PHYSICS

BOOKS - MTG GUIDE PHYSICS (HINGLISH)

MOTION OF SYSTEM OF PARTICLES AND RIGID BODY

Illustration

1. 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 . Show that the centre of mass of the composite system lies inside the square plate .

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2. A cheetah , weighing 150 kg , chases a deer , weighing 30 kg , in a straight path . The speed of the cheetah is 20 m/s and that of the deer is 25 m/s . The approximate speed of the centre of mass of the pair is

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3. A circular plate of uniform thickness has a diameter of 56 cm . A circular portion of diameter 42 cm is removed from one edge of

the plate as shown in the figure . Find the position of the centre of mass of the remaining portion .

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4. Three identical spheres , each of mass M , are placed at the corners of a right angled triangle with mutually perpendicular sides equal to 2 m . Taking their point of

intersection as the origin , find the position vector of centre of mass

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5. Three particles A , B and C of equal mass move with equal speed V along the medians of an equilateral triangle as shown in figure .

They collide at the centroid G of the triangle . After the collision , A comes to rest , B retraces

its path with the speed V . what is the velocity of C ?

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6. Show that internal forces can change the kinetic energy but not linear momentum .

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

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8. In an electric clock the extremity of the hour hand moves one twentiech as fast as that of the minute hand . What is the length of the hour if the minute hand is 10 cm long ?

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9. Calculate the moment of inertia of a diatomic molecule about an axis passing

through its centre of mass and perpendicular to the line joining the two atoms .

Given : The two masses are m_1 and m_2 separated by a distance r .

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10. Point masses 1 , 2 ,3 and 4 kg are lying at the point (0 , 0 , 0) , (2 , 0 , 0) , (0 , 3 , 0) and $(-2, -2, 0)$ respectively . Find the moment of inertia of this system about X-axis

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11. Find the moment of inertia about the axis shown in the following situations .

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12. A cylinder of mass M and radius R starts falling under gravity at t = 0 as shown in the figure . Calculate

(i) tension in the massless string

(ii) acceleration of the cylinder

(iii) instantaneous power developed by gravitational force .

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13. Torques of equal magnitude are applied to a hollow cylinder and a solid sphere , both having the same mass and radius . The cylinder is free to rotate about its standard axis of symmetry , and the sphere is free to

rotate about an axis passing through its centre . Which of the two will acquire a greater angular speed after a given time .

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14. A force of $-F\hat{k}$ acts on O , the origin of the coordinate system . Find the torque about the point $(1, -1, 0)$

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15. A particle of mass 2 kg is on a smooth horizontal table and moves in a circular path of radius 0.6 m . The height of the table from the ground is 0.8 m . If the angular speed of the particle is $12 rads^{-1}$. Find the magnitude of its angular momentum about a point on the ground right under the centre of the circle

.

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16. A particle performs uniform circular motion with an angular momentum L . If the frequency of particle's motion is doubled and its kinetic energy is halved , then find the new angular momentum in terms of L.

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17. A solid sphere , a hollow sphere and a disc , all having same mass and radius , are placed at the top of an incline and released . The friction

coefficient between the objects and the incline are same and not sufficient to allow pure rolling . Prove that time taken in reaching the bottom is same for all .

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18. A ring rolls , without slipping , on the ground . Its centre C moves with a constant speed u as shown in figure . Calculate , speeds of points A , B , D and E , with respect to the

ground .

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19. A ring of mass M is rolling down an inclined plane . The length of this plane is L . It makes an angle θ with the horizontal . Find the velocity of the centre of mass of the ring at the centre of the plane.

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20. A circular disc reaches , from top to bottom , of an inclined plane of length S . When it slips down the plane , it takes time t_1 . When it rolls down the plane , it takes t_2 . Calculate the ratio $\frac{t_2}{t_1}$

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Neet Cafe Topicwise Practice Questions

1. Three particles, each of mass m, are placed at the corners of a right angled triangle as

shown in figure. If OA = a and OB = 5, the position vector of the centre of mass is (Here $\hat{i}$ and $\hat{j}$ are unit vectors along x and m y axes respectively).

A. $\frac{1}{3}\left(a\hat{i}+b\hat{j}\right)$

B. $\frac{1}{3}\left(a\hat{i}-b\hat{j}\right)$

C. $\frac{2}{3}\left(a\hat{i}+b\hat{j}\right)$

D. $\frac{2}{3}\left(a\hat{i}-b\hat{j}\right)$

Answer: A

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2. The position of centre of mass of a system of particles does not depend upon

A. masses of particles

B. forces on particles

C. position of the particles

D. relative distance between the particles

Answer: B

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3. Three particles of masses 1 kg, 2 kg and 3 kg are situated at the corners of an equilateral triangle of side b in the x-y plane with mass 1 kg at the origin and 2 kg on the x-axis. The coordinates of the centre of mass are

A. $\left(\frac{7b}{12}, \frac{3\sqrt{3}b}{12}\right)$

B. $\left(\frac{3\sqrt{3}b}{12}, \frac{7b}{12}\right)$

C. $\left(\frac{b}{12}, \frac{3\sqrt{3}b}{12}\right)$

D. $\left(\frac{7b}{12}, \frac{\sqrt{3}b}{12}\right)$

Answer: A

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

A. $g/4$

B. g/2

C. g

D. 2g

Answer: A

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5. The centre of mass of three bodies each of mass 1 kg located at the points (0,0), (3, 0) and (0, 4) in the x-y plane is

A. $\left(\frac{4}{3}, 1\right)$

B. $\left(\frac{1}{3}, \frac{2}{3}\right)$

C. $\left(\frac{1}{2}, \frac{1}{2}\right)$

D. $\left(1, \frac{4}{3}\right)$

Answer: D

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6. Particles of masses m, 2m, 3m, ... , nm grams are placed on the same line at distances l, 2l, 3l, ..., nl cm from a fixed point. The distance of centre of mass of the particles from the fixed point in centimetres is

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

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

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

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

Answer: A

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7. Two particles of masses 1 kg and 3 kg have position vectors $2\hat{i}+3\hat{j}+4\hat{k}$ and

$-2\hat{i}+3\hat{j}-4\hat{k}$ respectively. The centre of mass has a position vector

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

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

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

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

Answer: D

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8. Four particles of masses m, 2m, 3m and 4m are arranged at the corners of a parallelogram with each side equal to a and one of the angle between two adjacent sides as 60° The parallelogram lies in the x-y plane with mass m at the origin and 4m on the r-axis. The centre of mass of the arrangement will be located at

A. $\left(\frac{\sqrt{3}}{2}a, 0.95a\right)$

B. $\left(0.95a, \frac{\sqrt{3}}{4}a\right)$

C. $\left(\frac{3a}{4}, \frac{a}{2}\right)$

D. $\left(\frac{a}{2}, \frac{3a}{4}\right)$

Answer: B

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9. Figure shows position and velocities of two particles moving under mutual gravitational attraction in space at time t=0. The position of centre of mass after one second is

A. x = 4 m

B. $x = 6$ m

C. $x = 8$ m

D. $x = 10$ m

Answer: D

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10. A T shaped object with dimensions shown in figure, is lying on a smooth floor. A force F is applied at the point P parallel to AB, such that the object has only translational motion

without rotation. Find the location of P with respect to C

A. I

B. $\frac{4}{3}I$

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

D. $\frac{2}{3}I$

Answer: B

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11. A circular disc of radius R is removed from a bigger of the discs coincide. The centre of mass of the new disc is ar from the centre of the bigger disc. The value of α is

A. $\frac{1}{4}$

B. $\frac{1}{3}$

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

D. $\frac{1}{6}$

Answer: B

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12. In a carbon monoxide molecule, the carbon and oxygen atoms are separated by a distance of 1.12×10^{-10} m. The distance of the centre of mass from the carbon atom is

A. 0.48×10^{-10} m

B. $0.51 \times 10^{-10} m$

C. $0.56 \times 10^{-10} m$

D. 0.64×10^{-10} m

Answer: D

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13. A thin rod of length L is lying along the x-axis with its ends at x = 0 and x = L. Its linear density (mass/length) varies with x as $k\left(\frac{x}{L}\right)^n$ where n can be zero or any positive integer. If position X_{cm} of centre of mass of the rod is plotted against n, which of the following graphs best approximates the dependence of x_{CM} on n?

A. 

B. 

C. 

D. 

Answer: A

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14. Three bricks each of length L and mass M are arranged as shown from the wall. The distance of the centre of mass of the system

from the wall is

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

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

C. $\left(\frac{3}{2}\right)L$

D. $\left(\frac{11}{12}\right)L$

Answer: D

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15. Two masses m_1 = 1 kg and m_2 = 2 kg are connected by a light inextensible string and suspended by means of a weightless pulley as shown in the figure. Assuming that both the masses start from rest, the distance travelled by the centre of mass in two 1 kg seconds is (Take g= $10ms^{-2}$)

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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16. A cricket bat is cut at the location of its centre of mass as shown. Then

A. the two pieces will have the same mass

B. the bottom piece will have larger mass

C. the handle piece will have larger mass

D. mass of handle piece is double the mass of bottom piece

Answer: B

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17. A system consisting of two masses connected by a massless rod lies along the x-axis. A 0.4 kg mass is at a distance x = 2 m

while a 0.6 kg mass is at a distance r = 7 m. The x-coordinate of the centre of mass is

A. 5 m

B. 3.5 m

C. 4.5 m

D. 4 m

Answer: A

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18. Three identical spheres, each of mass 1 kg are kept as shown in figure, touching each other, with their centres on a straight line. If their centres are marked P, Q, R respectively, the distance of centre of mass of the system from P is

A. $\frac{PQ + PR + QR}{3}$

B. $\frac{PQ + PR}{3}$

C. $\frac{PQ + QR}{3}$

D. $\frac{PR + QR}{3}$

Answer: B

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19. A system consists of 3 particles each of mass m located at points (1, 1), (2, 2) and (3, 3). The coordinates of the centre of mass are

A. (6,6)

B. (3,3)

C. (1 ,1)

D. (2 ,2)

Answer: D

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20. Centre of mass of 3 particles 10 kg, 20 kg and 30 kg is at (0, 0, 0). Where should a particle of mass 40 kg be placed so that the combined centre of mass will be at (3, 3, 3)?

A. (0,0,0)

B. (7.5 , 7.5 , 7.5)

C. (1 , 2 , 3)

D. (4 , 4 , 4)

Answer: B

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21. In the diagram shown below, m_1 and m_2 are the masses of two particles and x_1 and x_2 are the respective distances from the origin O

. The centre of mass of the system is

A. $\frac{m_1x_2 + m_2x_1}{m_1 + m_2}$

B. $\frac{x_1 + x_2}{2}$

C. $\frac{m_1x_1 + m_2x_2}{m_1 + m_2}$

D. $\frac{m_1m_2 + x_1x_2}{m_1 + m_2}$

Answer: C

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22. The centre of mass of a system of three particles of masses 1 g, 2 g and 3 g is taken as the origin of a coordinate system. The position vector of a fourth particle of mass 4 g such that the centre of mass of the four particle system lies at the point (1,2,3) is $\alpha\left(\hat{i}+2\hat{j}+3\hat{k}\right)$, where α is a constant. The value of α is

A. $\frac{10}{3}$

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

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

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

Answer: B

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23. Centre of mass of three particles of masses 1 kg, 2 kg and 3 kg lies at the point (1, 2, 3) and centre of mass of another system of particles 3 kg and 2 kg lies at the point (-1, 3, -2). Where should we put a particle of mass 5 kg 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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24. If the density of material of a square plate and a circular plate shown in figure is same, 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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25. Two bodies of masses 2 kg and 4 kg are moving with velocities 2 m s^{-1} and 10 m s^{-1} towards each other due to mutual gravitational attraction. What is the velocity of their centre of mass?

A. $5.3ms^{-1}$

B. $6.4ms^{-1}$

C. zero

D. $8.\ 1ms^{-1}$

Answer: C

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26. What is the torque of a force $3\hat{i} + 7\hat{j} + 4\hat{k}$ about the origin, if the force acts on a particle whose position vector is

A. $\hat{i} - 5\hat{j} + 8\hat{k}$

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

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

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

Answer: A

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27. A force F = 2.0 N acts on a particle P in the xz-plane. The force F is parallel to x-axis. The particle P (as shown in the figure) is at a distance 3 m and the line joining P with the origin makes angle 30° with the x-axis. The

magnitude of torque on P with respect to origin O (in N m) is

A. 2

B. 3

C. 4

D. 5

Answer: B

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28. The torque acting on a body is the rotational analogue of

A. mass of the body

B. linear kinetic energy of the body

C. linear velocity of the body

D. force in linear motion

Answer: D

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29. Moment of a couple is called

A. impulse

B. couple

C. torque

D. angular momentum

Answer: C

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30. Four equal and parallel forces are acting on a rod of length 100 cm, as shown in figure, at distances of 20 cm, 40 cm, 60 cm and 80 cm respectively from one end of the rod. Under the influence of these forces, the rod (neglecting its weight)

A. experiences no torque

B. experiences torque

C. experiences a linear motion

D. experiences torque and also a linear motion

Answer: B

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31. A uniform rod of length of 1 m and mass of 2 kg is attached to a side support at O as shown in the figure. The rod is at equilibrium due to upward force T acting at P.

Assume the acceleration due to gravity as $10ms^{-2}$. The value of T'is

A. 0

B. 2N

C. 5 N

D. 10 N

Answer: D

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32. A uniform horizontal metre scale of mass m is suspended by two vertical strings attached to its two ends. A body of mass 2m is placed on the 75 cm mark. The tensions in the two strings are in the ratio is

A. $1:2$

B. $1:3$

C. $2:3$

D. $3:4$

Answer: A

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

A. 56 g

B. 66 g

C. 76 g

D. 86 g

Answer: B

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

A. I and II only

B. II and III only

C. I and III only

D. The net torque is zero in all cases

Answer: A

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35. A thin rod of length I and mass m is bent at mid-point O at angle of 60° . The moment of inertia of the rod about an axis passing through O and perpendicular to the plane of

the rod will be

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

B. $\frac{ml^2}{6}$

C. $\frac{ml^2}{8}$

D. $\frac{ml^2}{12}$

Answer: D

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36. Three point masses, each of mass m, are placed at the corner of an equilateral triangle of side 1. Then the moment of inertia of this system about an axis along one side of the triangle is

A. $3ml^2$

B. ml^2

C. $\frac{3}{4}ml^2$

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

Answer: C

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37. A solid cylinder of mass 20 kg rotates about its axis with angular speed 100 rad/s. The radius of the cylinder is 0.25 m. The kinetic energy associated with the rotation of the cylinder is

A. 3025 J

B. 3225 J

C. 3250 J

D. 3125 J

Answer: D

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38. Four small objects each of mass m are fixed at the corners of a rectangular wire-frame of negligible mass and of sides a and b (a $>$ b). If the wire frame is now rotated about an axis passing along the side of length b, then the

moment of inertia of the system for this axis of rotation is

A. $2ma^2$

B. $4ma^2$

C. $2m\left(a^2+b^2\right)$

D. $2m\left(a^2-b^2\right)$

Answer: A

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39. The moment of inertia of a thin uniform rod of mass M and length l about an axis perpendicular to the rod through its centre is I. The moment of inertia of the rod through its end point is

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

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

C. $2I$

D. $4I$

Answer: D

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40. Two particles of masses m_1 and m_2 are connected to a rigid massless rod of length r to constitute a dumb bell which is free to move in the plane. The moment of inertia of the dumb bell about an axis perpendicular to the plane passing through the centre of mass is

A. $\frac{m_1 m_2 r^2}{m_1 + m_2}$

B. $(m_1 + m_2) r^2$

C. $\frac{m_1 m_2 r^2}{m_1 - m_2}$

D. $(m_1 - m_2) r^2$

Answer: A

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41. Four point masses, each of value m, are placed at the corners of a square ABCD of side 1. The moment of inertia of this system about an axis through A and parallel to BD is

A. ml^2

B. $2ml^2$

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

D. $3ml^2$

Answer: D

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42. The radius of gyration of a uniform rod of length L about an axis passing through its centre of mass is

A. $\frac{L}{\sqrt{12}}$

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

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

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

Answer: A

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43. A circular disc X of radius R is made from an iron plate of thickness t, and another disc Y of radius 4R is made from an iron plate of

thickness $\frac{t}{4}$. Then the relation between the moment of inertia I_x and l_y is

A. $I_y = 32I_x$

B. $I_y = 16I_x$

C. $I_y = I_x$

D. $I_y = 64I_x$

Answer: D

View Text Solution

44. A thin wire of length / and mass m is bent in m the form of a semicircle as shown in the figure. Its moment of inertia about an axis joining its free ends will be

A. ml^2

B. zero

C. ml^2 / p^2

D. $ml^2 / 2\pi^2$

Answer: D

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45. Two discs one of density 7.2 g/cm^3 and the other of density 8.9 g/cm^3 are of same mass and thickness. Their moments of inertia are in the ratio

A. $8.9 : 7.2$

B. $7.2 : 8.9$

C. $(8.9 \times 7.2) : 1$

D. $1 : (8.9 \times 7.2)$

Answer: A

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46. A point mass m_A is connected to a point mass mg by a massless rod of length / as shown in the figure. It is observed that the ratio of the moment of inertia of the system about the two axes BB and AA, which are parallel to each other and perpendicular to the rod is $\frac{I_{BB}}{I_{AA}} = 3$

The distance of the centre of mass of the

system from the mass A is

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

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

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

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

Answer: B

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47. A uniform rod of mass m and length / makes a constant angle θ with an axis of rotation which passes through one end of the rod. Its moment of inertia about this axis is

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

B. $\frac{ml^2}{3}\sin\theta$

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

D. $\frac{ml^2}{3}\cos^2\theta$

Answer: C

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48. The moment of inertia of a body about a given axis is 1.2 kg m^2. Initially, the body is at rest. In order to produce a rotational kinetic energy of 6000 joule, an angular acceleration of 25 rad/s^2 must be applied about that axis for a duration of

A. 4 s

B. 2 s

C. 8 s

D. 10 s

Answer: A

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49. One solid sphere A and another hollow sphere B are of same mass and same outer radii. Their moments of inertia about their diameters are respectively I_A and I_B such that where d_A and d_B are their densities .

A. $I_A = I_B$

B. $I_A > I_B$

C. $I_A < I_B$

D. $\frac{I_A}{I_B} = \frac{d_A}{d_B}$

Answer: C

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50. A coin of mass m and radius r having moment of inertia I about the axis passing through its centre and perpendicular to its plane. It is beaten uniformly to form a disc of

radius 2r. What will be the moment of inertia about the same axis?

A. I

B. 2I

C. 4 I

D. 16 I

Answer: C

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51. Moment of inertia of a hollow cylinder of mass M and radius r about its own axis is

A. $\frac{2}{3}Mr^2$

B. Mr^2

C. $\frac{1}{3}Mr^2$

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

Answer: B

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52. A solid sphere of mass M and radius R spins about an axis passing through its centre making 600 rpm. Its kinetic energy of rotation is

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

B. $\frac{2}{5}\pi M^2 R^2$

C. $80\pi MR$

D. $80\pi^2 MR^2$

Answer: D

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53. A fly wheel is a uniform disc of mass 72 kg and radiu 50 cm. When it is rotating at the rate of 70 rpm, its kinetic energy is

A. 142 J

B. 242 J

C. 342 J

D. 300 J

Answer: B

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54. A solid cylinder of mass 20 kg has length 1 m and radius 0.2 m. Then its moment of inertia (in kg m) about its geometrical axis is (in kg m^2)

A. 0.8

B. 0.4

C. 0.2

D. 0.6

Answer: B

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55. The moment of inertia of a flywheel having kinetic energy 360 J and angular speed of 20 rad/s is

A. 18 kg m^2

B. 1.8 kg m^2

C. 2.5 kg m^2

D. 9 kg m^2

Answer: B

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56. From a circular ring of mass M and radius R, an arc corresponding to a 90° sector is removed. The moment of inertia of the remaining part of the ring about an axis passing through the centre of the ring and perpendicular to the plane of the ring is k times MR^2. Then the value of k is

A. $3/4$

B. $7/8$

C. $1/4$

D. $1/8$

Answer: A

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57. A T-joint is formed by two identical rods A and B each of mass m and length L in the XY plane as shown. Its moment of inertia about the axis coinciding with A is

A. $\frac{2mL^2}{3}$

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

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

D. none of these

Answer: B

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58. Moment of inertia does not depend on

A. mass distribution of body

B. torque

C. shape of the body

D. the position of axis of rotation

Answer: B

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59. Three thin uniform rods each of mass M and length L are placed along the three axes of a cartesian coordinate system. The moment of inertia of the system about z-axis is

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

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

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

D. ML^2

Answer: B

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60. In the rectangular lamina shown in the figure, AB=BC/2. The moment of inertia of the lamina is minimum along the axis passing

through

A. AB

B. BC

C. EG

D. FH

Answer: D

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61. The moment of inertia of a rod about an axis passing through its centre and perpendicular to it is $\frac{1}{12}ML^2$(where, M is the mass and L the length of the rod.) The rod is bent in the middle so that the two halves make an angle of 30°. The moment of inertia of the bent rod about the same axis would be

A. $\frac{1}{48}ML^2$

B. $\frac{1}{12}ML^2$

C. $\frac{1}{24}ML^2$

D. $\frac{ML^2}{8\sqrt{3}}$

Answer: B

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62. If I_1 is the moment of inertia of a thin' rod about an axis perpendicular to its length and passing through the centre of mass and I_2 is the moment of inertia of the ring formed by bending this rod in the form of a ring, then $\frac{I_1}{I_2}$ is

A. $1:1$

B. $\pi^2:3$

C. $\pi:4$

D. $3:5$

Answer: B

View Text Solution

63. Three point masses m_1, m_2, m_3 are located at the vertices of an equilateral triangle of length a. The moment of inertia of

systein about an axis along the altitude of the triangle passing through m_1 is

A. $(m_2 + m_3)\frac{a^2}{4}$

B. $(m_1 + m_2 + m_3)a^2$

C. $(m_1 + m_2)\frac{a^2}{2}$

D. $(m_2 + m_3)a^2$

Answer: A

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64. From a given sample of uniform wire, two circular loops moment of inertia of O about its axis is 4 times that of P about its axis (assuming wire diameter much smaller, than either radius), the value of n is

A. $(4)^{2/3}$

B. $(4)^{1/3}$

C. $(4)^{1/2}$

D. $(4)^{1/4}$

Answer: B

View Text Solution

65. Two rings of the same radius and mass are placed such that their centres are at a common point and their planes are perpendicular to each other. The moment of inertia of the system about an axis passing through the centre and perpendicular to the plane of one of the rings is (mass of the ring = m, radius = r)

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

B. mr^2

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

D. $2mr^2$

Answer: C

View Text Solution

66. The radius of gyration of a solid cylinder of mass M and radius R about its own axis is

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

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

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

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

Answer: A

View Text Solution

67. Moment of inertia of a ring of mass M and radius R about an axis passing through the centre and perpendicular to the plane is I.

What is the moment of inertia about its diameter?

A. I

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

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

D. $I + MR^2$

Answer: B

View Text Solution

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

A. $\frac{7}{36}ML^2$

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

C. $\frac{11}{48}ML^2$

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

Answer: B

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69. A hoop of mass M and radius R is hung from a support fixed in a wall . Its moment of inertia about the support is

A. $2MR^2$

B. $3MR^2$

C. $4MR^2$

D. $6MR^2$

Answer: A

View Text Solution

70. The moment of inertia of a circular ring about one of its diameters is I . What will be its moment of inertia about a tangent parallel to the diameter?

A. 4 I

B. 2 I

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

D. $3I$

Answer: D

View Text Solution

71. Two thin discs each of mass M and radius r are attached as shown to form 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

View Text Solution

72. A uniform thin bar of mass 6m and length 12L is bent to make a regular hexagon. Its moment of inertia about an axis passing

through the centre of mass and perpendicular to the plane of hexagon is

A. $20mL^2$

B. $30mL^2$

C. $\left(\frac{12}{5}\right)mL^2$

D. $6mL^2$

Answer: A

View Text Solution

73. AB and CD are two identical rods each of length l and mass m joined to form a cross. The moment of inertia of these two rods about a bisector (XY) of angle between the rods is

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

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

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

D. $\frac{ml^2}{6}$

Answer: A

View Text Solution

74. Four spheres of diameter 2a and mass M are placed with their centres on the four corners of a square of side b. Then the moment of inertia of the system about an axis along one of the sides of the square is

A. $\frac{4}{5}Ma^2 + 2Mb^2$

B. $\frac{8}{5}Ma^2 + 2Mb^2$

C. $\frac{8}{5}Ma^2 + Mb^2$

D. $\frac{4}{5}Ma^2 + 4Mb^2$

Answer: B

View Text Solution

75. A square plate of side / has mass M. What is its moment of inertia about one of its diagonals ?

A. $\frac{Ml^2}{6}$

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

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

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

Answer: B

View Text Solution

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

A. $\frac{1}{6}Ml^2$

B. $\frac{1}{4}Ml^2$

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

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

Answer: D

View Text Solution

77. Four particles each of mass m are lying symmetrically on the rim of a disc of mass M and radius R. Moment of inertia of this system

about an axis passing through one of the particles and I to plane of disc is

A. $16mR^2$

B. $(3M + 16m)\frac{R^2}{2}$

C. $(3m + 12M)\frac{R^2}{2}$

D. zero

Answer: B

View Text Solution

78. The radius of gyration of a solid sphere of radius r about a certain axis is r. The distance of this axis from the centre of the sphere is

A. r

B. 0.5 r

C. $\sqrt{0.6}r$

D. $\sqrt{0.4}r$

Answer: C

View Text Solution

79. Moment of inertia of a ring of mass M and radius R about a tangent to the circle of the ring is

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

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

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

D. MR^2

Answer: B

View Text Solution

80. The moment of inertia of a uniform circular disc of mass M and of radius R about one of its diameter is

A. $\frac{1}{4}MR^2$

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

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

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

Answer: A

View Text Solution

81. A circular thin disc of mass 2 kg has a diameter 0.2 m. Calculate its moment of inertia about an axis passing through the edge and perpendicular to the plane of the disc (in kg m^2)

A. 0.01

B. 0.03

C. 0.02

D. 3

Answer: B

View Text Solution

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

A. 5 kg m^2

B. 2.7 kg m^2

C. 3.5 kg m^2

D. 4.5 kg m^2

Answer: C

View Text Solution

83. A thin wire of length / and uniform linear mass density p is bent into a circular loop with centre O and radius r as shown in figure . The moment of inertia of the loop about the axis XX' is

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

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

C. $\frac{3\rho l^3}{8\pi^2 r}$

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

Answer: A

View Text Solution

84. For the given uniform square lamina ABCD, whose centre is O,

A. $I_{AC} = \sqrt{2} I_{EF}$

B. $\sqrt{2} I_{AC} = I_{EF}$

C. $I_{AD} = 3I_{EF}$

D. $I_{AC} = I_{EF}$

Answer: D

View Text Solution

85. A solid sphere of mass M and radius R having moment of inertia about an axis passing through the centre of mass as I, is recast into a disc of thickness I, whose moment of inertia about an axis passing

through its edge and perpendicular to its plane remains I. Then, radius of the disc will be

A. $\frac{2R}{\sqrt{15}}$

B. $R\sqrt{\frac{2}{15}}$

C. $\frac{4R}{\sqrt{15}}$

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

Answer: A

View Text Solution

86. The moment of inertia of a circular disc of radius 2 m and mass 1 kg about an axis passing through the centre of mass but perpendicular to the plane of the disc is 2 kg m^2. Its moment of inertia about an axis parallel to this axis but passing through the edge of the disc is (See the given figure).

A. $8kgm^2$

B. $4kgm^2$

C. $10kgm^2$

D. $6kgm^2$

Answer: D

View Text Solution

87. An electric motor drill, rated 350 W has an efficiency of 35%. The torque produced, if it is working at 3000 rpm.

A. 0.25 N m

B. 0.35 N m

C. 0.39 N m

D. 0.30 N m

Answer: C

View Text Solution

88. A wheel whose moment of inertia is 2 kg m^2 has an initial angular velocity of 50 rad/s. A constant torque of 10 Nm acts on the wheel. The time in which the wheel is accelerated to 80 rad's is

A. 12 s

B. 3 s

C. 6 s

D. 9 s

Answer: C

View Text Solution

89. A solid body rotates about a stationary axis so that its angular velocity depends on the rotational angle ϕ as $\omega = \omega_0 - k\phi$ where ω_0

and k are positive constants. At the moment t = 0, $\phi = 0$, the time dependence of rotation angle is

A. $k\omega_0 e^{-kt}$

B. $\frac{\omega_0}{k} e^{-kt}$

C. $\frac{\omega_0}{K}\left(1 - e^{-kt}\right)$

D. $\frac{k}{\omega_0}\left(e^{-kt} - 1\right)$

Answer: C

View Text Solution

90. A cord is wound over the rim of a flywheel of mass 20 kg and radius 25 cm. A mass 2.5 kg attached to the cord is allowed to fall under gravity. The angular acceleration of the flywheel is

A. $25 rad/s^2$

B. $20 rad/s^2$

C. $10 rad/s^2$

D. $5 rad/s^2$

Answer: C

View Text Solution

91. The angular acceleration a of a spinning top as a function of t is : $\alpha = 3t^2 + 5t$. At t = 0, the angular velocity $\omega_0 = 10$ rad/s and angular position $\theta = 8$ rad. The angular position as a function of time t is given by which of the following expression?

A. $\frac{1}{4}t^4 + \frac{5}{6}t^3 + 10t + 8$

B. $\frac{5}{6}t^4 + \frac{1}{4}t^3 + \frac{2}{5}t + 8$

C. $2t^4 + 3t^3 + 5t + 8$

D. $\frac{1}{4}t^4 + \frac{3}{4}t^3 + 6t^2 + 8$

Answer: A

View Text Solution

92. If the frequency of a rotating platform is v and the distance of a boy from the centre is r, what is the area swept out per second by the line connecting the boy to the centre?

A. πrv

B. $2\pi rv$

C. $\pi r^2 v$

D. $2\pi r^2 v$

Answer: C

View Text Solution

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

torques of equal magnitude are applied to them, then the ratio of angular accelerations produced is

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

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

C. $\frac{5}{4}$

D. $\frac{4}{5}$

Answer: A

View Text Solution

94. A constant torque of 3.14 N mis exerted on a pivoted wheel. If the angular acceleration of the wheel is $4\pi \text{rad}/s^2$ then the moment of inertia of the wheel is

A. $0.25kgm^2$

B. $2.5kgm^2$

C. $4.5kgm^2$

D. $25kgm^2$

Answer: A

View Text Solution

95. A string is wound round the rim of a mounted flywheel of mass 20 kg and radius 20 cm. A steady pull of 25 N is applied on the cord. Neglecting friction and mass of the string, the angular acceleration of the wheel is

A. 50 rad s^{-2}

B. 25 rad s^{-2}

C. 12.5 rad s^{-2}

D. 6.25 rad s^{-2}

Answer: C

View Text Solution

96. When a ceiling fan is switched on, it makes 10 revolutions in the first 3 seconds. Assuming a uniform angular acceleration, how many rotations it will make in the next 3 seconds?

A. 10

B. 20

C. 30

D. 40

Answer: C

View Text Solution

97. A flywheel rotates with a uniform angular acceleration. Its angular velocity increases from 20 π rad/s to 40 π rad/s in 10 seconds. How many rotations did it make in this period?

A. 80

B. 100

C. 120

D. 150

Answer: D

View Text Solution

98. A wheel rotates with a constant acceleration of 2.0 rad/s^2. If the wheel starts from rest, the number of revolutions it makes in first ten seconds is

A. 8

B. 16

C. 24

D. 32

Answer: B

View Text Solution

99. A rigid body rotates about a fixed axis with variable angular velocity equal to (a - bt) at time t where a and b are constants. The angle

through which it rotates before it comes to rest is

A. $\frac{a^2}{b}$

B. $\frac{a^2}{2b}$

C. $\frac{a^2}{4b}$

D. $\frac{a^2}{2b^2}$

Answer: B

View Text Solution

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

A. $45ms^{-2}$

B. $182ms^{-2}$

C. $187ms^{-2}$

D. $192ms^{-2}$

Answer: A

View Text Solution

101. A fly wheel of moment of inertia 3×10^2 kg mạis rotating with uniform angular speed of 4.6 rad s^{-1}. If a torque of 6.9×10^2 N m retards he wheel, then the time in which the wheel comes to rest is

A. 1.5 s

B. 2 s

C. 0.5 s

D. 1 s

Answer: B

View Text Solution

102. A wheel of moment of inertia 2.5 kg m^2 has an initial angular velocity of 40 rad s^{-1}. A constant torque of 10 N m acts on the wheel. The time during which the wheel is accelerated to 60 rad s^{-1} is

A. 4.5 s

B. 6 s

C. 5 s

D. 2.5 s

Answer: C

View Text Solution

103. A 2 kg mass is rotating on a circular path of radius 0.8 m with angular velocity of 44 rad/sec. If radius of the path becomes 1 m,

then what will be the value of angular velocity?

A. 28.16 rad/sec

B. 19.28 rad/sec

C. 8.12 rad/sec

D. 35.26 rad/sec

Answer: A

View Text Solution

104. A rigid horizontal smooth rod AB of mass 0.75 kg and length 40 cm can rotate freely about a fixed vertical axis through its midpoint O. Two rings each of mass 1 kg initially at rest are placed at a distance of 10 cm from O on either side of the rod. The rod is set in rotation with an angular velocity of 30 radian per sec and when the rings reach the ends of the rod, the angular velocity in rad/sec is

A. 5

B. 10

C. 15

D. 20

Answer: B

View Text Solution

105. The radius vector and linear momentum are respectively given by vectors $2\hat{i}+\hat{j}+\hat{k}$ and $2\hat{i}-3\hat{j}+3\hat{k}$ Then the angular momentum is

A. $2\hat{i} - 4\hat{k}$

B. $4\hat{i} - 8\hat{k}$

C. $2\hat{i} - 4\hat{j} + 2\hat{k}$

D. $4\hat{i} - 8\hat{j}$

Answer: B

View Text Solution

106. A mass is whirled in a circular path with constant angular velocity and its angular momentum is L. If the string is now halved

keeping the angular velocity the same, the angular momentum is

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

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

C. L

D. 2 L

Answer: A

View Text Solution

107. A rotating wheel changes angular speed from 1800 rpm to 3000 rpm in 20 s. What is the angular acceleration assuming to be uniform?

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

B. $60\pi rads^{-2}$

C. $40\pi rads^{-2}$

D. $90\pi rads^{-2}$

Answer: A

View Text Solution

View Text Solution

108. A thin uniform circular disc of mass M and radius R is rotating in a horizontal plane about an axis passing through its centre and perpendicular to its plane with an angular velocity ω. Another disc of same dimensions but of mass M/4 is placed gently on the first disc coaxially. The angular velocity of the system now is

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

B. $\frac{4\omega}{5}$

C. $\frac{5\omega}{4}$

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

Answer: B

View Text Solution

109. A particle is moving along a straight line parallel to x-axis with constant velocity. Its angular momentum about the origin

A. decreases with time

B. increases with time

C. remains constant

D. is zero

Answer: C

View Text Solution

110. A child is standing with folded hands at the centre of platform rotating about its central axis. The kinetic energy of the system is K. The child now stretches his arms so that the

moment of inertia of the system becomes doubled. The kinetic energy of the system now is

A. 2 K

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

C. $\frac{K}{4}$

D. 4 K

Answer: B

View Text Solution

111. The position of a particle is given by $\overrightarrow{r} = \hat{i} + 2\hat{j} - \hat{k}$ and its linear momentum is given by $\overrightarrow{p} = 3\hat{i} + 4\hat{j} - 2\hat{k}$. Then its angular momentum, about the origin is perpendicular to

A. yz-plane

B. z-axis

C. y-axis

D. x-axis

Answer: D

View Text Solution

112. A particle of mass 1 kg is moving along the line y = x + 2 (here x and y are in metres) with speed 2 m/s. The magnitude of angular momentum of particle about its origin is

A. $4kgm^2s^{-1}$

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

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

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

Answer: B

View Text Solution

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

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

B. $2L$

C. $4L$

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

Answer: C

View Text Solution

114. The diameter of a flywheel is 1 m. It has a mass of 20 kg. It is rotating about its axis with a speed of 120 rotations in one minute. Its angular momentum in kg m s' is

A. 13.4

B. 31.4

C. 41.4

D. 43.4

Answer: B

View Text Solution

115. The moment of inertia of a uniform disc about an axis passing through its centre and perpendicular to its plane is 1 kg m^2. It is

rotating with an angular velocity 100 rad s^{-1} Another identical 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 kilo joules is

A. 2.5

B. 3.0

C. 3.5

D. 4.0

Answer: A

View Text Solution

116. Consider a body shown in figure consisting two identical balls, cach of mass M connected by a light rigid rod. If an impulse J - Mv is imparted to the body at one of its ends, what would be its angular velocity ?

A. $\frac{v}{L}$

B. $\frac{2v}{L}$

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

D. $\frac{v}{4L}$

Answer: A

View Text Solution

117. Two fly wheels A and B are mounted side by side with frictionless bearings on a common shaft. Their moments of inertia about the shaft are 5.0 kg m^2 and 20.0 kg m^2 respectively. Wheel A is made to rotate at 10 revolution per second. Wheel B, initially

stationary, is now coupled to A with the help of a clutch. The rotation speed of the wheels will become

A. $2\sqrt{5}$ rps

B. 0.5 rps

C. 2 rps

D. 1 rps

Answer: C

View Text Solution

118. In the absence of external torque for a body revolving about any axis, the quantity that remains constant is

A. kinetic energy

B. potential energy

C. linear momentum

D. angular momentum

Answer: D

View Text Solution

119. A ballet dancer, dancing on a smooth floor is spinning about a vertical axis with her arms folded with an angular velocity of 20 rad/s. When she stretches her arms fully, the spinning speed decreases to 10 rad/s. If I is the initial moment of inertia of the dancer, the new moment of inertia is

A. 2I

B. 3 I

C. I/2

D. I/3

Answer: A

View Text Solution

120. Angular momentum of a body is defined as the product of

A. mass and angular velocity

B. centripetal force and radius

C. linear velocity and angular velocity

D. moment of inertia and angular velocity

Answer: D

View Text Solution

121. A particle with position vector has a linear momentum p. Which of the following statements is true in respect of its angular momentum L about the origin?

A. L acts along p

B. L acts along r

C. L is maximum when p and r are parallel.

D. L is maximum when p is perpendicular to r.

Answer: D

View Text Solution

122. If I is the moment of inertia and E is the kinetic energy of rotation of a body, then its angular momentum will be

A. $\sqrt{(EI)}$

B. $2EI$

C. E/I

D. $\sqrt{(2EI)}$

Answer: D

View Text Solution

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

A. zero

B. maximum

C. minimum

D. unity

Answer: A

View Text Solution

124. If the angular momentum of a rotating body about a fixed axis is increased by 10%. Its kinetic energy will be increased by

A. 0.1

B. 0.2

C. 0.21

D. 0.05

Answer: C

View Text Solution

125. A body of mass 1.0 kg is rotating on a circular path of diameter 2.0 m at the rate of

10 rotations in 31.4 s. The angular momentum of the body, in kg m^2/s, is

A. 1.0

B. 1.5

C. 2.0

D. 4.0

Answer: C

View Text Solution

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

A. Both K and L increase

B. Both K and L remain unchanged

C. Kremains constant, L increases

D. K increases but L remains constant

Answer: D

View Text Solution

127. A billiard ball of mass m and radius 7, when hit in a horizontal direction by a cue at a height h above its centre, acquired a linear velocity v_0. The angular velocity Wo acquired by the ball is

A. $\frac{5v_0r^2}{2h}$

B. $\frac{2v_0r^2}{5h}$

C. $\frac{2v_0h}{5r^2}$

D. $\frac{5v_0h}{2r^2}$

Answer: D

View Text Solution

128. Two wheels are connected by a belt. The radius of the larger wheel is three times that of the smaller one. What is the ratio of the moment of inertia of larger wheel to the smaller wheel, when both wheels have same angular momentum?

A. 3

B. 6

C. 9

D. 12

Answer: A

View Text Solution

129. The angular speed of a body changes from ω_1 to ω_2 without applying a torque, but due to

changes in moment of inertia. The ratio of radii of gyration in the two cases is

A. $\omega_2 : \omega_1$

B. $\sqrt{\omega_1} : \sqrt{\omega_2}$

C. $\sqrt{\omega_2} : \sqrt{\omega_1}$

D. $\omega_1 : \omega_2$

Answer: C

View Text Solution

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

A. 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 the given data.

Answer: C

View Text Solution

131. A solid sphere of mass 2 kg is rolling on a frictional horizontal surface with velocity 6 m/s. It collides on the free end of an ideal spring whose other end in fixed. The maximum compression produced in the spring will be (Force constant of the spring is 36 N/m).

A. $\sqrt{14}$m

B. $\sqrt{2.8}$ m

C. $\sqrt{1.4}$ m

D. $\sqrt{0.7}$ m

Answer: B

View Text Solution

132. A ring and a disc roll on the horizontal surface without slipping with same linear velocity. If both have same mass and total

kinetic energy of the ring is 4 J then total kinetic energy of the disc is

A. 3 J

B. 4 J

C. 5 J

D. 6 J

Answer: A

View Text Solution

133. A solid sphere is rolling down an inclined plane. Then the ratio of its translational kinetic energy to its rotational kinetic energy is

A. 2.5

B. 1.5

C. 1

D. 0.4

Answer: A

View Text Solution

View Text Solution

134. A uniform solid spherical ball is rolling down a smooth inclined plane from a height h. The velocity attained by the ball when it reaches the bottom of the inclined plane is v. If the ball is now thrown vertically upwards with the same velocity v, the maximum height to which the ball will rise is

A. 5h/8

B. 3h/5

C. 5h/7

D. 7h/9

Answer: C

View Text Solution

135. The acceleration of the centre of mass of a uniform solid disc rolling down an inclined plane of angle θ is

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

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

C. $g\sin\theta$

D. $\frac{1}{4}g\sin\theta$

Answer: B

View Text Solution

136. A thin metal disc of radius of 0.25 m and mass 2 kg starts from rest and rolls down on an inclined plane. If its rotational kinetic

energy is 4 J at the foot of inclined plane, then the linear velocity in m/s) at the same point is

A. 2

B. $2\sqrt{2}$

C. $2\sqrt{3}$

D. $3\sqrt{2}$

Answer: B

View Text Solution

137. A solid sphere of mass I kg, radius 10 cm rolls down an inclined plane of height 7 m. The velocity of its centre as it reaches the ground level is

A. 7 m/s

B. 10 m/s

C. 15 m/s

D. 20 m/s

Answer: B

View Text Solution

View Text Solution

138. A solid cylinder rolls without slipping down an inclined plane of height h. The velocity of the cylinder when it reaches the bouom is

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

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

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

D. $\sqrt{gh}$

Answer: B

View Text Solution

139. A disc of mass M and radius R is rolling with angular speed ω on a horizontal surface as shown in figure . The magnitude of angular momentum of the disc about the origin O is (here v is the linear velocity of the disc)

A. $\frac{3}{2}MR^2\omega^2$

B. $MR^2\omega$

C. MRv

D. $\frac{3}{2}MRv$

Answer: D

View Text Solution

140. A sphere of mass m and radius r rolls on a horizontal plane without slipping with the speed u . Now if it rolls up vertically , the maximum height it would attain will be

A. $3u^2/4g$

B. $5u^2/2g$

C. $7u^2/10g$

D. $u^2/2g$

Answer: C

View Text Solution

Check Your Neet Vitals

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

A. A pencil

B. A shotput

C. A dice

D. A bangle

Answer: D

View Text Solution

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

What is the loss in kinetic energy of the system in the process ?

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

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

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

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

Answer: A

View Text Solution

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

A. The sense of rotation remains same

B. The orientation of the axes of rotation remains the same

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

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

Answer: D

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5. Which of the following statements is incorrect ?

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

B. A couple produces rotation without translation .

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

the lid

D. When a compass needle points in the north-south direction a couple acts on the needle by the earth's magnetic field.

Answer: D

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

How many revolutions does the engine make during this time ?

A. 376

B. 476

C. 576

D. 676

Answer: C

View Text Solution

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

The centre of mass of the rod will be

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

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

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

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

Answer: A

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8. Whch of the following statements is incorrect ?

A. In pure translation motion , every particle of the body moves with the same velocity at any instant of time .

B. 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

C. The centre of gravity of a body coincides with its centre of mass only if the gravitational field does not vary from one part of the body to the other .

D. The angular momentum L and the angular velocity $\vec{\omega}$ are necessarily parallel vectors .

Answer: D

View Text Solution

9. Moment of inertia of a ring of mass M and radius R about a tangent to the circle of the ring is

A. MR^2

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

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

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

Answer: C

View Text Solution

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

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

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

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

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

Answer: D

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11. A solid cylinder rolls up an inclined plane of angle of inclination 30° . At the bottom of the inclined plane the centre of mass of the cylinder has a speed of $5ms^{-1}$. How far will

cylinder go up the plane ?

(Take g = $10ms^{-2}$)

A. $\frac{15}{4}$ m

B. $\frac{4}{15}$ m

C. $\frac{10}{3}$ m

D. $\frac{3}{10}$ m

Answer: A

View Text Solution

12. Three bodies , a ring , a solid cylinder and a solid sphere roll down the same inclined plane without slipping . They start from rest . The radii of the bodies are identical . Which of the bodies reaches the ground with maximum velocity ?

A. Ring

B. Solid cylinder

C. Solid sphere

D. All reach the ground with same velocity

Answer: C

View Text Solution

13. A merry -go-round , made of a ring-like platform of radius R and mass M, is revolving with angular speed ω . A person of mass M is standing on it . At one instant , the person jumps off the round , radially away from the centre of the round . The speed of the round afterwards is

A. 2ω

B. ω

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

D. 0

Answer: B

View Text Solution

14. A metre stick is balanced on a knife edge at its centre . When two coins , each of mass 5 g are put one on top of the other at the 12.0 cm

mark , the stick is found to be balanced at 45.0 cm . What is the mass of the metre-stick ?

A. 56 g

B. 66 g

C. 76 g

D. 86 g

Answer: B

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Aipmt Neet Mcqs

1. A circular disk of moment of inertia I_t is rotating in a horizontal plane , about its symmetry axis , with a constant angular speed ω_i . Another disk of moment of inertia I_b is dropped coaxially onto the rotating disk . Initially the second disk has zero angular speed . eventually both the disks rotate with a constant angular speed ω_f . The energy lost by the initially rotating disc to friction is

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

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

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

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

Answer: D

View Text Solution

2. Two particles which are initially at rest , move towards each other under the action of their internal attraction . If their speeds are v

and 2v at any instant , then the speed of centre of mass of the system will be

A. 2 v

B. zero

C. 1.5 v

D. v

Answer: B

View Text Solution

3. From a circular disc of radius R and mass 9 M , a small disc of mass M and radius $\frac{R}{3}$ is removed concentrically . The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through its centre is

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

B. MR^2

C. $4MR^2$

D. $\frac{4}{9}MR^2$

Answer: A

View Text Solution

4. 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. Both together only when angle of inclination of plane is 45°

B. Both together

C. Hollow cylinder

D. Solid cylinder

Answer: D

View Text Solution

5. A thin circular ring of mass M and radius r is rotating about its axis with 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 angular velocity given by

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

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

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

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

Answer: D

View Text Solution

6. The instantaneous angular position of a point on a rotating wheel is given by the equation $\theta(t) = 2t^3 - 6t^2$. The torque on the wheel becomes zero at

A. t = 1 s

B. t = 0.5 s

C. t = 0.25 s

D. t = 2 s

Answer: A

View Text Solution

7. The moment of inertia of a thin uniform rod of mass M and length L about an axis passing through its midpoint and perpendicular to its length is I_0 . Its moment of inertia about an axis passing through one of its ends and perpendicular to its length is

A. $I_0 + ML^2/2$

B. $I_0 + ML^2/4$

C. $I_0 + 2ML^2$

D. $I_0 + ML^2$

Answer: B

View Text Solution

8. A small mass attached to a strong rotates on a frictionless table top as shown . If the tension in the string is increased by pulling

the string causing the radius of the circular motion to decrease by a factor of 2 , the kinetic energy of the mass will

A. decreases by a factor of 2

B. remain constant

C. increases by a factor of 2

D. increase by a factor of 4

Answer: D

View Text Solution

9. ABC is an equilateral triangle with O as its centre $\overrightarrow{F}_1, \overrightarrow{F}_2$ and $\overrightarrow{F}_3$ represent the sides AB , BC and AC respectively . If the total torque about O is zero then the magnitude of $\overrightarrow{F}_3$ is

A. $F_1 + F_2$

B. $F_1 - F_2$

C. $\frac{F_1 + F_2}{2}$

D. $2(F_1 + F_2)$

Answer: A

View Text Solution

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

A. 3.0 m

B. 2.3 m

C. zero

D. 0.75 m

Answer: C

View Text Solution

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

A. a line perpendicular to the plane of rotation

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

C. the radius

D. the tangent to the orbit

Answer: A

View Text Solution

12. A circular platform is mounted on a frictionless vertical axle . Its radius R = 2 m and its moment of inertia about the axle is 200 kg m^2 . It is initially at rest . A 50 kg man stands on the edge of 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. πs

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

C. $2\pi s$

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

Answer: C

View Text Solution

13. 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

View Text Solution

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

A. 40 cm

B. 45 cm

C. 50 cm

D. 30 cm

Answer: A

View Text Solution

15. A small object of uniform density rolls up a curved surface with an initial velocity 'v' . It

reaches upto a maximum height of $\frac{3v^2}{4g}$ with respect to the initial position . The object is

A. hollow sphere

B. disc

C. ring

D. solid sphere

Answer: B

View Text Solution

16. A solid cylinder of mass 50 kg and radius 0.5 m is free to rotate about the horizontal axis . A massless string is wound around 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

View Text Solution

17. 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

View Text Solution

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

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

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

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

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

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

Answer: B

View Text Solution

19. Three identical spherical shells , each of mass m and radius r are placed as shown in figure . Consider an axis XX' which is touching two shells and passing through diameter of third shell . Moment of inertia of the system consisting of these three spherical shells about XX' axis is

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

B. $4mr^2$

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

D. $3mr^2$

Answer: B

View Text Solution

20. 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 perpendicular 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. $x = \frac{m_2}{m_1} L$

B. $x = \frac{m_2 L}{m_1 + m_2}$

C. $x = \frac{m_1 L}{m_1 + m_2}$

D. $x = \frac{m_1}{m_2} L$

Answer: B

View Text Solution

21. An automobile moves on a road with a speed of $54kmh^{-1}$. The radius of its wheels is 0.45 m and the moment of inertia of the wheel about its axis of rotation is 3 kg m^2 . If the vehicle is brought to rest in 15 s , the magnitude of average torque transmitted by its brakes to the wheel is

A. $10.86kgm^2s^{-2}$

B. $2.86kgm^2s^{-2}$

C. $6.66kgm^2s^{-2}$

D. $8.58kgm^2s^{-2}$

Answer: C

View Text Solution

22. A force $\vec{F} = \alpha\hat{i} + 3\hat{j} + 6\hat{k}$ is acting at a point $\vec{r} = 2\hat{i} - 6\hat{j} - 12\hat{k}$. The value of α for which angular momentum about origin is conserved is

A. zero

B. 1

C. -1

D. 2

Answer: C

View Text Solution

23. A disk and a 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. Both reach at the same time

B. Depends on their masses

C. Disk

D. Sphere

Answer: D

View Text Solution

24. 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 the remaining part of the

disc about a perpendicular axis , passing through the centre ?

A. 11 $MR^2/32$

B. $9MR^2/32$

C. $15MR^2/32$

D. $13MR^2/32$

Answer: D

View Text Solution

25. A uniform circular disc of radius 50 cm at rest is free to turn about an axis which is perpendicular to its plane and passes through its centre . It is subjected to a torque which produces a constant angular acceleration of 2.0 rad s^{-2} . Its net acceleration in ms^{-2} at the end of 2.0 s is approximately

A. 6.0

B. 3.0

C. 8.0

D. 7.0

Answer: C

View Text Solution

26. Two rotating bodies A and B of masses m and 2 m with moments of inertia I_A and $I_B (I_B > I_A)$ have equal kinetic energy of rotation . If L_A and L_B be their angular momenta respectively , then

A. $L_A = \frac{L_B}{2}$

B. $L_A = 2L_B$

C. $L_B > L_A$

D. $L_A > L_B$

Answer: C

View Text Solution

27. 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 energies of rotation $\left(E_{\text{sphere}} / E_{\text{cylinder}}\right)$ will be

A. $2:3$

B. $1:5$

C. $1:4$

D. $3:1$

Answer: B

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

A. $\frac{m_1 m_2}{m_1 + m_2} l^2$

B. $\frac{m_1 + m_2}{m_1 m_2} l^2$

C. $(m_1 + m_2) l^2$

D. $\sqrt{m_1 m_2} l^2$

Answer: A

View Text Solution

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

A. 0.25 rad s^{-2}

B. 25 rad s^{-2}

C. 5 m s^{-2}

D. $25ms^{-2}$

Answer: B

View Text Solution

30. Two discs of same moment of inertia rotating about 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 face coinciding the axis of rotation . The expression for loss of energy during this process is

A. $\frac{1}{4}I(\omega_1 - \omega_2)^2$

B. $I(\omega_1 - \omega_2)^2$

C. $\frac{1}{8}I(\omega_1 - \omega_2)^2$

D. $\frac{1}{2}I(\omega_1 + \omega_2)^2$

Answer: A

View Text Solution

31. Which of the following statements are correct ?

(1) Centre of mass of a body always coincides

with the centre of gravity of the body

(2) Centre of mass of a body is the point at which the total gravitational torque on the body is zero

(3) A couple on a body produces both translational and rotational motion in a body

(4) Mechanical advantage greater than one means that small effort can be used to lift a large load.

A. (1) and (2)

B. (2) and (3)

C. (3) and (4)

D. (2) and (4)

Answer:

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32. Three objects , 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 amounts

of work (W) required to bring them to rest , would satisfy the relation .

A. $W_C > W_B > W_A$

B. $W_A > W_B > W_C$

C. $W_B > W_A > W_C$

D. $W_A > W_C > W_B$

Answer: A

View Text Solution

33. 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. $-8\hat{i} - 4\hat{j} - 7\hat{k}$

B. $-4\hat{i} - \hat{j} - 8\hat{k}$

C. $-7\hat{i} - 8\hat{j} - 4\hat{k}$

D. $-7\hat{i} - 4\hat{j} - 8\hat{k}$

Answer: D

View Text Solution

34. A solid sphere is in rolling motion . In rolling motion a body possesses translational kinetic energy (K_t) as well as rotational kinetic energy (K_r) simultaneously . The ratio $K_t : (K_t + K_r)$ for the sphere is

A. $7:10$

B. $5:7$

C. $10:7$

D. $2:5$

Answer: B

View Text Solution

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

A. Angular velocity

B. Moment of inertia

C. Rotational kinetic energy

D. Angular momentum

Answer: D

View Text Solution

36. A solid cylinder of mass 2 kg and radius 4 cm rotating about its axis at the rate of 3 rpm . The torque required to stop after 2π revolutions is

A. $2 \times 10^6 Nm$

B. 2×10^{6} N m

C. 2×10^{-3} N m

D. 12×10^{-4} N m

Answer: B

View Text Solution

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

A. 1 J

B. 3 J

C. 30 kJ

D. 2 J

Answer: B

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