PHYSICS

BOOKS - MHTCET PREVIOUS YEAR PAPERS AND PRACTICE PAPERS

ROTATIONAL MOTION'

Example

1. Two points masses of 2 kg and 3 kg lie at 5 m and 9 m away from origin O respectively. Find

out the distance of centre of mass of these point masses from the origin.

A. 14.2 m

B. 7.4 m

C. 20 m

D. 6 m

Answer: B

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2. Three point masses m_1, m_2 and m_3 are located at the vertices of an equilateral triangle of side α. What is the moment of inertia of the system about an axis along the altitude of the triangle passing through m_1?

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

B. $\frac{a^2}{2}(m_1 + m_3)$

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

D. $\frac{a^2}{4}(m_1 + m_2)$

Answer: C

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3. (a) Find the moment of inertia of a sphere about a tangent to the sphere, given the moment of inertia of the sphere about any of its diameters to be $2MR^2/5, where M$ is the mass of the sphere and R is the radius of the sphere.

(b) Given the moment of inertia of a disc of mass M and radius R about any of its diameters to be $\frac{1}{4}MR^2$, find the moment of

inertia about an axis normal to the disc passing through a point on its edge.

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

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

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

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

Answer: B

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4. Find the moment of inertia of a uniform rign of mass M and radius R about a diameter.

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

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

C. $2MR^2$

D. $4MR^2$

Answer: B

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5. Four masses are rotated about an axis as shown. What is the radius of gyration of the system ?

A. r

B. r^2

C. r^4

D. $\sqrt{2r}$

Answer: A

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6. A wheel of mass 10 kg and radius of gyration 50 cm is rotating at 300 rpm. Then, the rotational kinetic energy of the wheel is

A. 8 kJ

B. 6.4 kJ

C. 1.2 kJ

D. 2.2 kJ

Answer: C

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

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

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

C. $2\hat{i}-12\hat{j}-10\hat{k}$

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

Answer: B

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8. In a hydrogen atom, electron revolves in a circular orbit of radis 0.53 Å with a velocity of $2.2 \times 10^{6} ms^{-1}$ and angle between its position and velocity is 30°. If the mass of electron is $9 \times 10^{-31} kg$. Find its angular momentum.

A. $5.247 \times 10^{-37} kg - m^{2} s^{-1}$

B. $2.345 \times 10^{-30} kg - m^{2} s^{-1}$

C. $6.372 \times 10^{-36} kg - m^{2} s^{-1}$

D. None of these

Answer: A

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9. A unit mass at position vector $\overrightarrow{r} = \left(3\hat{i} + \hat{j}\right)$ is moving with velocity $\overrightarrow{v} = \left(5\hat{i} - 6\hat{j}\right)$. What is the angular momentum of the body about the origin?

A. 0 and $8\hat{i} + 8\hat{k}N - m$

B. 0 and $4\hat{i} + 4\hat{k}N - m$

C. 0 and $2\hat{i} + 2\hat{k}N - m$

D. None of these

Answer: A

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10. A star of mass equal to two solar masses and radius $10^6 km$ rotates about its axis with an angular speed of $10^{-6} rads^{-1}$. What is the angular speed of the star, when it collapses

(due to inward gravitational forces) to a radius of $10^4 km$?

A. $10^{-1} \text{rad s}^{-1}$

B. $10^{-2} \text{rad s}^{-1}$

C. $10^{-3} \text{rad s}^{-1}$

D. $10^{-4} \text{ rad s}^{-1}$

Answer: B

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11. 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. 1

B. 20

C. 2

D. 4

Answer: D

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12. A solid sphere rolls down without slipping on an inclined plane at angle 60° over a distance of 5 m. The acceleration (in ms^{-2}) is

A. 5.23

B. 7.07

C. 6.06

D. 3.23

Answer: B

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PRACTICE EXERCISE (Exercise 1 (TOPICAL PROBLEMS))

1. 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 inerti about an axis parallel to this axis but passing through the edge of

the dics is (see the given figure).

A. $8kg - m^2$

B. $4kg - m^2$

C. $10kg - m^2$

D. $6kg - m^2$

Answer: D

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

A. $4l$

B. $2l$

C. $\frac{5l}{2}$

D. $5l$

Answer: D

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3. The moment of inertia of a sphere of mass M and radius R about an axis passing through its centre is $\frac{2}{5}MR^2$. The radius of gyration of the sphere about a parallel axis to the above and tangent to the sphere is

A. $\frac{7}{5}R$

B. $\frac{3}{5}R$

C. $\left(\sqrt{\frac{7}{4}}\right)$

D. $\left(\sqrt{\frac{3}{5}}\right)$

Answer: C

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4. The moment of inertia of ring about an axis passing through its diameter is I. Then moment of inertia of that ring about an axis passing through its centre and perpendicular to its plane is

A. $2l$

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

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

D. l

Answer: A

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5. The ratio of the radii of gyration of a circular disc and a circular ring of the same radii about a tangential axis perpendicular to plane of disc or ring is

A. $1:2$

B. $\sqrt{5}:\sqrt{6}$

C. $2:3$

D. $\sqrt{3}:2$

Answer: D

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6. 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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7. From a circular disc od a radius R and mass 9M, a small disc of a radius $\frac{R}{3}$ is removed from the disc (as shown in figure) the moment of inertia of the remaining dics 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. $10MR^2$

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

Answer: A

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

A. $\frac{(M+3m)L^2}{12}$

B. $\frac{(M+6m)L^2}{12}$

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

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

Answer: B

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9. The moment of inerta of a ring of mass $1kg$ about an axis passing through its centre perpendicular to its surface is $4kgm^2$. Calculate the radius of the ring.

A. 2 m

B. 4 m

C. 5 m

D. 6 m

Answer: B

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10. The moment of inetia of a flywheel having kinetic energy 360 J and angular speed of $20\ \mathrm{rad\ s^{-1}}$ is

A. $18kg - m^2$

B. $1.8kg - m^2$

C. $2.5kg - m^2$

D. $9kg - m^2$

Answer: B

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11. Four similar point masses (m each) are symmetrically placed on the circumference of a disc of mass M and radius R. Moment of

inertia of the system about an axis passing through centre O and perpendicular to the plane of the disc will be

A. $MR^2 + 4mR^2$

B. $MR^2 + \frac{8}{5}mR^2$

C. $mR^2 + 4MR^2$

D. $\frac{MR^2}{2} + 4mR^2$

Answer: D

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12. Two disc have same mass and thickness. Their materials have densities d_1 and d_2 . The ratio of their moment of inertia about central axis will be

A. $d_1 : d_2$

B. $d_1 d_2 : 1$

C. $1 : d_1 d_2$

D. $d_2 : d_1$

Answer: D

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13. One quarter of the disc of mass m is removed. If r be the radius of the disc, the new moment of inertia is

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

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

C. $\frac{3}{8}mr^2$

D. None of these

Answer: C

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14. 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. $L/\sqrt{12}$

B. $L^2/12$

C. $L/\sqrt{3}$

D. $L/\sqrt{2}$

Answer: A

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15. The radius of gyration of a disc of mass 50 g and radius 2.5 cm, about an axis passing through its centre of gravity and perpendicular to the plane is

A. 6.54 cm

B. 3.64 cm

C. 1.77 cm

D. 0.88 cm

Answer: C

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16. The radius of gyration of rod of length L and mass M about an axis perpendicular to its length and passing through a point at a distance $L/3$ from one of its ends is

A. $\frac{\sqrt{7}}{6}L$

B. $\frac{L^2}{9}$

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

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

Answer: C

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17. The moment of an inertia about an axis of a body which is rotating with angular velocity 1rad s^{-1} is numerically equal to

A. one - fourth of its rotational kinetic energy

B. half of the rotational kinetic energy

C. rotational kinetic energy

D. twice the rotational kinetic energy

Answer: D

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18. Two wheels A and B are mounted on the same axle. Moment of inertia of A is 6 kg m^2 and is rotated at 600 rpm, when B is at rest.

What will be moment of inertia of B, if their combined speed is 400 rpm?

A. $8kg - m^2$

B. $4kg - m^2$

C. $3kg - m^2$

D. $5kg - m^2$

Answer: C

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19. Two thin uniform circular rings each of radius 10 cm and mass 0.1 kg are arranged such that they have a common centre and their planes are perpendicular to each other. The moment of inertia of this system about an axis passing through their common centre and perpendicular to the plane of one of the rings in $kg - m^2$ is

A. 1.5×10^{-3}

B. 5×10^{-3}

C. 1.5×10^{-6}

D. 18×10^{-4}

Answer: A

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20. 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. $2\frac{Ml^2}{3}$

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

Answer: D

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21. Of the two eggs which have identical sizes, shapes and weights, one is raw and other is half boiled. The ratio between the moment of

inertia of the raw to the half boiled egg about central axis is:

A. one

B. greater than one

C. less than one

D. not comparable

Answer: B

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22. Moment of inertia of a solid cylinder of length L and diameter D about an axis passing through its centre of gravity and perpendicular to its geometric axis is

A. $M\left(\frac{D^2}{4}+\frac{L^2}{12}\right)$

B. $M\left(\frac{L^2}{16}+\frac{D^2}{8}\right)$

C. $M\left(\frac{D^2}{4}+\frac{L^2}{6}\right)$

D. $M\left(\frac{L^2}{12}+\frac{D^2}{16}\right)$

Answer: D

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23. Four spheres of diameter 2a and mass M are placed with their centres on the four corners of a square of side b. Then moment of inertia of the system about an axis about 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. $\frac{8}{5}Ma^2$

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

Answer: B

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24. The ratio of the radii of gyration of a circular disc about a tangential axis in the plane of the disc and a circular ring of the same radius about a tengential axis in the plane of the ring is

A. $2:3$

B. $2:1$

C. $\sqrt{5}:\sqrt{6}$

D. $1:\sqrt{2}$

Answer: C

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25. Three point masses, each of mass m, are placed at the corners of an equilateral triangle of side L. The moment of inertia of this system about an axis along one side of the triangle is

A. $3ml_2$

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

C. ml^2

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

Answer: D

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26. A thin rod of length L and mass M is bent at the middle point O at an 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. $\frac{ML^2}{6}$

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

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

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

Answer: B

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27. The diameter of a flywheel is increased by 1% . Increase in its moment of interia about the central axis is

A. 1%

B. 0.5%

C. 2%

D. 4%

Answer: C

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28. About which axis in the following figure the moment of inertia of the rectangular lamina is maximum ?

A. 1

B. 2

C. 3

D. 4

Answer: C

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29. Moment of inertia of a thin rod of a mass M and length L about an axis passing through its centre is $\frac{ML^2}{12}$. Its moment of inertia about a parallel axis at a distance of `(L)/(4) from this acis is given by

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

B. $\frac{ML^3}{48}$

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

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

Answer: D

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

A. $L/4$

B. $L/2$

C. less than one

D. 2 L

Answer: A

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31. A spherical solid ball of 1 kg mass and radius 3 cm is rotating about an axis passing through its centre with an angular velocity of 50 rad s^{-1}. The kinetic energy of rotation is

A. 450 J

B. 45 J

C. 90 J

D. 0.45 J

Answer: D

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32. The torque of the force $\vec{F} = \left(2\hat{i} - 3\hat{j} + 4\hat{k}\right)N$ acting at the point $\vec{r} = \left(3\hat{i} + 2\hat{j} + 3\hat{k}\right)m$ about the origin be

A. $-17\hat{i}+6\hat{j}+13\hat{k}$

B. $-6\hat{i}+6\hat{j}-12\hat{k}$

C. $17\hat{i}-6\hat{j}-13\hat{k}$

D. $6\hat{i}+6\hat{j}+12\hat{k}$

Answer: C

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33. A thin rod of mass m and length $2L$ is made to rotate about an axis passing through its center and perpendicular to it. If its angular

velocity changes from O to ω in time t, the torque acting on it is

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

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

C. $\frac{ml^2\omega}{t}$

D. $\frac{4ml^2\omega}{3t}$

Answer: B

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34. 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. t = 0.25 s

C. t = 2 s

D. t = 1 s

Answer: D

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35. If r is the distance between the Earth and the Sun. Then, angular momentum of the Earth around the sun is proportional to

A. $r^{3/2}$

B. r

C. $\sqrt{r}$

D. r^2

Answer: C

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36. A battet dancer spins with 2.8 rps with her arms out stretched. When the moment of inertia about the same axis becomes 0.7 l. the new rate of spin is

A. 3.2 rps

B. 4.0 rps

C. 4.8 rps

D. 5.6 rps

Answer: B

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37. If the earth suddenly charges its radius x times the present value, the new period of rotation would be

A. $6x^2h$

B. $12x^2h$

C. $24x^2h$

D. $48x^2h$

Answer: C

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38. A thin uniform rod AB of mass m and length l is hinged at one end to the level floor and stands vertically. If it s allowed to fall, with what angular velocity will it strike the floor?

A. $\left(\frac{mg}{L}\right)$

B. $\left(\frac{mg}{3L}\right)^{1/2}$

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

D. $\left(\frac{3g}{L}\right)^{1/2}$

Answer: D

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39. A particle of mass m is projected with a velocity v making an angle of 45° with the horizontal. The magnitude of the angular momentum of the projectile abut the point of projection when the particle is at its maximum height h is.

A. zero

B. $\frac{mvh^2}{\sqrt{2}}$

C. $\frac{mv^2h}{2}$

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

Answer: D

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40. The angular momentum of a rotating body changes from A_0 to $4A_0$ in 4 min. The torque acting on the body is

A. $\frac{3}{4}A_0$

B. $4A_0$

C. $3A_0$

D. $\frac{3}{2}A_0$

Answer: A

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41. What torque will increase angular velocity of a solid disc of mass 16kg and diameter 1 m from zero to 2 rpm in 8 s ?

A. $\left(\frac{\pi}{4}\right)N - m$

B. $\left(\frac{\pi}{2}\right)N - m$

C. $\left(\frac{\pi}{3}\right)N - m$

D. $(\pi)N - m$

Answer: D

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42. A particle of mass m is projected with a velocity v making an angle of 45° with the horizontal. The magnitude of the angular

momentum of the projectile abut the point of projection when the particle is at its maximum height h is.

A. Zero

B. $mv^3 / 4\sqrt{2}g$

C. $mv^2 / \sqrt{2}g$

D. $m\left(2gh^3\right)$

Answer: B

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43. Total kinetic energy of a rolling solid spher of mass m with velocity is

A. $\frac{7}{10}Mv^2$

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

C. $\frac{7}{5}Mv^2$

D. $\frac{10}{7}Mv^2$

Answer: A

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44. A force of 100 N is applied perpendicularly to the left edge of the rectangle as shown in the figure. The torque (magnitude and direction) produced by this force with respect to an axis perpendicular to the plane of the rectangular at corner A and with respect to a similar axis at corner B are respectively.

A. 75 N-m counter - clockwise, 125 N-m counter - clockwise

B. 125 N-m counter - clockwise, 75 N-m clockwise

C. 125 N-m clockwise, 75 N-m clockwise

D. 125 N-m counter - clockwise, 75 N-m clockwise

Answer: C

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45. The moment of inertia of the body about an axis is 1.2 kg m^2. Initially the body is at rest. In order to produce a rotational kinetic energy of 1500J, an angualr acceleration of 25 $ra\frac{d}{s^2}$ must be applied about the axis for the duration of

A. 4 s

B. 2 s

C. 8 s

D. 10 s

Answer: B

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46. 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. 2 L

B. 4 L

C. L / 2

D. L / 4

Answer: D

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47. An ice skater spins at $3\pi \ \mathrm{rad\,s^{-1}}$ with hers arms extended. If her moment of inertia with arms folded is $75\,\%$ of that with arms extended, her angular velocity when she fold her arms is

A. $(\pi)\mathrm{rad\ s}^{-1}$

B. $(2\pi)\mathrm{rad\ s}^{-1}$

C. $(3\pi)\mathrm{rad\ s}^{-1}$

D. $(4\pi)\mathrm{rad\ s}^{-1}$

Answer: D

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48. 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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49. 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. $\left(\frac{2gh}{l+mr}\right)^{1/2}$

B. $\left(\frac{2mgh}{l+mr^2}\right)^{1/2}$

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

D. $(2gh)^{1/2}$

Answer: B

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50. A ring of diameter $0.4m$ and of mass $10kg$ is rotating about its axis at the rate of 2100 rpm. Calculate moment of inertia, angular momentum and rotational KE of the ring.

A. $60.28\ \text{kg-m}^2\text{s}^{-1}$

B. $55.26kg - m^2s^{-1}$

C. 40.28kg-m^2s^{-1}

D. $50.28kg - m^2s^{-1}$

Answer: D

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51. A solid sphere is rotating about a diameter at an angular velocity ω. If it cools so that its radius reduces to $1/n$ of its original value, its angular velocity becomes

A. $\frac{\omega}{n}$

B. $\frac{\omega}{n^2}$

C. $n\omega$

D. $n^2\omega$

Answer: D

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52. A 3 kg moves with constant speed of $2ms^{-1}$ in the xy-plane in the y-direction along the line x = 4 m. the angular momentum (in

$kg - m^2 s^{-1}$) relative to the original and the torque about the original needed to maintain this motion are respectively

A. 12, 0

B. 24, 0

C. 0, 24

D. 0, 12

Answer: B

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53. A disc of mass 2 kg and radius 0.2 m is rotating with angular veocity $30\,\mathrm{rad\,s^{-1}}$. What is angular velocity, if a mass of 0.25 kg is put on periphery of the disc?

A. $24\,\mathrm{rad\,s^{-1}}$

B. $36\,\mathrm{rad\,s^{-1}}$

C. $15\,\mathrm{rad\,s^{-1}}$

D. $26\,\mathrm{rad\,s^{-1}}$

Answer: A

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54. in a circular motion the angle between a particle's linear momentum and its angular moment is

A. 0°

B. 45°

C. 90°

D. 180°

Answer: C

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55. When a celling fan is switched off, its angular velocity falls to half while it makes 36 rotations. How many more rotations will it make before coming to rest ?

A. 36

B. 24

C. 18

D. 12

Answer: D

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56. 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. $2:1$

B. $1:2$

C. $\sqrt{2}:1$

D. $1 : \sqrt{2}$

Answer: B

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57. A wheel of mass 8 kg and radius 40 cm is rolling on a horizontal road with angular velocity 15 rad/s. If moment of inertia of the wheel about its axis is $0.64 kgm^2$, then the rolling kinetic energy of wheel will be

A. 288 J

B. 216 J

C. 72 J

D. 144 J

Answer: B

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58. A sphere and a hollow cylinder roll without slipping down two separate inclined planes and travel the same direction in the same time. If the angle of the plane dowm which the

sphere rolls is 30° , the angle of the other pane is

A. 60°

B. 53°

C. 37°

D. 45°

Answer: D

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59. A solid cylinder rolls down an inclined plane of height $3m$ and reaches the bottom of plane with angular velocity of $2\sqrt{2}rad/s$. The radius of cylinder must be [take $g = 10m/s^2$]

A. 5 cm

B. 0.5 cm

C. $\sqrt{10}cm$

D. $\sqrt{5}m$

Answer: D

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60. If a sphere rolling on an inclined plane with velocity v without slipping, the vertical height of the inclined in terms of velocity will be

A. $\frac{7v}{10g}$

B. $\frac{7v^2}{10g}$

C. $\frac{2v^2}{5g}$

D. $\frac{3v}{5g}$

Answer: B

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61. A cylinder is rolling down on a inclined plane of inclination 60°. What is iths acceleration?

A. $g/3$

B. $g/\sqrt{3}$

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

D. None of these

Answer: B

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62. The speed of a homogeneous solid sphere after rolling down an inclined plane of vertical height h from rest without slipping will be.

A. $\sqrt{\frac{10}{7}gh}$

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

C. $\sqrt{gh}$

D. $\sqrt{\frac{6}{5}gh}$

Answer: A

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63. A rupee coin, starting from rest rolls down a distance of 1 m on a plane inclined at an angle of 30° with the horizontal. Assuming that $g = 9.81ms^{-2}$, time taken is : -

A. 0.78 s

B. 0.6 s

C. 0.5 s

D. 0.7 s

Answer: A

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64. When a uniform solid sphere and a disc of the same mass and of the same radius roll down an inclined smooth plane from rest to the same distance, then ratio of the time taken by them is

A. $15:14$

B. $15^2 : 14^2$

C. $\sqrt{14} : \sqrt{15}$

D. $14 : 15$

Answer: C

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

$4J$ at the foot of the inclined plane, then its linear velocity at the same point is

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66. An iron rod of mass M and length L is cut into n equal parts by cutting it perpendicular to its length. If I is the M.I. of the rod, about an axis passing through its centre and perpendicular to its axis, then the moment of interia of each part about the similar axis

A. $\frac{l}{n}$

B. $\frac{l}{n^2}$

C. $\frac{l}{n^3}$

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

Answer: C

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67. 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. $\frac{(l_1 + l_2)\omega_1}{l_1}$

B. $\frac{l_1\omega_1}{l_1 + l_2}$

C. ω_1

D. $\frac{l_2\omega_1}{l_1 + l_2}$

Answer: B

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68. Two discs cone of density 7200 kg/m^3 and another of density $9000km/m^3$ have the same mass and thickness. What is the ratio of their moments of inertia?

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

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

C. $\frac{5}{9}$

D. $\frac{1}{9 \times 7.2}$

Answer: B

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

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

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

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

Answer: D

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70. A thin wire of length L and uniform linear mass density ρ is bent into a circular loop with centre at O as shown in the figure. What is the moment of inertia of the loop anout the axis XX'?

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

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

C. $\frac{5}{16}\rho L^3\pi$

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

Answer: D

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PRACTICE EXERCISE (Exercise 2 (MISCELLANEOUS PROBLEMS))

1. Three identical square plates rotate about the axes shown in the figure in such a way that their kinetic energies are equal. Each of the rotation axis passes through the centre of the square. Then, the ratio of angular speeds $\omega_1 : \omega_2 : \omega_3$ is

A. $1:1:1$

B. $\sqrt{2}:\sqrt{2}:1$

C. $1:\sqrt{2}:1$

D. $1:2:\sqrt{2}$

Answer: A

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2. Match the following column.

Choose the correct option regarding above column.

A.

A	B	C	D
3	1	2	4

B.
A	B	C	D
3	2	1	4

C.
A	B	C	D
2	1	2	5

D.
A	B	C	D
3	2	1	4

Answer: B

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3. The Ml of a disc of mass M and radius R, about an axis passing through the centre O and perpendicular to the plane of the disc is $\frac{MR^2}{2}$. If one quarter of the disc is removed,

the new moment of inertia of the disc will be

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

B. $\frac{MR^2}{4}$

C. $\frac{3}{8}MR^2$

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

Answer: C

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

A. $25\ \mathrm{rad\ s^{-2}}$

B. $10\ \mathrm{rad\ s^{-2}}$

C. $35\ \mathrm{rad\ s^{-2}}$

D. $40\ \mathrm{rad\ s^{-1}}$

Answer: A

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5. A force F = 2 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 orgin O (in N-m) is

A. 2

B. 3

C. 4

D. 5

Answer: B

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6. 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

7. A solid sphere is given a kinetic energy E. What fraction of kinetic energy is associated with rotation

A. $3/7$

B. $5/7$

C. $1/2$

D. $2/7$

Answer: D

Watch Video Solution

8. A body of moment of inertia about its axis of rotation is $3kgm^2$ and angular velocity 3 rad/s. The kinetic energy of rotating body is

same as that of body of mass 27 kg moving with a speed of

A. $1ms^{-1}$

B. $0.5ms^{-1}$

C. $2ms^{-1}$

D. $1.5ms^{-1}$

Answer: A

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9. Three identical spheres, each of mass 1 kg are kept as shown in figure below, 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

View Text Solution

10. A thin uniform rod of length l and mass m is swinging freely about a horizontal axis passing through its end. Its maximum angular speed is ω. Its centre of mass rises to a maximum height of -

A. $\frac{1}{2}\frac{l^2\omega^2}{g}$

B. $\frac{1}{6}\frac{l\omega}{g}$

C. $\frac{1}{2}\frac{l^2\omega^2}{g}$

D. $\frac{1}{6}\frac{l^2\omega^2}{g}$

Answer: D

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11. A body is rolling down an inclined plane. If kinetic energy of rotation is $40\,\%$ of kinetic energy in translatory start then the body is a.

A. solid cylinder

B. solid sphere

C. disc

D. ring

Answer: B

 Watch Video Solution

12. 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

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13. The angular speed of a body changes from ω_1 to ω_2 without applying a torque but due to change in its moment of inertia. The ratio of radii of gyration in the two cases is :-

A. $\sqrt{\frac{\omega_2}{\omega_1}}$

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

C. $\omega_2 : \omega_1$

D. $\omega_1 : \omega_2$

Answer: A

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14. A thin hollow sphere of mass m is completely filled with a liquid of mass m. What the sphere rolls with a velocity v, kinetic energy of the system is (neglect friciton)

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

B. mv^2

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

D. $\frac{4}{5}mv^2$

Answer: C

 Watch Video Solution

15. Two circular rings A and B of radii nR and R are made from the same wire. The Ml of A about an axis passing through the centre and perpendicular to the plane of A is 27 times that of the smaller loop B. What is the value of n if the length of A = n (length of B) ?

A. 2

B. 3

C. 4

D. 5

Answer: B

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16. A system consists of 3 particles each of mass 'm' are located at (1, 1) (2, 2) and (3, 3). The co-ordinates of the centre of mass are

A. (6, 6)

B. (3, 3)

C. (1, 1)

D. (2, 2)

Answer: D

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17. A thin horizontal circular disc is roating about a vertical axis passing through its centre. An insect is at rest at a point near the

rim of the disc. The insect now moves along a diameter of the disc to reach its other end. During the journey of the insect, the angular speed of the disc.

A. continuously decreases

B. continuously increases

C. first increases and then decreases

D. remains unchanged

Answer: C

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18. A solid sphere of radius R has moment of inetia I about its geometrical axis. If it is melted into a disc of radius r and thickness t. If its moment of inertia about the tangential axis (which is perpencidular to plane of the disc), is also equal to I, then the value of r is equal to

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

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

C. $\frac{3}{\sqrt{15}}R$

D. $\frac{\sqrt{3}}{\sqrt{15}}R$

Answer: A

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

A. $2ml^2$

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

C. $3ml^2$

D. ml^2

Answer: C

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20. A circular disc of radius R and thickness $R/6$ has moment of inertia I about an axis passing through its centre and perpendicular

to its plane. It is melted and recast into a solid sphere. The $M.I$ of the sphere about its diameter as axis of rotation is

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

B. $\frac{2l}{6}$

C. l

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

Answer: D

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

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

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

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

Answer: D

Watch Video Solution

22. if the earth is treated as a sphere of radius Radn mass M, Its angular momentum about the axis of its rotation with period T, is

A. $\frac{\pi MR^3}{T}$

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

C. $\frac{2\pi MR^3}{5T}$

D. $\frac{4\pi MR^2}{5T}$

Answer: D

Watch Video Solution

23. Consider a body, shown in the figure, consisting of two identical balls, each 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. v/L

B. 2v/L

C. v/3L

D. v/4L

Answer: A

View Text Solution

24. A dancer is standing on a stool rotating about the vertical axis passing through its centre. She pulls her arms towards the body reducing her moment of inertia by a factor of

n. The new angular speed of turn table is proportional to

A. n

B. n^{-1}

C. n^{0}

D. n^{2}

Answer: A

Watch Video Solution

25. Three identical spheres of mass M each are placed at the corners of an equilateral triangle of side 2 m. Taking one of the corners as the origin, the position vector of the centre of mass is

A. $\sqrt{3}\left(\hat{i}-\hat{j}\right)$

B. $\frac{\hat{i}}{\sqrt{3}}+\hat{j}$

C. $\hat{i}+\hat{j}/3$

D. $\hat{i}+\hat{j}/\sqrt{3}$

Answer: D

Watch Video Solution

26. Two thin discs each of mass M and radius R are placed at either and of a rod of mass m length l and radius r. Moment of inertia of the system about an axis passing through the centre of rod and perpendicular to its length is

A. $\frac{mL^2}{12} + \frac{1}{2}MR^2 + \frac{1}{2}ML^2$

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

C. $\frac{1}{2}mL^2 + \frac{mR^2}{2} + \frac{ML^2}{12}$

D. $\frac{mL^2}{12} + MR^2 + \frac{1}{2}ML^2$

Answer: A

View Text Solution

27. Four particles, each of mass m, are lying symmetrically on the rim of a disc of mass M and radius R. M.I. of this system about an axis passing through one of the particles and perpendicular to plane of disc is

A. $16mr^2$

B. $(3M + 19m)\frac{R^2}{2}$

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

D. zero

Answer: B

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28. Bodies of regular geometrical shape were allowed to roll on a horizontal surface. It was found that for one rolling body, die

translational KE was equal to rotational KE, the body must be

A. a solid sphere

B. a hollow sphere

C. a disc

D. a thin ring

Answer: D

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29. Two sphere each of mass M and radius R/2 are connected with a massless rod of length 2 R as shown in 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. $\frac{21}{5}MR^2$

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

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

D. $\frac{5}{21}MR^2$

Answer: A

View Text Solution

30. A uniform rod of mass m and length l is suspended by means of two light inextansible strings as shown in the figure. Tension in one string immediately after the other string is cut is

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

B. mg

C. $2mg$

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

Answer: D

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31. 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 $12\,\mathrm{rad\,s^{-1}}$, the magnitude of its angular momentum about a point on the ground right under the centre of the circle is

A. $14.4kg - m^2s^{-1}$

B. $8.64kg - m^2s^{-1}$

C. $20.16kg - m^2s^{-1}$

D. $11.52kg - m^2s^{-1}$

Answer: A

Watch Video Solution

32. The mass of the earth is increasing at the rate 1 part in 5×20^{19} per day by the accretion of meteors falling normally upon the earth's surface. Find the corresponding rate of change of the period of rotation of the earth supporting the earth to be a sphere of uniform density.

[Hint: Consider the deposit as a spherical shell and apply principle of conservation of angular momentum]

A. 2.0×10^{-30}

B. 2.66×10^{-19}

C. 4.33×10^{-18}

D. 5.66×10^{-17}

Answer: A

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33. Four holes of radius R are cut from a thin square plate of side 4 R 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. $\left(\frac{4}{3}-\frac{\pi}{6}\right)MR^2$

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

Answer: D

View Text Solution

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

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

B. mr^2

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

D. $4mr^2$

Answer: D

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35. A string of negligible thickness is wrapped several times around a cylinder kept on a rough horizontal surface. A boy standing at a distance l from the cylinder holds one end of the string and pulls the cylinder toward him. Assuming no slipping the length of the thread

passed through the hands of the man is

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

B. l

C. $2l$

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

Answer: C

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36. A solid cylinder of mass $20kg$ rotates about its axis with angular speed $100s^{-1}$. The radius of the cylinder is $0.25m$. What is the kinetic energy associated with the rotation of the cylinder ? What is the magnitude of angular momentum of the cylinder about its axis ?

A. $3200J, 62.5J - s$

B. $3125J, 62.5J - s$

C. $3500J, 68J - s$

D. $3400J, 63.3J - s$

Answer: B

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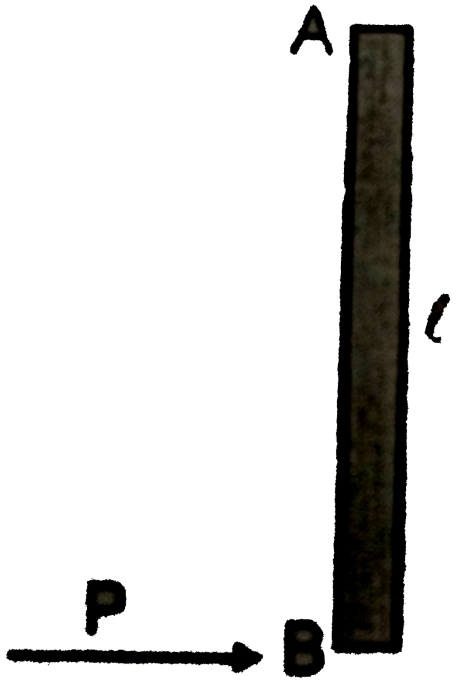
37. A uniform rod AB of mass m and length l at rest on a smooth horizontal surface. An impulse P is applied to the end B. The time taken by the rod to turn through a right angle

is :



A. $2\pi\frac{ml}{P}$

B. $\frac{\pi P}{ml}$

C. $\frac{\pi}{12}\frac{ml}{P}$

D. $\frac{\pi P}{ml}$

Answer: C

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38. A particle of mass m moves along line PC with velocity v as shown in the figure. What is the angular momentum of the particle about O?

A. mvL

B. mvl

C. mvr

D. zero

Answer: B

View Text Solution

39. A ring of mass M and radius R is rotating about its axis with angular velocity ω. Two identical bodies each of mass m are now gently attached at the two ends of a diameter

of the ring. Because of this, the kinetic energy loss will be :

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

B. $\frac{Mm}{(M+2m)}\omega^2 R^2$

C. $\frac{Mn}{(M-2m)}\omega^2 R^2$

D. $\frac{(M+m)M}{(M+2m)}\omega^2 R^2$

Answer: B

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40. A hoop of radius r and mass m rotating with an angular velocity ω_0 is placed on a rough horizontal surface. The initial velocity of the centre of the hoop is zero. What will be the velocity of the centre of the hoop when it ceases ot slip?

A. $\frac{r\omega_0}{4}$

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

C. $\frac{r\omega_0}{2}$

D. $r\omega_0$

Answer: C

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

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

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

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

Answer: A

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42. The moment of inertia of a uniform rod about a perpendicular axis passing through one end is I_1. The same rod is bent into a ring and its moment of inertia about a diameter is I_2. Then I_1 / I_2 is

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

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

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

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

Answer: A

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43. A solid sphere rolls down a smooth inclined plane of height h. If it stats from rest

then the speed of the sphere when it reaches the bottom is given by

A. $\sqrt{gh}$

B. $\sqrt{\frac{10}{7}gh}$

C. $\sqrt{\frac{4}{7}gh}$

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

Answer: B

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44. A child is standing with folded hands at the center of a platform rotating about its central axis. The kinetic energy of the system is K. The child now stretches his arms so that the moment of inertia of the system doubles. The kinetic energy of the system now is

A. K

B. 2K

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

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

Answer: C

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45. 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. $K_A = K_B$

B. $K_A > K_B$

C. $K_A < K_B$

D. $K_A = \frac{K_B}{2}$

Answer: B

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46. Two wheels of radii 10 cm and 30 cm are connected to each other by a belt. What is the ratio of the moment of inertia of the larger wheel to that of the smaller wheel, when both of them have the same angular momentum?

A. 2

B. 3

C. 4

D. 5

Answer: B

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47. Two spheres of unequal masses but of the same radii are released from the top of a smooth inclined plane. They roll down the plane without slipping. Which one will reach the bottom first?

A. Both will reach the bottom at the same time

B. Heavier sphere

C. Lighter sphere

D. None of the above

Answer: A

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MHT CET Corner

1. A circular disc of radius R and thickness $R/6$ has moment of inertia I about an axis passing through its centre and perpendicular to its plane. It is melted and recast into a solid sphere. The $M.I$ of the sphere about its diameter as axis of rotation is

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

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

C. $\frac{1}{32}$

D. $\frac{1}{64}$

Answer: A

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

A. 1

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

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

D. $\frac{1}{8}$

Answer: B

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3. 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. $[mgh]^{1/2}$

B. $\left[\frac{2mgh}{1+2mr^2}\right]^{1/2}$

C. $\left[\frac{2mgh}{1+mr^2}\right]^{1/2}$

D. $\left[\frac{mgh}{1+mr^2}\right]^{1/2}$

Answer: C

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4. A satellite of mass m is in a circular orbit of radius r round the Earth. Calculate its angular momentum with respect to the centre of the orbit in terms of the mass M of the Earth and G.

A. $(GMmr)^{1/2}$

B. $\left(GMm^2r\right)^{1/2}$

C. $\left(GMm^2r^2\right)^{1/2}$

D. $\left(GM^2m^2r\right)^{1/2}$

Answer: B

 Watch Video Solution

5. A ring and a disc roll on the horizontal surface without slipping, with same linear velocity. If bolh have same mass and radius 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

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6. A circular disc of radius R and thickness $R/6$ has moment of inertia I about an axis passing through its centre and perpendicular to its plane. It is melted and recast into a solid

sphere. The $M.I$ of the sphere about its diameter as axis of rotation is

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

B. $\frac{l}{6}$

C. $\frac{l}{32}$

D. $\frac{l}{64}$

Answer: A

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

A. 1

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

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

D. $\frac{1}{8}$

Answer: B

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8. An object of radius R and mass M is rolling horizontally without slipping with speed v . It then rolls up the hill to a maximum height $h = \frac{3v^2}{4g}$. The moment of inertia of the object is (g = acceleration due to gravity)

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

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

C. MR^2

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

Answer: B

Watch Video Solution

9. The moment of inertia of a uniform rod about a perpendicular axis passing through one end is I_1. The same rod is bent into a ring

and its moment of inertia about a diameter is I_2. Then I_1 / I_2 is

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

B. $\frac{8\pi^2}{3}$

C. $\frac{5\pi}{3}$

D. $\frac{8\pi^2}{5}$

Answer: B

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

A. $\frac{AB + AC}{2}$

B. $\frac{AB + BC}{2}$

C. $\frac{AC - AB}{3}$

D. $\frac{AB + AC}{3}$

Answer: D

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

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

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

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

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

Answer: A

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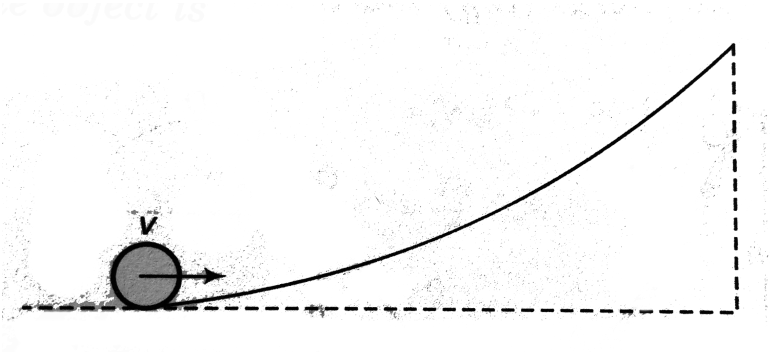
12.



A small object of uniform density rolls up a curved surface with an initial velocity v. It reaches up to a maximum height of $\frac{3v^2}{4g}$ with

respect to the initial position. The object is

(a). Ring

(b). solid sphere

(c). hollow sphere

(d). disc

A. ring

B. solid sphere

C. hollow sphere

D. disc

Answer: D

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

A. iron and aluminium layers in alternate order

B. aluminium at interior and iron surrounding it

C. iron at interior and aluminium surrounding it

D. Either (a) or (c)

Answer: B

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14. When a disc is rotating with angular velocity ω , a particle situated at a distance of 4 cm just begins to slip . If the angular velocity

is doubled , at what distance will the particle start to slip ?

A. 1 cm

B. 2 cm

C. 3 cm

D. 4 cm

Answer: A

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15. Which relation is not correct of the following ?

A. Torque = Moment of inerita $\times$ angular acceleration

B. Torque = Dipole moment $\times$ magnetic induction

C. Moment of inertia = Torque $\times$ angular acceleration

D. Linear moment = Moment of inertia $\times$ angular velocity.

Answer: C

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16. The moment of inertia of a uniform thin rod of length L and mass M about an axis passing through a point at a distance of $L/3$ from one of its ends and perpendicular to the rod is

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

B. $\frac{ML^2}{9}$

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

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

Answer: B

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17. 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. 6 I

B. 4 L

C. 2 I

D. 8 I

Answer: A

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18. The moment of inertia of two freely rotating bodies A and B are l_A and l_B respectively. $l_A > l_B$ and their angular momenta are equal. If K_A and K_B are their kinetic energies,then

A. $K_A = K_B$

B. $kK_A \neq K_B$

C. $K_A < K_B$

D. $K_A = 2K_B$

Answer: C

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19. Moment of inertia of big drop is I. If 8 droplets are formed from big drop, then moment of inertia of small droplet is

A. $\frac{l}{32}$

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

C. $\frac{l}{6}$

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

Answer: A

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20. Moment of inertia of a rod of mass M and length L about an axis passing through a point midway between centre and end is

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

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

C. $\frac{7ML^2}{24}$

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

Answer: D

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21. From a disc of radius R, a concentric circular portion of radius r is cut out so as to leave an annular disc of mass M. The moment of inertia of this annular disc about the axis perpendicular to its plane and passing through its centre of gravity is

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

B. $\frac{1}{2}M\left(R^2-r^2\right)$

C. $\frac{1}{2}M\left(R^4+r^4\right)$

D. $\frac{1}{2}M'\left(R^4 - r^4\right)$

Answer: A

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22. Two spheres of equal masses, one of which is a thin spheical shelll and the other a solid, have the same moment of inertia about their respective diameters. The ratio of their radii well be

A. $5:7$

B. $3:5$

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

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

Answer: C

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23. 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

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24. The moment of inertia of a solid sphere about an axis passing through the centre radius is $\frac{1}{2}MR^2$, then its radius of gyration

about a parallel axis at a distance $2R$ from first axis is

A. 5 R

B. $\sqrt{\frac{22}{5}}R$

C. $\frac{5}{2}R$

D. $\sqrt{\frac{12}{5}}R$

Answer: B

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25. Moment of inertia of a disc about an axis which is tangent and parallel to its plane is I . Then the moment of inertia of disc about a tangent, but perpendicular to its plane will be

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

B. $\frac{5l}{6}$

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

D. $\frac{6l}{5}$

Answer: D

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26. By keeping moment of inertia of a body constant, if we double the time period, then angular momentum of body

A. remains constant

B. becomes half

C. doubles

D. quadruples

Answer: B

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27. A disc of moment of inertia $9.8/\pi^2 kgm^2$ is rotating at 600 rpm. If the frequency of rotation changes from 600 rpm to 300 rpm, then what is the work done ?

A. 1470 J

B. 1452 J

C. 1567 J

D. 1632 J

Answer: A

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28. The center of mass of a system of two particles divides the distance between them.

A. in inverse ratio of square of masses of particles

B. in direct ratio of square of masses of particles

C. in inverse ratio of masses of particles

D. in direct ratio of masses of particles

Answer: C

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

B. $\frac{(M-2m)}{M}$

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

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

Answer: C

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30. Moment of inertia depends on

A. distribution of particles

B. mass

C. position of axis of rotation

D. All of the above

Answer: D

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31. Moment of inertia of a disc about its own axis is I. Its moment of inertia about a tangential axis in its plane is

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

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

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

D. $\frac{7MR^2}{4}$

Answer: C

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32. A sphere of mass 0.5 kg and diameter 1m rolls without sliding with a constant velocity of 5 m/s . What is the ratio of the rotational K.E. to the total kinetic energy of the sphere?

A. $\frac{7}{10}$

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

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

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

Answer: C

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33. A body of moment of inertia of $3kgm^2$ rotating with an angular velocity of 2 rad/s has the same kinetic energy as that that of mass 12 kg moving with a velocity of

A. $8ms^{-1}$

B. $0.5ms^{-1}$

C. $2ms^{-1}$

D. $1ms^{-1}$

Answer: D

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34. The moment of inertia of a thin circular disc of mass M and radius R about any diameter is

A. $2MR^2$

B. $\frac{MR^2}{4}$

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

D. MR^2

Answer: B

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35. The radius of gyration of a disc of mass 100 g and radius 5 cm about an axis pasing through centre of gravity and perpendicular to the plane is

A. 3.54 cm

B. 1.54 cm

C. 4.54 cm

D. 2.54 cm

Answer: A

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