PHYSICS

BOOKS - A2Z PHYSICS (HINGLISH)

ROTATIONAL DYNAMICS

Centre Of Mass

1. The motion of the centre of mass of a system of two particles is unaffected by their internal forces.

A. irrespective of the actual direction of the internal forces.

B. only if they are along the line joining the particles

C. only if they are at right angles to the joining the particles

D. only if they are obliquely inclined to the line joining the particle.

Answer: A

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2. Two bodies A and B initially at rest are attracted towards each other due to gravitation. Given that A is much heavier. Than B. Which of the followings correctly describes the relative motion of the centre of mass of the bodies ?

A. it moves towards A

B. it moves towards B

C. it moves perpendicular to the line joining the particles

D. it remains at rest.

Answer: D

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3. The position of center of mass of a system of particles does not depend upon the

A. masses of the particles

B. forces on the particles

C. positions of the particles

D. relative distance between the particles

Answer: B

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4. Two bodies A and B have masses M and m respectively where $M > m$ and they are at a distance d apart. Equal force is applied to each of them so that they approach each other. The position where they hit each other is :

A. nearer to B

B. nearer to A

C. at equal distance from A and B

D. cannot be decided

Answer: B

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5. Three identical particle each of mass $1kg$ are placed with their centres on a straight line. Their centres are marked $A, B \text{ and } C$ respectively. The distance of centre of mass of the system from A is.

A. $\dfrac{AB + AC + BC}{3}$

B. $\dfrac{AB + AC}{3}$

C. $\dfrac{AB + AC}{3}$

D. $\dfrac{AB + BC}{3}$

Answer: B

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6. Two particles of equal mass have velocities $\vec{v}_1 = 2\hat{i}m/s^{-1}$ and $\vec{v}_2 = 2\hat{j}m/s^{-1}$. First particle has an acceleration $\vec{a}_1 = \left(3\hat{i} + 3\hat{j}\right)ms^{-2}$ while the acceleration of the other particle is zero. The centre of mass of the two particles moves in a path of.

A. circle

B. parabola

C. straight line

D. ellipse

Answer: C

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7. The centre of mass of a system of two particle of masses m_1 and m_2 is at a distance d_1 from 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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8. Two particles of mass $1kg$ and $3kg$ 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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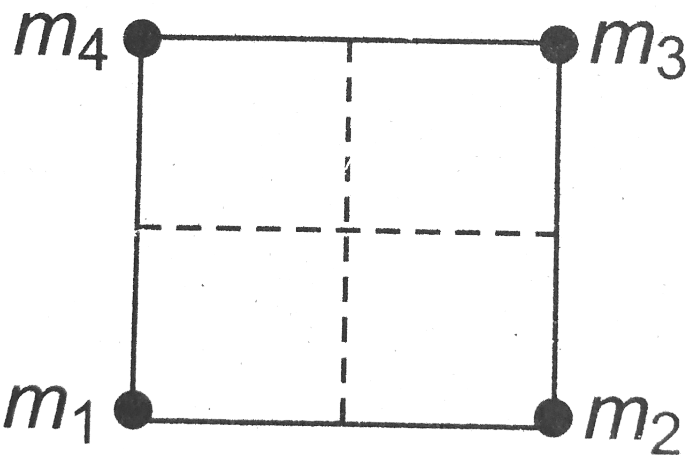
9. Four particle of masses $m_1 = 2m, m_2 = 4m, m_3 = m$ and m_4 are placed at four corners of a square. What should be the value of m_4 so that the centres of mass of all the four particle are exactly at the centre of the square ?



A. 3 m

B. 5 m

C. 8 m

D. none of these

Answer: D

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

A. $\left(\frac{5a}{9}, \frac{2a}{3\sqrt{3}}\right)$

B. $\left(\frac{2a}{33}, \frac{5a}{9}\right)$

C. $\left(\frac{5a}{9}, \frac{2a}{\sqrt{3}}\right)$

D. $\left(\frac{2a}{\sqrt{3}}, \frac{5a}{9}\right)$

Answer: A

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11. 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 $3kg$ 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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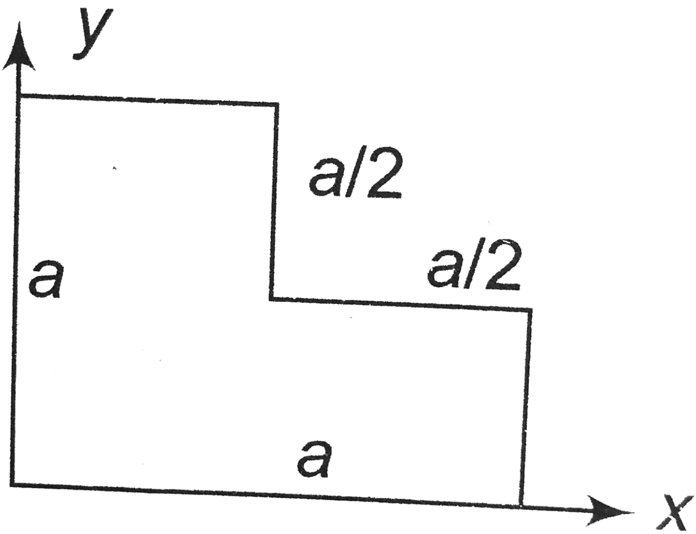
12. A square of side a and uniform thickness is divided into four equal parts. If upper right part is removed, then find the coordinates of centre of mass of remaining part.



A. $\left(\frac{5}{12}a, \frac{5}{12}a\right)$

B. $\left(\frac{7}{12}a, \frac{7}{12}a\right)$

C. $\left(\frac{1}{4}a, \frac{1}{4}a\right)$

D. $\left(\frac{1}{3}a, \frac{1}{3}a\right)$

Answer: A

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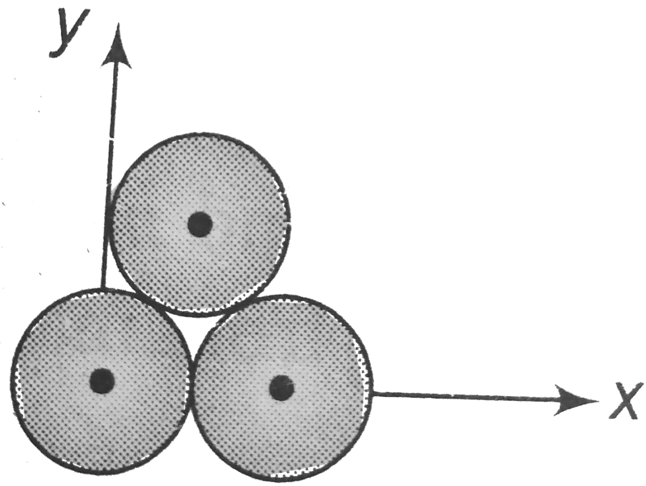
13. Three identical spheres each of radius R are placed touching each other on a horizontal table as shown in figure. The co-ordinates of centre of mass are :



A. (R, R)

B. $(0, 0)$

C. $\left(\frac{R}{2}, \frac{R}{2}\right)$

D. $\left(R, \frac{R}{\sqrt{3}}\right)$

Answer: D

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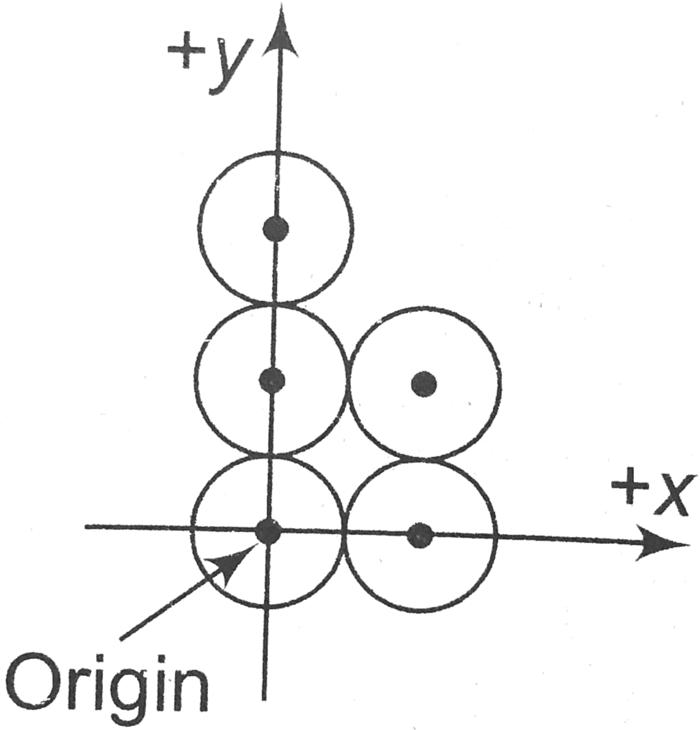
14. Five uniform circular plates, each of diameter b and mass m are laid out in a pattern shown. Using the origin shown, find the y co-ordinate of the centre of mass of the five-plate system.



A. $b/5$

B. $b/3$

C. $4b/5$

D. $2b/5$

Answer: C

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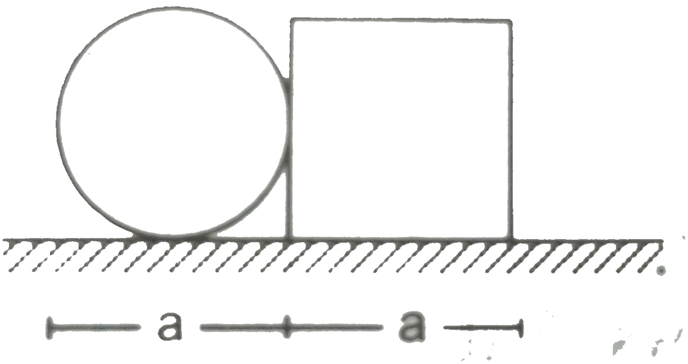
15. A circular plate of diameter d is kept in contact with a square plate of edge d as shown in figure. The density of the material and the thickness are same everywhere. The centre of mass of the composite system will be



A. Inside the square plate

B. Inside the circular plate

C. At the point of contact

D. Outside the system

Answer: A

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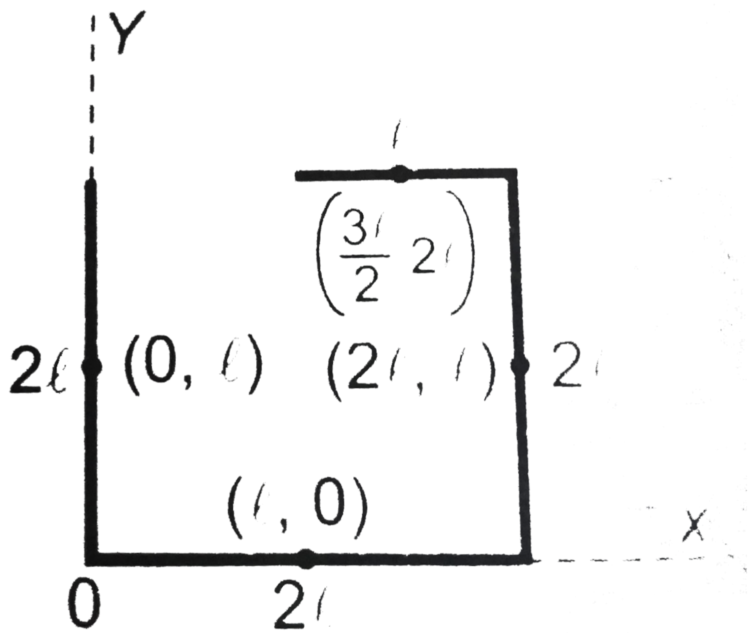
16. A wire of uniform cross-section is bend in the shape shown in figure. The co-ordinate of the centre of mass of each side are shown in (figure). The co-ordinates of the centre of mass of the system are.



A. $\left(\frac{15l}{14}, \frac{6l}{7}\right)$

B. $\left(\frac{15l}{14}, l\right)$

C. $\left(l, \frac{l}{2}\right)$

D. (l, l)

Answer: A

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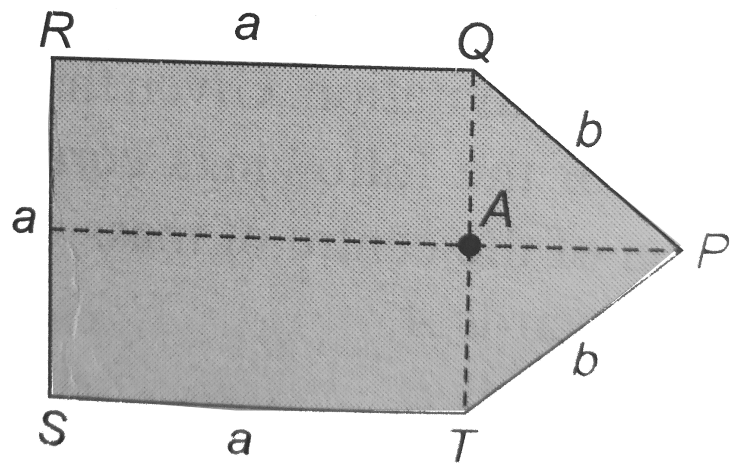
17. A homogeneous plate $PQRST$ is as shown in figure. The centre of mass of plate lies at midpoint A if segment QT. Then the ratio of $\frac{b}{a}$

is $(PQ = PT = b, QR = RS = ST = a)$



A. $\frac{13}{4}$

B. $\frac{13}{2}$

C. $\sqrt{\frac{13}{2}}$

D. $\sqrt{\frac{13}{4}}$

Answer: D

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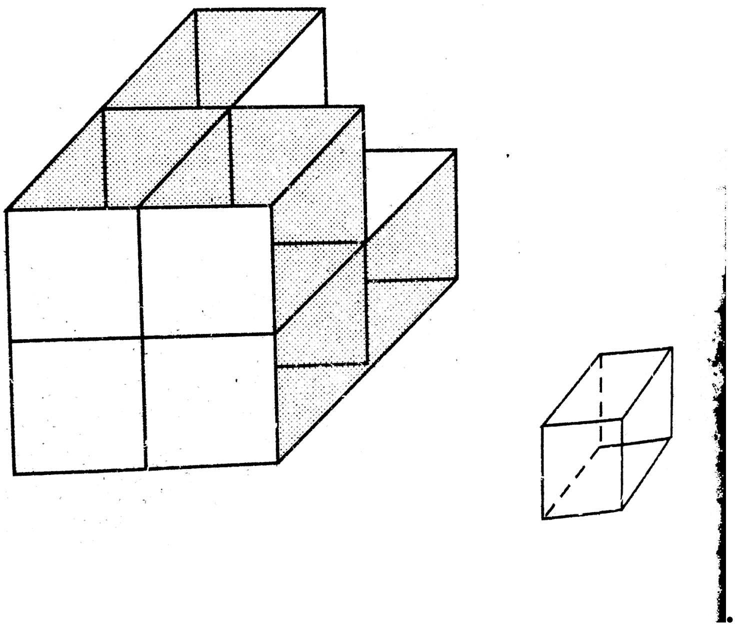
18. Eight solid uniform cubes of edge l are stacked together to form a single cube with centre O. One cube is removed from this system. Distance, of the centre of mass of remaining 7 cubes from O is.



A. $\frac{7\sqrt{3}l}{16}$

B. $\frac{\sqrt{3}l}{16}$

C. $\frac{\sqrt{3}l}{14}$

D. zero

Answer: C

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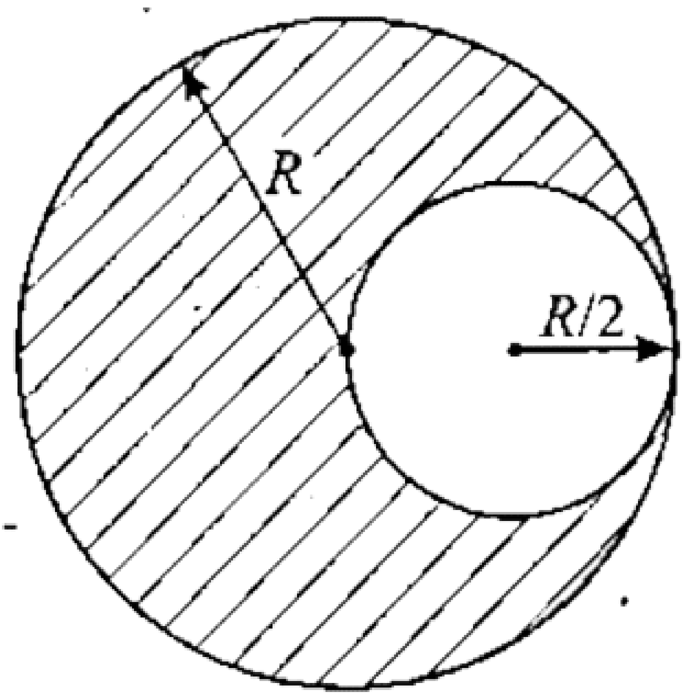
19. From the circular disc of radius $4R$ two small discs of radius R are cut off. The centre of mass of the new structure will be at



A. $\hat{i}\frac{R}{5} + \hat{j}\frac{R}{5}$

B. $-\hat{i}\frac{R}{5} + \hat{j}\frac{R}{5}$

C. $\frac{-3R}{14}\left(\hat{i} + \hat{j}\right)$

D. None of these

Answer: C

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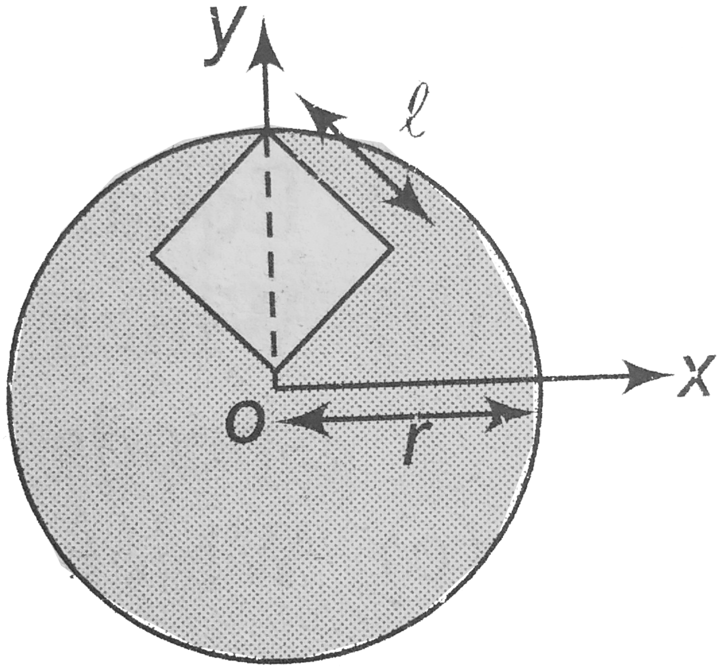
20. A disc (of radius r cm) of uniform thickness and uniform density σ has a square hole with sides of length $l = \frac{r}{\sqrt{2}} cm$. One corner of the hole is located at the centre of the disc and centre of the hole lies y-axis as shown. Then the y-coordinate of position of centre of mass of disc with hole (in cm) is.



A. $-\dfrac{r}{2\left(\pi - {}^{1}/_{4}\right)}$

B. $-\dfrac{r}{4\left(\pi - {}^{1}/_{4}\right)}$

C. $-\dfrac{r}{4\left(\pi - {}^{1}/_{2}\right)}$

D. $-\frac{3r}{4\left(\pi - {}^{1}/_{4}\right)}$

Answer: C

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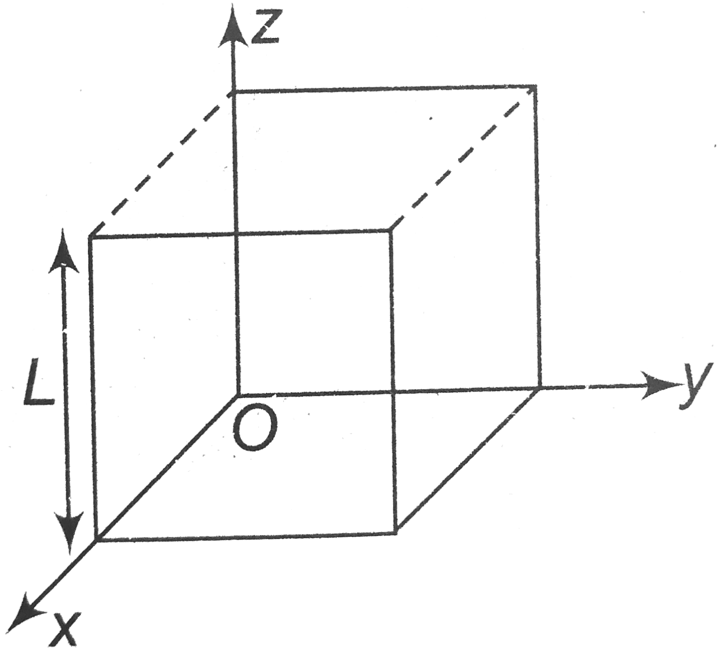
21. Figure shown a cubical box that has been constructed from uniform metal plate of negligible thickness. The box is open at the top and has edge length $40cm$. The z co-ordinate of the centre of mass of the box in cm, is.



A. 12

B. 16

C. 20

D. 22

Answer: B

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22. The centre of mass of a non uniform rod of length L, whose mass per unit length varies as $\rho = \frac{k.x^2}{L}$ where k is a constant and x is the distance of any point from one end is (from the same end)

A. $\frac{3}{4}L$

B. $\frac{1}{4}L$

C. $\frac{k}{L}$

D. $\frac{3k}{L}$

Answer: A

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Displacement , Velocity And Acceleration Of Centre Of Mass

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

A. minimum

B. maximum

C. unity

D. zero

Answer: D

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2. A system of particles is free from any external force $\vec{v}$ and $\vec{a}$ be the velocity and acceleration of the centre of mass, then it necessarily follows that :

A. $\vec{v} = 0, \vec{a} = 0$

B. $\vec{v} \neq 0, \vec{a} = 0$

C. $\vec{v} = 0, \vec{a} \neq 0$

D. None of these

Answer: D

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3. A child is sitting at one end of a long trolley moving with a uniform speed v on a smooth horizontal track. If the child starts running towards the other end of the trolley with a speed u (w.r.t. trolley), the speed of the centre of mass of the system will.

A. $u + v$

B. v - u`

C. v

D. none

Answer: C

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4. When an explosive 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. vertically downwards

B. along the original parabolic path

C. vertically upwards and then vertically downwards

D. horizontally followed by parabolic path

Answer: B

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5. The velocity of the CM of a system changes from $\vec{v}_1 = 4\hat{i}m/s \rightarrow \vec{v}_2 = 3\hat{j}m/s$ during time

$\Delta t = 2s$. If the mass of the system is $m = 10kg$, the constant force acting on the system is :

A. 25 N

B. 20 N

C. 50 N

D. 5 N

Answer: A

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6. An insulated particle of mass m is moving in a horizontal plane (x - y) along X-axis. At a certain height above the ground, it suddenly explodes into two fragments of masses $m/4$ and $3m/4$. An instant later, the smaller fragment is at $Y = +15$. The larger fragment at this instant is at :

A. $Y = -5cm$

B. $Y = +20cm$

C. $Y = +5cm$

D. $Y = -20cm$

Answer: A

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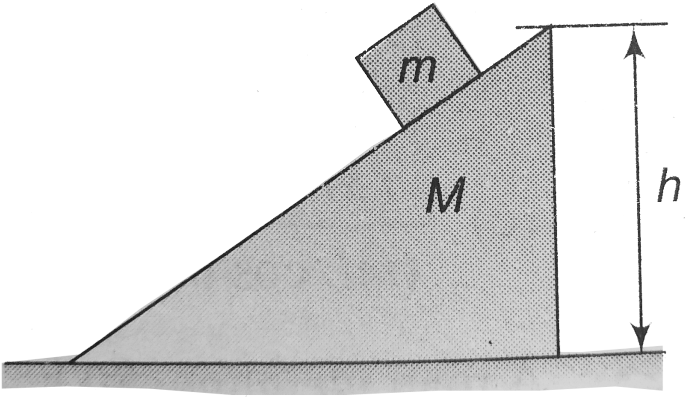
7. A mass m is at rest on an inclined plane of mass M which is further resting on a smooth horizontal plane. Now if the mass starts moving, the position of centre of mass of the system will :



A. remain unchanged

B. change along the horizontal

C. move up in the vertical direction

D. change along the vertical while remains

same along the horizontal

Answer: D

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8. Consider a large block placed on a smooth horizontal surface, with a man standing at one end of the block. The man walks to the other end, relative to the block. The distances (absolute) moved by the man and the block are :

A. In the inverse ratio masses

B. In the direction ratio of their masses

C. Independent of their masses

D. Dependent both on their masses and speeds.

Answer: A

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9. A body A of mass M while falling vertically downwards under gravity brakes into two parts, a body B of mass $\frac{1}{3}$ M and a body C of mass $\frac{2}{3}$ M. The center of mass of bodies B and C taken together shifts compared to that of body A towards

A. Body C

B. Body B

C. Depends on height of breaking

D. Does not shift

Answer: D

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10. A boy of mass m is standing on a block of mass M kept on a rough surface. When the boy walks from left to right on the block, the centre of mass (boy + block) of system :

A. remains stationary

B. shifts towards left

C. shift towards right

D. shift towards right if $M > m$ and towards left if $M < m$.

Answer: C

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11. A $10kg$ boy standing in a $40kg$ boat floating on water is $20m$ away from the shore of the river. If the boy moves $8m$ on the boat towards the shore, then how far is he from the shore ? (Assume no friction between boat and water).

A. 12.0 m

B. 13.6 m

C. 12.8 m

D. 11.6 m

Answer: B

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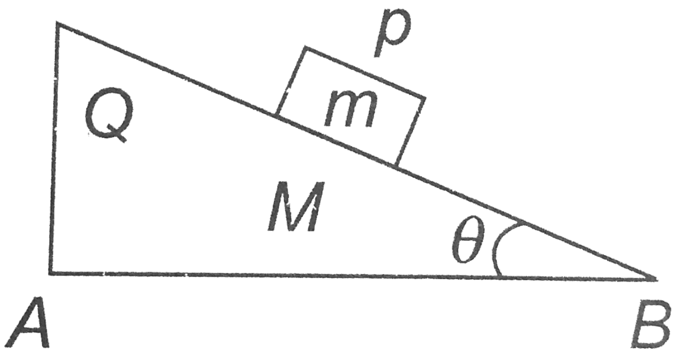
12. A wedge Q of mass M is placed on a horizontal frictionless surface AB and a its frictionless slope. As P slides by a length L on this slope of inclination θ, Q would slide by a distance of.



.

A. $\left(\frac{m}{M}\right)L\cos\theta$

B. $\frac{m}{L}(M+m)$

C. $\frac{(M+m)}{(mL\cos\theta)}$

D. $\frac{(mL\cos\theta)}{(m+M)}$

Answer: D

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13. A man weighing $80kg$ is standing on a trolley weighing $320kg$. The trolley is resting on frictionless horizontal rails. If the man starts walking on the trolley along the rails at speed $1m/s$ (w.r.t. to trolley) then after $4s$ his displacement relative to the ground will be :

A. 5 m

B. 4.8 m

C. 3.2 m

D. 3.0 m

Answer: C

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14. In a gravity free space, man of mass M standing at a height h above the floor, throws a ball of mass m straight down with a speed u. When the ball reaches the floor, the distance of the man above the floor will be.

A. $h(1 + m/M)$

B. $h(2 - m/M)$

C. 2 h

D. a function of m, h and u.

Answer: A

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15. Two paricle A and B initially at rest, move towards each other under mutual force of attraction. At the instant when the speed of A is V and the speed of B is 2V, the speed of the centre of mass of the system is

A. 0

B. v

C. 1.5 v

D. 3 v

Answer: A

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16. Three balls of different masses are thrown at different instants up againsts up gravity. While all the three balls are in air, the centre of mass of the system of three balls has an acceleration :

A. Equal to 'g'

B. Which depends on the direction of motion and speed of different balls.

C. Which depends on the velocities, height and masses of the balls.

D. Which depends on the direction of motion, speeds and masses of the ball.

Answer: A

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17. A particle of mass $200g$ is dropped from a height of $50m$ and another particle of mass $100g$ is simultaneously projected up from the ground along the same lime, with a speed of

$100 m/s$. The acceleration of the centre of mass after $1 \sec$ is.

A. $10 m/s^2$

B. $\frac{10}{3} m/s^2$

C. 0

D. $9.8 m/s^2$

Answer: D

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18. In the above problem the velocity of the centre of mass after $1 \sec$ will be :

A. $\frac{20}{3} m/s$ vertically down

B. $\frac{20}{3} m/s$ vertically up

C. $\frac{70}{3} m/s$ vertically down

D. $\frac{70}{3} m/s$ vertically up.

Answer: D

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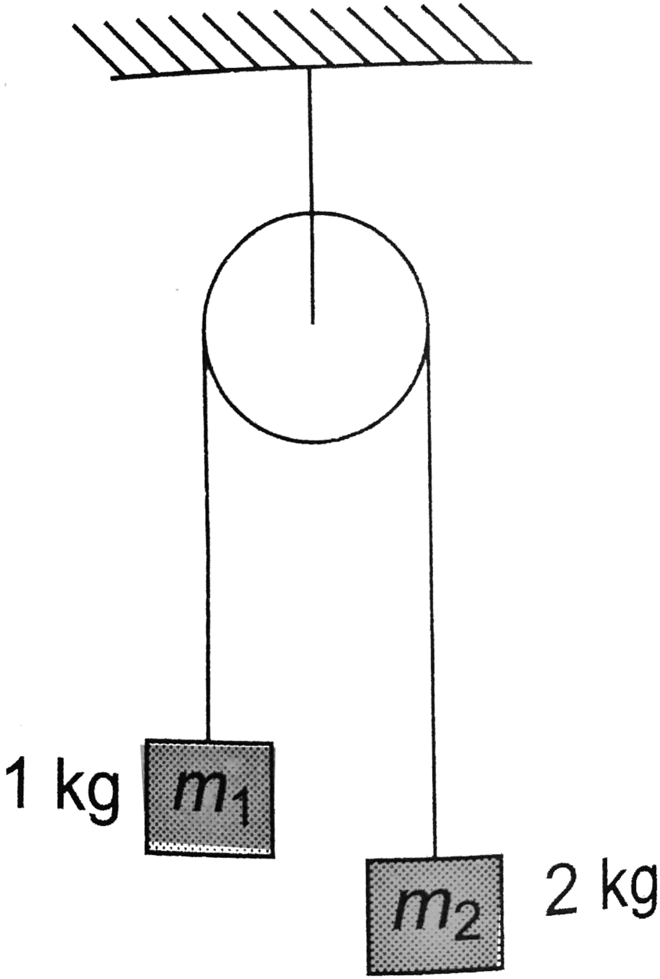
19. Two masses $m_1 = 1kg$ and $m_2 = 2kg$ are connected by a light inextensible string and suspended by means of a weightness pulley as shown in the figure. Assuming that both the masses start from rest, the distance travelled by the centre of mass in two seconds is

$\left(Take g = 10 ms^{-2}.\right.$



A. $\frac{20}{9} m$

B. $\frac{40}{9} m$

C. $\frac{2}{3}m$

D. $\frac{1}{3}m$

Answer: A

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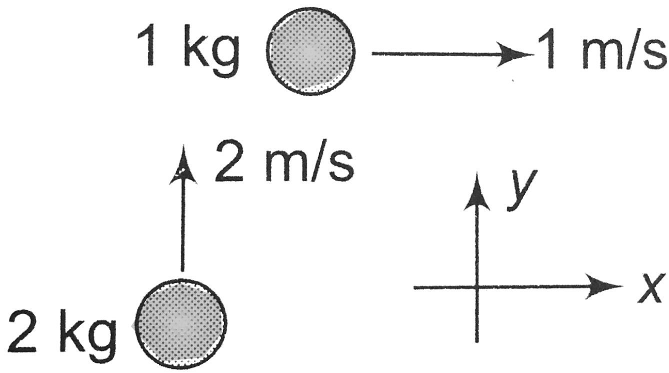
20. Two bodies of masses $1kg$ and $2kg$ are moving in two perpendicular direction with velocities $1m/s$ and $2m/s$ as shown in figure. The velocity of the centre of mass (in magnitide) of the system will be :



A. $3 m/s$

B. $1.67 m/s$

C. $1.5 m/s$

D. $1.37 m/s$

Answer: D

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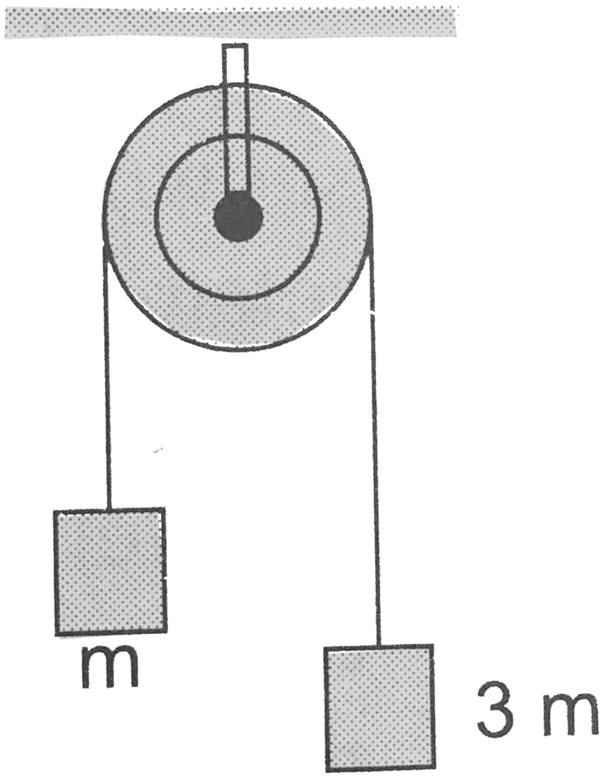
21. If the system is released, then the acceleration of the centre of mass of the system is :



A. $\frac{g}{4}$

B. $\frac{g}{2}$

C. g

D. 2 g

Answer: A

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22. Two particles of equal mass have velocities $\vec{v}_1 = 2\hat{i} = m/s^{-1}$ and $\vec{v}_2 = 2\hat{j}m/s^{-1}$. First particle has an acceleration

$\vec{a}_1 = \left(3\hat{i} + 3\hat{j}\right)ms^{-2}$ while the acceleration of the other particle is zero. The centre of mass of the two particles moves in a path of.

A. straight line

B. parabola

C. circle

D. ellipse

Answer: A

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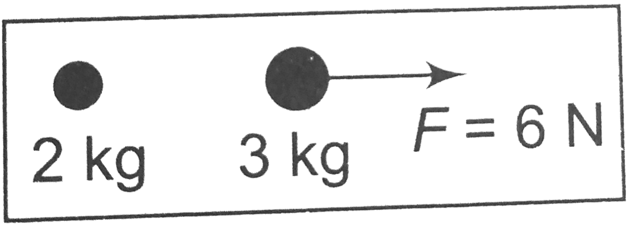
23. Two particles are shown in figure. At $t = 0$ a constant force $F = 6N$ starts acting on $3kg$. Find the velocity of circle of mass of these particle at $t = 5s$.



A. $5m/s$

B. $4m/s$

C. $6m/s$

D. $3m/s$

Answer: C

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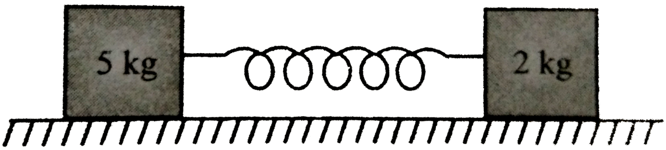
24. Figure shows two blocks of masses $5kg$ and $2kg$ placed on a frictionless surface and connected with a spring. An external kick gives a velocity of $14m/s$ to the heavier block in the direction of lighter one. Deduce (a) velocity gained by the centre of mass and (b) the separate velocities of the two blocks in the centre of mass coordinates just after the kick.



A. $4m/s, 4m/s$

B. $10m/s, 4m/s$

C. $4m/s, 10m/s$

D. $10m/s, 10m/s$

Answer: C

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25. In a system of particles $8kg$ mass is subjected to a force of $16N$ along $+ve$ x-axis and another $8kg$ is subjected to a force of $8N$ along $+ve$ y-axis. The magnitude of acceleration of centre of mass and the angle made by it with x-axis are given respectively by :

A. $\frac{\sqrt{5}}{2} ms^{-2}, \theta = 45°$

B. $3\sqrt{5} ms^{-2}, \theta = \tan^{-1}(2/3)$

C. $\frac{\sqrt{5}}{2} ms^{-2}, \theta = \tan^{-1}(1/2)$

D. $1 ms^{-2}, \theta = \tan^{-1}\sqrt{3}$

Answer: C

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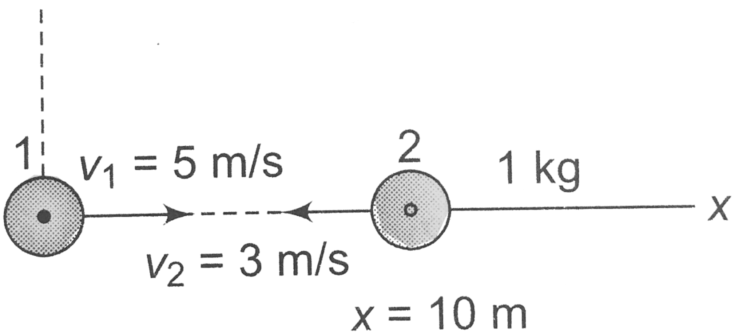
26. At $t = 0$, the positions and velocities of two particles are as shown in the figure. They are kept on a smooth surface and being mutually attracted by gravitational force. Find the position of centre of mass at $t = 2s$.



A. $X = 5$ m

B. $X = 7$ m

C. $X = 3$ m

D. $X = 2$ m

Answer: B

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27. Two blocks of masses 10 kg and 4 kg are connected by a spring of negligible mass and placed on a frictionless horizontal surface. An impulse gives a velocity of $14 m/s$ to the heavier block in the direction of the lighter block. The velocity of the centre of mass is

A. $30 m/s$

B. $20 m/s$

C. $10 m/s$

D. $5 m/s$

Answer: C

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28. A wagon of $200kg$ is moving on a smooth track with velocity of $2m/\sec$. A man of $80kg$ also runs in the wagon with a velocity such that speed of the centre of mass of the system is zero. Find the velocity of man relative to the wagon (in m//s).

A. 5

B. 6

C. 7

D. 8

Answer: C

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29. The velocities of two particles A and B of same mass are $\vec{V}_A = a\hat{i}$ and $\vec{V}_B = b\hat{j}$ where a and b are constants. The acceleration of particle A is $\left(2a\hat{i} + 4b\hat{j}\right)$ and acceleration of particle B is $\left(a\hat{i} - 4b\hat{j}\right)$ in $\left(m/s^2\right)$. The centre of mass of two particle will move in :

A. straight line

B. parabola

C. ellipse

D. circle

Answer: A

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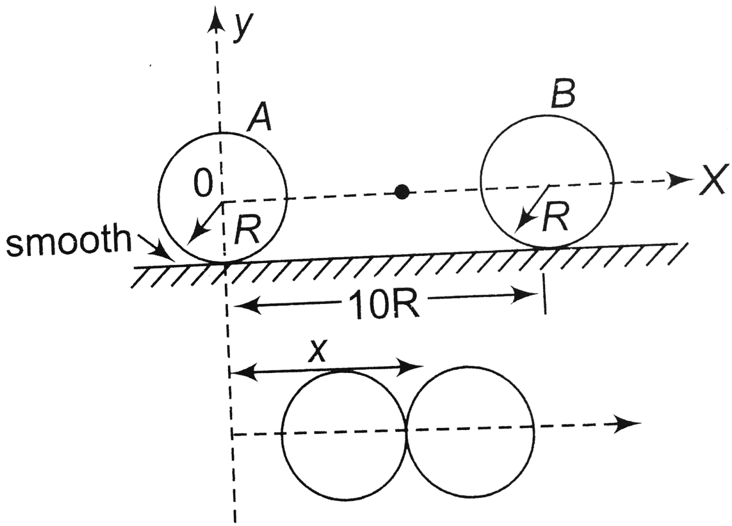
30. Two uniform non conducting balls A and B have identical size having radius R but made of different density material (density of A = 2 density of B). The ball $Ais + vely$ charged and ball B is - vely charged. The balls are released on the horizontal smooth surface at the separation $10R$ as shown in figure. because of mutual attraction the balls start moving towards each other. They will collide at a point.



A. $x = \frac{10R}{3}$

B. $x = \frac{11R}{3}$

C. $x = 5R$

D. $x = \frac{7R}{3}$

Answer: A

Watch Video Solution

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. 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

Answer: A

Watch Video Solution

3. The moment of interia of a body depends upon

A. mass of the body

B. axis of rotation of the body

C. shape and sixe of the body

D. all of these

Answer: D

Watch Video Solution

4. 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. $\frac{ML^2}{4}$

B. $\frac{ML^2}{2}$

C. ML^2

D. $2ML^2$

Answer: B

Watch Video Solution

5. There are four solid balls with their centres at the four corners of a square of side a. the mass of each sphere is m and radius is r. Find the moment of inertia of the system about (i) one of the sides of the square (ii) one of the diagonals of the square.

A. $\frac{8}{5}mr^2$

B. $\frac{8}{5}mr^2 + ma^2$

C. $\frac{8}{5}mr^2 + 2ma^2$

D. $\frac{4}{5}mr^2 + 4ma^2$

Answer: C

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6. The radius of gyration of a 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

Watch Video Solution

7. Moment of inertia of a uniform rod of length L and mass M, about an axis passing through $L/4$ from one end and perpendicular to its length is

A. $\frac{Ml^2}{48}$

B. $\frac{ML^2}{48}$

C. $\frac{ML^2}{12}$

D. $\frac{7ML^2}{48}$

Answer: D

Watch Video Solution

8. The radius of gyration of an uniform rod of length L about an axis passing through its centre of mass and perpendicular to its length is.

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

B. $\frac{L^2}{\sqrt{12}}$

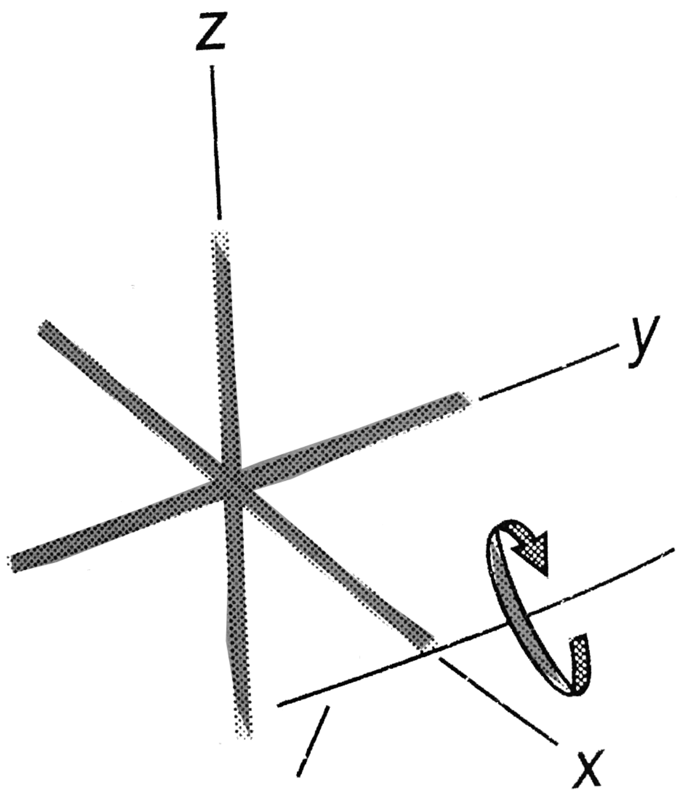
C. $\frac{L}{\sqrt{3}}$

D. $\frac{L}{\sqrt{2}}$

Answer: A

Watch Video Solution

9. Three identical thin rods, each of length L and mass m, are welded perpendicular to one another as shown in figure. The assembly is rotated about an axis that passes through the end of one rod and is parallel to another. The moment of inertia of this structure about this axis is.



.

A. $\frac{7}{12}mL^2$

B. $\frac{11}{14}mL^2$

C. $\frac{5}{12}mL^2$

D. $\frac{11}{12}mL^2$

Answer: D

Watch Video Solution

10. Three identical thin rods, each of mass m and length l, are joined to form an equilateral triangular frame. Find the moment of inertia of the frame about an axis parallel to its one side and passing through the opposite vertex. Also find its radius of gyration about the given axis.

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

B. $\frac{5}{4}ml^2$

C. $\frac{3}{2}ml^2$

D. $\frac{5}{3}ml^2$

Answer: B

Watch Video Solution

11. A uniform thin bar of mass $6m$ and length $12L$ is bend to make a regular hexagon. Its moment of inertia about an axis passing through the centre of mass and perpendicular to the plane of the hexagon is :

A. $20mL^2$

B. $6mL^2$

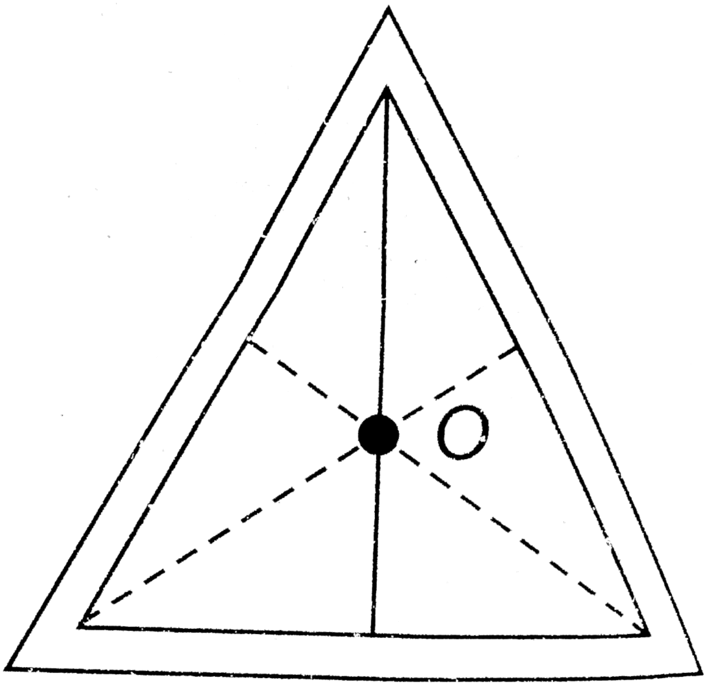
C. $\frac{12}{5}mL^2$

D. $30mL^2$

Answer: A

Watch Video Solution

12. A rod of mass $M kg$ and length $L m$ is bent in the from of an equilateral tringle as shown in Gig. The moment of inertia of the triangle about a vertical axis perpendicular to the plane of the triangle and passing through the centre (in units of kgm^2) is.



A. $\frac{ML^2}{12}$

B. $\frac{ML^2}{54}$

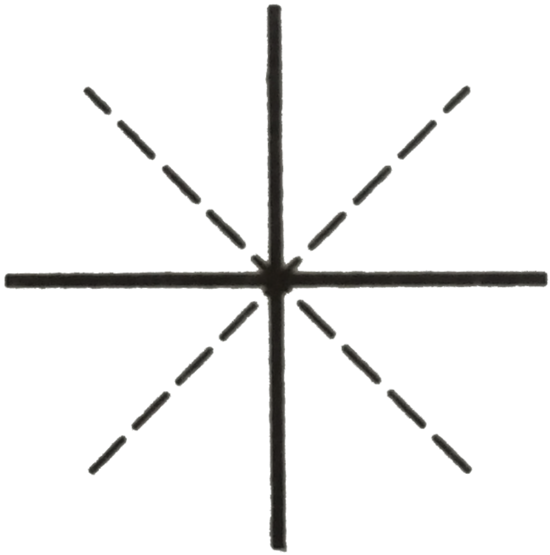
C. $\frac{ML^2}{162}$

D. $\frac{ML^2}{108}$

Answer: B

Watch Video Solution

13. Two uniform identicla rods each of mass M and length l are joined to form a cross as shown in figure. Find the momet of inertia of the cross about a bisector as shown doted in the figure



A. $\dfrac{ML^2}{6}$

B. $\dfrac{ML^2}{4}$

C. $\dfrac{ML^2}{12}$

D. $\dfrac{ML^2}{3}$

Answer: C

Watch Video Solution

14. Three identical thin rods each of length l and mass M are joined together to from a letter. H. What is the moment of inertia of the system about one of the sides of H ?

A. $\frac{Ml^2}{4}$

B. $\frac{Ml^2}{3}$

C. $\frac{2Ml^2}{3}$

D. $\frac{4Ml^2}{3}$

Answer: D

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15. 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.

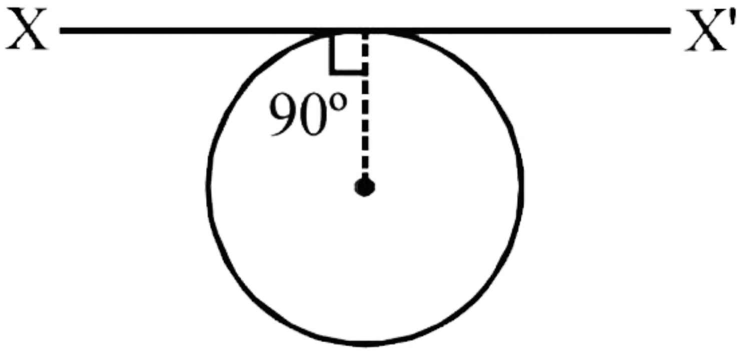
C. A hollow sphere about any of its diameter

D. A solid sphere about any of its diameter.

Answer: C

Watch Video Solution

16. A thin wire of length L and uniform linear mass density ρ is bent into a circular loop with centre at O as shown. The moment of inertia of the loop about the axis XX' is



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A. $\frac{\rho L^3}{8\pi^2}$

B. $\frac{\rho L^3}{16\pi^2}$

C. $\frac{5\rho L^3}{8\pi^2}$

D. $\frac{3\rho L^3}{8\pi^2}$

Answer: D

Watch Video Solution

17. We have two spheres, one of which is hollow and the other solid. They have identical massses and moment of intertia about theur respective diameters. The ratio of their radius is given by.

A. $5:7$

B. $3:5$

C. $\sqrt{3}:\sqrt{5}$

D. $\sqrt{3}:\sqrt{7}$

Answer: C

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18. The radius of gyration of a sphere of radius R about a tangent is.

A. $\frac{\sqrt{2}}{3}R$

B. $\frac{\sqrt{2}}{5}R$

C. $\sqrt{\frac{5}{3}}R$

D. $\sqrt{\frac{7}{5}}R$

Answer: D

Watch Video Solution

19. The moment of inertia of a disc of mass M and radius R about an axis. Which is tangential to sircumference of disc and parallel to its diameter is.

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

B. $\frac{2}{3}MR^2$

C. $\frac{3}{2}MR^2$

D. MR^2

Answer: A

Watch Video Solution

20. 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.

A. 5 I

B. 3 I

C. 6 I

D. 4 I

Answer: C

Watch Video Solution

21. Two circular discs A and B of equal masses and thicknesses. But are made of metals with densities d_A and $d_B\left(d_A > d_B\right)$. If their moments of inertia about an axis passing through the centre and normal to the circular faces be I_A and I_B, then.

A. $I_A = I_B$

B. $I_A > I_B$

C. $I_A < I_B$

D. $I_A \geq I_B$

Answer: C

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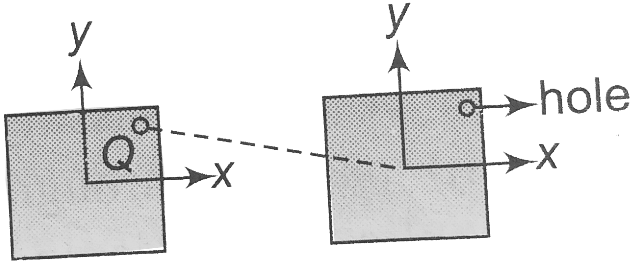
22. A uniform square plate has a small piece Q of an irregular shape removed and glued to the centre of the plate leaving a hole behind in figure. The moment of inertia about the z-axis is then,



A. increased

B. decreased

C. the same

D. changed in unpredicted manner

Answer: B

Watch Video Solution

23. The moment of inertia of an elliptical disc of uniform mass distribution of mass 'm' major axis 'r', minor axis 'd' about its axis is :

A. $= \frac{mr^2}{2}$

B. $= \frac{md^2}{2}$

C. $> \frac{mr^2}{2}$

D. $< \frac{mr^2}{2}$

Answer: D

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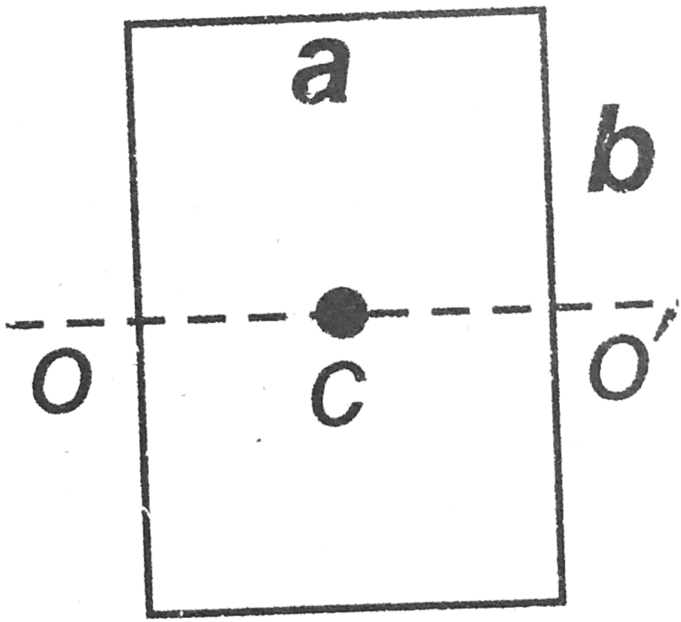
24. A rectangular lop has mass M and sides a and b. An axis OO' passes through the centre

C of the loop and is parallel to side a (lie in the plane of the loop). Then the radius of gyration of the loop, for the axis OO' is.



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

B. $\frac{\sqrt{(a^2+b^2)}}{12}$

C. $\sqrt{\frac{b^2+3a^2}{12}}$

D. none of these

Answer: A

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25. The moment of inertia of a door of mass m, length $2l$ and width l about its longer side is.

A. $\frac{11ml^2}{24}$

B. $\frac{5ml^2}{24}$

C. $\frac{ml^2}{3}$

D. none of these

Answer: C

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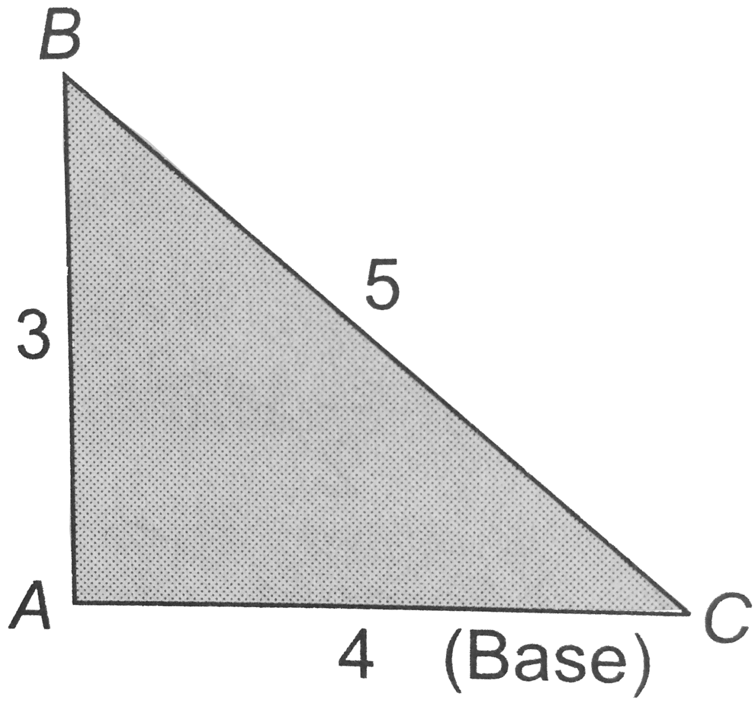
26. Moment of inertia of uniform triangular plate about axis passing through sides

AB, AC, BC are I_p, I_B and I_H respectively and about an axis perpendicular to the plane and passing through point C is I_C. Then :



A. $I_C > I_p > I_B > I_H$

B. $I_H > I_B > I_C > I_p$

C. $I_p > I_H > I_B > I_C$

D. none of these

Answer: A

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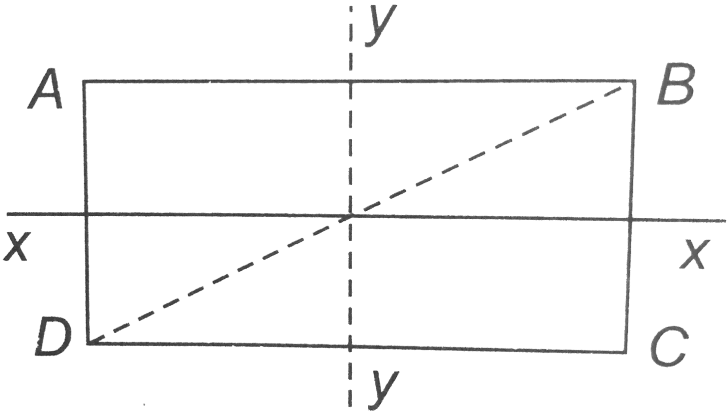
27. In a rectangle $ABCD, AB = 21$ and $BC = 1$. Axes × and yy pass through centre of the rectangle. The moment of inertia is least about :



A. DB

B. BC

C. xx

D. yy

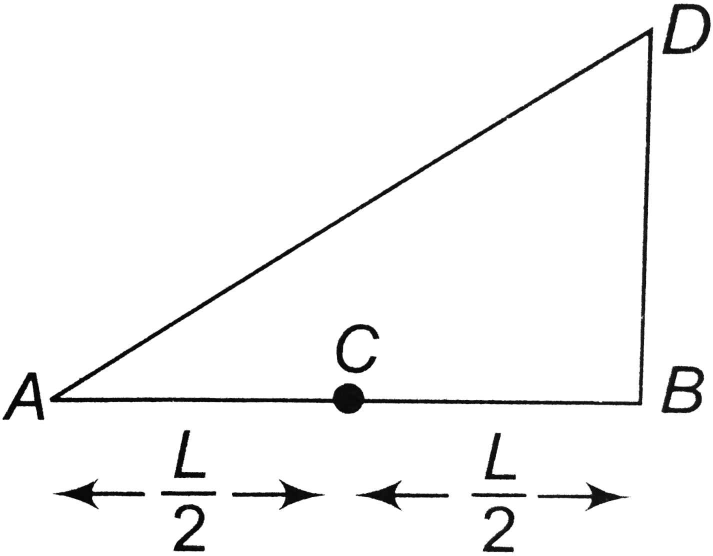
Answer: A

Watch Video Solution

28. A triangular plate of uniform thickness and density is made to rotate about an axis perpendicular to the plane of the paper and

(i) passing through A,

(ii) passing through B, by the application of some force F at C (mid - point AB) as shown in the figure. In which case angular acceleration is more ?



A. In case (i)

B. In case (ii)

C. Both (i) and (ii)

D. None of these

Answer: B

Watch Video Solution

29. A circular disc A of radius r is made from aniron plate of thickness t and nother circular disc B of rdius 4r is made fro an iron plate of thickness t/4. The relatiion between the moments of inertia I_A and I_B is

A. $I_A > I_B$

B. $I_A = I_B$

C. $I_A < I_B$

D. depends on the actual values of t and r.

Answer: C

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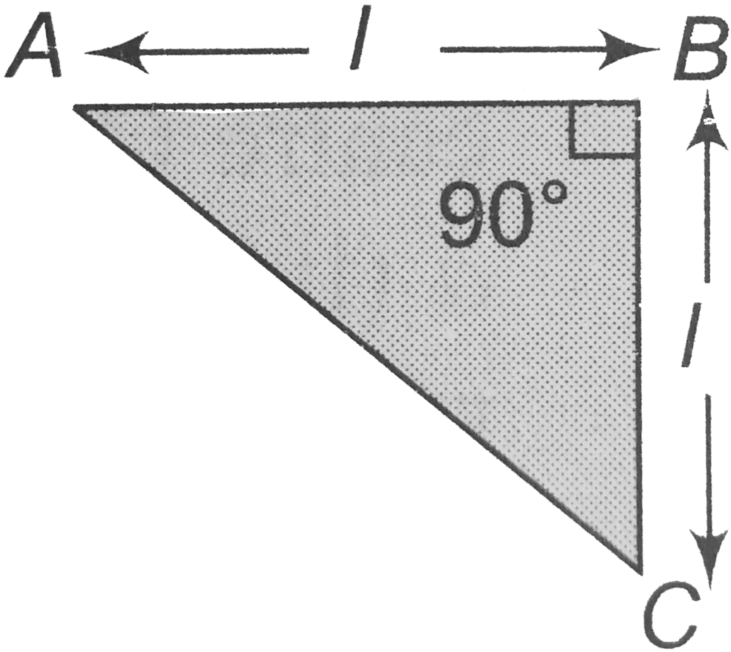
30. Figure shows a thin metallic triangular sheet ABC. The mass of the sheet is M. The moment of inertia of the sheet about side AC

is :



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A. $\dfrac{Ml^2}{18}$

B. $\dfrac{Ml^2}{12}$

C. $\dfrac{Ml^2}{6}$

D. $\dfrac{Ml^2}{4}$

Answer: B

Watch Video Solution

31. Two spheres each of mass M and radius $R/2$ are connected at their centres with a mass less rod of length $2R$. What will be the moment of inertia of the system about an axis passing through the centre of one of the sphere and perpendicular to the rod ?

A. $21MR^2/5$

B. $2MR^2/5$

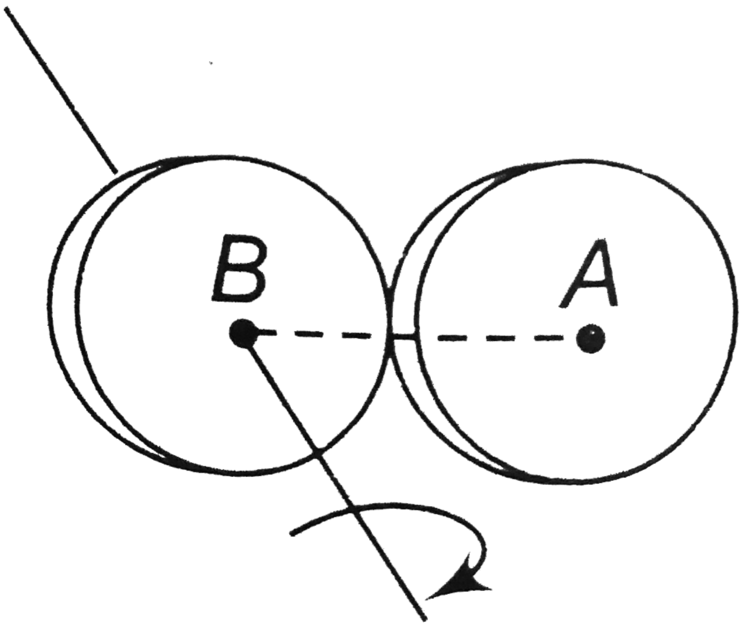
C. $5MR^2/2$

D. $5MR^2/21$

Answer: A

Watch Video Solution

32. Two thin discs each of mass M and radius r are attached as shown in figure, to from a rigid body. The rotational inertia of this body about an axis perpendicular to the plane of disc B and passing through its centre is :



A. $2Mr^2$

B. $3Mr^2$

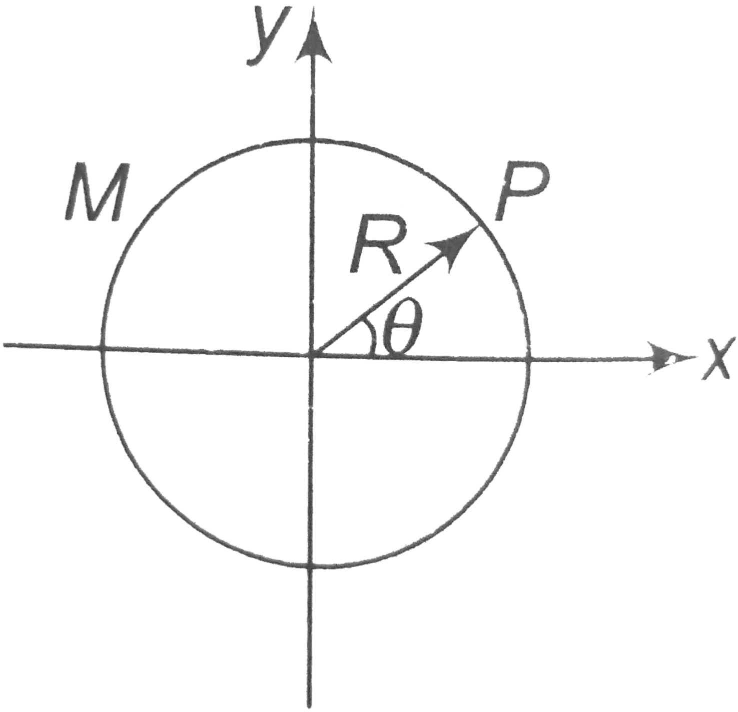
C. $4Mr^2$

D. $5Mr^2$

Answer: D

Watch Video Solution

33. A ring of mass M and radius R lies in x - y plane with its centre at origin as shown. The mass distribution of ring is non uniform such that, at any point P on the ring, the mass per unit length is given by $\lambda = \lambda_0 \cos^2\theta$ (where λ_0 is a positive constant). Then the moment of inertia of the ring about z-axis is :



A. MR^2

B. $\frac{1}{2}MR^2$

C. $\frac{1}{2}\frac{M}{\lambda_0}R$

D. $\frac{1}{\pi}\frac{M}{\lambda_0}R$

Answer: A

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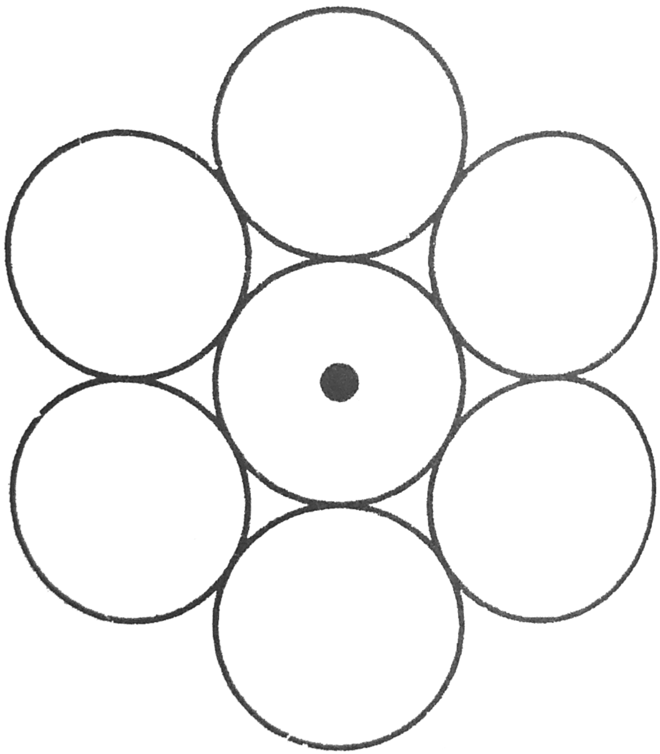
34. Seven identical discs are arranged in a hexagonal, planar pattern so as to touch each neighbor, as shown in the figure. Each disc has mass m and radius r. What is the moment of inertia of the system of seven discs about an axis passing through the centre of central disc and normal to plane of all discs ?



A. $\frac{7}{2}mr^2$

B. $\frac{13}{2}mr^2$

C. $\frac{29}{2}mr^2$

D. $\frac{55}{2}mr^2$

Answer: D

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35. A solid aluminimum sphere of radius R has moment of inertia I about an axis through its centre. The moment of inertia about a central axis of a solid aluminimum sphere of radius $2R$ is.

A. 4 I

B. 8 I

C. 16 I

D. 32 I

Answer: D

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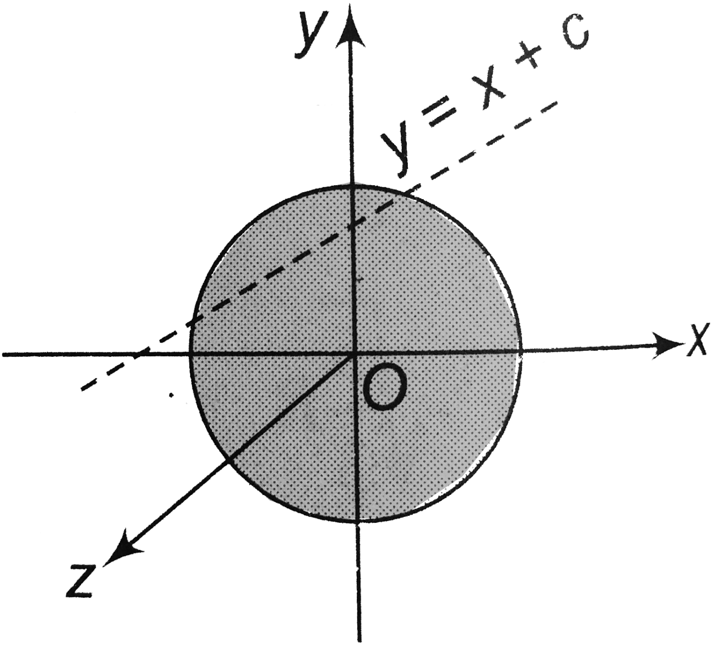
36. A uniform disc of radius R lies in the x - y plane, with its centre at origin. Its moment of inertia about z-axis is equal to its moment of inertia about line $y = x + c$. The value of c will be.



A. $-\frac{R}{2}$

B. $\pm \frac{R}{\sqrt{2}}$

C. $\frac{+R}{4}$

D. $-R$

Answer: B

Watch Video Solution

37. The moment of inertia of a hollow cubical box of mass M and side a about an axis passing through the centres of two opposite faces is equal to.

A. $\frac{5Ma^2}{3}$

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

C. $\frac{5Ma^2}{12}$

D. $\frac{5Ma^2}{18}$

Answer: D

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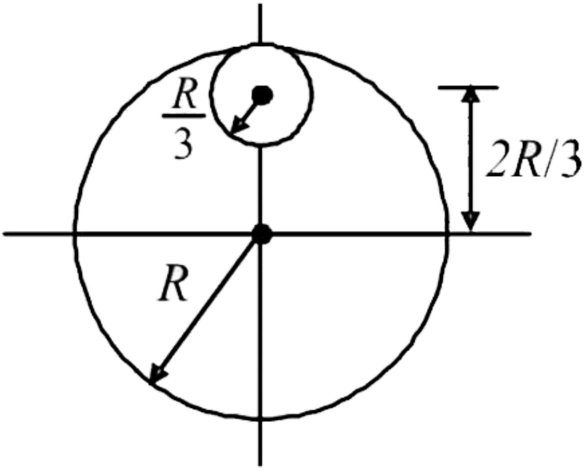
38. From a circular disc of radius R and mass 9 M , a small disc of radius R/3 is removed from the disc. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through O is



A. $4MR^2$

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

C. $40MR^2$

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

Answer: A

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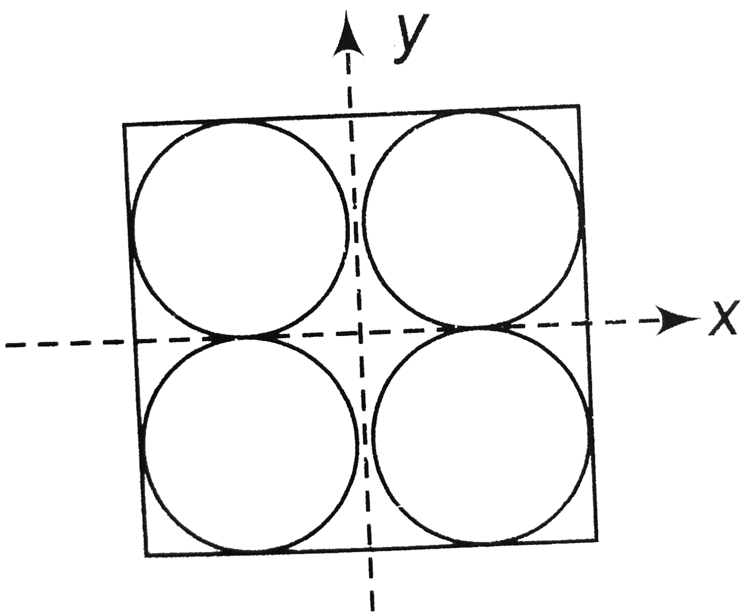
39. Four holes of radius R are cut from a thin square plate of side $4R$ and mass M. The moment of inertia of the remaining portion about z-axis is :



A. $\frac{\pi}{12}MR^2$

B. $\left(\frac{4}{3} - \frac{\pi}{4}\right)MR^2$

C. $\left(\frac{8}{3} - \frac{10\pi}{16}\right)MR^2$

D. $\left(\frac{4}{3} - \frac{\pi}{6}\right)MR^2$.

Answer: C

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Rotational Kinematics

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

A. 22 s

B. 11 s

C. 44 s

D. 12 s

Answer: A

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2. An athlete throws a discus from rest to a final angular velocity of $15 rads^{-1}$ 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. $45 ms^{-2}$

B. $180 ms^{-2}$

C. $187 ms^{-2}$

D. $192 ms^{-2}$

Answer: A

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3. The angular velocity of a rigid body about any point of that body is same :

A. only in magnitude

B. only in direction

C. both in magnitude and direction necessarily

D. both in magnitude and direction about some points but not about all points.

Answer: C

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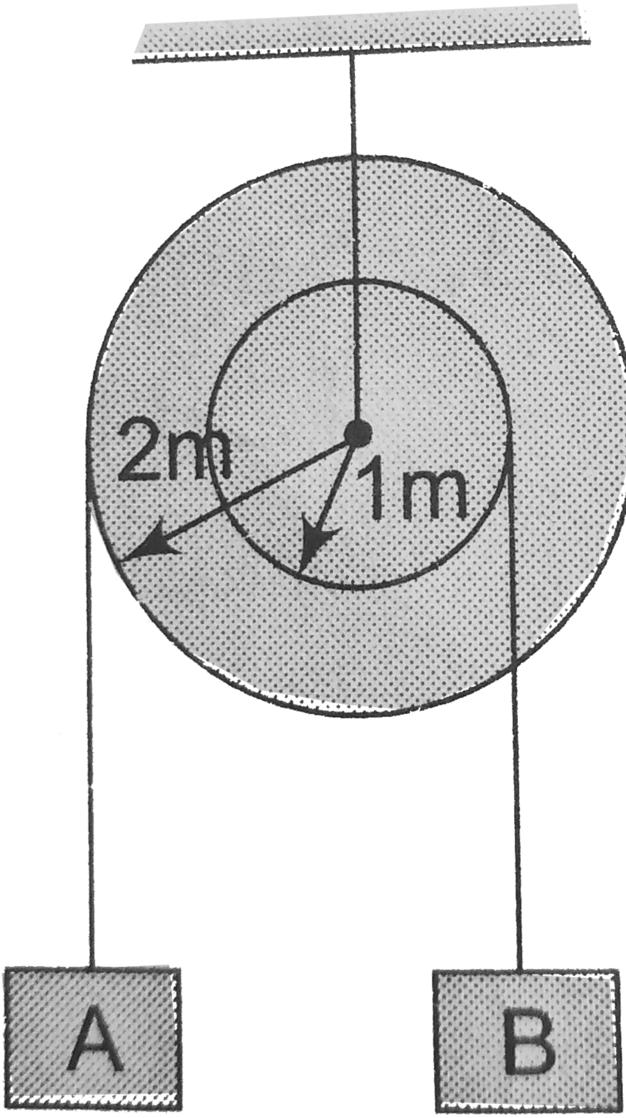
4. In the pulley system shown, if radii of the bigger and smaller pulley are $2m$ and $1m$ respectively and the acceleration of block A is $5m/s^2$ in the downward direction, then the acceleration of block B will be :



A. $0 m / s^2$

B. $5 m / s^2$

C. $10 m / s^2$

D. $\frac{5}{2} m / s^2$

Answer: D

Watch Video Solution

5. Two points of a rod move with velocity $3v$ and v perpendicular to the rod and in the same direction, separated by a distance r.

Then the angular velocity of the rod is :

A. $\frac{3v}{r}$

B. $\frac{4v}{r}$

C. $\frac{5v}{r}$

D. $\frac{2v}{r}$

Answer: D

Watch Video Solution

6. When a person throws a meter stick it is found that the centre of the stick is moving with speed $10 m/s$ and left end stick with speed $20 m/s$. Both points move vertically upwards at that moment. Then angular speed the stick is :

A. $20 rad/\sec$

B. $10 rad/\sec$

C. $30 rad/\sec$

D. none of these

Answer: A

Watch Video Solution

7. A ring of radius R rolls without slipping on a rough horizontal surface with a constant velocity. The radius of curvature of the path followed by any particle of the ring at the highest point of its path will be :

A. R

B. 2 R

C. 4 R

D. none of these

Answer: C

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8. A cyclist rides a bicycle with a wheel radius of $0.500m$ across campus. A piece of plastic on the front rim makes a clicking sound every time it passes through the fork. If the cyclist counts 320 clicks between her apartment and the cafeteria, how far has she travelled ?

A. 0.50 km

B. 0.80 km

C. 1.0 km

D. 1.5 km

Answer: C

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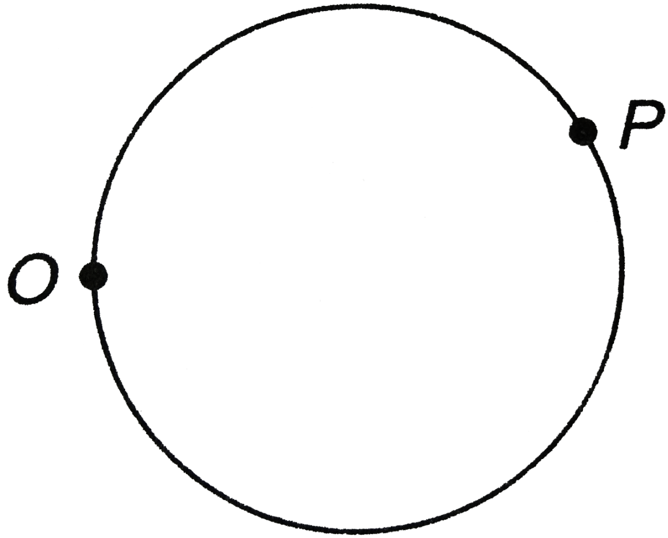
9.



Particle P shown in figure is moving in a circle of radius $R = 10$ cm with linear speed $v = 2m/s$ Find the angular speed of particle about point O.

A. $20 rads^{-1}$

B. $10 rads^{-1}$

C. $15 rads^{-1}$

D. $25 rads^{-1}$

Answer: B

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10. A grindstone increases in angular speed from $4.00 rad/s$ to $12.00 rad/s$ in $4.00s$. Through what angle does it turn during that time interval if he angular acceleration is constant ?

A. 8.00 rad

B. 12.0 rad

C. 16.0 rad

D. 32.0 rad

Answer: D

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11. Suppose a car's standard tires are replaced with tires 1.50 times larger in diameter. Will the car's speedometer reading be.

A. 2.25 times too high

B. 1.50 times too high

C. 1.50 times too low

D. 2.25 times too low

Answer: D

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12. In previous problem, the car's fuel economy in miles per gallon or km/L appear to be.

A. 1.50 times better

B. 2.25 times better

C. 1.50 times worse

D. 2.25 times worse

Answer: C

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13. When a slice of buttered toast is accidentally pushed over the edge of a counter, it rotates as it falls. If the distance to the floor is $80cm$ and for rotation less than $1rev$, what are the

(i) smallest and

(ii) largest angular speeds that cause the toast to hit and then topple to be butter-side down ?

A. smallest angular speed is $\frac{5\pi}{4} rad/s$ and largest angular speed is $\frac{15\pi}{4} ra\frac{d}{s}$.

B. smallest angular speed is $\frac{\pi}{4} rad/s$ and largest angular speed is $\frac{3\pi}{4} rad/s$

C. smallest angular speed is $\frac{\pi}{2} rad/s$ and largest angular speed is $\frac{3\pi}{2} rad/s.$

D. smallest angular speed is $\frac{5\pi}{2} rad/s$ and largest angular speed is $\frac{15\pi}{2} rad/s.$

Answer: A

Watch Video Solution

14. A diver makes 2.5 revolutions on the way from a $10 - m - high$ platform to the water.

Assuming zero initial vertical velocity, the average angular velocity during the dive is.

A. $\frac{3\pi}{\sqrt{2}} rad/s$

B. $\frac{5\pi}{\sqrt{2}} rad/s$

C. $\frac{5\pi}{\sqrt{3}} rad/s$

D. $\frac{\pi}{\sqrt{2}} rad/s$

Answer: B

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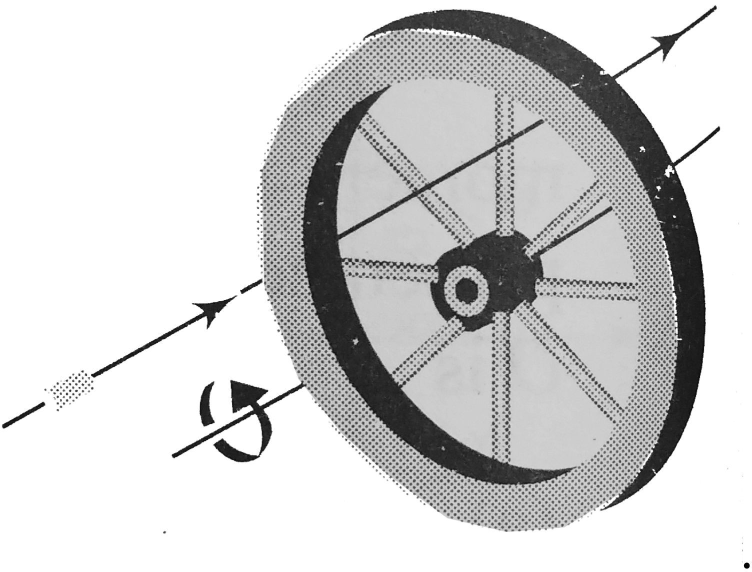
15. The wheel in figure has eight equally spaced spokes and of $30cm$. It is mounted on a fixed axle and is spinning at $2.5rev/s$. You want to shoot a 20 - cm - $long$ arrow parallel to this axle and through the wheel without hitting any of the spokes. Assume that the arrow and the spokes are very thin. What minimum speed must the arrow and the spokes are very thin.

What minimum speed must the arrow have ?



A. $3.50 m/s$

B. $2.5 m/s$

C. $5.0 m/s$

D. $4.0 m/s$

Answer: D

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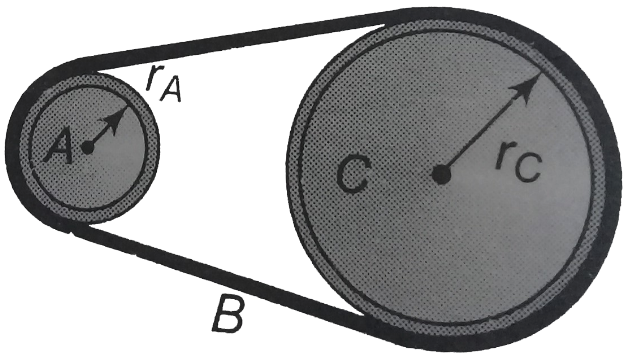
16. In figure whell A of radius $r_A = 10cm$ is coupled by belt B to whell C of radius $r_C = 25cm$. The angular speed of whell A is increased from rest at a constant rate of $1.6rad/s^2$. Find the time needed for whell C to reach an angular speed of $12.8rad/s$, assuming the belt does not slip.



A. 15 s

B. 12.5 s

C. 20 s

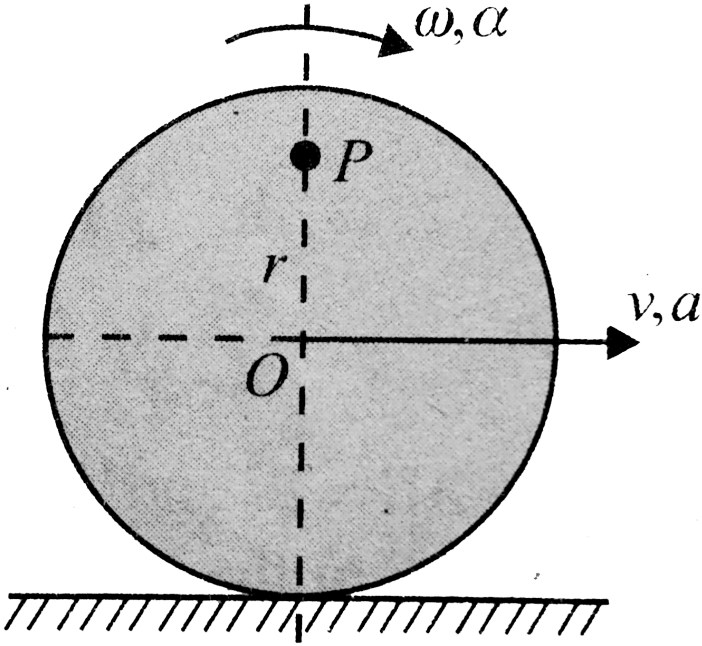
D. 10 s

Answer: C

Watch Video Solution

17. A disc of radius R rolls on a horizontal ground with linear acceleration a and angular acceleration α as shown in Fig. The magnitude of acceleration of point P as shown in the figure at an instant when its linear velocity is v

and angular velocity is ω will be a



A. $\sqrt{(a + r \propto)^2 + \left(r\omega^2\right)^2}$

B. $\frac{ar}{R}$

C. $\sqrt{r^2 \propto^2 + r^2\omega^4}$

D. $r \propto$

Answer: A

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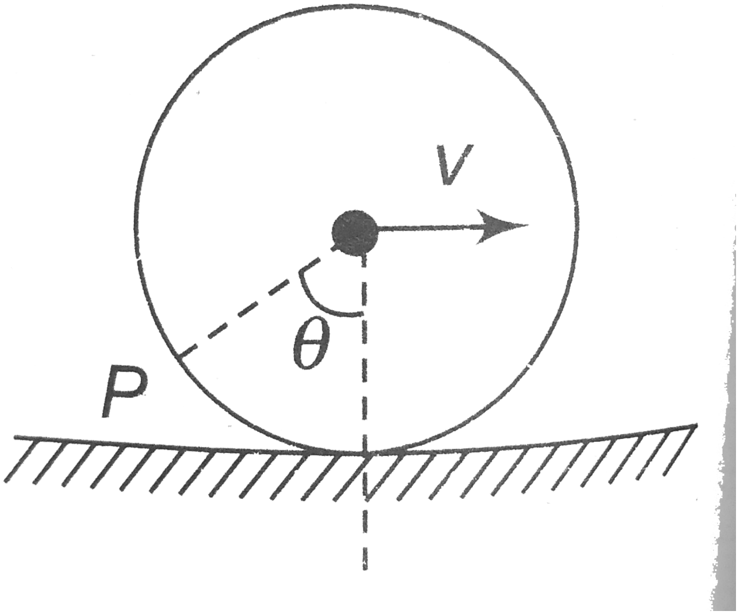
18. A hoop rolls on a horizontal ground without slipping with linear speed v. Speed of a particle P on the circumference of the hoop at angle θ is :



A. $2v\sin(\theta/2)$

B. $v\sin\theta$

C. $2v\cos(\theta/2)$

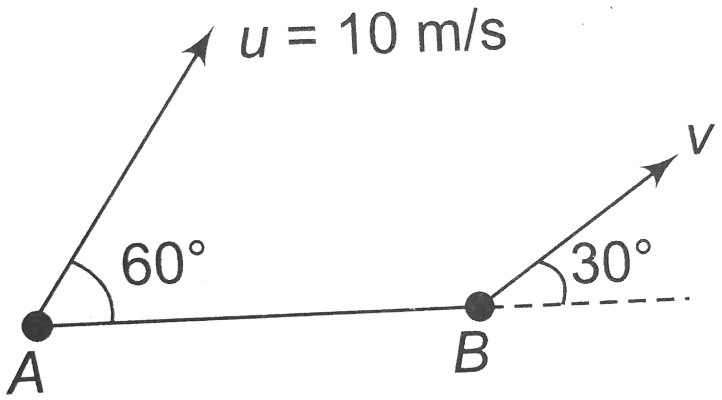
D. $v\cos\theta$

Answer: A

Watch Video Solution

19. Two particles A and B are situated at a distance $d = 2m$ apart. Particle A has a velocity of $10m/s$ at an angle of $60\,^\circ$ and particle B has a velocity v at an angle $30\,^\circ$ as shown in figure. The distance d between A and B is constant.

the angular velocity of B with respect to A is :



A. $5\sqrt{3} rad/s$

B. $\frac{5}{\sqrt{3}} rad/s$

C. $10\sqrt{3} rad/s$

D. $\frac{10}{\sqrt{3}} rad/s$

Answer: B

Watch Video Solution

Torque , Torque Equation And Equilibrium Of A Rigid Body

1. A couple produces.

A. purely translational motion

B. purely rotational motion

C. bth translational and rotational motion

D. no motion

Answer: B

Watch Video Solution

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. When a steady torque (net force is zero) is acting on a body, the body.

A. rotates at a constant speed

B. gets both linear and angular acceleration

C. gets no angular acceleration

D. centre of the body continues in its state of rest or uniform motion along a straight line.

Answer: D

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4. The force $7\hat{i} + 3\hat{j} - 5\hat{k}$ acts on a particle whose position vector is $\hat{i} - \hat{j} + \hat{k}$. What is the torque of a given force about the origin ?

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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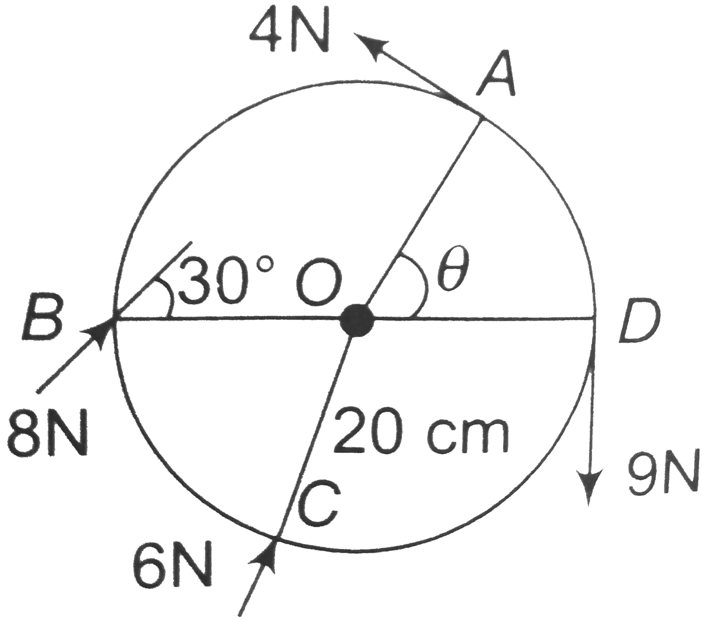
5. A wheel of radius $20cm$ has four forces applied to it as shown in fig. Then, the torque produced by these forces about O is.



A. $5.4Nm$ anticlockwise

B. $1.8Nm$ clockwise

C. $1.8Nm$ anticlockwise

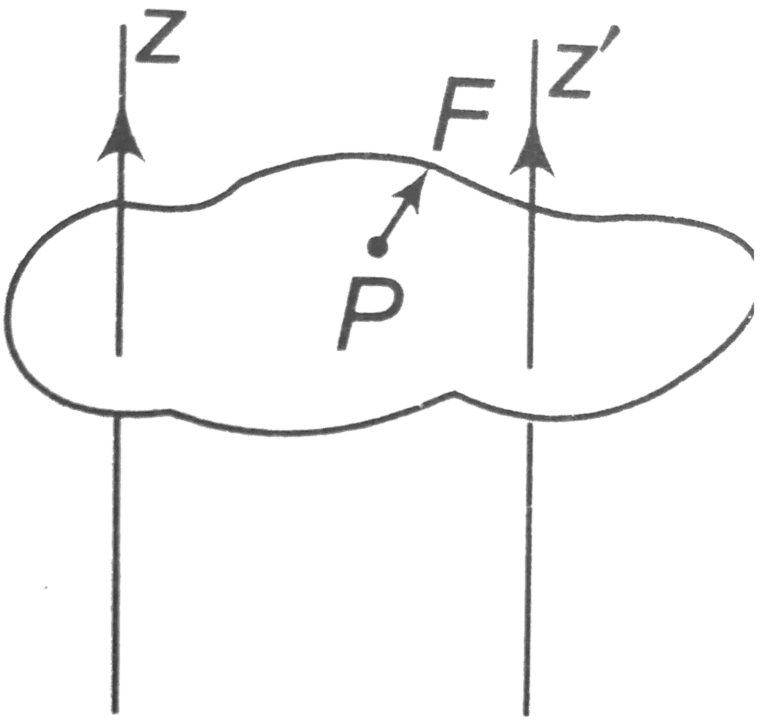
D. $5.4Nm$ clockwise

Answer: B

Watch Video Solution

6. 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 $z' - a\xi s$ 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 -$\hat{k}$

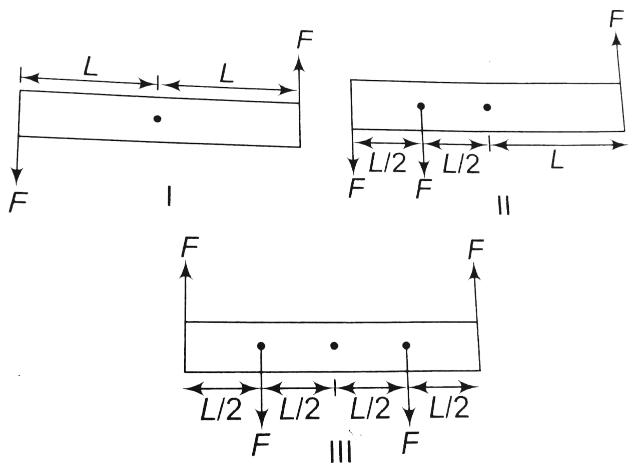
C. Torque caused by F about z axis is greater in magnitude than that about z' axis.

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

Answer: D

Watch Video Solution

7. 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

Watch Video Solution

8. A uniform rod of length $1m$ mass $4kg$ is supports on two 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. 60 N, 40 N

B. 75 N, 25 N

C. 65 N, 35 N

D. 55 N, 45 N

Answer: C

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9. A metre stick is balanced on a knife edge at its centre. When two coins, each of mass $5g$ are put one on one of the other at the $12cm$

mark, the stick is found to balanced at $45cm$.

The mass of the metre stick is.

A. 56 g

B. 66 g

C. 76 g

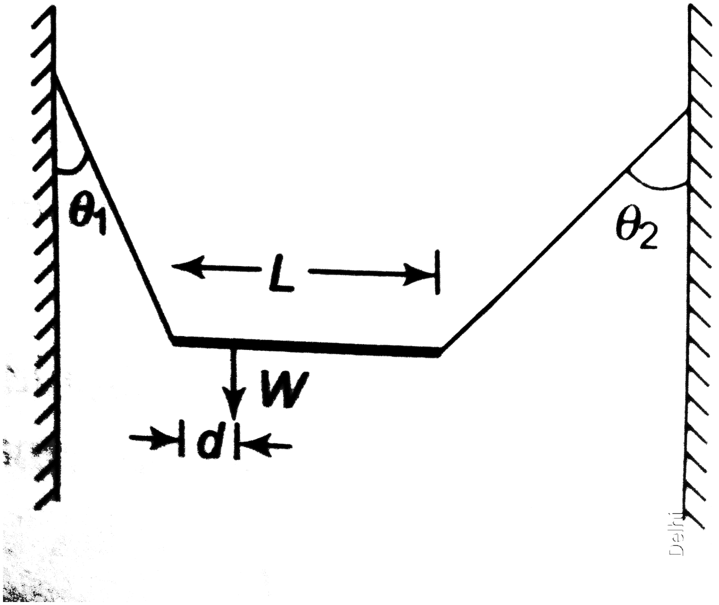
D. 36 g

Answer: B

Watch Video Solution

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

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

Answer: B

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11. A uniform cube of side a and mass m rests on a rough horizontal table. A horizontal force F is applied normal to one of the faces at a point that is directly above the centre of the face, at a height 3a/4 above the base. The minimum value of F which the cube begins to tip about the edge is ....(Assume that the cube does not slide).

A. $\frac{2mg}{3}$

B. $\frac{mg}{4}$

C. $\frac{3mg}{4}$

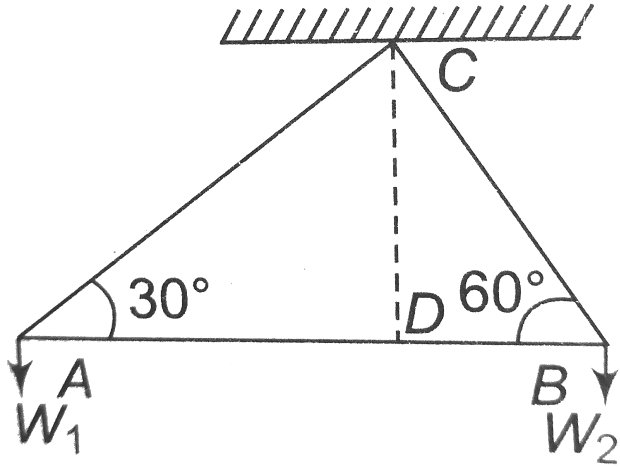
D. mg

Answer: A

Watch Video Solution

12. A triangular set square of angles $30°, 60°, 90°$ and of negligible mass is suspended freely from the right angled corner and weights are hung at the two corners. If the hypotenuse of the set square sets horizontally, then the ratio of the weights

W_1/W_2 is.



A. $1:1$

B. $1:3$

C. $\sqrt{3}:1$

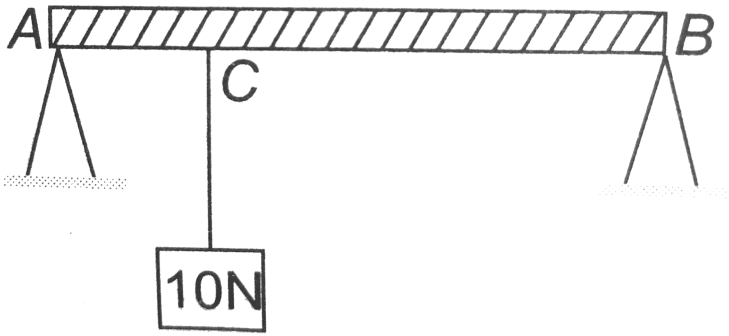
D. $1:\sqrt{3}$

Answer: B

Watch Video Solution

13. A rigid massless rod AB of length $1m$ is placed horizontally on two rigid supports at its ends as showm in figure. A weight $10N$ is hung from a point C at a distance $30cm$ from A. Find the reactions at the supports A and B

respectively.



A. 5 N, 5 N

B. 3 N, 7 N

C. 10 N, 0 N

D. 7 N, 3 N

Answer: D

Watch Video Solution

14. Solve the above question if rod has a weight $20N$ uniformly distributed over its length.

A. 15 N, 15 N

B. 13 N, 17 N

C. 18 N, 12 N

D. 17 N, 13 N

Answer: D

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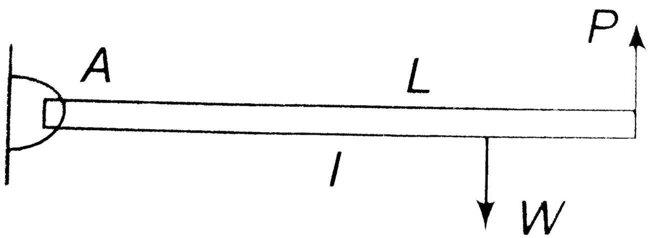
15. A rigid mass less rod of length L is hinged at its one end a weight W is hung at a distance $l(<L)$ from this end.

What is force P should be applied upwards at the other end so that the rod remains in equilibrium horizontally ?



A. $\dfrac{W(L-l)}{L}$

B. $\frac{W(L - l)}{l}$

C. $\frac{Wl}{L}$

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

Answer: C

Watch Video Solution

16. In previous problem, what is the reaction force on the hinge ?

A. $W - P$ upward

B. $W - P$ downward

C. $W - P$ to the left

D. None of these

Answer: B

Watch Video Solution

17. Where must a $800N$ weight be hung on a uniform horizontal $100N$ pole of length L so that a body at one end supports one-third as much as a man at the other end ?

A. at a distance of $0.22L$ from man

B. at a distance of $0.22L$ from boy

C. at a distance of $0.33L$ from man

D. in the middle

Answer: A

Watch Video Solution

18. A unifrom horizontal $200N$ beam AB length L has two weights hanging from it, $300N$ at $L/3$ from end A and $400N$ at $3L/4$ from the same end. What single additional force acting on the beam will produced equilibrium ?

A. $900N$, in the middle

B. $900N$, at $0.4L$ from A

C. $900N$, $at0.46L$ from A

D. $900N$, at $0.56L$ from A

Answer: D

Watch Video Solution

19. A weightless rod is acted on by upward parallel forces of $2N$ and $4N$ ends A and B respectively. The total length of the rod $AB = 3m$. To keep the rod in equilibrium a fo rce of $6N$ should act in the following manner :

A. Downwards at any point between A and B

B. Downwards at the mid point of AB

C. Downwards at a point C such that $AC = 1m$

D. Downwards at a point D such that

$BD = 1m$.

Answer: D

Watch Video Solution

20. A false balance has equal arms. An object weights W_1 when placed in one pan and W_2 when placed in the other pan. The true weight W of the object is.

A. $\sqrt{W_1 W_2}$

B. $\sqrt{W_1^2 + W_2^2}$

C. $\dfrac{W_1 + W_2}{2}$

D. $\dfrac{2W_1 W_2}{W_1 + W_2}$

Answer: C

Watch Video Solution

21. The beam and pans of a balance have negligible mass. An object weight W_1 when placed in one pan and W_2 when placed in the other pan. The weights W of the object is.

A. $\sqrt{W_1 W_2}$

B. $\sqrt{W_1^2 + W_2^2}$

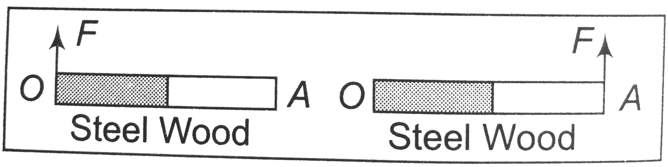
C. $\frac{W_1 + W_2}{2}$

D. $\frac{2W_1 W_2}{W_1 + W_2}$

Answer: A

Watch Video Solution

22. In first figure a meter stick, half of which is wood and the other half steel is pivoted at the wooden end at A and a force is applied at the steel and at O. On second figure the stick is pivoted at the steel end at O and the same force is applied at the wooden end at A. The angular acceleration.



A. in first is greater than in second

B. equal in both first and second

C. in second is greater than in first

D. None of the above.

Answer: C

Watch Video Solution

23. A ring starts from rest and acquires an angular speed of $10 rads^{-1}$ in $2s$. The mass of the ring is $500 gm$ and its radius is $20 cm$. The torque on the ring is.

A. 0.02 Nm

B. 0.20 Nm

C. 0.10 Nm

D. 0.01 Nm

Answer: C

Watch Video Solution

24. A wheel of moment of inertia $2.0 \times 10^3 kgm^2$ is rotating at uniform angular speed of

$4 rad s^{-1}$. What is the torque required to stop it in one second.

A. $0.5 \times 10^3 Nm$

B. $8.0 \times 10^3 Nm$

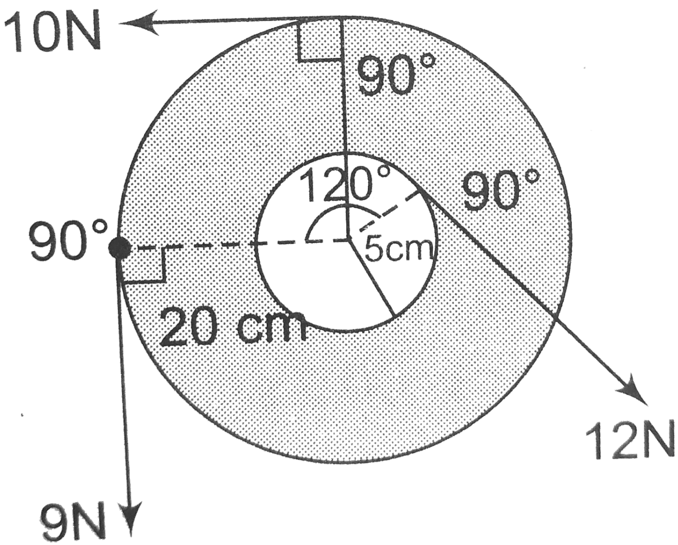
C. $2.0 \times 10^3 Nm$

D. none of these

Answer: B

Watch Video Solution

25. The moment of inertia of an angular wheel shown in figure is $3200 kgm^2$. If the inner radius is $5 cm$, and the outer radius is $20 cm$, and the wheel is acted upon by the forces shown, then the angular acceleration of the wheel is.



A. $10^{-1} rad/s^2$

B. $10^{-2} rad/s^2$

C. $10^{-3} rad/s^2$

D. $10^{-4} rad/s^2$

Answer: C

Watch Video Solution

26. A uniform disc of mass M and radius R is mounted on an axle supported in frictionless bearings. A light cord is wrapped around the rim of the disc and a steady downward pull T is exerted on the cord. The angular acceleration of the disc is

A. $\frac{T}{MR}$

B. $\frac{MR}{T}$

C. $\frac{2T}{MR}$

D. $\frac{MR}{2T}$

Answer: C

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27. In previous problem, the tangential acceleration of a point on the rim is :

A. $\frac{T}{M}$

B. $\frac{MR^2}{T}$

C. $\frac{2T}{M}$

D. $\frac{MR^2}{2T}$

Answer: C

Watch Video Solution

28. In $Q.137$, if we hang a body of mass m from the cord, the tangential acceleration of the disc is :

A. $\frac{mg}{M + m}$

B. $\frac{mg}{M + 2m}$

C. $\frac{2mg}{M + 2m}$

D. $\frac{M + 2m}{2mg}$

Answer: C

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29. In $Q.137$, the tension in the cord in the above problem is :

A. $\frac{mg}{M+m}$

B. $\frac{Mmg}{M+2m}$

C. $\frac{M+2m}{Mmg}$

D. none of these

Answer: B

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Angular Momentum And Its Conservation

1. A constant torque acting on a uniform circular wheel changes its angluar momentum from A_0 to $4A_0$ in $4s$. The magnitude of this torque is equal to.

A. $3A_0/4$

B. $4A_0$

C. A_0

D. $12A_0$

Answer: A

Watch Video Solution

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

A. is zero

B. remains constant

C. goes on increasing

D. goes on decreasing

Answer: B

Watch Video Solution

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

A. Moment of inertia

B. Angular momentum

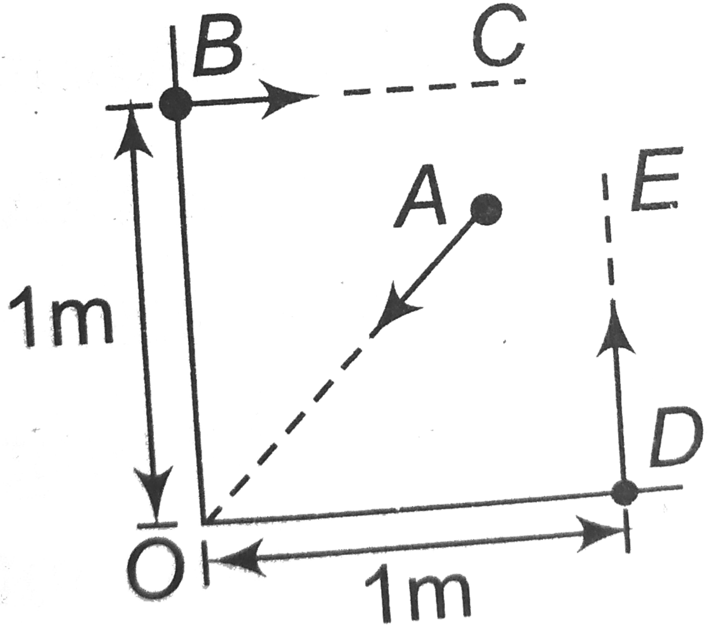
C. Angular velocity

D. Rotational kinetic energy

Answer: B

Watch Video Solution

4. A particle of mass M may move with the velocity v, along AO, or DE or BC. Then which of the following statements is not correct about particle's angular momentum about point O.



A. It is zero when it is at A andmoves along

OA.

B. It is same at all points along the line DE

C. It is of the same magnitude but oppositely directed B and D.

D. It increases as it moves along the line BC.

Answer: D

Watch Video Solution

5. A particle is made to move in circular path with decreasing speed. Which of the following is correct ?

A. Angular momentum is constant

B. Only the direction of $\vec{L}$ is constant

C. Acceleration is always directed towards the centre

D. Particle moves in helical path.

Answer: B

Watch Video Solution

6. A body of mass m and radius r is released from rest along a smooth inclined plane of angle of inclination θ. The angular momentum of the body about the instantanoues point contact after a time t from the instant of release of equal is :

A. $mgrt\cos\theta$

B. $mgrt\sin\theta$

C. $(3/2)mgrt\sin\theta$

D. none of these

Answer: B

Watch Video Solution

7. Consider an isolated system moving through empty space. The system consists of objects that interact with each other and can change location with respect to one another. Which of the following quatities can change in time ?

A. The angular momentum of the system

B. The linear momentum of the system

C. Both the angular momentum and linear momentum of the system

D. Neither the angular momentum nor linear momentum of the system.

Answer: D

Watch Video Solution

8. For a particle of a mass $100gm$, position and velocity at any instant are given as $10\hat{i} + 6\hat{j}cm$ and $\vec{v} = 5\hat{I}cm/s.$ Calculate the angular momentum about the point (1,1) cm.

A. $25 \times 10^{-5}\left(-\hat{k}\right)kgm^2s^{-1}$

B. $30 \times 10^{-5}\left(-\hat{k}\right)khm^2s^{-1}$

C. $3 \times 10^{-3}\left(-\hat{k}\right)kgm^2s^{-1}$

D. $25 \times 10^{-4}\left(-\hat{k}\right)kgm^2s^{-1}$

Answer: A

Watch Video Solution

9. A particle of mass m moves in the xy-plane with velocity of $\vec{v} = v_x\hat{i} + v_y\hat{j}$. When its position vector is $\vec{r} = x\vec{i} + y\vec{j}$, the angular momentum of the particle about the origin is.

A. $m\left(xv_y + yv_x\right)\hat{k}$

B. $-m\left(xv_y + yv_x\right)\hat{k}$

C. $m\left(yv_x - xv_y\right)\hat{k}$

D. $m\left(xv_y - yv_x\right)\hat{k}$.

Answer: D

Watch Video Solution

10. A hollow straight tube of length l and mass m can turn freely about its centre (fixed) on a smooth horizontal table. Another smooth uniform rod of same length and mass is fitted into the tube so that their centres coincide. They system is set in motion with an initial angular velocity ω_0. the angular velocity of the rod at an instant when the rod slips out of the tube is :

A. $\omega_0/3$

B. $\omega_0/2$

C. $\omega_0/4$

D. $\omega_0/7$

Answer: D

Watch Video Solution

11. A particle mass 1 kg is moving along a straight line $y = x + 4$. Both x and y are in metres. Velocity of the particle is $2m/s$. Find the magnitude of angular momentum of the particle about origin.

A. $4kgm^2s^{-2}$

B. $2\sqrt{2}kgm^2s^{-1}$

C. $4\sqrt{2}kgm^2s^{-1}$

D. $2kgm^2s^{-1}$

Answer: B

Watch Video Solution

12. 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. $1.2rads^{-1}$

B. $0.4rads^{-1}$

C. $0.7 rads^{-1}$

D. $2 rads^{-1}$

Answer: C

Watch Video Solution

13. An solid cylinder of mass $20kg$ and radius $20cm$ rotates about its axis with a angular speed $100 rads^{-1}$. 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

Answer: A

Watch Video Solution

14. 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. ω_0

B. $\frac{\omega_0}{3}$

C. $6\omega_0$

D. $\frac{\omega_0}{6}$

Answer: B

Watch Video Solution

15. 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. $\dfrac{I_1\omega_1 + I_2\omega_2}{I_1 + I_2}$

B. $\dfrac{I_2\omega_1 + I_1\omega_2}{I_1 + I_2}$

C. $\dfrac{I_1\omega_1 + I_2\omega_2}{I_1 - I_2}$

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

Answer: A

Watch Video Solution

16. 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. $I/3$

Answer: A

Watch Video Solution

17. 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

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18. A uniform solid disk of mass $m = 3.0kg$ and radius $r = 0.20m$ rotates about a fixed axis perpendicular to its face with angular frequency $0.6ra\frac{d}{s}$. The magnitude of the angular momentum of the disk when the axis of rotation momentum of the disk when the axis of rotation passes through a point midway between the centre and the rim is.

A. $0.72 kg. m^2/s$

B. $0.54 kg. m^2/s$

C. $0.36 kg. m^2/s$

D. $1.08 kg. m^2/s$

Answer: B

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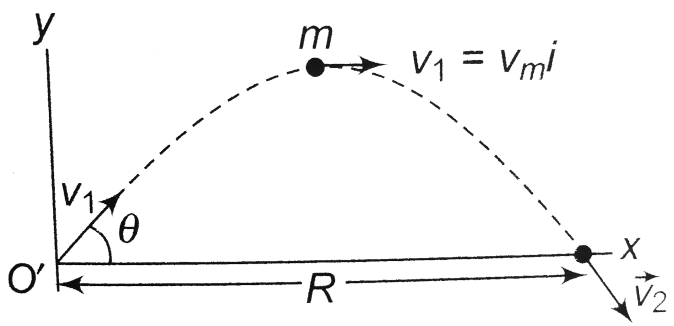
19. A projectile of mass m is launched with an initial velocity $\vec{v}_i$ making an angle θ with the horizontal as shown in figure. The projectile momentum of the particle about the origin when it is at the highest point of its trajectory is.



A. $\dfrac{-m_i^3 \sin\theta^2 \cos\theta}{2g}\hat{k}$

B. $\dfrac{m_i^3 \sin\theta^2 \cos\theta}{2g}\hat{k}$

C. $\dfrac{-m_i^3 \sin\theta^2 \cos\theta}{g}\hat{k}$

D. $\dfrac{2m_i^3 \sin\theta^2 \cos\theta}{g}\hat{k}$

Answer: A

Watch Video Solution

20. In previous problem, the angular momentum of the projectile about the origin when it just before hits the ground should be.

A. $\frac{-2mv_i^3 \sin\theta \sin\theta}{g}\hat{k}$

B. $\frac{mv_i^3 \sin\theta^2 \cos\theta}{2g}\hat{k}$

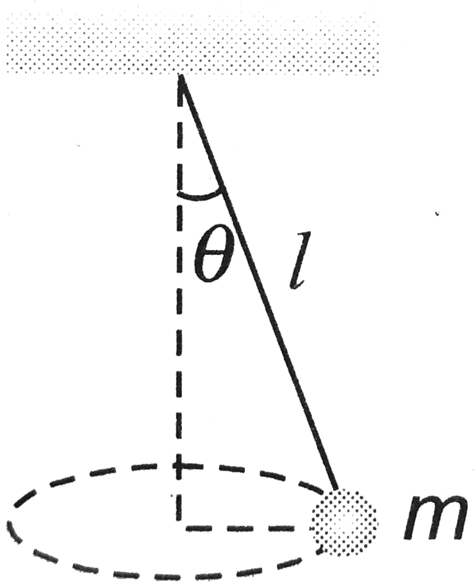
C. $\frac{-mv_i^3 \sin\theta^2 \cos\theta}{g}\hat{k}$

D. $\frac{2mv_i^3 \sin\theta^2 \cos\theta}{g}\hat{k}$.

Answer: A

Watch Video Solution

21. A conical pendulum consists of a bob of mass m in motion in a circular path in a horizontal plane as shown in figure. During the motion, the supporting wire of length l. Maintains a constant angle θ with the vertical. The magnitude of the angular momentum of the bob about the vertical dashed line is.



A. $\left(\frac{m^2gl^3\cos^4\theta}{\sin\theta}\right)^{1/2}$

B. $\left(\frac{m^2gl^3\cos^4\theta}{\cos\theta}\right)^{1/2}$

C. $\left(\frac{m^2gl^3\sin^3\theta}{\cos\theta}\right)^{1/2}$

D. $\left(\frac{m^2 g l^3 \cos^3\theta}{\cos\theta}\right)^{1/2}$.

Answer: B

Watch Video Solution

22. A uniform solid sphere of radius $r = 0.500m$ and mass $m = 15.0kg$ turns counterclockwise about a vertical axis through its centre.Find its vector angular momentum about this axis when its angular speed is $3.00 rad/s$.

A. $\left(2.50kg.\ m^2/s\right)\hat{k}$

B. - $\left(4.50kg.\ m^2/s\right)\hat{k}$

C. - $\left(2.50kg.\ m^2/s\right)\hat{k}$

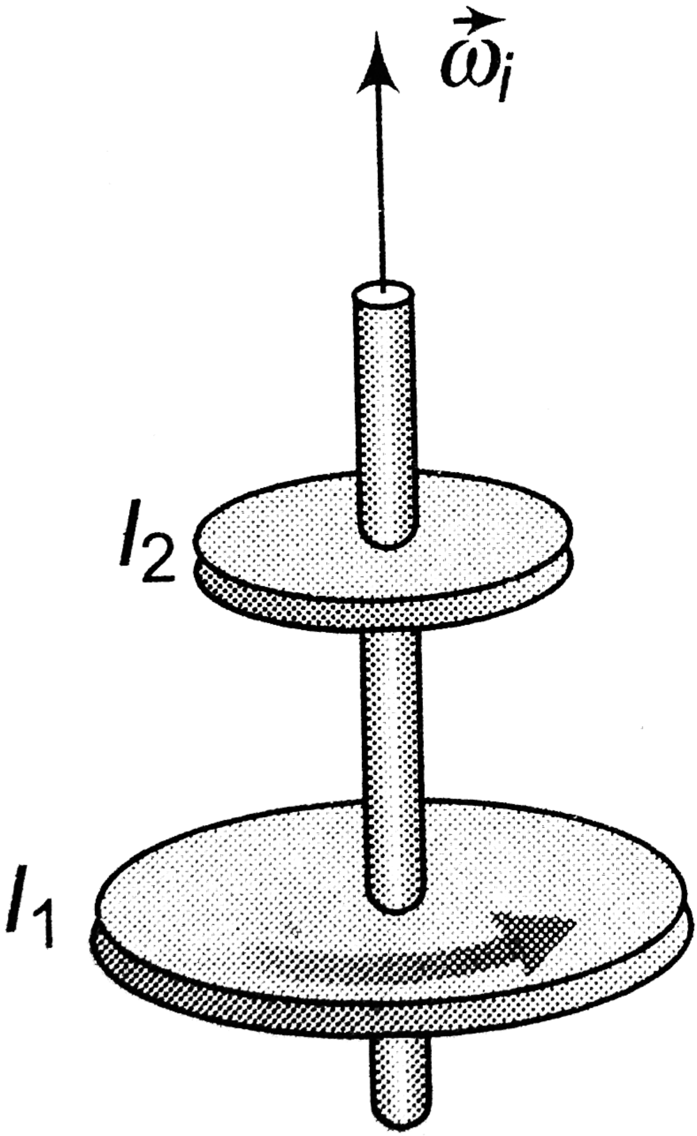
D. $\left(4.50kg.\ m^2/s\right)\hat{k}$

Answer: D

Watch Video Solution

23. A disk with moment of inertia I_1 rotates about frictionless, vertical axle with angular speed ω_i A second disk, this one having moment of inertia I_2 and initial not rotating, drops onto the first disk (Fig.) Because of friction between the surfaces, the two eventually reach the same angular speed ω_f.

The value of ω_f is.



Before

A. $\frac{I_1 + I_2}{I_1}\omega_i$

B. $\frac{I_1}{I_1 + I_2}\omega_i$

C. $\frac{I_1 + I_2}{I_2}\omega_i$

D. $\frac{I_1}{I_2}\omega_i$

Answer: B

Watch Video Solution

24. A playground merry-go-round of radius $R = 2.00$ has a moment of inertia $I = 250kg.\,m^2$

and is rotating $10.0 rev/\min$ about a frictionless, vertical axle. Facing axle, a $25.0\text{ - }kg$ child hops onto the merry-go-round and manages to sit down on the edge. The new angular speed of the merry-go-round is.

A. $5.25 rev/\min$

B. $8.45 rev/\min$

C. $7.14 rev/\min$

D. $3.14 rev/\min$

Answer: C

Watch Video Solution

25. A 60.0 - kg woman stands at the western rim of a horizontal turntable having a moment of inertia of $50kg.\,m^2$ and radius of $2.0m$. The turntable is initially at rest and free to rotate abot a frictionless, vertical axle through its centre. The woman then starts walking around the rim clockwise (as viewed from above the system) at constant speed of $1.50m/s$ relative to the Earth. The final angular velocity of the woman and the turntable systems.

A. $0.36 rad/s$(counterclockwise)

B. $1.8 rad/s$(counterclockwise)

C. $3.6 rad/s$(clockwise)

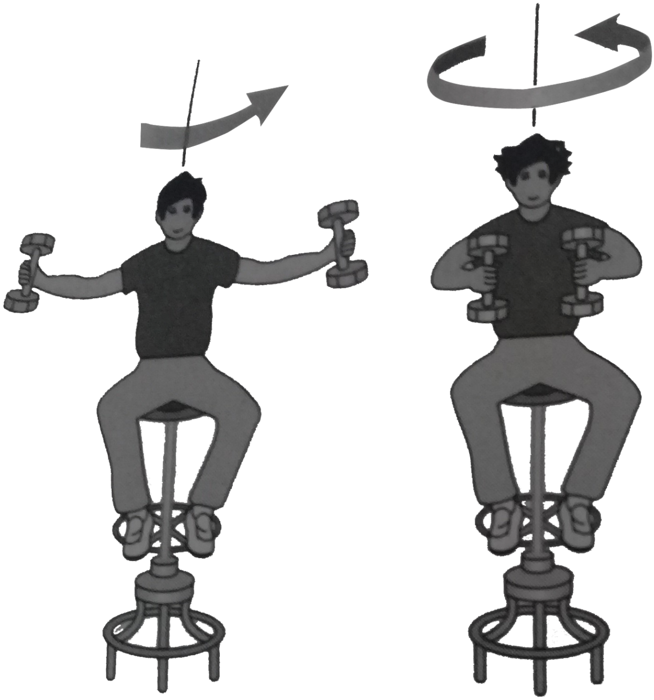
D. $0.36 rad/s$(clockwise)

Answer: A

Watch Video Solution

26. A student sits on a freely rotating stool holding dumbbells, each of mass $5.0kg$ (Fig). When his arms are extended horizontally (Fig a), the dumbbells are $1.0m$ from the axis of rotation and the student rotate with an angular speed of $1.0rad/s$. The moment of inertia of the student plus stool is $5.0kg.m^2$ and is assumed to be constant. The student pulls the dumbbells inward horizontally to a position $0.50m$ from the rotationa are (Fig.)

The new angular speed of the student is.



.

A. $1.5 rad/s$

B. $2.5 rad/s$

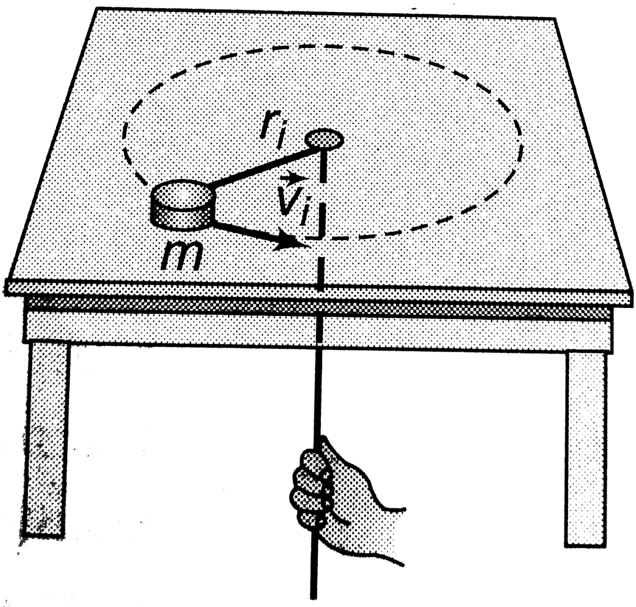
C. $2.0 rad/s$

D. $1.25 rad/s$

Answer: C

Watch Video Solution

27. A puck of mass $m = 50.0g$ is attached to a taut cord passing through a small hole in a frictionless, horizontal surface (Fig.) The puck is initially orbiting with speed $v_i = 1.50m/s$ in a circle of radius $r_i = 0.30m$. The cord is then slowly pulled from below, decreasing the radius of the circle to $r = 0.10m$. The puck's speed at the smaller radius is.



A. $2.25 m/s$

B. $5.50 m/s$

C. $4.50 m/s$

D. $6.0 m/s$

Answer: C

Watch Video Solution

28. A horizontal platform in the shape of a circular disk rotates on a frictionless bearing about a vertical axle through the centre of the disk. The platform has a mass of $150kg$, a radius of $2.0m$, and a rotational inertia of $300kgm^2$ about the axis of rotation. A $60kg$ student walks slowly from the rim of the platform toward the centre. If the angular speed of the system is $1.5 rad/s$ when the student starts at the rim, what is the angular speed when she is $0.50m$ from the centre ?

A. $1.2 rad/s$

B. $2.6 rad/s$

C. $1.5 rad/s$

D. $3.6 rad/s$

Answer: B

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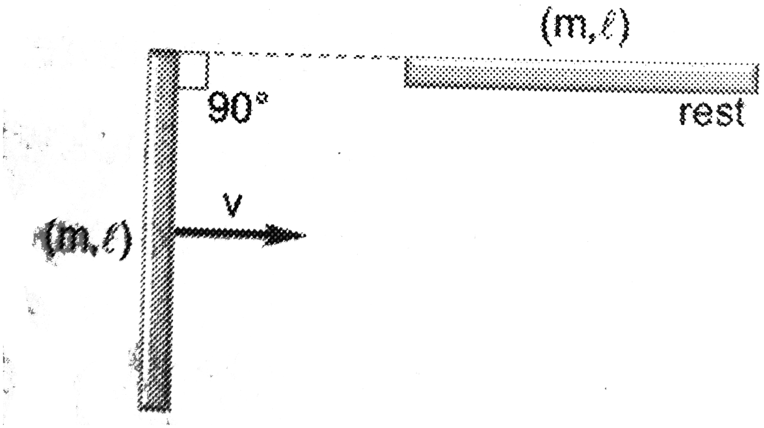
29. A bar of mass 'm' length 'l' is in pure translatory motion with its centre velocity 'v' It collides with another identical bar which is in rest and sticks to it.

Assume that after the collision it becomes one system, then the angular velocity of the system after the collision is.



A. $\frac{1}{5}\frac{v}{l}$

B. $\frac{2}{5}\frac{v}{l}$

C. $\frac{3}{5}\frac{v}{l}$

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

Answer: C

Watch Video Solution

30. A girl of mass M stands on the rim of a frictionless merry-go-round of radius R and rotational inertia I that is not moving. She throws a rock of mass m horizontally in a direction that is tangent to the outer edge of the merry-go-round. The speed of the rock, relative to the rock. relative to the ground, is v. After, the linear speed of the girl is.

A. $\dfrac{mvR^2}{I + MR^2}$

B. $\dfrac{(m + M)vR^2}{I + MR^2}$

C. $\dfrac{mvR^2}{I + (M + m)R^2}$

D. $\dfrac{mvR^2}{I + (M - m)R^2}$

Answer: A

Watch Video Solution

Work And Energy In Case Of Rotation

1. A basketball rolls a ramp sloping upward without slipping. With its centre of mass moving at a certain initial speed. A block of ice of the same mass is set sliding up the ramp with the same speed along a parallel line. Which object will travel farther up the ramp ?

A. basketball

B. the ice block

C. They will travel equally far up the ramp.

D. cannot be decided

Answer: A

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2. A loop rolls down on an inclined plane. The fraction of its kinetic energy that is associated with only the rotational motion is.

A. $1:2$

B. $1:3$

C. $1:4$

D. $2:3$

Answer: A

Watch Video Solution

3. When a sphere rolls without slipping the ratio of its kinetic energy of translation to its total kinetic energy is.

A. $1:7$

B. $1:2$

C. $1:1$

D. $5:7$

Answer: D

Watch Video Solution

4. The moment of inertia of a body about a given axis is $1.2kgm^2$. Initially, the body is at rest. In order to produce a rotational KE of

$1500J$, for how much duration, an acceleration of $25 rads^{-2}$ must be applied about that axis ?

A. 4 s

B. 2 s

C. 8 s

D. 10 s

Answer: B

Watch Video Solution

5. A loop and a disc have same mass and roll without slipping with the same linear velocity v. If the total kinetic energy of the loop is $8J$, the kinetic energy of the disc must be.

A. 8 J

B. 16 J

C. 6 J

D. 4 J

Answer: C

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6. Two bodies with moment of inertia I_1 and $I_2\left(I_1 > I_2\right)$ have equal angular momenta. If their kinetic energy of rotation are E_1 and E_2 respectively, then.

A. $E_1 = E_2$

B. $E_1 < E_2$

C. $E_1 > E_2$

D. E_1E_2

Answer: B

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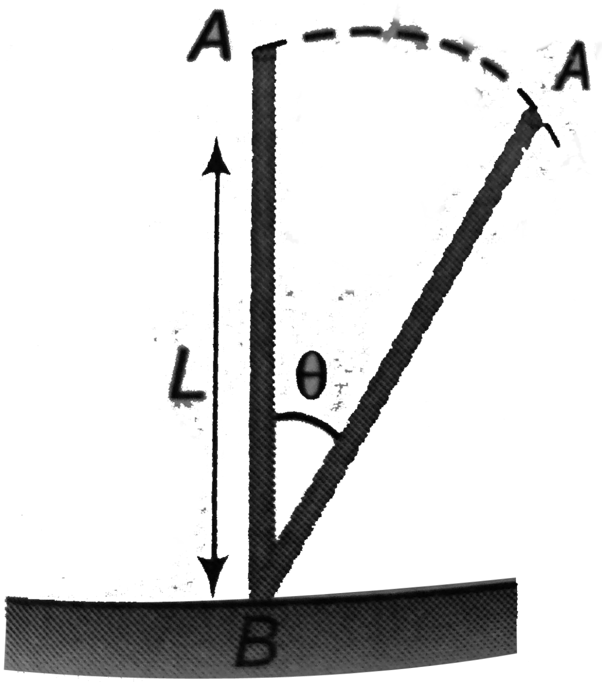
7. 

A uniform rod of length L is free to rotate in a vertical plane about a fixed horizontal axis through B. The rod begins rotating from rest. The angular velocity ω at angle θ is given as

A. $\sqrt{\frac{3g}{l}}\sin(\theta/2)$

B. $\sqrt{\frac{6g}{l}}\sin(\theta/2)$

C. $\sqrt{\frac{3g}{l}}\cos(\theta/2)$

D. $\sqrt{\frac{6g}{l}}\cos(\theta/2)$

Answer: B

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8. A rod of length l whose lower end is fixed on a horizontal plane, starts toppling from the vertical position. The velocity of the upper end when it hits the ground is.

A. $\sqrt{g/l}$

B. $\sqrt{3gl}$

C. $3\sqrt{g/l}$

D. $\sqrt{3g/(l)}$

Answer: B

Watch Video Solution

9. A body rolls without slipping. The radius of gyration of the body about an axis passing through its centre of mass is K. The radius of the body is R. The ratio of rotational kinetic energy to translational kinetic energy is.

A. $\frac{K^2}{R^2}$

B. $\frac{R^2}{K^2 + R^2}$

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

D. $K^2 + R^2$

Answer: A

Watch Video Solution

10. A horizontal $9kg$ merry-go-round is a solid disk of radius $1.50m$ and is started from rest by a constant horizontal force of $50.0N$ applied tangentially to the edge of the disk. The kinetic energy of the disk after $3.00s$ is.

A. 125 J

B. 500 J

C. 250 J

D. 150 J

Answer: C

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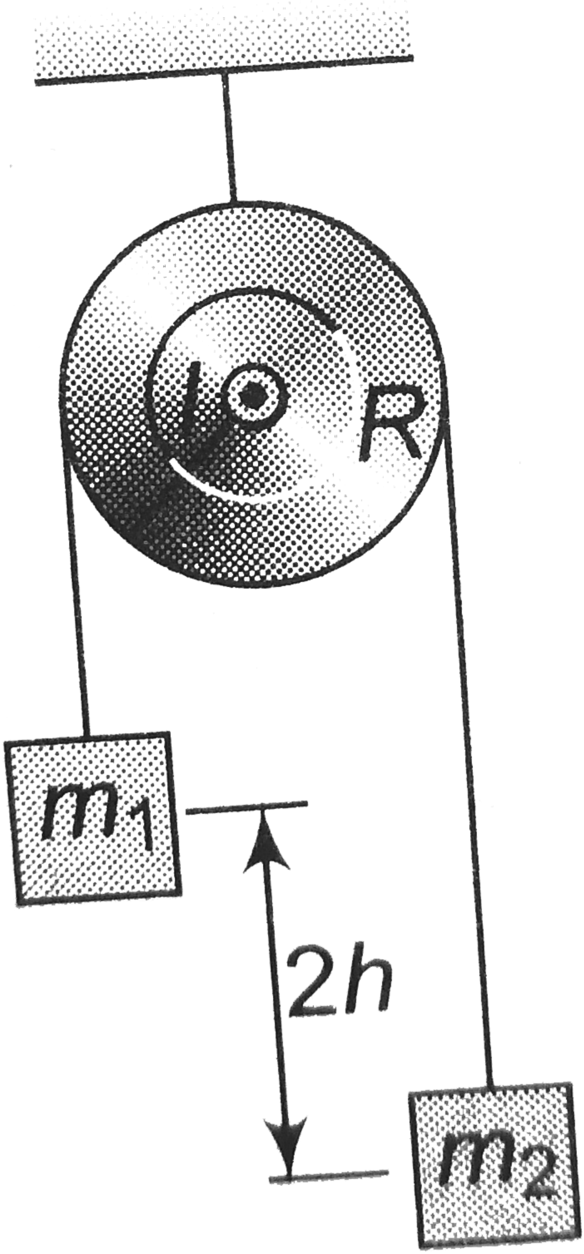
11. Consider two object with $m_1 > m_2$ connected by a light string that passes over a pulley having a moment of inertia of I about its axis of rotation as shown in figure. The string does not slip on the pulley or strech.

The pulley turns without friction. The two objects are released from rest separated by a vertical distance $2h$. The translational speeds of the objects as they pass each other is.



A. $\sqrt{\dfrac{2(m_1 + m_2)gh}{m_1 + m_2 + \dfrac{I}{R^2}}}$

B. $\sqrt{\dfrac{2(m_1 - m_2)gh}{m_1 + m_2 + \dfrac{I}{R^2}}}$

C. $\sqrt{\dfrac{(m_1 - m_2)gh}{m_1 + m_2 + \dfrac{I}{R^2}}}$

D. $\sqrt{\dfrac{(m_1 + m_2)gh}{m_1 + m_2 + \dfrac{I}{R^2}}}$

Answer: B

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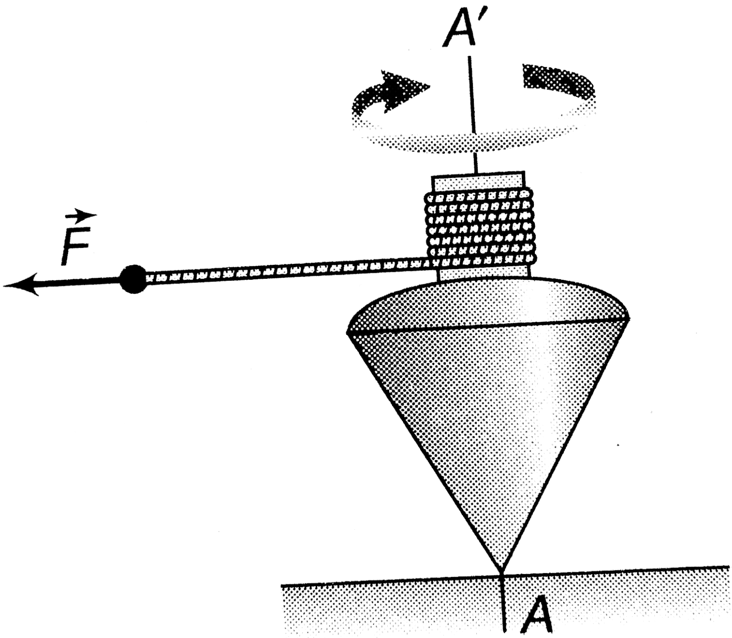
12. The top in figure has a moment of inertia of $4.00 \times 10^{-4} kg.\,m^2$ and is initially at rest. It is free to rotate about the stationary axis ∀′. A string, wrapped around a peg along the axis of the top, is pulled in such a manner as to maintain a constant tension of $2.5N$.If the string does not slip while it is unwound from the peg. What the angular speed of the top after $80.0 cm$ of string has been pulled off the peg ?



A. $75 rad/s$

B. $50 rad/s$

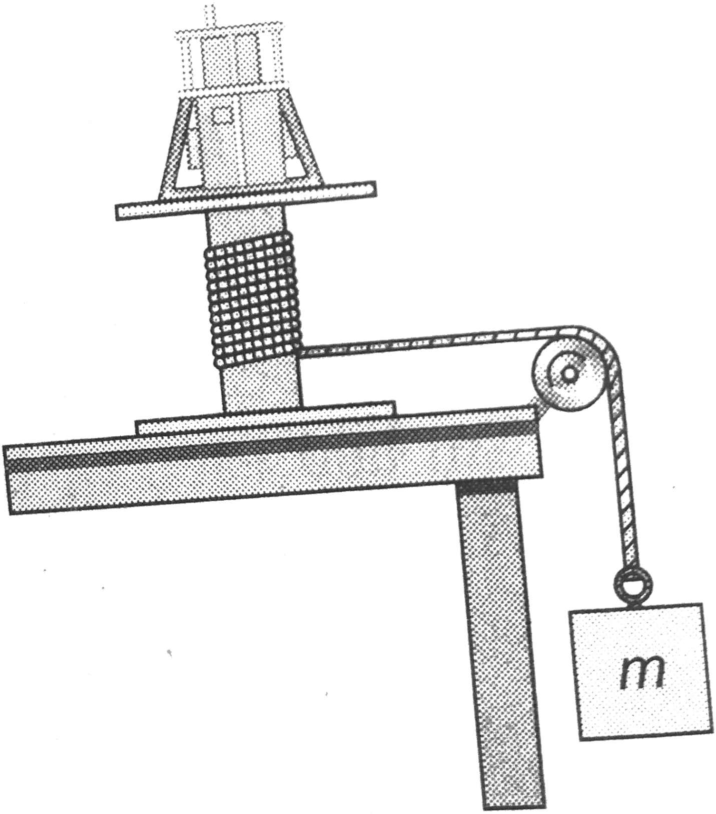
C. $125 rad/s$

D. $100 rad/s$

Answer: D

Watch Video Solution

13. Figure shows a counterweight of mass m suspended by a cord wound around a spool of radius r. forming part of a turntable supporting the object. The turntable can rotate without friction. When the counterweight is released from rest, it descends through a distance h, acquiring a speed v. The moment of inertia I of the rotating apparatus is.



A. $mr^2\left(\frac{2gh}{v^2}+1\right)$

B. $mr^2\left(\frac{gh}{v^2}+1\right)$

C. $mr^2\left(\frac{2gh}{v^2} - 1\right)$

D. $mr^2\left(\frac{gh}{v^2} + 1\right)$

Answer: C

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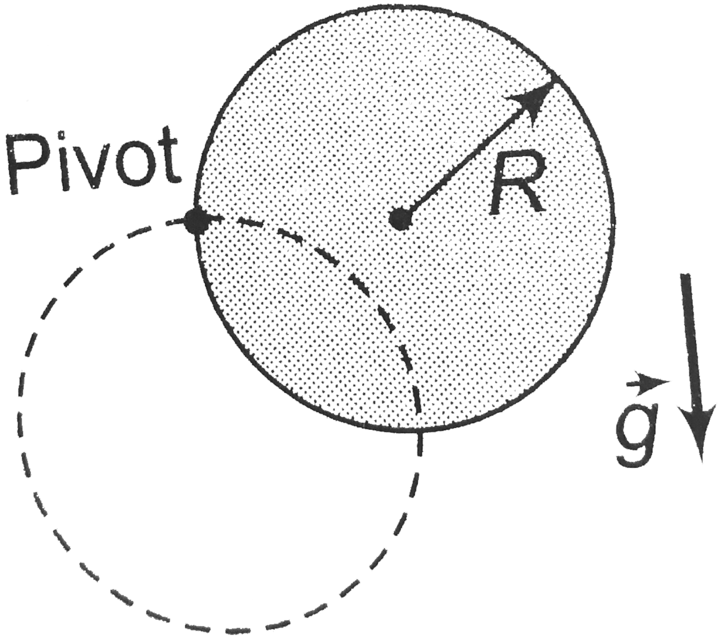
14. A unifrom solid disk of radius R and mass M is free to rotate on a frictionless pivot through a point on its rim. If the disk is released from rest in the position shown in figure. The speed of the lowest point on the disk in the dashed position is.



A. $4\sqrt{\frac{Rg}{3}}$

B. $2\sqrt{\frac{Rg}{3}}$

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

D. $3\sqrt{\frac{Rg}{2}}$

Answer: A

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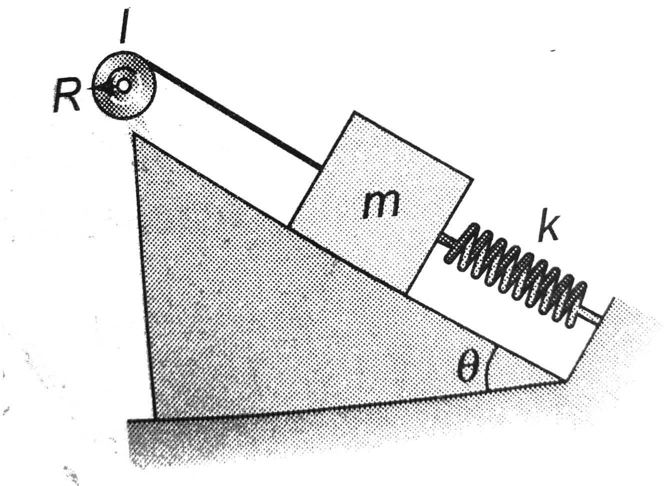
15. The reel shown in figure has radius R and moment of inertia I. One end of the block of mass m is connected to a spring of force constant k, and the other end is fastened to a cord wrapped around the reel. The reel axle and the incline are frictionless. The reel is wound counterclockwise so that the spring strectches a distance d from its unstretched position and the reel is then released from rest. The angular speed of the reel when the spring is again unstretched is.



A. $\sqrt{\dfrac{2mgd\sin\theta + kd^2}{I + mR^2}}$

B. $\sqrt{\dfrac{mgd\sin\theta + kd^2}{I + mR^2}}$

C. $\sqrt{\dfrac{mgd\sin\theta - kd^2}{I + mR^2}}$

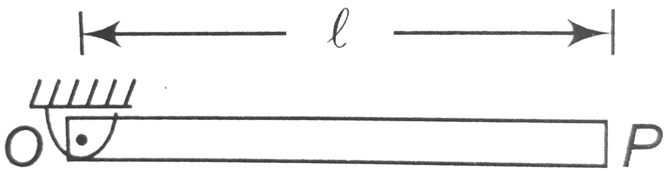
D. $\sqrt{\dfrac{2mgd\sin\theta - kd^2}{I + mR^2}}$

Answer: A

Watch Video Solution

16. A uniform rod smoothly pivoted at one of its ends is released from rest. If it swings in vertical plane, the maximum speed of the end

P of the rod is.



A. $2\sqrt{3gl}$

B. $\sqrt{3gl}$

C. $2\sqrt{2gl}$

D. $\sqrt{gl}$

Answer: B

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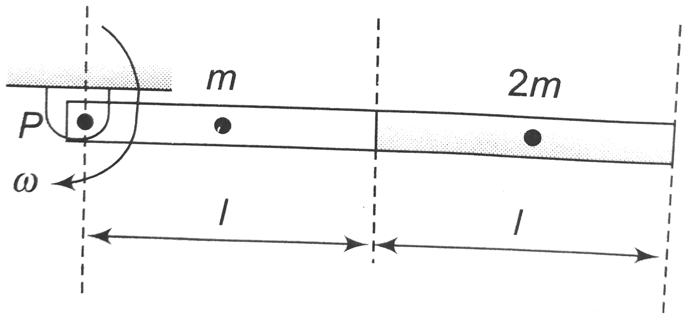
17. A composite rod comprising two rods of mass m and $2m$ and each of length $l = 1m$ as shown in the figure. Assume $\omega = 10rad/s$ and $m = 1kg$, the KE of the rotating composite rod is.



A. 125 J

B. 150 J

C. 250 J

D. 175 J

Answer: C

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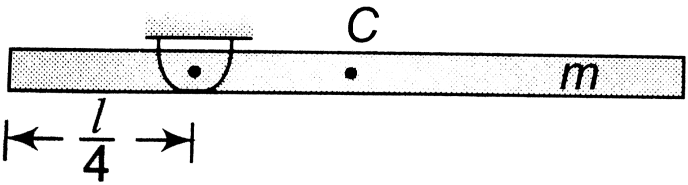
18. A uniform rod of length l is from rest such that it rotates about a smooth pivot. The angular speed of the rod when it becomes vertical is.



.

A. $2\sqrt{\frac{6g}{7l}}$

B. $\sqrt{\frac{6g}{7l}}$

C. $2\sqrt{\frac{3g}{7l}}$

D. $\sqrt{\frac{3g}{7l}}$

Answer: A

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19. A solid unifrom disk of mass m and radius R is pivoted about a horizontal axis through its centre and a small body of mass m is attached to the rim of the disk. If the disk is released from rest with the small body, initially at the same level as the centre, the angular velocity when the small body reaches the lowest point of the disk is.

A. $\sqrt{\frac{12g}{13r}}$

B. $\sqrt{\frac{11g}{12r}}$

C. $\sqrt{\frac{12g}{11r}}$

D. $\sqrt{\frac{7g}{11r}}$

Answer: C

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20. A copper ball of mass $m = 1kg$ with a radius of $r = 10cm$ rotates with angular velocity $\omega = 2rad/s$ about an axis passing through its centre. The work should be performed to increase the angular velocity of rotation of the ball two fold is.

A. $1.2 \times 10^{-2} J$

B. $2.4 \times 10^{-2} J$

C. $3.6 \times 10^{-2} J$

D. $4.8 \times 10^{-2} J$

Answer: B

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21. A thin -walled pipe rolls along the floor. What is the ratio of its translational kinetic energy to its rotational kinetic energy about the central axis parallel to its length ?

A. 1

B. $\frac{3}{2}$

C. $\frac{2}{3}$

D. $\frac{4}{3}$

Answer: A

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22. A body of radius R and mass m is rolling smoothly with speed v on a horizontal surface. It then rolls up a hill to a maximum height h. If $h = 3v^2/4g$. What might the body be ?

A. a solid circular cylinder

B. a hollow circular cylinder

C. a solid circular sphere

D. a hollow circular sphere.

Answer: A

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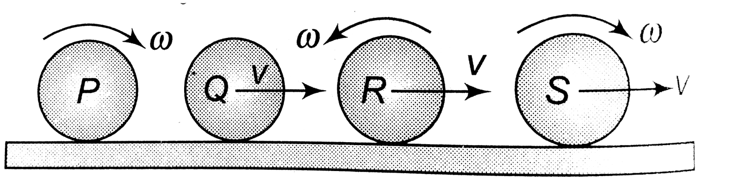
Rotation And Translation Combined And Rolling Motion

1. Four solid spheres are made to move on a rough horizontal surface. Sphere P is given a spin and released. Sphere Q is given a forward linear velocity. Spheres R and S are given linear and rotational motions as shown in the figure.

Directions of the friction force on spheres P, Q, R, S are respectively.



A. Right, Left, Right, Left

B. Right, Left, Left, Right

C. Left, Right,Left, either Left or Right

D. Right, Left,Left,either Left or Right

Answer: D

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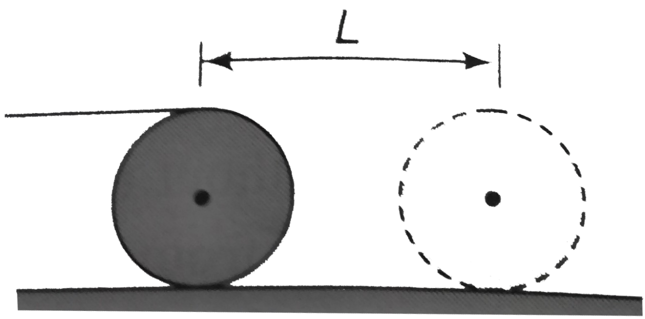
2. A cylindrical drum, pushed along by a board rolls forward on the ground. There is no slipping at any contact. The distance moved by the man who is pushing the board, when axis of the cylinder covers a distance L will be.



A. L

B. `2 L'

C. πL

D. $8\pi L$

Answer: B

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3. A cylinder is rolling without slipping on a horizontal plane P. The friction between the plank P and the cylinder is sufficient for no slipping. The coefficient of friction between the plank and the ground surface is zero.

Initially, P is attached with a string S as shown in the figure. If the string is now burned, then.

A. the plank with start motion with a speed v along forward direction.

B. the plank will start motion with a speed v along backward direction.

C. the plank will remain static

D. linear velocity of the cylinder will decrease and angular velocity will increase.

Answer: C

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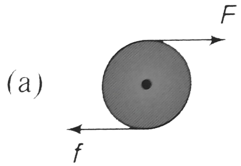
4. A disc is pulled by a force F acting at a point above the centre of mass of the disc.

The direction of frictional force (f_r) acting on disc pushed on a rough surface will be represented by.

A. 

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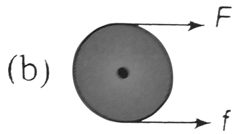
B. 

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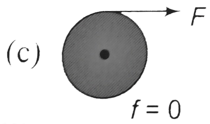
C. 

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D. Information is insufficient.

Answer: B

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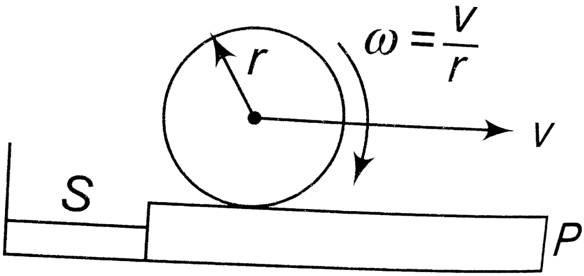
5. Find the acceleration of the body if a force $F = 8N$ pulls the string at P that passes over the body and it is connected by another string to a rigid support at Q. (Take radius of gyration $k = \frac{2}{\sqrt{3}} m$, $R = 2m$, $r = 1m$, and mass of the body $m = 3kg$).



A. $1m/s^2$

B. $1.5m/s^2$

C. $1.2m/s^2$

D. $2m/s^2$

Answer: A

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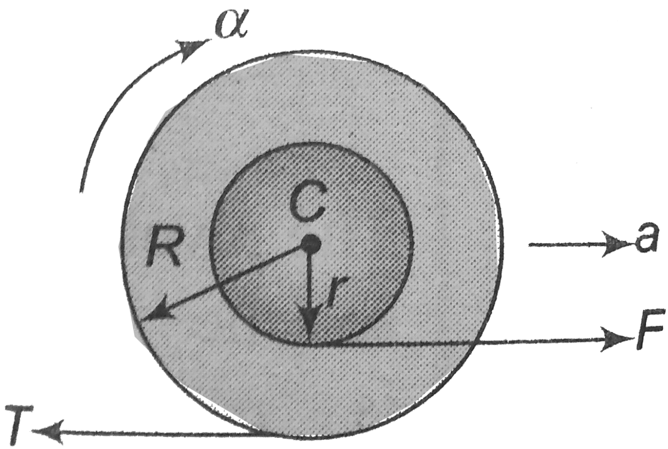
6. A cotton reel rolls without sliding such that the point P of the string has velocity $v = 6m/s$. If $r = 10cm$ and $R = 20cm$ then the velocity of its centre C is.



A. $2.5 m/s$

B. $5 m/s$

C. $4 m/s$

D. $2 m/s$

Answer: C

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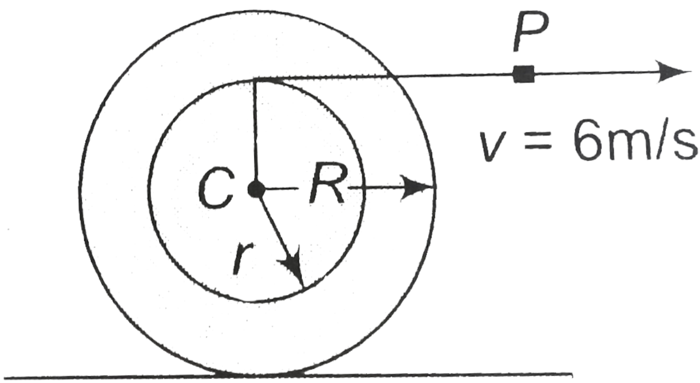
7. A bobbin is pushed along on a rough stationary horizontal surface as shown in the figure. The board is kept horizontal and there is no slipping at any contact points. The distance movedby the board when distance moved by the axis of the bobbin is l is



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A. $l\left(1+\frac{r}{2R}\right)$

B. $l\left(2+\frac{r}{2R}\right)$

C. $l\left(1+\frac{r}{R}\right)$

D. $l\left(1+\frac{2r}{R}\right)$

Answer: C

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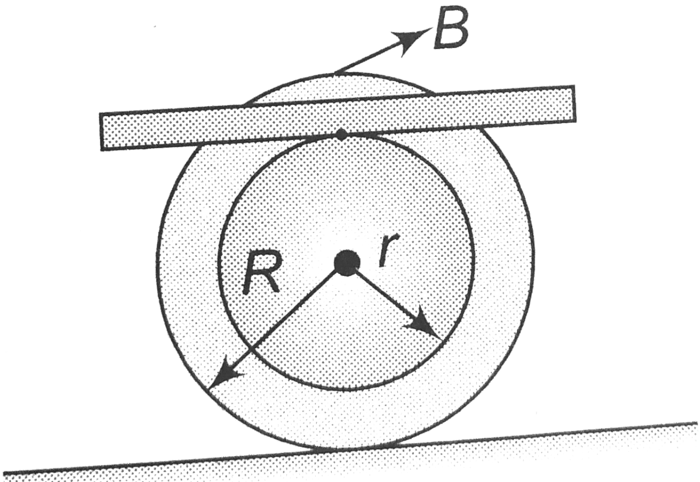
8. A solid sphere of mass $10kg$ is placed on a rough surface having coefficient of friction

$\mu = 0.1$. A constant force $F = 7N$ is applied along a line passing through the centre of the sphere as shown in the figure. The value of frictional force on the sphere is.



A. 1 N

B. 2 N

C. 3 N

D. 7 N

Answer: B

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9. When a body rolls without sliding up an inclined plane the frictional force is :

A. directed up the plane

B. directed down the plane

C. zero

D. dependent on its velocity

Answer: A

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10. 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

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

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

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

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

Answer: D

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12. 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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13. 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

14. 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. $\frac{1}{3}g\sin\theta$

B. $\frac{2}{3}g\sin\theta$

C. $\frac{2}{5}g\sin\theta$

D. $\frac{2}{7}g\sin\theta$

Answer: B

Watch Video Solution

15. 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

16. A uniform solid disk rolling down an incline making angle θ with the horizontal. The minimum coefficient of friction required to maintain pure rolling motion for the disk is.

A. $\left(\frac{2}{3}\tan\theta\right)$

B. $\left(\frac{1}{3}\tan\theta\right)$

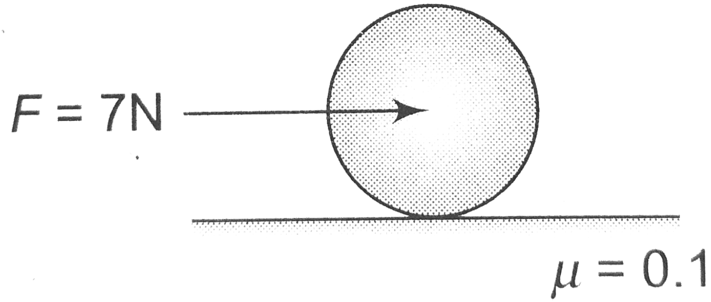
C. $\left(\frac{2}{5}\tan\theta\right)$

D. $\left(\frac{1}{2}\tan\theta\right)$

Answer: D

Watch Video Solution

17. A rolling object rolls without slipping down an inclined plane (angle of inclination θ), then the minimum acceleration it can have is.



A. $g\sin\theta$

B. $\frac{2g\sin\theta}{3}$

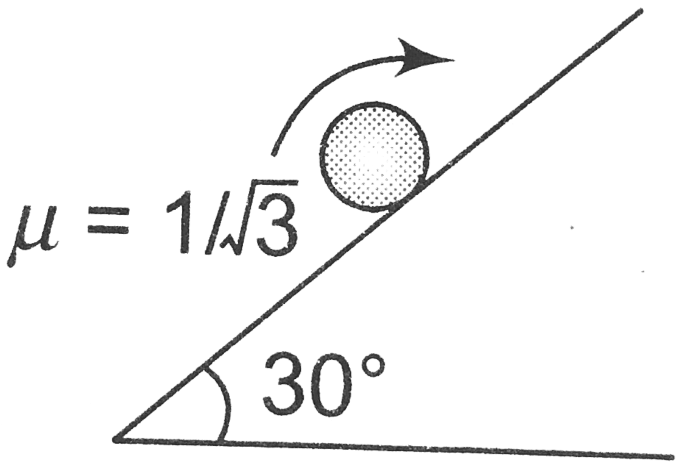
C. $\frac{g\sin\theta}{2}$

D. zero

Answer: C

Watch Video Solution

18. An cylinder of mass m is rotated about its axis by an angular velocity ω and lowered gently on an inclined plane as shown in figure. Then :



A. it will start going upward

B. it will first going upward and then downward

C. it will go downward just after it is lowered

D. it can never go upward.

Answer: D

Watch Video Solution

Problems Based On Mixed Concepts

1. A uniform rod of mass m and length l_0 is rotating with a constant angular speed ω about a vertical axis passing through its point of suspension. Find the moment of inertia of the rod about the axis of rotation if it make an angle θ to the vertical (axis of rotation).

A. $\frac{ml_0^2\sin^2\theta}{12}$

B. $\frac{ml_0^2\sin^2\theta}{6}$

C. $\frac{2ml_0^2\sin^2\theta}{3}$

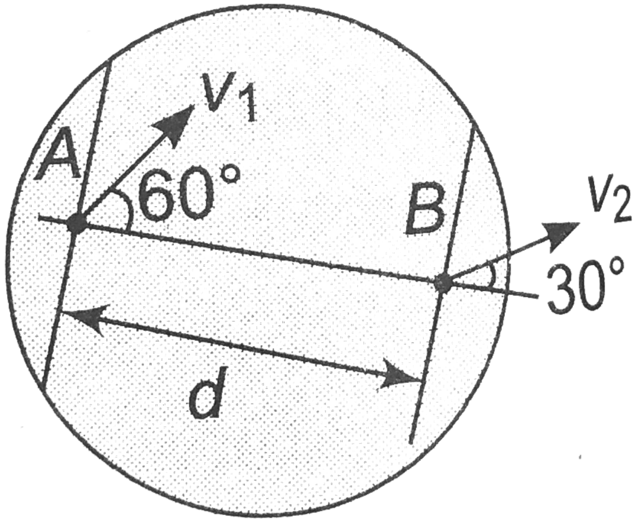
D. $\frac{ml_0^2\sin^2\theta}{3}$

Answer: D

Watch Video Solution

2. Two points A and B on a disc have velocities v_1 and v_2, respectively, at some moment. Their directions make angles 60° and 30° respectively, with the line of separation as shown in figure. The angular velocity of disc is

:



A. $\frac{\sqrt{3}v_1}{d}$

B. $\frac{v_2}{\sqrt{3}d}$

C. $\frac{v_2 - v_1}{d}$

D. $\frac{v_2}{d}$

Answer: D

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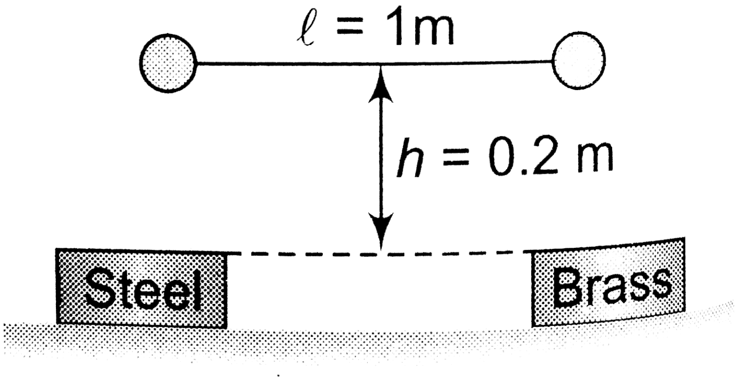
3. Two steel ball of equal diameter are connected by a rigid bar of negligible weight as shown and are dropped in the horizontal position from height h above the heavy steel and brass base plates. If the coefficient of restitition between the ball and steel base is

0.6 and the between the other ball and the brass base is 0.4. The angular velocity of the bar immediately after rebound is. (Assume the two impacts are simultaneous).



A. $\frac{2}{5} rad/\sec$

B. $\frac{1}{5} rad/\sec$

C. $\frac{3}{5} rad/\sec$

D. $\frac{1}{4} rad/\sec$

Answer: A

Watch Video Solution

4. A brick of length L is placed on the horizontal floor. The bricks of same length and size are placed on this brick, one above the other by providing a margin of $\frac{L}{8}$ from the edge of the brick placed just below, in the same direction.

Find the correct option.

A. Fifth brick will fall down

B. Sixth brick alone will fall down

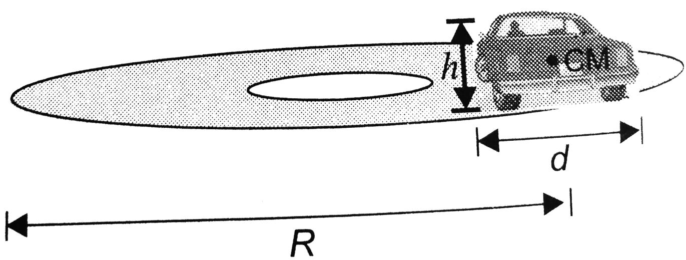
C. Sixth brick along with fifth brick will fall down

D. Fifth brick along with fourth brick will fall down.

Answer: C

Watch Video Solution

5. A car moves with speed v on a horizontal circular track of radius R. A head-on view of the car is shown in figure. The height of the car's centre of mass above the ground is h, and the separation between its inner and outer wheels is d The road is dry, and the car does not skid. The maximum speed the car can have without overturning is :



A. $\sqrt{\frac{gRd}{2h}}$

B. $\sqrt{\frac{gRd}{h}}$

C. $\sqrt{\frac{2gRd}{h}}$

D. $\sqrt{\frac{2gRd}{3h}}$

Answer: A

Watch Video Solution

6. A thin horizontal uniform rod AB of mass m and length l can rotate freely about a vertical axis passing through its end A. At a certain moment, the end B starts experiencing a constant force F which is always perpendicular to the original position of the stationary rod and directed in a horizontal plane. The angular velocity of the rod as a function of its rotation angle θ measured relative to the initial position should be.

A. $\sqrt{\frac{6F\sin\theta}{ml}}$

B. $\sqrt{\frac{2F\sin\theta}{ml}}$

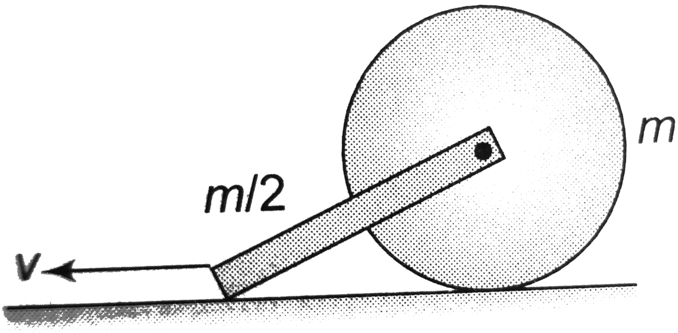
C. $\sqrt{\frac{3F\sin\theta}{ml}}$

D. $\sqrt{\frac{5F\sin\theta}{ml}}$

Answer: A

Watch Video Solution

7. A uniform disc of mass m is fitted (pivoted smoothly) with a rod of mass $m/2$. If the bottom of the rod os pulled with a velocity v, it moves without changing its and of orientation and the disc rolls without sliding. Take kinetic energy of the system (rod + disc) is.



A. $\frac{mv^2}{4}$

B. $\frac{mv^2}{2}$

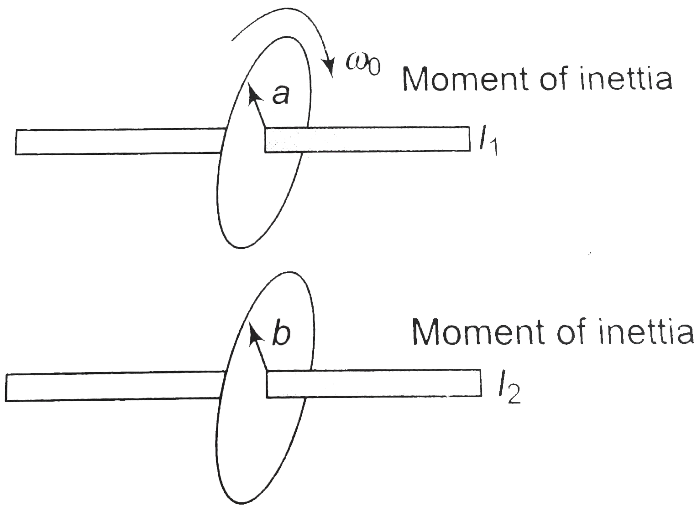
C. $\frac{5mv^2}{16}$

D. mv^2

Answer: D

Watch Video Solution

8. The two uniform discs rotate separately on parallel axles. The upper disc (radius a and momentum of inertia I_1) is given an angular velocity ω_0 and the lower disc of (radius b and momentum of inertia I_2) is at rest. Now the two discs are moved together so that their rims touch. Final angular velocity of the upper disc is.



A. $$\frac{(I_1\omega_0)}{[I_1 + (a^2I_2/b^2)]}$$

B. $$\frac{(I_2\omega_0)}{[I_2 + (a^2I_1/b^2)]}$$

C. $$\frac{(I_1\omega_0)}{[I_1 + (b^2I_2/a^2)]}$$

D. $\frac{(I_2\omega_0)}{\left[I_2 + \left(b^2 I_2 / a^2\right)\right]}$

Answer: A

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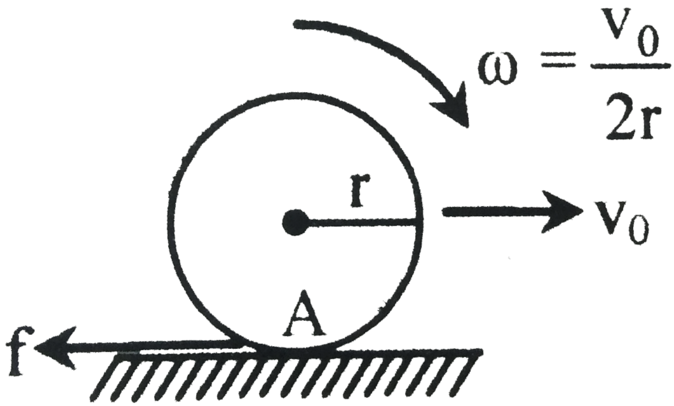
9. A sphere of mass M and radius r shown in figure slips on a rough horizontal plane. At some instant it has translational velocity V_0 and rotational velocity about the centre $\frac{v_0}{2r}$. Find the translational velocity after the sphere starts pure rolling.



A. $6v_0/7$ in forward direction

B. $6v_0/7$ in backward direction

C. $7v_0/6$ in forward direction

D. $7v_0/6$ in backward direction

Answer: A

Watch Video Solution

10. 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

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

A. Kinetic energy of A = Kinetic energy of B

B. Kinetic energy of A $>$ Kinetic energy of B

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

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

Answer: C

Watch Video Solution

12. 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

13. 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. $\frac{\omega_0 \mu_k R}{2g}$

B. $\frac{\omega_0 g}{2\mu_k R}$

C. $\frac{2\omega_0 R}{\mu_k g}$

D. $\frac{\omega_0 R}{2\mu_k g}$

Answer: D

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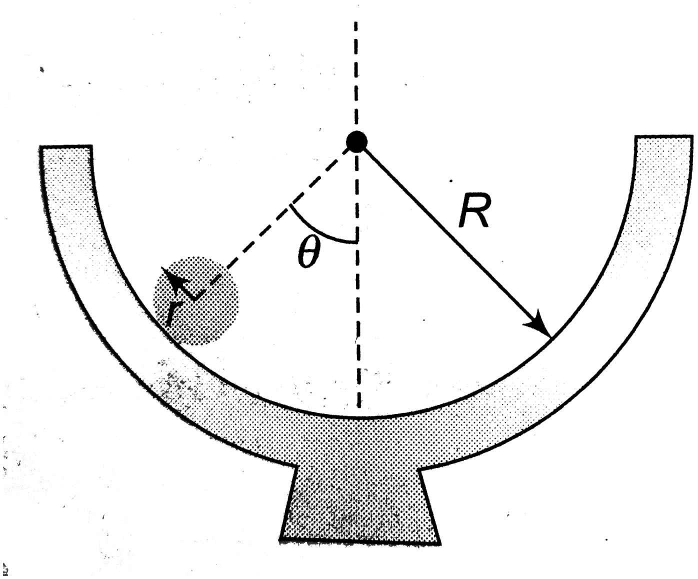
14. A uniform solid sphere of radius $r = \frac{R}{5}$ is placed on the inside surface of a hemisherical bowl with radius $R(=5r)$. The sphere is released from rest at an angle $\theta = 37^{\circ}$ to the vertical and rolls without slipping (Fig.) The angular speed of the sphere when it reaches the bottom of the bowl is.



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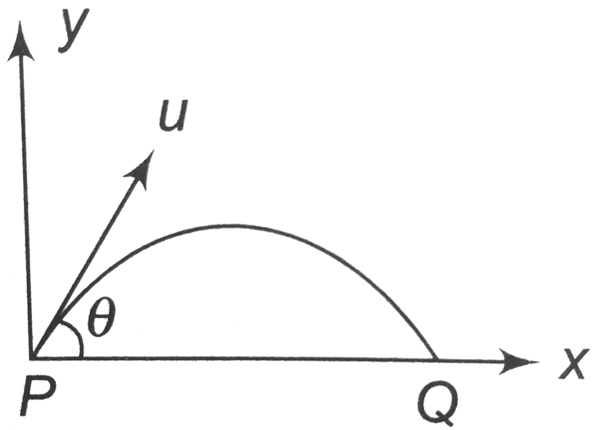
15. Average torque on a projectile of mass m (initial speed u and angle of projection θ) between initial and final positions P and Q as

shown in figure, about the point of projection

is :



A. $1\frac{mu^2\sin 2\theta}{2}$

B. $\frac{mu^2\cos\theta}{2}$

C. $mu^2\sin\theta$

D. $mu^2\cos\theta$

Answer: A

Watch Video Solution

16. 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. $4000N$ on each front wheel, $5000N$ on each back wheel.

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

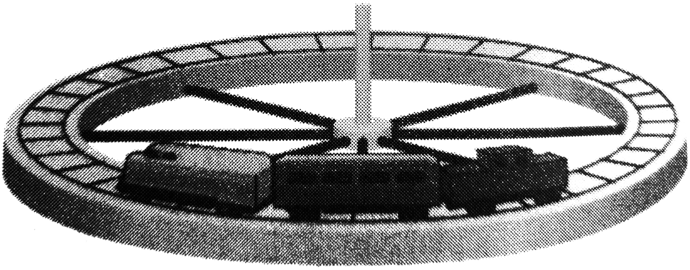
C. $4500N$ on each front wheel, $4500N$ on each back wheel

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

Answer: A

Watch Video Solution

17. A track is mounted on a large wheel that is free to turn with neiglibible friction about a vertical axis (Fig). A toy train of mass M is placed on the track and, with the system initially at rest, the train's electrical power is turned on. The train reaches speed v with respect to the track. What is the wheel's angular speed if its mass is m and its radius is r ? (Treat it as a hoop, and neglect the mass of the spokes and hub).



.

A. $\frac{v}{(M/m+1)R}$

B. $\frac{v}{(m/M+2)R}$

C. $\frac{v}{(M/m+2)R}$

D. $\frac{v}{(m/M+2)R}$

Answer: B

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18. A sphere of mass M rolls without slipping on rough surface with centre of mass has constant speed v_0. If mass of the sphere is m and its radius be R`, then the angular momentum of the sphere about the point of contact is.

A. $\frac{4}{5}Mv_0R\left(-\hat{k}\right)$

B. $\frac{9}{5}Mv_0R\left(-\hat{k}\right)$

C. $\frac{8}{5}Mv_0R\left(-\hat{k}\right)$

D. $\frac{7}{5}Mv_0R\left(-\hat{k}\right)$

Answer: D

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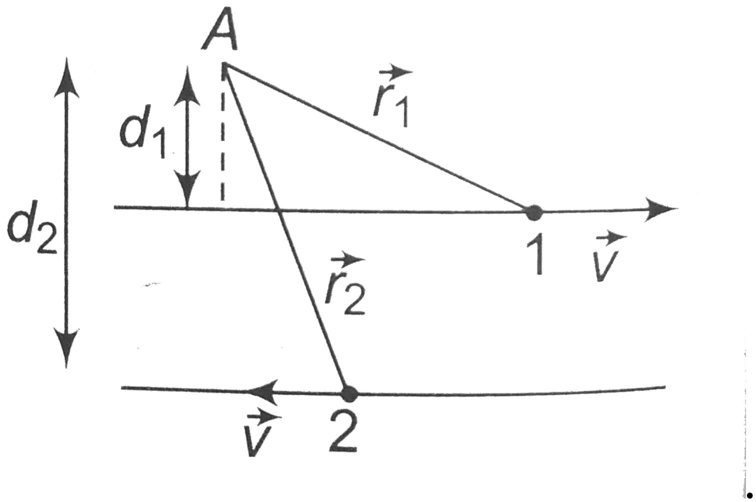
19. Figure shows two identical particles 1 and 2, each of mass m, moving in opposite directions with same speed $\vec{V}$ along parallel lines. At a particular instant, $\vec{r}_1$ and $\vec{r}_2$ are their respective position vectors drawn from point A which is in the plane of the parallel lines. Which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

,



A. Angular momentum $\vec{L}_1$ of particle 1 about A is $\vec{L}_1 = mv\vec{r}_1 \odot$

B. Angular momentum $\vec{L}_2$ of particle 2 about A is $\vec{L}_2 = mv\vec{r}_2 \odot$

C. Total angular momentum of the system about is $\vec{L} = mv\left(\vec{r}_1 + \vec{r}_2\right) \odot$

D. Total angular momentum of the system about A is $\vec{L} = mv\left(d_2 - d_1\right) \otimes$

[Here, $\otimes$ represents a unit vector going into the page and $\odot$ represents a unit vector coming out of the page].

Answer: D

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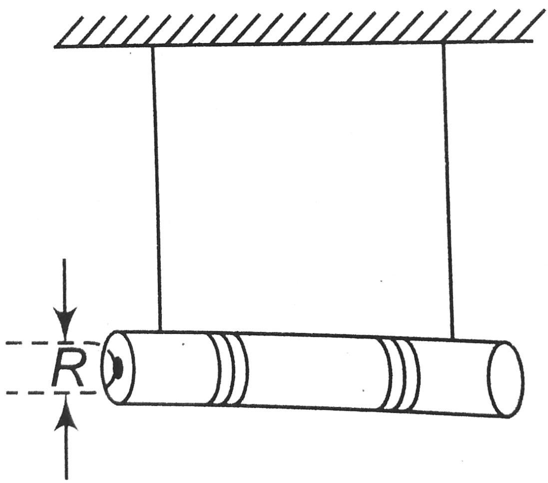
20. A cylindrical rod of mass M, length L and radius R has two cords wound around it whose ends are attached to the ceiling. The rod is held horizontally with the two cords vertical. When the rod is released, the cords unwind and the rod rotates the linear acceleration of the cylinder as it falls, is :



A. g

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

C. $\frac{2g}{3}$

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

Answer: C

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21. The moment of inertia of a uniform disc about an axis passing through its centre and perpendicular to its plane is $1kg - m^2$. It is rotating with an angular velocity $100 radia/\sec$. Another indentical disc is gently placed on it so that their centres coincide. Now these two discs together continue to rotate about the same axis. Then the loss in kinetic energy in kilojoules is :

A. 2.5

B. 3.0

C. 3.5

D. 4.0

Answer: A

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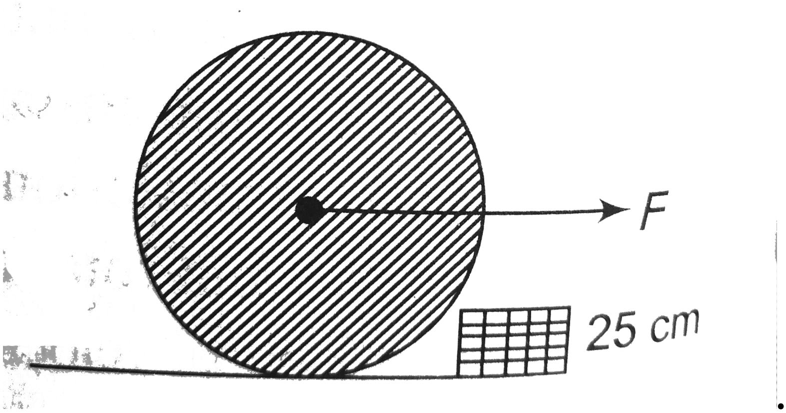
22. A vertical disc of mass $5kg$ and radius $50cm$ rests against a steo of height $25cm$ as shown in figure. What minimum horizontal force applied perpendicular to the axle will make the disc to climb the step ? Take $g = 10m/s^2$.



A. 50 N

B. $50\sqrt{3}N$

C. $25N$

D. none of these

Answer: B

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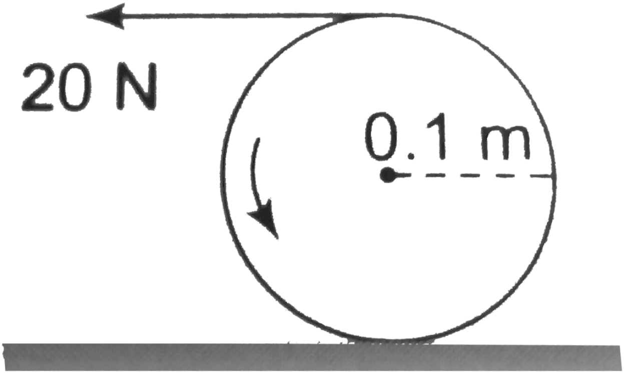
23. The rope shown in figure is wound around a cylinder of mass $4kg$ and moment of inertia $0.02kgm^2$ about the cylinder axis. If the cylinder rolls without slipping, then the linear acceleration of its centre of mass is.



A. $6.7 m/s^2$

B. $10.0 m/s^2$

C. $3.3 m/s^2$

D. none of these

Answer: A

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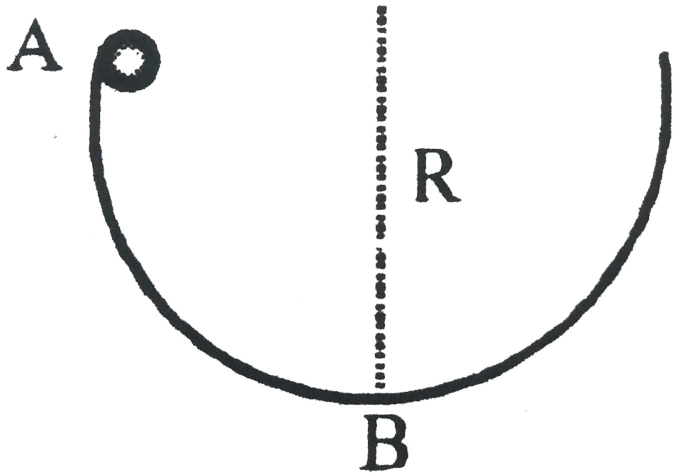
24. A small sphere D of mass and radius rols without slipping inside a large fixed hemispherical radius $R(> > r)$ as shown in figure. If the sphere starts from rest at the top point of the hemisphere normal force exerted by the small sphere on the hemisphere when its is at the bottom B of the hemisphere.



A. $\dfrac{10mg}{7}$

B. $\dfrac{9mg}{7}$

C. $\dfrac{17mg}{7}$

D. $\dfrac{3mg}{7}$

Answer: C

Watch Video Solution

25. Figure shows a rough track a portion of which is in the form of a cylinder of radius R. With what minimum linear speed should as sphere of radius r be set rolling on the horizontal part so that it completely goes round the circle on the cylindrical part.

A. $\sqrt{\frac{27}{7}g(R - r)}$

B. $\sqrt{\frac{20}{7}g(R - r)}$

C. $\sqrt{\frac{20}{7}gR}$

D. $\sqrt{\frac{17}{7}g(R - r)}$

Answer: A

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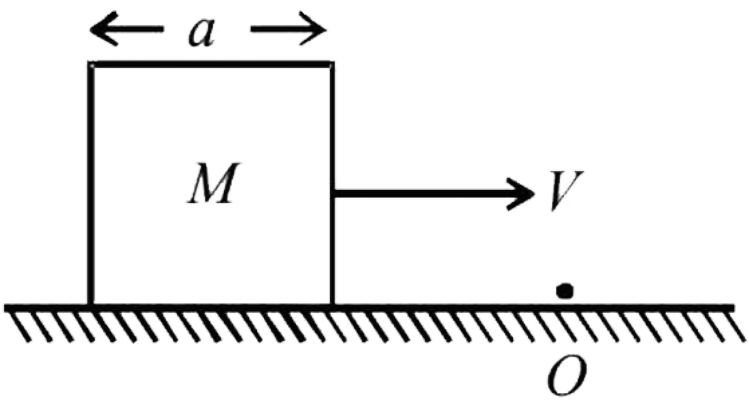
26. A cubical block of side a is moving with velocity V on a horizontal smooth plane as shown in Figure. It hits a ridge at point O. The angular speed of the block after it hits O is



A. $3v/(4a)$

B. $3v/(2a)$

C. $\sqrt{3}/\sqrt{2a}$

D. zero

Answer: A

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27. A body A of mass M while falling wertically downwards under gravity brakes into two parts, a body B of mass $\frac{1}{3}$ M and a body C of mass $\frac{2}{3}$ M. The center of mass of bodies B and

C taken together shifts compared to that of body A towards

A. Body C

B. Body B

C. Depends on height of breaking

D. Does not shift

Answer: D

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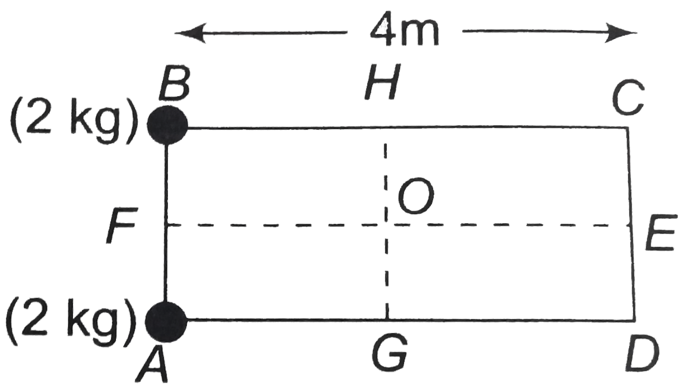
28. Masses of $2kg$ each are placed at the corners B and A of a rectangular plate $ABCD$ as shown in the figure. A mass of $8kg$ has to be placed on the plate so that the centre of mass of the system should be the centre O. Then the mass should be placed at :



A. $1m$ from O onOE

B. $2m$ from O on OF

C. $2m$ from O on OG

D. $2m$ from O on OH

Answer: A

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29. Particle of masses $m, 2m, 3m, \ldots, nm$ grams are placed on the same line at distance $l, 2l, 3l, \ldots\ldots, nlcm$ from a fixed point. The distance of centre of mass of the particles from the fixed point in centimeters is :

A. $\frac{(2n+1)l}{3}$

B. $\frac{l}{n+1}$

C. $\frac{n\left(n^2+1\right)l}{2}$

D. $\frac{2l}{n\left(n^2+1\right)}$

Answer: A

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30. Two blocks A and B of equal masses are attached to a string passing over a smooth pulley fixed to a wedge as shown in figure. Find the magnitude of acceleration of centre of mass of the two blocks when they are released from rest. Neglect friction.

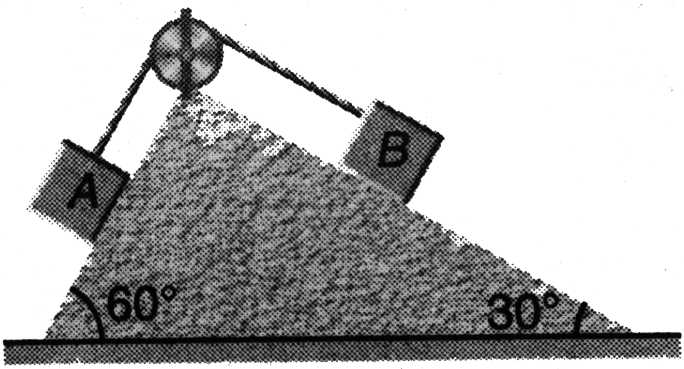

Fig. 11.23

A. $\frac{\sqrt{3}-1}{4\sqrt{2}}g$

B. $\left(\sqrt{3} - 1\right)g$

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

D. $\left(\frac{\sqrt{3} - 1}{\sqrt{2}}\right)g$

Answer: A

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31. A uniform cylinder has radius R and length L. If the moment of inertia of this cylinder about an axis passing through its centre and normal to its circular face is $\frac{mR^2}{2}$ is equal to moment of inertia of the same cylinder about an axis passing through its centre and normal to its length, then

A. $L = R$

B. $L = \sqrt{3}R$

C. $L = R/\sqrt{3}$

D. $L = 0$

Answer: B

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Assertion Reasoning

1. If rod is thrown upward with initial angular velocity and velocity of centre of mass then its momentum changes but angular velocity remains same.

Torque on rod about cente of mass due to gravitational force is zero.

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

assertion.

B. If both assertion and reason are 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. 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 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. The mass of a body cannot be considered to be concentrated at the centre of mass of the body for the purpose of computing its moment of inertia.

For then the moment of inertia of every body about an axis passing through its centre of mass would be zero.

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

B. If both assertion and reason are 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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4. 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 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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5. 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 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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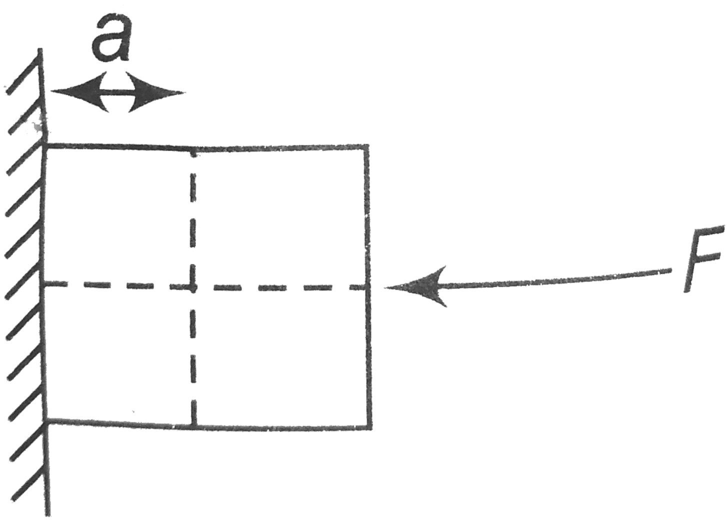
6. A horizontal force F is applied such that the block remains stationary because N will produce torque.

The torque produced by friction force is equal and opposite the torque produce due to normal reaction (N).



.

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

B. If both assertion and reason are 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

Watch Video Solution

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

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

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

B. If both assertion and reason are 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

Watch Video Solution

8. 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 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

Watch Video Solution

9. The moment of inertia of rigid body depends only on the mass of the body, its shape and size.

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 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. The motion of a ceiling fan is rotational only.

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 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

Watch Video Solution

11. Value of radius of gyration of a body depends on axis of rotation.

Radius of gyration is root mean square distance of particle of the body from 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 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

Watch Video Solution

12. 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 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. A ladders is more likely to slip when a person is near the top than when he is near the bottom.

The friction between the ladder and floor decreases as he climbs up.

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

B. If both assertion and reason are 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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14. A disc is rolling on an inclined plane without slipping. The velocity of centre of mass is V. These other point on the disc lie on a circular are having same speed as centre of mass.

When a disc is rolling on an inclined plane. The magnitude of velocities of all the point from the contact point is same, having distance equal to radius r.

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

B. If both assertion and reason are 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 is performing pure rolling on a rough horizontal surface with constant angular velocity. Frictional force acting on the sphere is zero.

Velocity of contact point is zero.

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

assertion.

B. If both assertion and reason are 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

Watch Video Solution

16. If earth shrink (without change in mass) to half it's present size. Length of the day would become 6 hours.

As size of earth changes its moment of inertia changes.

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

B. If both assertion and reason are 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

Watch Video Solution

17. A disc is rolling on a rough horizontal surface. The instantaneous speed of the point of contact during perfect rolling is zero with respect to ground.

The force of friction can help in achieving pure rolling condition.

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

B. If both assertion and reason are 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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18. A when a diver dives, the rotational kinetic energy of diver increases, during several somersaults.

When diver pulls his limbs, the moment of inertia decreases and on account of conservation of angular momentum his angular speed increases.

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

B. If both assertion and reason are 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

19. Assertion: The velocity of a body at the bottom of an inclind plane of given height is more when is slides down the plane, compared to, when it rolling down the same plane.

Reason: In rolling down a body acquires both, kinetic energy of translation and rotation.

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

B. If both assertion and reason are 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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20. A Moment of inertial of uniform disc and solid cylinder of equal mass and equal radius about an axis passing through centre and perpendicluar to plane will to same.

Moment of inertia depends upon distribution of mass from the axis of rotation i.e., perpendicular distance from 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 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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NEET Questions

1. A constant torque of $1000N - m$ turns a wheel of moment of inertia $200kg - m^2$ about an axis through its centre. Its angular velocity after 3 seconds is.

A. $1rad/s$

B. $5rad/s$

C. $10rad/s$

D. $15rad/s$

Answer: D

Watch Video Solution

2. A wheel of radius $1m$ rolls forward half a revolution on a horizontal ground. The magnitude of the displacement of the point of the wheel initially on contact with the ground is.

A. π

B. 2π

C. $\sqrt{2}\pi$

D. $\sqrt{\pi^2 + 4}$

Answer: D

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3. If the linear density (mass per unit length) of a rod of length $3m$ is proportional to x, where x, where x is the distance from one end of the rod, the distance of the centre of gravity of the rod from this end is.

A. 2.5 m

B. 1 m

C. 1.5 m

D. 2 m

Answer: D

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4. A composite disc to be made using equal masses of aluminimum and iron so that it has as high a moment of inertia as possible. This possible when.

A. The surfaces of the discs are made of iron with aluminimum inside

B. the whole of aluminimum is kept in the core and the iron at the outer rim of the disc

C. the whole of the iron is kepy in the core and the aluminimum at the outer rim of the disc

D. the whole disc is made with thin alternate sheets to iron and aluminimum.

Answer: B

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5. 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. $\frac{K^2}{R^2}$

B. $\dfrac{K^2}{K^2 + R^2}$

C. $\dfrac{R^2}{K^2 + R^2}$

D. $\dfrac{K^2 + R^2}{R^2}$

Answer: B

Watch Video Solution

6. The angular velocity of second's hand of a watch will be.

A. $\dfrac{\pi}{60} rad / \sec$

B. $\frac{\pi}{30} rad / \sec$

C. $60\pi rad / \sec$

D. $30\pi rad / \sec$

Answer: B

Watch Video Solution

7. 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 center of mass when the cylinder reaches its bottom

A. $\sqrt{\frac{3}{4}gh}$

B. $\sqrt{\frac{4}{3}gh}$

C. $\sqrt{4}gh)$

D. $\sqrt{2}gh)$

Answer: B

Watch Video Solution

8. A wheel having moment of inertia $2kgm^2$ about its vertical axis, rotates at the rate of $60r \pm$ about this axis. The torque which can stop the wheel's rotation in one minute would be

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

Answer: C

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9. Consider a two particle system with particles having masses m_1 and m_2 if the first particle is pushed towards the centre of mass through a distance d, by what distance should the second particle is moved, so as to keep the center of mass at the same position?

A. $\frac{m_1}{m_1 + m_2}d$

B. $\frac{m_1}{m_2}d$

C. d

D. $\frac{m_2}{m_1}d$

Answer: B

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10. A round disc of moment of inertia I_2 about its axis perpendicular to its plane and passing through its centre is placed over another disc of moment of inertia I_1 rotating with an angular velocity ω about the same axis. The final angular velocity of the combination of discs is.

A. $\frac{I_2\omega}{I_1 + I_2}$

B. ω

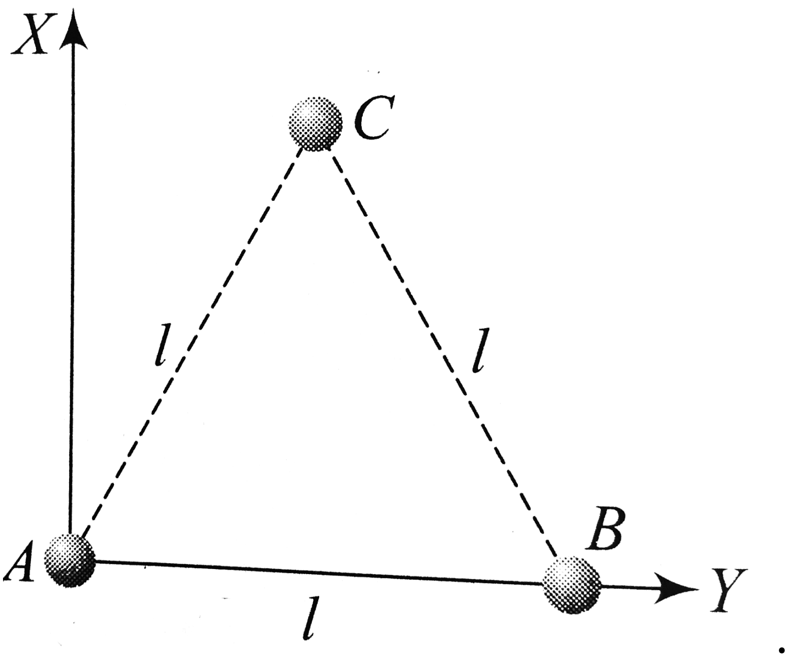
C. $\frac{I_1\omega}{I_1 + I_2}$

D. $\frac{\left(I_1 + I_2\right)\omega}{I_1}$

Answer: C

Watch Video Solution

11. Three particles, each of mass m grams situated at the vertices of an equilateral triangle AbC of side I cm (as shown in the figure). The moment of inertia of the system about a line AX perpendicular to AB and in the plane of ABC, in gram-cm^2 units will be.



A. $(3/4)ml^2$

B. $2ml^2$

C. $(5/4)ml^2$

D. $(3/2)ml^2$

Answer: C

Watch Video Solution

12. 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.

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

B. MR^2

C. $\frac{7}{2}MR^2$

D. $\frac{3}{2}MR^2$

Answer: D

Watch Video Solution

13. 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. $1:2$

B. $\sqrt{2}:1$

C. $2:1$

D. $1:\sqrt{2}$

Answer: D

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14. 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.

A. MR^2

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

C. $\frac{3}{2}MR^2$

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

Answer: C

Watch Video Solution

15. A wheel has angular acceleration of $3.0 rad/s^2$ and an initial angular speed of $2.00 rad/s$. In a tine of $2s$ it has rotated through an angle (in radian) of

A. 6

B. 10

C. 12

D. 4

Answer: B

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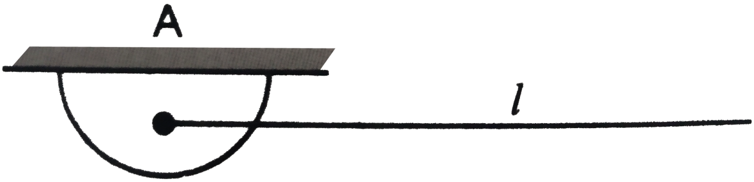
16. A uniform rod of length l and mass m is free to rotate in a vertical plane about A as shown in Fig. The rod initially in horizontal position is released. The initial angular acceleration of the rod is



A. $\frac{2g}{3l}$

B. $m\frac{g(l)}{2}$

C. $\frac{3}{2}gl$

D. $\frac{3g}{2l}$

Answer: D

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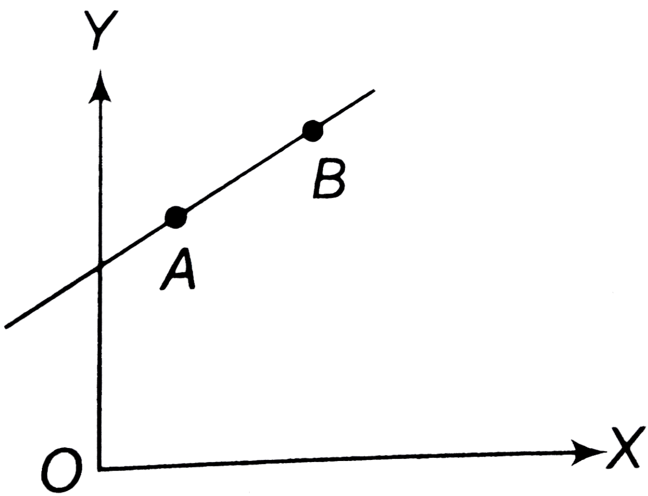
17. A particle of mass m moves in the XY plane with a velocity v along the straight line AB. If the angular momentum of the particle with respect to origin O is L_A when it is at A and L_B when it is at B, then



A. $L_A > L_B$

B. $L_A = L_B$

C. the relationship between L_A and L_B

depends upon the slope of the line AB.

D. $L_A < L_B$

Answer: B

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18. 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.

A. $\sqrt{3}:\sqrt{2}$

B. $1:\sqrt{2}$

C. $\sqrt{2}:1$

D. $\sqrt{2}:\sqrt{3}$

Answer: B

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19. A thin rod of length L and mass M is bent at its midpoint into two halves so that the angle between them is $90°$. The moment of inertia of the bent rod about an axis passing through the bending point and perpendicular to the plane defined by the two halves of the rod is.

A. $\frac{ML^2}{24}$

B. $\frac{ML^2}{12}$

C. $\frac{ML^2}{6}$

D. $\frac{\sqrt{2}ML^2}{24}$

Answer: B

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20. A thin circular ring of mass m and radius R is rotating about its axis with a constant angular velocity ω. Two objects each of mass M are attached gently to the opposite ends of a diameter of the ring. The ring now rotates with an angular velocity $\omega' =$

A. $\frac{\omega(M - 2m)}{M + 2m}$

B. $\frac{\omega M}{M + 2m}$

C. $\frac{\omega(M + 2m)}{M}$

D. $\frac{\omega M}{M + m}$.

Answer: B

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

A. $\vec{r}.\vec{\tau} \neq 0$ 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 $\vec{F}.\vec{\tau} = 0$

D. $\vec{r}.\vec{\tau} = 0$ and $\vec{F}.\vec{\tau} \neq 0$

Answer: C

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22. Four identical thin rods each of mass M and length l, from a square frame. Moment of inertia of this frame about an axis through the centre of the square and perpendicular to its plane is

A. $\frac{4}{3}Ml^2$

B. $\frac{2}{3}Ml^2$

C. $\frac{13}{3}Ml^2$

D. $\frac{1}{3}Ml^2$

Answer: A

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23. Two bodies of mass $1kg$ and $3kg$ have position vectors $\hat{i}+2\hat{j}+\hat{k}$ and $-3\hat{i}-2\hat{j}+\hat{k}$, respectively. The centre of mass of this system has a position vector.

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

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

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

D. $-1\hat{i}+\hat{j}+\hat{k}$

Answer: B

Watch Video Solution

24. A circular disc of moment of inertia I_t is rotating in a horizontal plane about its symmetry axis with a constant angular velocity ω_i. Another disc of moment of inertia I_b is dropped co-axially onto the rotating disc. Initially, the second disc has zero angular speed. Eventually, both the discs rotate with a constant angular speed ω_f. Calculate the energy lost by the initially rotating disc due to friction.

A. $\frac{1}{2}\frac{I_b^2}{(I_t + I_b)}\omega_i^2$

B. $\frac{1}{2}\frac{I_t^2}{(I_t + I_b)}\omega_i^2$

C. $\frac{1}{2}\frac{I_b - I_t}{(I_t + I_b)}\omega_i^2$

D. $\frac{1}{2}\frac{I_b I_t}{(I_t + I_b)}\omega_i^2$

Answer: D

Watch Video Solution

25. Two paricle A and B initially at rest, move towards each other under mutual force of attraction. At the instant when the speed of A is V and the speed of B is 2V, the speed of the centre of mass of the system is

A. 2 v

B. 0

C. 1.5 v

D. v

Answer: B

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26. A man of $50kg$ mass is standing in a gravity free space at a height of $10m$ above the floor. He throws a stone of $0.5kg$ mass downwards with a speed $2m/s$. When the stone reaches the floor, the distance of the man above the floor will be

A. 9.9 m

B. 10.0 m

C. 10 m

D. 20 m

Answer: B

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27. 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 =0.5 s

B. 1 = 0.25 s

C. t = 2 s

D. t = 1 s

Answer: D

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28. The moment of inertia of a thin uniform rod of mass M and length L about an axis passing through its mid-point and perpendicular to its length isI_0. Its moment of inertia about an axis passing through one of its ends perpendicular to its length is.

A. $I_0 + ML^2/4$

B. $I_0 + 2ML^2$

C. $I_0 + ML^2$

D. $I_0 + ML^2/2$

Answer: A

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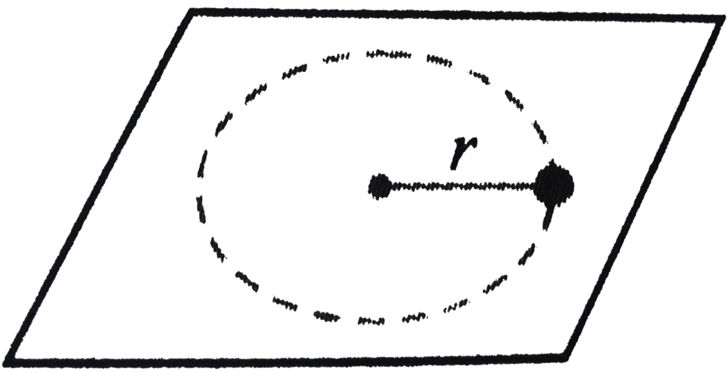
29. A small mass attached to a string rotates on a frictionless table top as shown in Fig. If the tension in the string is increased by pulling the string causing the radius of the circular motion to decrease by a factor of 2, the kinetic energy of the mass will



A. remain constant

B. increase by a factor of 2

C. increase by a factor of 4

D. decrease by a factor of 2

Answer: C

Watch Video Solution

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

A. the tangent to the orbit

B. a line perpendicular to the plane of rotation

C. the line making an angle of 45° to the plane of rotation

D. the radius

Answer: B

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31. Two persons of masses $55kg$ and $65kg$ respectively are at the opposite ends of a boat. The length of the boat is $3.0m$ and weights $100kg$. The $55kg$ man walks up to the $65kg$ man and sits with him. If the boat is in still water the centre of mass of the system shifts by.

A. 0.75 m

B. 3.0 m

C. 2.3 m

D. zero

Answer: D

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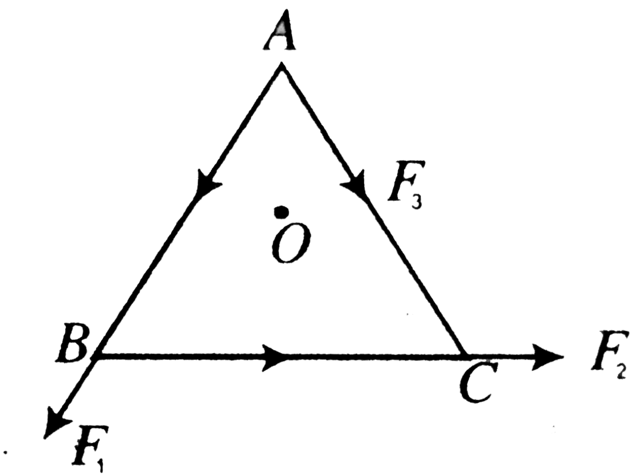
32. O is the centre of an equilateral triangle ABC. F_1, F_2 and F_3 are the three forces acting along the sides AB, BC and AC respectively. What should be the value of F_3 so that the total torque about O is zero?



A. $\left(F_1 + F_2\right)$

B. $F_1 + F_2$

C. $F_1 - F_2$

D. $\dfrac{F_1 + F_2}{2}$

Answer: B

Watch Video Solution

33. A circular platform is mounted on a frictionless vertical axle. Its radius $R = 2m$ and its moment of inertia about the axle is $200kgm^2$. It is initially at rest. A $50kg$ man stands on the edge at the platform and begins to walk along the edge at the speed of $1ms^{-1}$ relative to the ground. Time taken by the man to complete one revolution is :

A. πsec

B. $\frac{3\pi}{2}$sec

C. 2πsec

D. $\frac{\pi}{2}$sec

Answer: C

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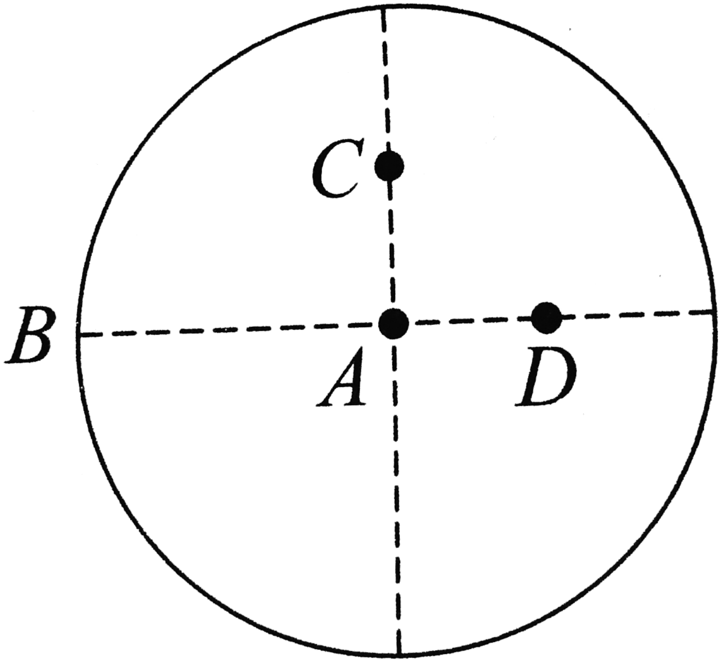
34. The moment of inertia of a uniform circular disc is maximum about an axis perpendicular to the disc and passing through.



A. B

B. C

C. D

D. A

Answer: A

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

A. 40 cm

B. 45 cm

C. 50 cm

D. 30 cm

Answer: A

Watch Video Solution

36. A solid cylinder of mass $3kg$ is rolling on a horizontal surface with velocity $4ms^{-1}$. It collides with a horizontal spring of force constant $200 Nm^{-1}$. The maximum compression produced in the spring will be :

A. 0.2 m

B. 0.5 m

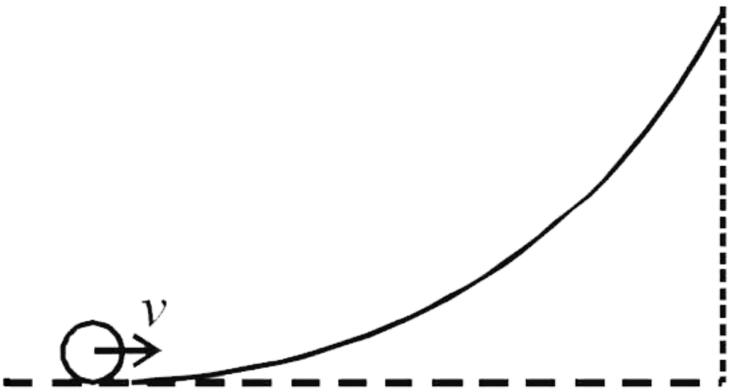
C. 0.6 m

D. 0.7 m

Answer: C

Watch Video Solution

37. A small object of uniform density rolls up a curved surface with an initial velocity v. it reaches up to a maximum height of `(3v^2)/(4g)



with respect to the initial position. The object is

A. Ring

B. Solid sphere

C. Hollow sphere

D. Disc

Answer: D

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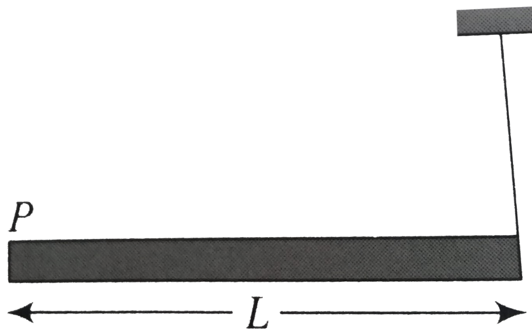
38. A rod PQ of mass M and length L is hinged at end P. The rod is kept horizontal by a massless string tied to point Q as shown in the figure. When string is cut, the initial angular accleration of the rod is.



A. $\frac{3g}{2L}$

B. $\frac{g}{L}$

C. $\frac{2g}{L}$

D. $\frac{2g}{3L}$

Answer: A

Watch Video Solution

39. A cylinder of mass $50mg$ and radius $0.5m$ is free to rotate about the horizontal axis. A massless string is wound round the cylinder with one end attached to it and other hanging freely. Tension in the string required to produce an angular acceleration of 2 revolutions s^{-2} is

A. 25 N

B. 50 N

C. 78.5 N

D. 157 N

Answer: D

Watch Video Solution

40. 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

A. $5:7$

B. $2:3$

C. $2:5$

D. $7:5$

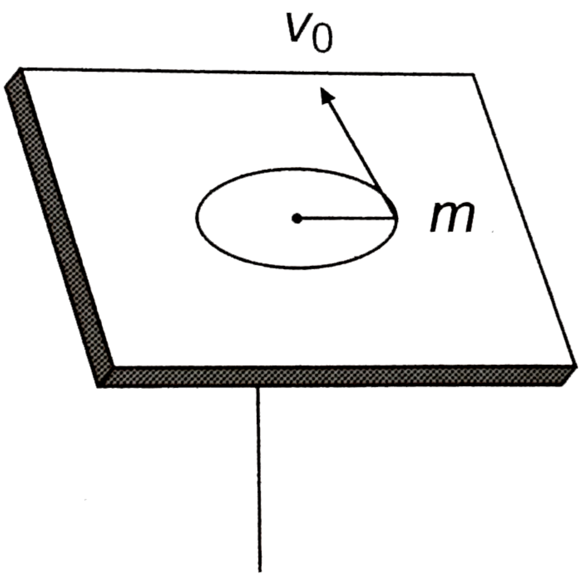
Answer: A

Watch Video Solution

41. A mass m moves in a circles on a smooth horizontal plane with velocity v_0 at a radius R_0. The mass is attached to string which passes through a smooth hole in the plane as shown.

The tension in string is increased gradually and finally m moves in a cricle of radius $\frac{R_0}{2}$.

the final value of the kinetic energy is



A. mv_0^2

B. $2mv_0^2$

C. $\frac{1}{4}mv_0^2$

D. $\frac{1}{2}mv_0^2$

Answer: B

Watch Video Solution

42. 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 a distance x from A.

A. $\frac{Wx}{d}$

B. $\frac{Wd}{x}$

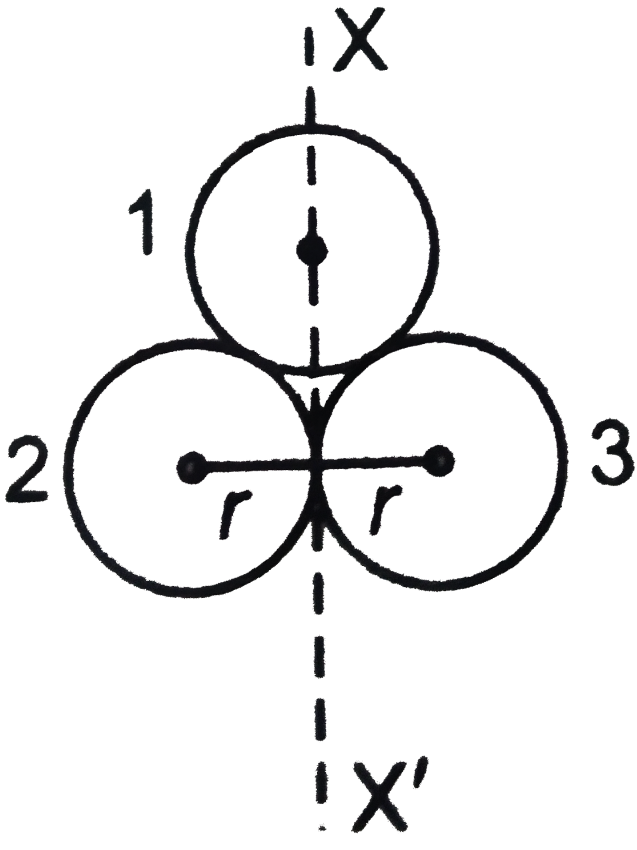
C. $\frac{W(d - x)}{x}$

D. $\frac{W(d - x)}{d}$

Answer: D

Watch Video Solution

43. Three idential spherical shells each of mass m and radius r are placed as shown in Fig. Consider an axis XX' which is touching the two shells and passing through diameter of third shell. Moment of Inertia of the system consisting of these three spherical shells about XX' as axis is :



A. $\frac{11}{5}mr^2$

B. $\frac{16}{5}mr^2$

C. $3mr^2$

D. $4mr^2$

Answer: D

Watch Video Solution

44. An autmobile moves on road with a speed of $54km/h$. The radius of its wheel is $0.45m$ and the moment of inertia of the wheel about its axis of rotation is $3 kgm^2$. If the vehicle is brought to rest in $15s$, the magnitude of average torque tansmitted by its brakes to the wheel is :

A. 2.86 kg $m^2 s^{-2}$

B. 6.66 kg $m^2 s^{-2}$

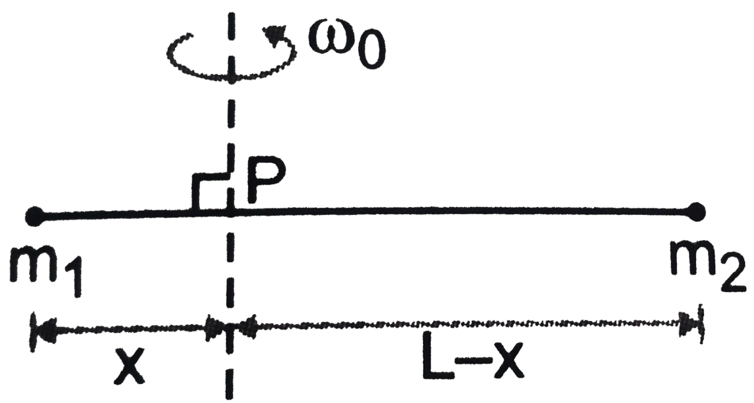
C. 8.58 kg $m^2 s^{-2}$

D. 10.86 kg $m^2 s^{-2}$

Answer: B

Watch Video Solution

45. Point masses m_1 and m_2 are placed at the opposite ends of a rigid rod of length L, and negligible mass. The rod is to be set rotating about an axis perpendicualr to it. The position of point P on this rod through which the axis should pass so that the work required to set the rod rotating with angular velocity ω_0 is minimum, is given by :



A. $x = \frac{m_2 L}{m_1 + m_2}$

B. $x = \frac{m_1 L}{m_1 + m_2}$

C. $x = \frac{m_1}{m_2} L$

D. $x = \frac{m_2}{m_1} L$

Answer: A

Watch Video Solution

46. A force $\vec{F} = \propto \hat{i} + 3\hat{j} + 6\hat{k}$ is acting at a point $\vec{r} = 2\hat{i} - 6\hat{j} - 12\hat{k}$. The value of $\propto$ for which angular momentum about origin is conserved is.

A. 1

B. -1

C. 2

D. zero

Answer: B

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47. From a disc of radius R and mass$M$, a circular hole of diameter R, whose rim passes through the centre is cut. What is the moment of inertia of remaining part of the disc about a perependicular axis, passing through the centre ?

A. $3MR^2/32$

B. $15MR^2/32$

C. $13MR^2/32$

D. $11MR^2/32$

Answer: C

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48. A uniform circular disc of radius $50cm$ at rest is free to turn about an axis, which is perpendicular to the plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of $2.0rad/s^2$. Its net acceleration in m/s^2 at the end of $2.0s$ is approximately

A. 8.0

B. 7.0

C. 6.0

D. 3.0

Answer: A

Watch Video Solution

49. A disc and a solid sphere of same radius but different masses roll off on two inclined planes of the same altitude and length. Which one of the two objects gets to the bottom of the plane first ?

A. Disk

B. Sphere

C. Both reach at the same time

D. Depends on their masses

Answer: B

Watch Video Solution

50. Two rotating bodies A and B of masses m and $2m$ with moments of inertia I_A and $I_B\left(I_B > I_A\right)$ have equal kinetic energy of rotation. If L_A and L_B are their angular momenta respectively, then.

A. $L_B > L_A$

B. $L_A > L_B$

C. $L_A = \frac{L_B}{2}$

D. $L_A = 2L_B$

Answer: A

Watch Video Solution

51. 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: D

Watch Video Solution

52. 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. $(m_1 + m_2)l^2$

B. $\sqrt{m_1 m_2} l^2$

C. $\frac{m_1 m_2}{m_1 + m_2} l^2$

D. $\frac{m_1 + m_2}{m_1 m_2} l^2$

Answer: C

Watch Video Solution

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

A. $0.25 rad/s^2$

B. $25 rad/s^2$

C. $5m/s^2$

D. $25m/s^2$

Answer: B

Watch Video Solution

54. Two discs of same moment of inertia rotating their regular axis passing through centre and perpendicular to the plane of disc with angular velocities ω_1 and ω_2. They are brought into contact face to the face coinciding the axis of rotation. The expression for loss of enregy during this process is :

A. $\frac{1}{4} I\left(\omega_1 - \omega_2\right)^2$

B. $I\left(\omega_1 - \omega_2\right)^2$

C. $\frac{1}{9} I\left(\omega_1 - \omega_2\right)^2$

D. $\frac{1}{2}I(\omega_1 + \omega_2)^2$

Answer: A

Watch Video Solution

55. Which of following statements are correct ? ltbgt (a) Centre of mass of a body always coincides with the centre of gravity of the body

(b) Central of mass of a body is the point at which the total gravitational torque on the body is zero

(c) Couple on a body produces both translational and rotation motion in a body

(d) Mechanical advantage greater than one means that small efforts can be used to lift a large load

A. (a) and (b)

B. (b) and (c)

C. (c) and (d)

D. (b) and (d)

Answer: D

Watch Video Solution

56. 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

A. $-7\hat{i} - 4\hat{j} - 8\hat{k}$

B. $-8\hat{i} - 4\hat{j} - 7\hat{k}$

C. $-7\hat{I} - 8\hat{j} - 4\hat{k}$

D. $-4\hat{i} - \hat{j} - 8\hat{k}$

Answer: A

Watch Video Solution

57. There object, A : (a solid sphere), B : (a thin circular disk) and C : (a circular ring), each have the same mass M and radius R. They all spin with the same angular speed ω about their own symmetry axes. The amount of work (W) required ot bring them to rest, would satisfy the relation

A. $W_A > W_C > W_B$

B. $W_C > W_B > W_A$

C. $W_B > W_A > W_C$

D. $W_A > W_B > W_C$

Answer: B

Watch Video Solution

58. A solid sphere is in rolling motion. In rolling motion a body prosseses translational kinetic energy (K_t) as well as rotational kinetic energy $\left(K_r\right)$ simutaneously. The ratio $K_t : \left(K_t + K_r\right)$ for the sphere is

A. $2:5$

B. $7:10$

C. $10:7$

D. $5:7$

Answer: D

Watch Video Solution

59. 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 ?

A. angular momentum

B. angular velocity

C. rotational kinetic energy

D. moment of inertia

Answer: A

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AIIMS Questions

1. A metal ball of mass $2kg$ moving with speed of $36Km/h$ has a collision with a stationary ball of mass $3kg$. If after collision, both the ball move together, the loss in Kinetic energy due to collision is :

A. 40 J

B. 60 J

C. 100 J

D. 140 J

Answer: B

Watch Video Solution

2. A constant torque of $31.4N - m$ is exterted on a pivoted wheel. If the angular acceleration of the wheel is $4\pi rad/s^2$, then the moment of inertia will be.

A. $2.5kg - m^2$

B. $5.8kg - m^2$

C. $4.5kg - m^2$

D. $5.6kg - m^2$

Answer: A

Watch Video Solution

3. We have two spheres, one of which is hollow and the other solid. They have identical masses and moment of intertia about their respective diameters. The ratio of their radius is given by.

A. $5:7$

B. $3:5$

C. $\sqrt{3}:\sqrt{5}$

D. $\sqrt{3}:\sqrt{7}$

Answer: C

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4. The direction of the angular velocity vector is along

A. the tangent to the circular path

B. the axis of rotation

C. the inward radius

D. the outward radius

Answer: B

Watch Video Solution

5. A gun fires a bullet of mass $50g$ with a velociy of $30m/s$. Due to this, the gun is pushed back with a velocity of $1m/s$, then the mass of the gun is :

A. 5.5 kg

B. 1.5 kg

C. 0.5 kg

D. 3.5 kg

Answer: B

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6. In an orbital motion, the angular momentum vector is :

A. perpendicular to the orbital plane

B. along the radius vector

C. parallel to the linear momentum

D. in the orbital plane

Answer: A

Watch Video Solution

7. A neutron makes a head-on elastic collision with a stationary deuteron. The fraction energy loss of the neutron in the collision is

A. $16/81$

B. $8/9$

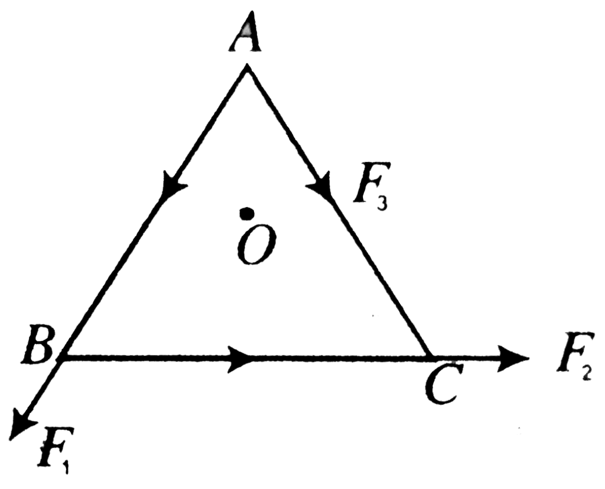
C. $8/27$

D. $2/3$

Answer: B

Watch Video Solution

8. O is the centre of an equilateral triangle ABC. F_1, F_2 and F_3 are the three forces acting along the sides AB, BC and AC respectively. What should be the value of F_3 so that the total torque about O is zero?



A. $\left(F_1 + F_2\right)$

B. $\frac{F_1 + F_2}{2}$

C. $F_1 - F_2$

D. $F_1 + F_2$

Answer: D

Watch Video Solution

9. A horizontal platform is rotating with uniform angular velcity around the vertical axis passing through its centre. At some instant of time a viscous fluid of mass m is dropped at the centre and is allowed to spread out and finally fall. The angular velocity during this period :

A. decreases continously

B. remains unltered

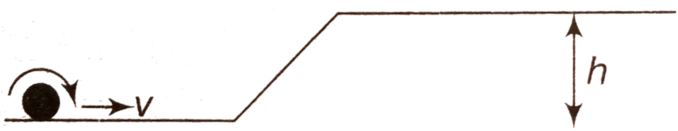
C. decreases initially and increases again

D. increases continuously

Answer: C

Watch Video Solution

10. A solid sphere is rolling on a frictionless surface, shown in figure with a translational velocity $v m/s$. If it is to climb the inclined surface then v should be :



A. $\geq \sqrt{2gh}$

B. $2gh$

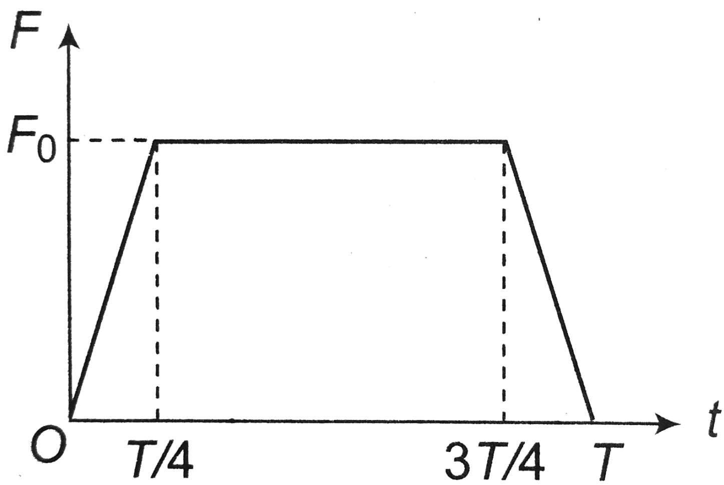
C. $\geq \sqrt{\frac{10}{7}gh}$

D. $\frac{10}{7}gh$

Answer: C

Watch Video Solution

11. A particle of mass m moving with a velocity u makes an elastic one-dimensional collision with a stationary particle of mass m establishing a contact with it for extermely small time. T. Their force of contact increases from zero to F_0 linearly in time $T/4$, remains constant for a further time $T/2$ and decreases linearly from F_0 to zero in further time $T/4$ as shown. The magnitude possessed by F_0 is.



A. $\frac{mu}{T}$

B. $\frac{2mu}{T}$

C. $\frac{4mu}{3T}$

D. $\frac{3mu}{4T}$

Answer: C

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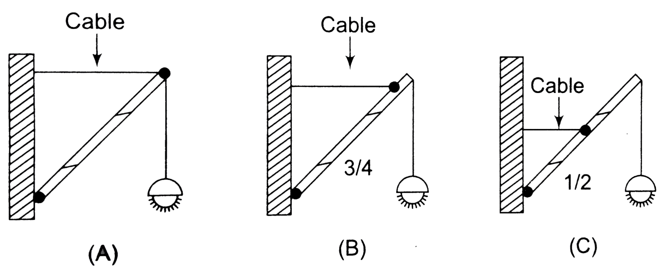
12. If a street light of mass M is suspended from the end of a uniform rod of length L in different possible patterns as shown in figure, then:



A. pattern B is more sturdy

B. pattern C is more sturdy

C. pattern A is more sturdy

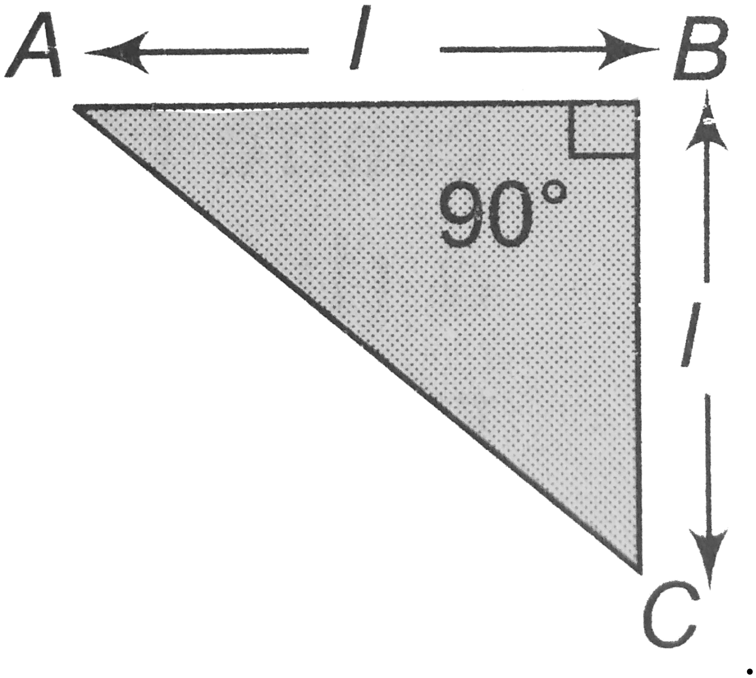
D. all will have same sturdiness

Answer: C

Watch Video Solution

13. Figure shows a thin metallic triangular sheet ABC. The mass of the sheet is M. The moment of inertia of the sheet about side AC

is :



A. $\frac{Ml^2}{18}$

B. $\frac{Ml^2}{12}$

C. $\frac{ML^2}{6}$

D. $\frac{Ml^2}{4}$

Answer: B

Watch Video Solution

14. Two equal masses m_1 and m_2 moving along the same straight line with velocites $+3m/s$ and -$5m/s$ respectively collide elastically. Their velocities after the collision will be respectively.

A. $+4m/s$ for both

B. -$3m/s$ and $+5m/s$

C. -$4m/s$ and $+4m/s$

D. -$5m/s$ and $+3m/s$

Answer: D

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15. A bomb of mass $3.0kg$ explodes in air into two pieces of masses $2.0kg$ and $1.0kg$. The smaller mass goes at a speed of $80m/s$. The total energy imparted to the two fragments is :

A. 1.07 k J

B. 2.14 k J

C. 4.8 k J

D. 2.4 k J

Answer: C

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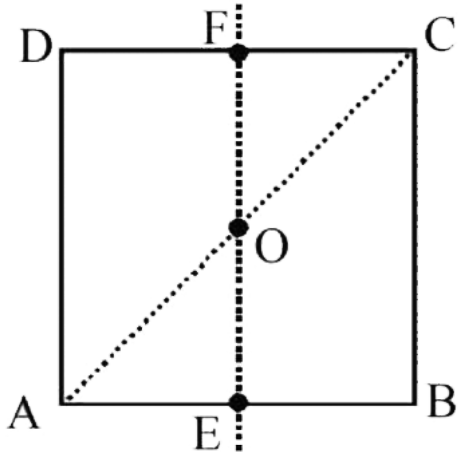
16. For the given uniform square lamina ABCD, whose centre is O,



A. $I_{AC} = I_{EF}$

B. $\sqrt{2}I_{AC} = I_{EF}$

C. $I_{AD} = 3I_{EF}$

D. $I_{AB} = \sqrt{2}I_{EF}$

Answer: A

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17. For inelastic collsion between two spherical rigid bodies

A. the total kinetic energy is conserved

B. the total mechanical energy is not conserved

C. the linear momentum is not conserved

D. the linear momentum is conserved

Answer: D

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18. A particle of mass m moving with velocity v strikes a stationary particle of mass $2m$ and sticks to it. The speed of the system will be.

A. v//2

B. 2 v

C. v//3

D. 3 v

Answer: C

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19. A wheel has angular acceleration of $3.0 rad/s^2$ and an initial angular speed of $2.00 rad/s$. In a tine of $2s$ it has rotated through an angle (in radian) of

A. 6

B. 12

C. 10

D. 4

Answer: C

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20. A ball of mass m moving with velocity V, makes a head on elastic collision with a ball of the same moving with velocity $2V$ towards it. Taking direction of V as positive velocities of the two balls after collision are.

A. $-V$ and $2V$

B. $2V$ and $-V$

C. V and $-2V$

D. $-2v$ and V

Answer: D

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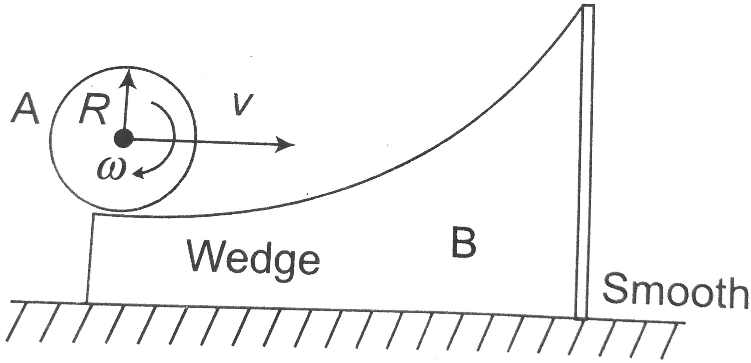
21. In the figure shown, a cylinder A is initially rolling with velocity v on the horizontal surface of the wedge B (of same mass as A). All surfaces are smooth and B has no initial velocity. Then maximum height reached by cylinder on the wedge will be.



A. $v^2/4g$

B. v^2/g

C. $v^2/2g$

D. $v^2/8$

Answer: A

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22. A ball of mass m falls vertically to the ground from a height h_1 and rebound to a height h_1 and rebound to a height h_2. The change in momentum of the ball on striking the ground is.

A. $mg\left(h_1 - h_2\right)$

B. $m\left(\sqrt{2gh_1} + \sqrt{2gh_2}\right)$

C. $m\sqrt{2g\left(h_1 + h_2\right)}$

D. $m\sqrt{2g}\left(h_1 + h_2\right)$

Answer: B

Watch Video Solution

23. A solid iron sphere A rolls down an inclined plane. While an identical hollow sphere B of same mass sides down the plane in a frictionless manner. At the bottom of the inclined plane, the total kinetic energy of sphere A is.

A. less than that of B

B. equal to that of B

C. more than that of B

D. sometimes more and sometimes less.

Answer: B

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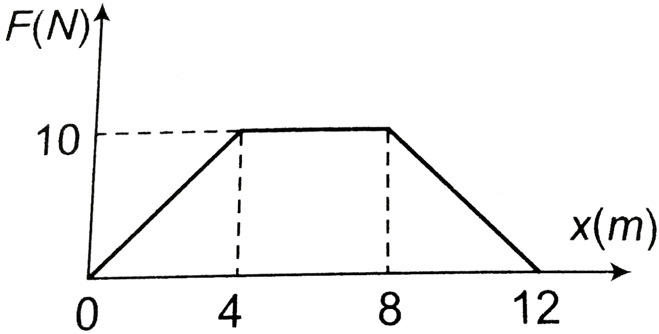
24.



A particle of mass 0.1 kg is subjected to a force which varies with distance as shown in figure. If it starts its journey from rest at $x = 0$, its velocity at $x = 12m$ is

A. $0 m/s$

B. $20\sqrt{2} m/s$

C. $20\sqrt{3} m/s$

D. $40m/s$

Answer: D

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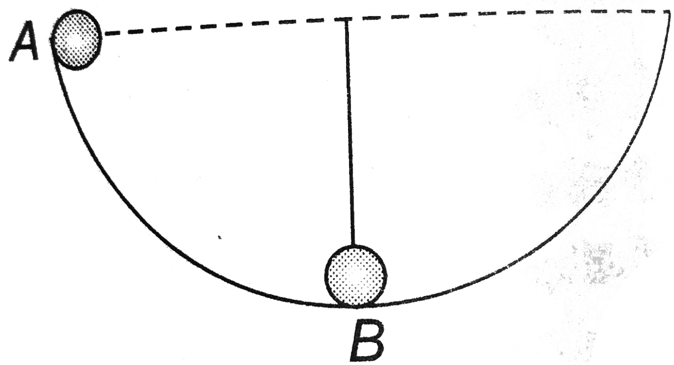
25. A ball of mass m and radius r rolls inside a fixed hemispherical shell of radius R. It is released from rest from point A as shown in figure. The angular velocity of centre of the ball in position B about the centre of the shell is.



A. $2\sqrt{\frac{g}{5(R - r)}}$

B. $\sqrt{\frac{10g}{7(R - r)}}$

C. $\sqrt{\frac{g}{7(R - r)}}$

D. $\sqrt{\frac{5g}{2(R - r)}}$

Answer: B

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26. A particle moves in a circular path with decreasing speed . Choose the correct statement.

A. Angular momentum remians constant.

B. Acceleration $(\vec{a})$ is towards the centre.

C. Particle moves in a spiral path with decreasing radius.

D. The directon of angular momentum remains constant.

Answer: D

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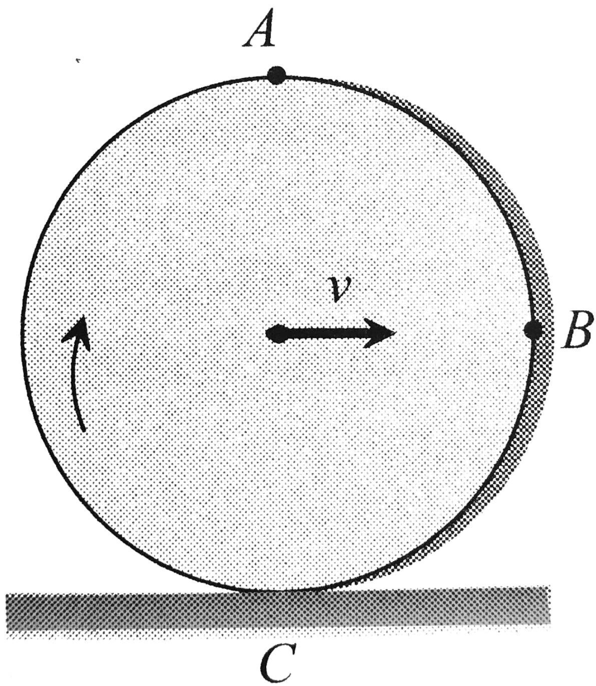
27. A solid disc rolls clockwise without slipping over a horizontal path with a constant speed v. Then the magnitude of the velocities of points A, B and C (see figure) with respect to a standing observer are, respectively,



A. v, v and v

B. $2v$, $\sqrt{2}v$ and zero

C. $2v$, $2v$ and zero

D. $2v$, $\sqrt{2}v$ and $\sqrt{2}v$

Answer: B

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28. A wheel which initiallty at rest starts rotating at time $t = 0$. The angular acceleration $\propto$ decrease from $50 rad/s^2$ to zero value 5 seconds. During this interval, $\propto$ varies according to the.

$$\propto = \propto_0 \left(1 - \frac{t}{5}\right)$$

The angular velocity of the wheel at $t = 5s$ will be.

A. $10 rad/s$

B. $250 rad/s$

C. $125 rad/s$

D. $100 rad/s$

Answer: C

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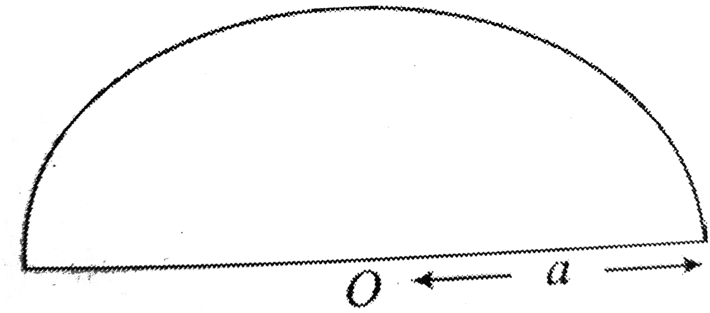
29. What will be the position of centre of mass of a half disc shown ?



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

B. $\frac{4a}{3\pi}$

C. $\frac{a}{\pi}$

D. $\frac{2a}{3\pi}$

Answer: B

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30. Assertion: In an elasticcollision of two billard balls, the total KE is conservation during the short times of collision of the balls`(i.e., when they are in constant).

Reason: Energy spend against friction does not follow the law of conservation of energy.

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

B. If both assertion and reason are 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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31. The earth is slowing down and as a result the moon is coming nearer to it.

The angular momentum of the earth-moon system is not conserved.

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

B. If both assertion and reason are 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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32. There are very small sporadic changes in the speed of rotation of the earth.

Shifting of large air masses in the earth's atmosphere produce a change in the moment of inertia of the earth causing its speed of rotation to charge.

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

B. If both assertion and reason are 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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33. For of particles under central forcer field, the total angular momentum is conserved.

The torque acting on such a system is zero.

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

B. If both assertion and reason are 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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34. A judo fighter in order to throw his opponent on the mat tries to initially bend his opponent and then rotate him around his hip. As the mass of the opponent is brought closer to the fighter's hip, the force required to throw the opponent is reduced.

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

B. If both assertion and reason are 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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35. Assertion: A quick collision between two bodies is more violent that show collision , even when initial and final velocity are identical.

Reason: The rate of change of momentum determine that force is small or large.

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

B. If both assertion and reason are 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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36. Assertion: In an elastic collision of two bodies , the momentum and energy of each body is conserved.

Reason: If two bodies stick to each other , after colliding , the collision is said to be perfectly elastic.

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

B. If both assertion and reason are 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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37. Assertion: The velocity of a body at the bottom of an inclind plane of given height is more when is slides down the plane, compared to, when it rolling down the same plane.

Reason: In rolling down a body acquires both, kinetic energy of translation and rotation.

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

B. If both assertion and reason are 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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38. Assertion: The velocity of a body at the bottom of an inclind plane of given height is more when is slides down the plane, compared to, when it rolling down the same plane.

Reason: In rolling down a body acquires both, kinetic energy of translation and rotation.

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

B. If both assertion and reason are 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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39. A solid sphere rolling on a rough horizontal surface. Acceleration of contact point is zero.

A solid sphere can roll on the smooth surface.

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

B. If both assertion and reason are 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

Watch Video Solution

40. Torque on a body can be zero even if there is a net force on it.

Torque and force on a body are always perpendicular.

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

B. If both assertion and reason are 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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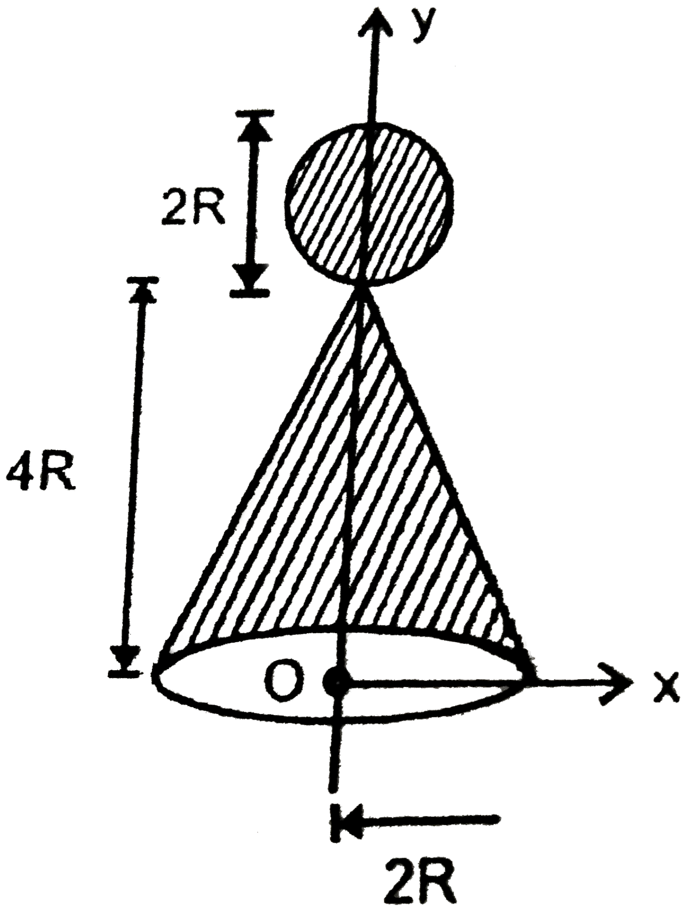
Chapter Test

1. A carpenter has constructed a toy as shown in figure. If the density of the material of the sphere is 12 tirnes that of cone, the y -

coordinate of COM of toy point O



A. at a distance of $2R$ from O

B. at a distance of $3R$ from O

C. at a distance of $4R$ from O

D. at a distance of $5R$ from O

Answer: C

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2. From a given sample of uniform wire, two circular loops P and Q are made, P of radius r and Q of radius nr. If the M.I. of Q about its axis is four times that of P about its axis (assuming the wire to be of diameter much smaller than either radius), the value of n is

A. $(4)^{2\frac{/}{3}}$

B. $(4)^{1/3}$

C. $(4)^{1/2}$

D. $(4)^{1/4}$

Answer: B

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3. A particle of mass m is moving in a plane along a circular path of radius r. Its angular momentum about the axis of rotation is L. The centripetal force acting on the particle is.

A. $\frac{L^2}{mr}$

B. $\frac{L^2 m}{r}$

C. $\frac{L^2}{mr^3}$

D. $\frac{L^2}{mr^2}$

Answer: C

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4. A particle performing uniform circular motion gas angular momentum L. If its angular frequency is double and its kinetic energy halved, then the new angular momentum is :

A. $\frac{L}{4}$

B. L

C. 2 L

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

Answer: A

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

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

D. speed and time od descend both are different.

Answer: B

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6. What is the minimum value of coefficient of friction between the cylinder and inclined plane for rolling without slipping ?

A. $\frac{1}{3}\sin\theta$

B. $\frac{1}{3}\tan\theta$

C. $\frac{2}{3}\sin\theta$

D. $\frac{2}{3}\tan\theta$

Answer: B

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7. The kinetic energy of an object rotating about a fixed axis with angular momentum $L = I\omega$ can be written as.

A. $K = L^2/2I$

B. $K = 2l^2/I$

C. $K = L^2/I$

D. $K = \sqrt{2}L^2/I$

Answer: A

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8. An ice skater starts a spin with her arms stretched out to the sides. She balances on the tip of one skate to turn without friction.

She then pulls her arms in so that her moment of inertia decrease by a factor of 2. In the process of her doing so, what happens to her kinetic energy ?

A. It increases by a factor of 4.

B. It increases by a factor of 2

C. It remains constant

D. It decreases by a factor of 2.

Answer: B

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9. Find the centre of mass of a uniform L shaped lamina (a thin flat plate) with dimension as shown in Fig. The mass of the lamina is $3kg$.

A. $\left(\frac{5}{6}m, \frac{5}{6}m\right)$

B. $(1m, 1m)$

C. $\left(\frac{6}{5}m, \frac{6}{5}m\right)$

D. $(2m, 2m)$

Answer: A

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10. From a uniform disc of radius R, a circular section of radius $R/2$ is cut out. The centre of the hole is at $R/2$ from the centre of the original disc. Locate the centre of mass of the resulting flat body.

A. $\dfrac{Rr^2}{2\left(R^2 - r^2\right)}$ towards right of O

B. $\frac{Rr^2}{2(R^2 - r^2)}$ towards left of O

C. $\frac{2Rr^2}{2(R^2 + r^2)}$ towards right of O

D. $\frac{2Rr^2}{2(R^2 + r^2)}$ towards left of O

Answer: B

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11. Half of the recrtangular plate shown in figure is made of a material of density ρ_1 and the other half of density ρ_2. The length of the plate is L. Locate the centre of mass of the plate.

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

B. $\frac{\left(\rho_1 + 3\rho_2\right)}{4\left(\rho_1 + \rho_2\right)}L$

C. $\frac{\left(3\rho_1 + \rho_2\right)}{\left(\rho_1 + \rho_2\right)}L$

D. $Mx = m(L\cos\theta - x)$

Answer: B

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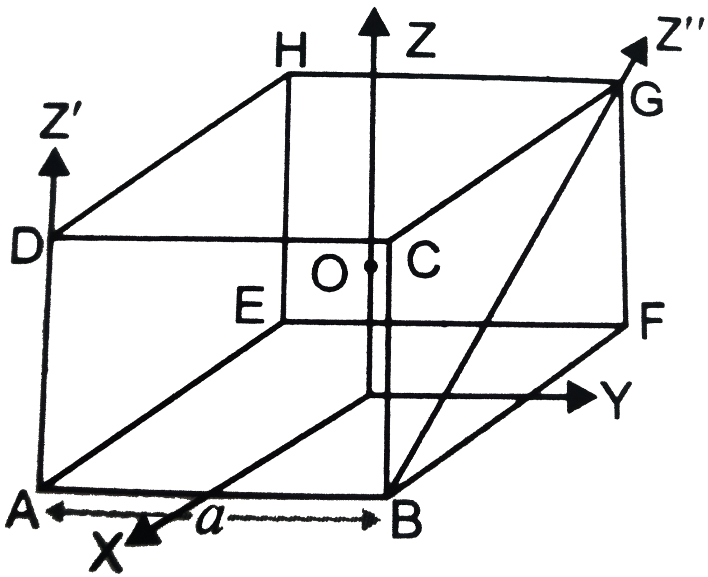
12. With reference to Fig. of a cube of edge a and mass m, state whether the following are true or false. (O is the centre of the cube.)



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''

$$I_z + \frac{ma^2}{2}$$

C. $I_x = I_y$

D. None of these

Answer: B

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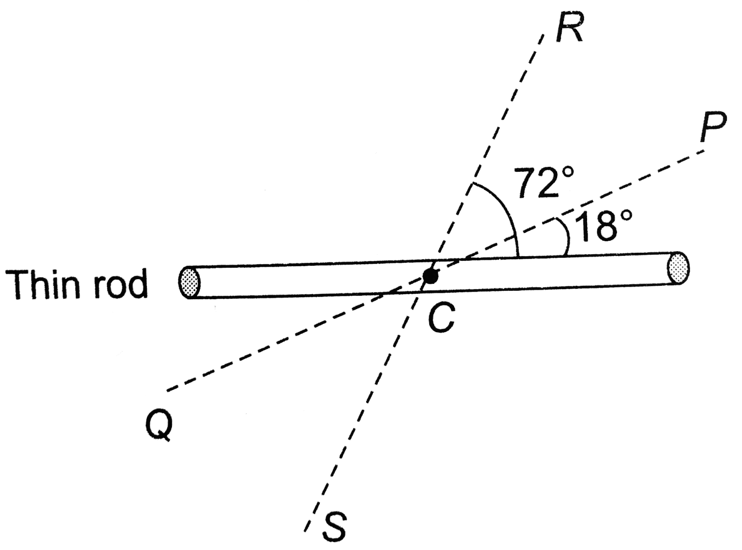
13. The moment of inertia of a uniform thin rod of mass m and length l about two axis PQ and RS passing through centre of rod C and in the plane of the rod are I_{PQ} and I_{RS} respectivley. Then $I_{PQ} + I_{RS}$ is equal to.



A. $\frac{ml^2}{3}$

B. $\frac{ml^2}{2}$

C. $\frac{ml^2}{4}$

D. $\frac{ml^2}{12}$

Answer: D

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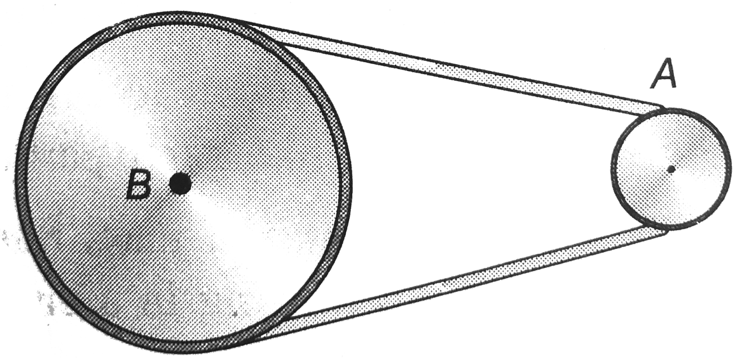
14. Wheels A and B in Figure are connected by a belt that does not slip. The radius of B is

3.00 times the radius of A. What would be the ratio of the rotational inertias I_A/I_B if the two wheels had same angular momentum about their central axes.



A. $\frac{3}{4}$

B. $\frac{2}{3}$

C. $\frac{1}{3}$

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

Answer: C

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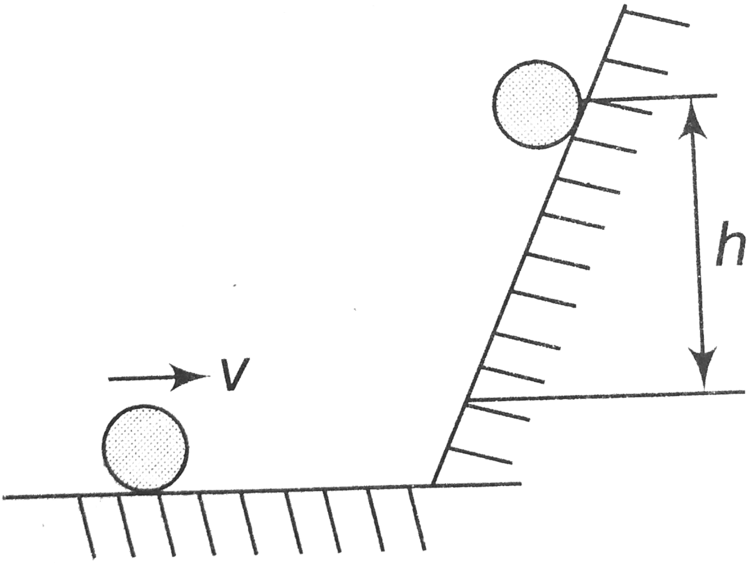
15. A disc of radius R and mass M is rolling horizontally without slipping with speed with speed v. It then moves up an incline as shown in figure. The maximum height upto which it can reach is.



A. v^2/g

B. $v^2/2g$

C. $v^2/3g$

D. $3v^2/4g$

Answer: D

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16. A sphere of outer radius R having some cavity inside is allowed to roll down on an incline. The incline is then made smooth by waxing and the sphere is allowed to slide without rolling and now the speed attained is $(5/4)v_0$. What is the radius of gyration of the sphere about an axis passing through its centre ?

A. $\sqrt{\frac{2}{5}}R$

B. $\sqrt{\frac{2}{3}}R$

C. $\left(\frac{4}{5}\right)R$

D. $\left(\frac{3}{4}\right)R$

Answer: D

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17. In a bicycle the radius of rear wheel is twice the radius of front wheel. If v_F and v_r are the speeds of top most points of front and rear wheels respectively, then :

A. $v_r = 2v_F$

B. $v_F = 2v_r$

C. $v_F = v_r$

D. $v_F > v_r$

Answer: C

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18. A cord is wound round the circumference of wheel of radius r. The axis of the wheel is horizontal and fixed and moment of inertia about it is I. A weight mg is attached to the end of the cord and falls from rest. After falling through a distance h, the angular velocity of the wheel will be.

A. $\sqrt{\frac{2gh}{I + mr}}$

B. $\left[\frac{2mgh}{I + mr^2}\right]^{\frac{1}{2}}$

C. $\left[\frac{2mgh}{I + 2m}\right]^{\frac{1}{2}}$

D. $\sqrt{2gh}$

Answer: B

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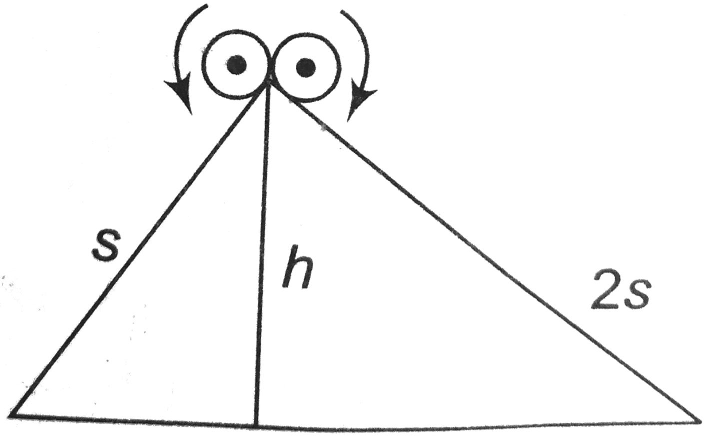
19. Two identical cylinders roll from rest on two identical planes of slant lengths s and $2s$ but of the same height h. Then, the velocities, v_1 and v_2 acquired by the cylinders when they reach the bottom of the incline are related as.



A. $v_1 = v_2$

B. $v_1 = 2v_2$

C. $2v_1 = v_2$

D. None of the above.

Answer: A

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20. 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 ?

A. solid cylinder

B. hollow cylinder

C. both will take the same time

D. it cannot be predicted

Answer: A

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21. A solid sphere and a disc of same radii are falling along an inclined plane without slip. One reaches earlier than the other due to.

A. different radius of gyration

B. different size

C. different friction

D. different moment of inertia

Answer: A

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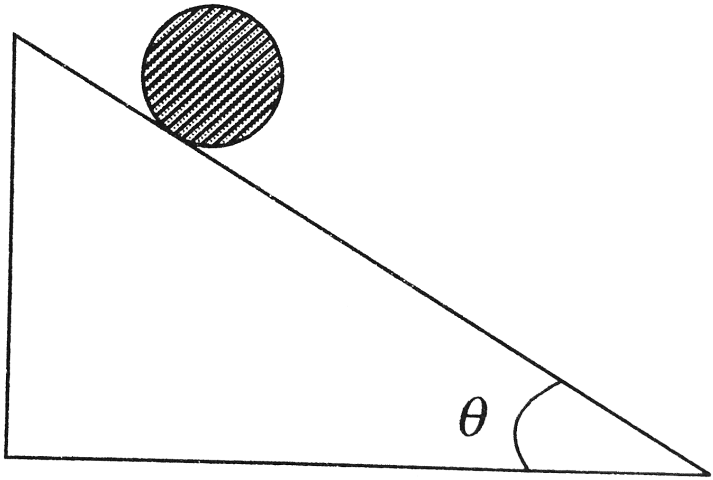
22. A homogeneous ball is placed on a plane making an angle θ with the horizontal. At what values of the coefficient of friction μ the ball roll down the plane without slipping ?



A. $\geq \frac{2}{7} g \tan\theta$

B. $\geq \frac{2}{5} g \tan\theta$

C. $\geq \frac{2}{3} \tan\theta$

D. $\geq \frac{3}{4} \tan\theta$

Answer: A

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23. A solid cylinder of mass M and radius R rolls down an inclined plane of height h without slipping. The speed of its centre when it reaches the bottom is.

A. $\sqrt{(2gh)}$

B. $\sqrt{(4/3)gh}$

C. $\sqrt{(3/4)gh}$

D. $\sqrt{(4g/h)}$

Answer: B

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24. A body of mass m slides down an incline and reaches the bottom with a velocity v. If the same mass were in the form of a ring which rolls down this incline, the velocity of the ring at the bottom would have been

A. v

B. $\sqrt{2}v$

C. $v/\sqrt{2}$

D. $\sqrt{(2/5)}v$

Answer: C

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25. The speed of a homogeneous solid sphere after rolling down an inclined plane of vertical height h from rest without slipping will be.

A. $\sqrt{\frac{10gh}{7}}$

B. $\sqrt{gh}$

C. $\sqrt{\frac{6}{5}gh}$

D. $\sqrt{\frac{4}{3}gh}$

Answer: A

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26. Consider a rod of mass M and length L pivoted at its centre is free to rotate in a vertical position plane. The rod is at rest in the vertical position. A bullet of mass M moving horizontally at a speed v strikes and embedded in one end of the rod. The angular velocity of the rod just after the collision will be.

A. v/L

B. $2v/L$

C. $3v/2L$

D. $6v/L$

Answer: C

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

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 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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29. If there are no external forces, the centre of mass of a double star moves like a free particle.

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

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

B. If both assertion and reason are 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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