $1:\sqrt{2}$

D. $\frac{2}{1}$

Answer: C

Watch Video Solution

7. A child is standing with his two arms outstretched at the centre of a turntable that is rotating about its central axis with an angular speed ω_0. Now, the child folds his hands back so that moment of inertia becomes 3 times the initial value. The new angular speed is.

A. $3\omega_o$

B. $\omega_o/3$

C. $6\omega_o$

D. $\omega_o/6$

Answer: B

Watch Video Solution

8. A circular platform is mounted on a vertical frictionless axle. Its radius is $r = 2m$ and its moment of inertia$I = 200kgm^2$. It is initially at rest. A $70kg$ man stands on the edge of the platform and begins to walk along the edge at speed $v_0 = 1ms^{-1}$ relative to the ground.

The angular velocity of the platform is: a) 1.2 rad/s b) 0.4 rad/s c) 0.7 rad/s d) 2 rad/s

A. $1.2 rads^{-1}$

B. $0.4 rads^{-1}$

C. $0.7 rads^{-1}$

D. $2 rads^{-1}$

Answer: c

Watch Video Solution

9. A man stands on a rotating platform with his arms stretched holding a $5kg$ weight in each hand. The angular speed of the platform is $1.2revs^{-1}$. The moment of inertia of the man together with the platform may be taken to be constant and equal to $6kgm^2$. If the man brings his arms close to his chest with the distance n each weight from the axis changing from $100cm$ to$20cm$. The new angular speed of the platform is.

A. $2revs^{-1}$

B. $3revs^{-1}$

C. $5revs^{-1}$

D. $6revs^{-1}$

Answer: b

Watch Video Solution

10. Two discs of moments of inertia I_1 and I_2 about their respective axes , rotating with angular frequencies ω_1 and ω_2 respectively, are brought into contact face to face with their

axes of rotation coincident. The angular frequency of the composite disc will be

A. a. $I_1\omega_1 + \frac{I_1\omega_2}{I_1} + I_2$

B. b. $I_2\omega_1 + \frac{I_1\omega_2}{I_1} + I_2$

C. c. $I_1\omega_1 - \frac{I_2\omega_2}{I_1} - I_2$

D. d. $I_2\omega_1 - \frac{I_1\omega_2}{I_1} - I_2$

Answer: a

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11. A ballet dancer, dancing on a smooth floor is spinning about a vertical axis with her arms folded with angular velocity of $20 rad/s$. When the stretches her arms fully, the spinning speed decrease in $10 rad/s$. If I is the initial moment of inertia of the dancer, the new moment of inertia is: a) 2I b) 3I c) I/2 d) I/3

A. 2I

B. 3I

C. $\frac{I}{2}$

D. $\frac{I}{3}$

Answer: a

Watch Video Solution

12. Angular momentum L and rotational kinetic energy K_R of a body are related to each other by the relation. (I = moment of inertia)

A. 1. K_R = 2IL

B. 2. $K_R = \frac{L^2}{2I}$

C. 3. $K_R = \frac{2I}{L}$

D. 4. $K_R = \frac{L^2}{I}$

Answer: b

Watch Video Solution

13. A person with outstretched arms, is spinning on a rotating stool. He suddenly brings his arms down to his sides. Which of the following is true about his kinetic energy K and angualr momentum L?

A. 1.Both K and L increase

B. 2.Both K and L remain unchanged

C. 3.K remains constant, L increases

D. 4.K increases but L remains constant

Answer: d

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14. A child is standing with folded hands at the center of a platform rotating about its central axis. The kinetic energy of the system is K. The

child now stretches his arms so that the moment of inertia of the system doubles. The kinetic energy of the system now is: a) K/4 b) K/2 c) 2K d) 4K

A. K/4

B. K/2

C. 2 K

D. 4 K

Answer: b

Watch Video Solution

15. A solid sphere of mass m and radius R is rotating about its diameter. A solid cylinder of the same mass and same radius is also rotating about its geometrical axis with an angular speed twice that of the sphere. The ratio of their kinetic emergies of rotation $\left(E_{\text{sphere}} / E_{\text{cylinder}}\right)$ will be.

A. $1:4$

B. $3:1$

C. $2:3$

D. $1:5$

Answer: b

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16. Two discs of moments of inertia I_1 and I_2 about their respective axes (normal to the disc and passing through the centre), and rotating with angular speed ω_1 and ω_2 are brought into contact face to face with their axes of

rotation coincident. What is the loss in kinetic energy of the system in the process?

A. $I_1 I_2 \frac{(\omega_1 - \omega_2)^2}{2}(I_1 + I_2)$

B. $I_1 I_2 \frac{(\omega_1 - \omega_2)^2}{2(I_1 + I_2)}$

C. $I_1 I_2 \frac{(\omega_1 + \omega_2)^2}{I_1 - I_2}$

D. $I_1 I_2 \frac{(\omega_1 + \omega_2)^2}{2}(I_1 - I_2)$

Answer: a

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Rolling Motion

1. A solid sphere rolls down two different inclined planes of the same height but of different inclinations

A. the speed and time of descend will be same.

B. the speed will be same but time of descend will be different.

C. the speed will be different but time are descend will be same.

D. speed and time of descend both are different..

Answer: b

Watch Video Solution

2. Which of the following statements is correct?

A. Torque is the rotational analogue of force.

B. Rolling motion of cylinder down an inclined plane is combination of translation and rotational motion.

C. If the effort arm is larger than the load arm, the mechanical advantage is lesser than one.

D. For the extended body, the centre of mass and centre of gravity do not

coincide.

Answer: c

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3. Which of the following statements is not correct?

A. During rolling, the instantaneous speed of the point of contact is zero

B. During rolling, the instantaneous acceleration of the point of contact is zero.

C. For perfect rolling motion, work done against friction is zero.

D. A wheel moving down a perfectly frictionless inclined plane will slip but not roll on the plane.

Answer: b

Watch Video Solution

4. A ball rolls without slipping. The radius of gyration of the ball about an axis passing through its centre of mass is k. If radius of the ball be R, then the fraction of total energy associated with its rotation will be.

A. $\frac{k^2 + R^2}{R^2}$

B. $\frac{k^2}{R^2}$

C. $\frac{k^2}{k^2 + R^2}$

D. $\frac{R^2}{k^2 + R^2}$

Answer: c

Watch Video Solution

5. A solid cylinder of mass M and radius R rolls without slipping down an inclined plane making an angle 6 with the horizontal. Then its acceleration is.

A. 1/3 g sinθ

B. 2/3 g sinθ

C. 2/5 g sinθ

D. 2/7 g $\sin\theta$

Answer: b

Watch Video Solution

6. In the question number 89, the force of friction acting on the cylinder is

A. 2/3 Mg $\sin\theta$

B. 1/3 Mg $\sin\theta$

C. 2/5 Mg $\sin\theta$

D. $2/7\ Mg\ \sin\theta$

Answer: b

View Text Solution

7. A solid cylinder rolls up an inclined plane of inclination θ with an initial velocity v. How far does the cylinder go up the plane ?

A. $\frac{3v^2}{2}g\sin\theta$

B. $\frac{v^2}{4}g\sin\theta$

C. $\frac{3v^2}{g}\sin\theta$

D. $\frac{3v^2}{4}g\sin\theta$

Answer: d

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8. A cylinder of radius R and mass M rolls without slipping down a plane inclined at an angle θ. Coeff. of friction between the cylinder and the plane is μ. For what maximum

inclination θ, the cylinder rolls without slipping ?

A. $\tan\theta$ gt $3\mu_s$

B. $\tan\theta \leq 3\mu_s$

C. $\tan\theta$ lt $3\mu_s$

D. None of these

Answer: b

Watch Video Solution

9. A ring of radius R is rotating with an angular speed ω_0 about a horizontal axis. It is placed on a rough horizontal table. The coefficient of kinetic friction is μ_k. The time after it starts rolling is.

A. $\frac{\omega_o \mu_k R}{2} g$

B. $\frac{\omega_o g}{2} \mu_k R$

C. $\frac{2\omega_o R}{\mu_k} g$

D. $\frac{\omega_o R}{2} \mu_k g$

Answer: d

Watch Video Solution

10. When a solid sphere rolls without slipping down an inclined plane making an angle θ with the horizontal, the acceleration of its centre of mass is a. If the same sphere slides without friction, its.

A. $\frac{7}{2}$ a

B. $\frac{5}{7}$ a

C. $\frac{7}{5}$ a

D. $\frac{5}{2}$ a

Answer: c

Watch Video Solution

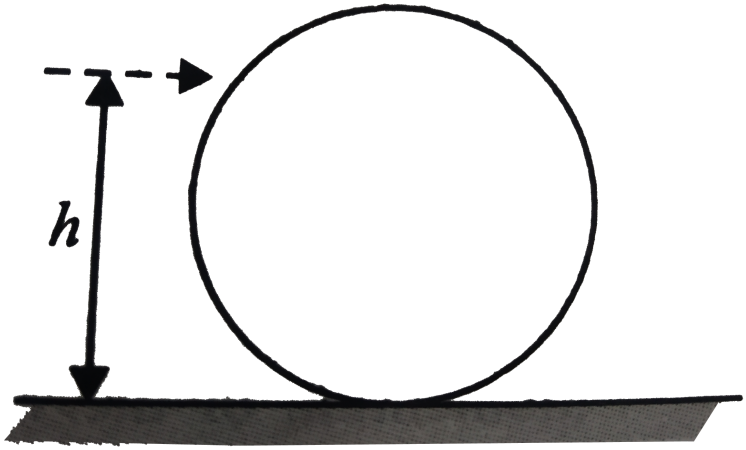
11. A uniform sphere of mass m and radius R is placed on a rough horizontal surface [Fig.] The sphere is struck horizontally at a hight h from the floor. Match the following :

(a) $h = R/2$ (i) Sphere rolls without slipping with a constant velocity and no loss of energy.

(b) $h = R$ (ii) Sphere spins clockwise, loses energy by friction.

(c) $h = 3R/2$ (iii) Sphere spins anti-clockwise, loses energy by friction.

(d) $h = 7R/5$ (iv) Sphere has only a translational motion, looses energy by friction.



A. A -r, B - s, C - q, D - p

B. A - s, b - p, C - r, D - q

C. A - q, B - r, C - p, D - s

D. A - p, B - q, C - s, D - r

Answer: a

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12. The moments of inertia of two rotating bodies A and B are I_A and $I_B(I_A > I_B)$. If their angular momenta are equal then.

A. a. Kinetic energy of A = Kinetic energy of B

B. b. Kinetic energy of A > Kinetic energy of B

C. c. Kinetic energy of A < Kinetic energy of B

D. d. Kinetic energy of the two bodies cannot be compared with the given data

Answer: c

Watch Video Solution

13. A body is rolling down an inclined plane. If kinetic energy of rotation is 40% of kinetic energy in translatory state then the body is a.

A. ring

B. cylinder

C. hollow ball

D. solid ball

Answer: d

Watch Video Solution

14. A wheel of mass $5kg$ and radius $0.40m$ is rolling on a road without sliding with angular velocity $10rads^{-1}$. The moment of ineria of the wheel about the axis of rotation is $0.65kgm^2$. The percentage of kinetic energy of rotate in the total kinetic energy of the wheel is.

A. 22.4%

B. 11.2%

C. 88.8%

D. 44.8%

Answer: d

Watch Video Solution

15. Three bodies, a ring, a soild cylinder and a soild 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 ?

A. Ring

B. Solid cylinder

C. Solid sphere

D. All reach the ground with same velocity

Answer: c

 Watch Video Solution

16. A hoop of radius $2m$ weight $100kg$.It rolls along a horizontal floor so that its centre of mass has a speed of $20cms^{-1}$. How much work has to be done to stop it ?

A. 2 J

B. 4 J

C. 6 J

D. 8 J

Answer: b

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Hots Higher Order Thinking Skill

1. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω. Determine the force exerted by the liquid at the other end.

A. $M\omega^2 \frac{L}{2}$

B. $M\omega^2 L$

C. $M\omega^2 \frac{L}{4}$

D. $M\omega^2 \frac{L^2}{2}$

Answer: a

Watch Video Solution

2. Ler I be the moment of inertia of a uniform square plate about an axis AB that passes through its centre and is parallel to two of its sides. CD is a line in the plane of the plate that

passes through the centre of the plate and makes an angle θ with AB. The moment of inertia of the plate about the axis CD is then equal to

A. I

B. $I \sin^2 \theta$

C. $I \cos^2 \theta$

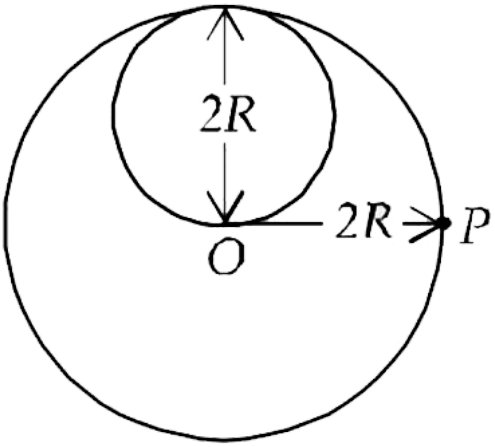
D. $I \cos^2 \left(\frac{\theta}{2} \right)$.

Answer: a

Watch Video Solution

3. A lamina is made by removing a small disc of diameter 2R from a bigger disc of uniform mass density and radius 2R, as shown in the figure. The moment of inertia of this lamina about axes passing though O and P is I_O and I_P respectively. Both these axes are perpendicular to the plane of the lamina. The

ratio $\frac{I_P}{I_O}$ is



A. $13/37$

B. $37/13$

C. $73/31$

D. $8/13$

Answer: b

Watch Video Solution

4. A boy is pushing a ring of mass 2 kg and radius 0.5 m with a stick as shown in the figure. The stick applies a force of 2 N on the ring and rolls it without slipping with an acceleration of $0.3m/s^2$. The coeffecient of friction between the ground and the ring is large enough that rolling always occur and the coefficient of friction between the stick and the ring

A. 0.4

B. 0.8

C. 0.2

D. 0.5

Answer: a

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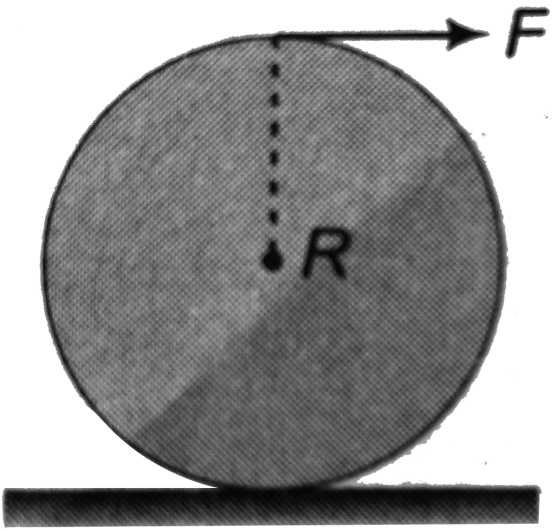

5.

A tangential force F acts at the top of a thin spherical shell of mass m and radius R. Find the acceleration of the shell if it rolls without slipping.

A. a. Acceleration of disc = 2F/3m

B. b. Friction force between disc and surface = 2F/3

C. c. Acceleration of disc = 6F/5m

D. d. Friction force between disc and surface is F/3

Answer: d

 Watch Video Solution

6. A stone of mass m tied to the end of a string, is whirled around in a horizontal circle. (Neglect the force due to gravity). The length of the string is reduced gradually keeping the angular momentum of the stone about the centre of the circle constant. Then, the tension in the string is given by $T = Ar^n$ where A is a constant, r is the instantaneous radius of the circle and n=....

A. a. -3

B. b. 3

C. c. 2

D. d. -4

Answer: a

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7. A rod of weight w is supported by two parallel knife edges A and B and is in equilibrium in a horizontal position. The knives are at a distance d from each other. The centre

of mass of the rod is at distance x from A. The normal reaction on A is.. And on B is.....

A. 1 . $w\frac{d-x}{d}$,$w\frac{x}{d}$,

B. 2. wd, $w\frac{x}{d}$

C. 3. wd, $w\frac{x-d}{d}$

D. 4. $\left(x\frac{w}{d}-x\right)$, $x\frac{w}{d}$

Answer: c

Watch Video Solution

8. A particle is projected at time t=0 from a point P on the ground with a speed $v_0,$ at an angle of 45° to the horizontal. Find the magnitude and direction of the angular momentum of the particle about P at tiem $t = v_0 / g$

A. a. $\frac{mv_0^3}{2\sqrt{2}g}$

B. b. $\frac{mv_0^3}{\sqrt{2}g}$

C. c. $\frac{3mv_0^3}{\sqrt{2}g}$

D. d. $\frac{\sqrt{2}mv_0^3}{g}$

Answer: a

Watch Video Solution

Ncer Examplar Problems

1. 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

Answer: d

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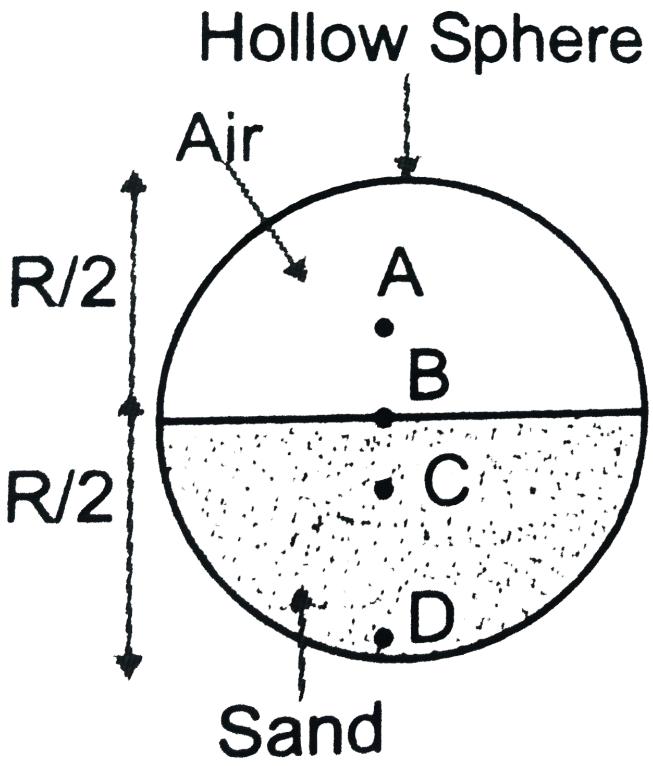
2. Which of the following points is the likely position of the centre of mass of the system

shown in Fig.



A. A

B. B

C. C

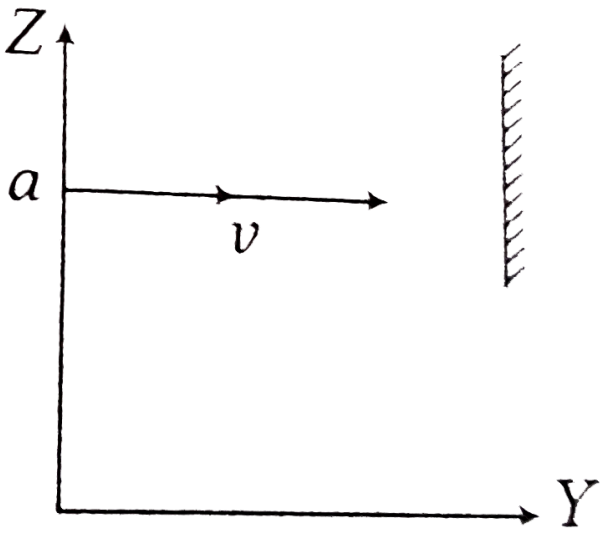
D. D

Answer: c

View Text Solution

3. A particle of mass m is moving in YZ-plane with a uniform velocity v with its trajectory running parallel to $+ve$ Y-axis and intersecting Z-axis at $z = a$ in figure. The change in its angular momentum about the origin as it bounces elastically form a wall at

y=constant is



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4. When a disc rotates with uniform angular velocity, which of the following is not true ?

A. a. The sense of rotation remains same.

B. b. The orientation of the axis of rotation remains same.

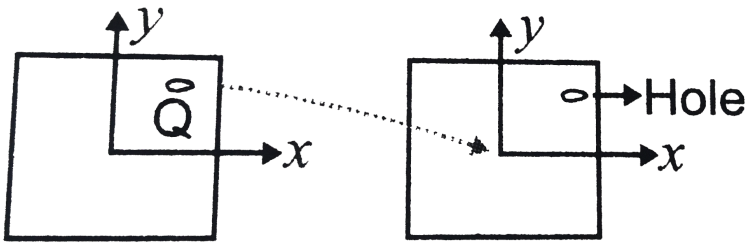
C. c. The speed of rotation is non-zero and remains same.

D. d. The angular acceleration is non-zero and remains same.

Answer: d

Watch Video Solution

5. A unifrom square plate has a small piece Q of an irregular shape removed and glued to the centre of the plate leaving a hole behind [Fig.] The moment of inertia about the z-axis is than



A. increased

B. decreased

C. the same

D. changed in unpredicted manner

Answer: b

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6. In problem 5, $theCM$ of the plate is now in the following quadrant of $x - y$ plane.

A. I

B. II

C. III

D. IV

Answer: c

View Text Solution

7. The density of a non-uniform rod of length $1m$ is given by $\rho(x) = a\left(1 + bx^2\right)$ where a and b are constants and $0 \leq x \leq 1$.

The centre of mass of the rod will be at

A. $\frac{3(2+b)}{4}(3+b)$

B. $\frac{4(2+b)}{3}(3+b)$

C. $\frac{3(3+b)}{4}(2+b)$

D. $\frac{4(3+b)}{3}(2+b)$

Answer: a

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8. A Merry -go-round, made of a ring-like plarfrom of radius R and $massM$, is revolving with angular speed ω. A person of mass M is standing on it. At one instant, the

person jumps off the round, radially awaay from the centre of the round (as see from the round). The speed of the round after wards is

A. 2ω

B. ω

C. $\omega/2$

D. 0

Answer: b

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Assertion And Reason

1. Assertion: No real body is truly rigid.

Reason: A rigid body is a body with a perfectly definite and unchanging shape. The distances between different pairs of particles of such a body do not change.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: a

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2. The position of centre of mass does not depend upon the reference frame.

Centre of mass depends only upon the mass of the body.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: c

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3. Statement-1 : The centre of mass of a body may lie where there is no mass.

Statement-2 : The centre of mass has nothing to do with the mass.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: c

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4. To determine the motion of the centre of mass of a system, knowledge of internal forces of the system is required.

`For this purpose we need not to know the external forces on the system.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: d

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5. Assertion: If there are no external forces, the center of mass of a double star moves like a free particle.

Reason: If we go to the center of mass frame, then we find that the two stars are moving in a circle about the center of mass, which is at rest.

A. Both assertion and reason are true and reason is the correct explanation of assertion.

B. Both assertion and reason are true but reason is not the correct explanation of assertion

C. Assertion is true but reason is false.

D. Both assertion and reason are false.

Answer: b

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6. Assertion: A girl sits on a rolling chair, when she stretch her arms horizontally, her speed is reduced.

Reason: Principle of conservation of angular momentum is applicable in this situation.

A. Both assertion and reason are true and reason is the correct explanation of assertion.

B. Both assertion and reason are true but reason is not the correct explanation of

assertion

C. Assertion is true but reason is false.

D. Both assertion and reason are false.

Answer: a

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7. Assertion : The moment of inertia of a rigid body reduces to its minimum value, when the axis of rotation passes through its centre of gravity.

Reason : The weight of a rigid body always acts through its centre of gravity.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: a

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8. Assertion: The centre of gravity of a body coincides with its centre of mass only if the gravitational field does not vary form one part of the body to the other.

Reason: Centre of gravity is independent of the gravitational field.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: c

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9. Assertion:The moment of inertia of rigid body depends only on the mass of the body, its shape and size. Reason: Moment of inertia $I = MR^2$ where M is the mass of the body and R is the radius vector.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: d

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10. Assertion: Value of radius of gyration of a body depends on axis of rotation.

Reason: Radius of gyration is root mean square distance of particle of the body from the axis of rotation.

A. Both assertion and reason are true and reason is the correct explanation of assertion.

B. Both assertion and reason are true but reason is not the correct explanation of

assertion

C. Assertion is true but reason is false.

D. Both assertion and reason are false.

Answer: a

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11. Assertion: A boiled egg can be easily distinguished from a raw unboiled egg by spinning.

Reason: The hard boiled egg has a moment of inertia which is more than that of the raw egg.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: c

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12. Assertion: A rigid body not fixed in some way can have either pure translation or a combination of translation and rotation.

Reason: In rotation about a fixed axis, every particle of the rigid body moves in a circle which lies in a plane perpendicular to the axis and has its centre on the axis.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: b

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13. Assertion: The motion of a ceiling fan is rotational only.

Reason: The motion of a rigid body which is pivoted fixed of rotation.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of

assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: a

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14. Assertion: If the head of a right handed screw rotates with the body, the screw advances in the direction of the angular velocty.

Reason: For rotation about a fixed axis, the angular velocity vector lies along the axis of rotation.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: a

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15. A sphere cannot roll on a smooth inclined surface.

The motion of a rigid body which is pivoted or fixed in some way is rotation.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: b

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Kinematics Of Rotational Motion About A Fixed Axis

1. An athlete throws a discus from rest to a final angular velocity of $15 rad s^{-1}$ in $0.270 s$ before releasing it. During acceleration, discuss moves a circular arc of radius $0.810 m$. Acceleration of discus before it is released is.

A. $45 m s^{-2}$

B. $182 m s^{-2}$

C. $187ms^{-2}$

D. $192ms^{-2}$

Answer: a

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2. A flywheel rotating at 420 rpm slows down at a constant rate of $2rads^{-2}$. The time required to stop the flywheel is:

A. 22 s

B. 11 s

C. 44 s

D. 12 s

Answer: A

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3. The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds. The angular acceleration of the

motor wheel is a) 2 π rads−2 b) 4 π rads−2 c) 6 π rads−2 d) 8 π rads−2

A. $2\pi rads^{-2}$

B. $4\pi rads^{-2}$

C. $6\pi rads^{-2}$

D. $8\pi rads^{-2}$

Answer: B

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Higher Order Thinking Skills

1. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω. Determine the force exerted by the liquid at the other end.

A. $M\omega^2\frac{L}{2}$

B. $M\omega^2 L$

C. $M\omega^2\frac{L}{4}$

D. $M\omega^2\frac{L^2}{2}$

Answer: a

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2. Ler I be the moment of inertia of a uniform square plate about an axis AB that passes through its centre and is parallel to two of its sides. CD is a line in the plane of the plate that passes through the centre of the plate and makes an angle θ with AB. The moment of inertia of the plate about the axis CD is then equal to

A. I

B. $I \sin^2 \theta$

C. $I \cos^2 \theta$

D. $I \cos^2 \left(\frac{\theta}{2} \right)$.

Answer: a

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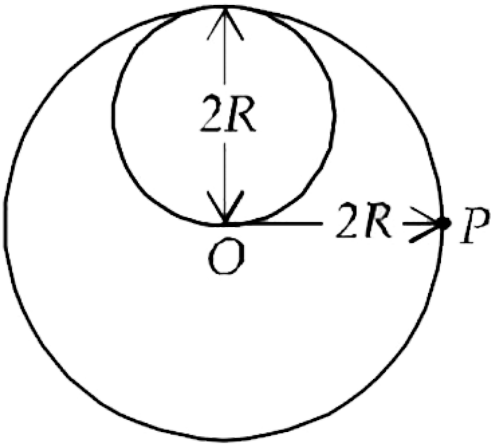
3. A lamina is made by removing a small disc of diameter 2R from a bigger disc of uniform mass density and radius 2R, as shown in the

figure. The moment of inertia of this lamina about axes passing though O and P is I_O and I_P respectively. Both these axes are perpendicular to the plane of the lamina. The ratio $\frac{I_P}{I_O}$ is



A. $13/37$

B. $37/13$

C. $73/31$

D. $8/13$

Answer: b

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4. A boy is pushing a ring of mass 2 kg and radius 0.5 m with a stick as shown in the figure. The stick applies a force of 2 N on the ring and rolls it without slipping with an acceleration of $0.3m/s^2$. The coeffecient of

friction between the ground and the ring is large enough that rolling always occur and the coefficient of friction between the stick and the ring

A. 0.4

B. 0.8

C. 0.2

D. 0.5

Answer: a

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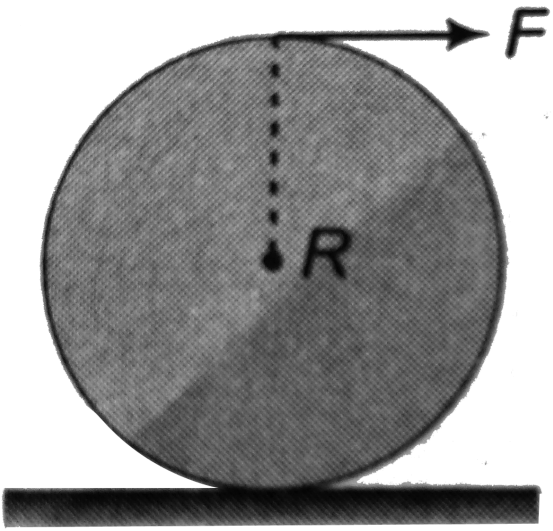

5.

A tangential force F acts at the top of a thin spherical shell of mass m and radius R. Find the acceleration of the shell if it rolls without slipping.

A. a. Acceleration of disc = 2F/3m

B. b. Friction force between disc and surface = 2F/3

C. c. Acceleration of disc = 6F/5m

D. d. Friction force between disc and surface is F/3

Answer: d

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6. A stone of mass m tied to the end of a string, is whirled around in a horizontal circle. (Neglect the force due to gravity). The length of the string is reduced gradually keeping the angular momentum of the stone about the centre of the circle constant. Then, the tension in the string is given by $T = Ar^n$ where A is a constant, r is the instantaneous radius of the circle and n=....

A. a. -3

B. b. 3

C. c. 2

D. d. -4

Answer: a

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7. A rod of weight w is supported by two parallel knife edges A and B and is in equilibrium in a horizontal position. The knives are at a distance d from each other. The centre

of mass of the rod is at distance x from A. The normal reaction on A is.. And on B is.....

A. 1 . $w\frac{d-x}{d}$,$w\frac{x}{d}$,

B. 2. wd, $w\frac{x}{d}$

C. 3. wd, $w\frac{x-d}{d}$

D. 4. $\left(x\frac{w}{d}-x\right)$, $x\frac{w}{d}$

Answer: c

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8. A particle is projected at time t=0 from a point P on the ground with a speed $v_0,$ at an angle of 45° to the horizontal. Find the magnitude and direction of the angular momentum of the particle about P at tiem $t = v_0 / g$

A. a. $\frac{mv_0^3}{2\sqrt{2}g}$

B. b. $\frac{mv_0^3}{\sqrt{2}g}$

C. c. $\frac{3mv_0^3}{\sqrt{2}g}$

D. d. $\frac{\sqrt{2}mv_0^3}{g}$

Answer: a

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Ncert Exemplar

1. 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

Answer: d

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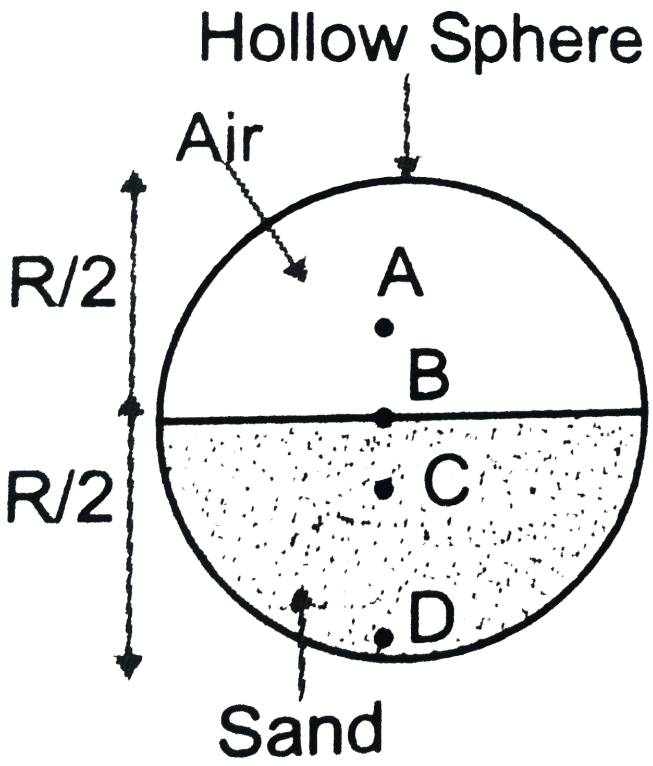
2. Which of the following points is the likely position of the centre of mass of the system

shown in Fig.



A. A

B. B

C. C

D. D

Answer: c

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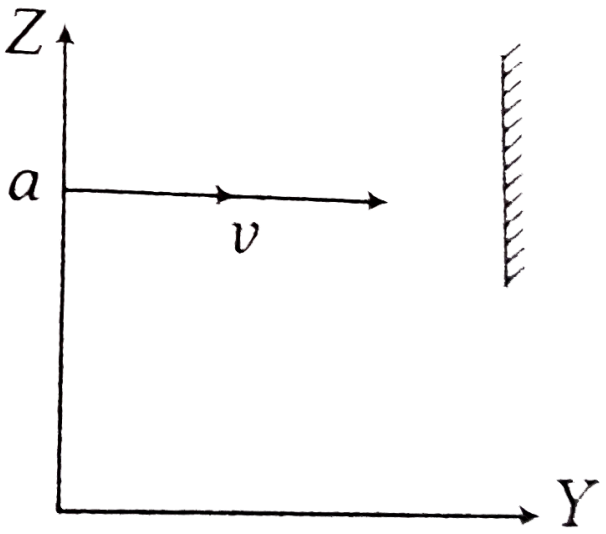
3. A particle of mass m is moving in YZ-plane with a uniform velocity v with its trajectory running parallel to $+ve$ Y-axis and intersecting Z-axis at $z = a$ in figure. The change in its angular momentum about the origin as it bounces elastically form a wall at

y=constant is



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4. When a disc rotates with uniform angular velocity, which of the following is not true ?

A. a. The sense of rotation remains same.

B. b. The orientation of the axis of rotation remains same.

C. c. The speed of rotation is non-zero and remains same.

D. d. The angular acceleration is non-zero and remains same.

Answer: d

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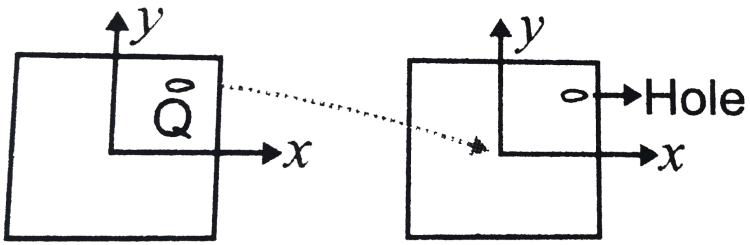
5. A unifrom square plate has a small piece Q of an irregular shape removed and glued to the centre of the plate leaving a hole behind [Fig.] The moment of inertia about the z-axis is than



A. increased

B. decreased

C. the same

D. changed in unpredicted manner

Answer: b

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6. In problem 5, $theCM$ of the plate is now in the following quadrant of $x - y$ plane.

A. I

B. II

C. III

D. IV

Answer: c

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7. The density of a non-uniform rod of length $1m$ is given by $\rho(x) = a\left(1 + bx^2\right)$ where a and b are constants and $0 \leq x \leq 1$.

The centre of mass of the rod will be at

A. $\frac{3(2+b)}{4}(3+b)$

B. $\frac{4(2+b)}{3}(3+b)$

C. $\frac{3(3+b)}{4}(2+b)$

D. $\frac{4(3+b)}{3}(2+b)$

Answer: a

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8. A Merry -go-round, made of a ring-like plarfrom of radius R and $massM$, is revolving with angular speed ω. A person of mass M is standing on it. At one instant, the

person jumps off the round, radially awaay from the centre of the round (as see from the round). The speed of the round after wards is

A. 2ω

B. ω

C. $\omega/2$

D. 0

Answer: b

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