PHYSICS

BOOKS - CHHAYA PHYSICS (BENGALI ENGLISH)

ROTATION OF RIGID BODIES

Numerical Examples

1. If the radius of the earth decreases by $\frac{1}{2}\%$, then what will be the change in the length of a

day? Assume that the earth is a uniform sphere and its moment of inertia, $I = \frac{2}{5}MR^2$, where M and R are the mass and the radius of the earth.

View Text Solution

2. A solid sphere of mass 1 kg and of radius 10 cm is rotating about one of its diameter with an angular velocity of π rad . s^{-1}. Calculate the kinetic energy of the sphere by using the relevant formula.

Watch Video Solution

3. A thin rod of length l and mass m per unit length is rotating about an axis passing through the mid-point of its length and perpendicular to it. Prove that its kinetic energy $=\frac{1}{24}m\omega^2 l^3$, ω= angular velocity of the rod.

Watch Video Solution

4. Calculate the moment of inertia of a solid cylinder of length 10 cm and of radius 20 cm about its own axis. Density of the material of the cylinder = 9 g . cm^{-3}.

Watch Video Solution

5. A solid sphere of diameter 2 cm and of mass 20 g is rolling with a velocity of 3 cm.s^{-1}. What is the total kinetic energy of the sphere?

Watch Video Solution

6. A stone of mass m tied with a thread is rotating along a horizontal circular path (force of gravity is neglected). The length of the thread is decreasing gradually in such a manner that the angular momentum of the stone remains constant with respect to the centre of the circle. If the tension in the thread is T= Ar^n , where A = constant , r = instantaneous radius of the circle, then find the value of n.

View Text Solution

7. Two ends of a uniform rod weighing W, are placed on supports so that the rod remains horizontal. If a support at one end is suddenly removed, what will be the force exerted on the horizontal rod by the support at the other end?

View Text Solution

8. A rod of length L and mass M is attached with a hinge on a wall at a point O. After

releasing the rod from its vertical position OA, when it comes to the position OA', then what is the reaction on the point O of the rod by the hinge ?

View Text Solution

9. A particle of mass m is projected at an angle of 45° with the horizontal. At the highest point of its motion (h), what will be its angular

momentum with respect to the point of projection?

View Text Solution

10. Initially a sphere of radius r is rotating with an angular velocity ω about its own horizontal axis. When the sphere falls on a surface (coefficient of friction μ), then it begins to skid first and then starts rotating without skidding. What will be the final linear velocity of its centre of mass?

View Text Solution

11. Initially a sphere of radius r is rotating with an angular velocity ω about its own horizontal axis. When the sphere falls on a surface (coefficient of friction μ), then it begins to skid first and then starts rotating without skidding. How much distance will the sphere cover before reaching this velocity?

View Text Solution

12. A small sphere of radius r at rest begins to slide down the surface of a hemispherical bowl from the brim of the bowl. When the sphere reaches the bottom of the bowl, what fraction of its total energy will be converted into translational kinetic energy and what fraction into rotational kinetic energy ?

Watch Video Solution

Section Related Question

1. Write down the dimension of moment of inertia.

Watch Video Solution

2. Define angular impulse .

Watch Video Solution

Higher Order Thinking Skill Hots Questions

1. Is there any change in the angular velocity of the earth when a body strikes the earth's surface from outside ?

View Text Solution

2. Why is it easier to rotate an object tied to the end of a short string than that of a long string?

View Text Solution

3. A solid and a hollow sphere of the same mass have the same outer radius. Which one has a larger radius of gyration?

Watch Video Solution

4. If the ice at the poles of the earth melts, how would this affect the length of the day?

View Text Solution

5. A cricket ball sometimes rebounds from the cricket pitch with a velocity greater than which it was bowled with by a bowler. How can it be possible?

View Text Solution

6. Can the moment of inertia of a body be different about different axes?

View Text Solution

7. A man is standing on a rotating table and he drops a heavy mass from his hand outside the table. How will the angular speed of the table change?

View Text Solution

8. When a body of mass m slides down from the top of an inclined plane and reaches the bottom its velocity becomes v. When a circular disc of the same mass is rolled down the

inclined plane it acquires a velocity v_1. Show that ,$v_1 = \sqrt{\frac{2}{3}}v$.

Watch Video Solution

9. Prove that the length of a day becomes T' = 6 h instead of T = 24 h if the earth suddenly contracts to half its present radius (consider earth as a spherical body), without having any change in its mass.

View Text Solution

10. Show that the torque acting on a body is equal to the rate of change of angular momentum of the body.

View Text Solution

11. What is the relation between torque and angular acceleration?

Watch Video Solution

12. Keeping the radius of the earth unchanged if the mass of the earth is doubled , then what will be the length of a day?

View Text Solution

13. A circular disc of mass m and radius r is rolling over a horizontal table top with angular velocity ω. Prove that the total energy of the disc , $K = \frac{3}{4}m\omega^2 r^2$.

Watch Video Solution

14. Between two circular discs of equal mass and equal thickness but of different densities which one would have a greater moment of inertia about its central perpendicular axis?

Watch Video Solution

15. Given the moment of inertia of a disc of mass M and radius R about any of its diameters to be $\frac{MR^2}{4}$. Find its moment of

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

Watch Video Solution

16. Moment of inertia plays the same role in rotational motion as mass plays in translational motion' explain the statement.

View Text Solution

17. 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 $\frac{2MR^2}{5}$, where M is the mass of the sphere and R is the radius of the sphere.

View Text Solution

18. A solid sphere of mass m and radius R rolls down from the top of a table. With how much

angular speed will it touch the ground?

View Text Solution

19. A uniform rod AB of mass M and length L is hung from a ceiling in such a way that the rod can rotate freely in the vertical plane around point A. An object of mass m coming horizontally with velocity v_0 hits the rod. What will be the maximum angle with the vertical that the rod makes in this type of collision?

(Here , M = 6 m)

View Text Solution

20. A spherical object of mass m is released on a smooth inclined plane which is inclined at an angle θ with the horizontal. State whether it will roll or slip. Give reasons in support of your answer.

View Text Solution

Exercise Multiple Choice Questions

1. A stone is tied with a massless rope and is rotated with uniform speed. Angular momentum of the stone is L . Keeping the angular velocity unchanged it the length of the rope is halved its angular momentum will be

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

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

C. L

D. 2 L

Answer: A

Watch Video Solution

2. Vector representation of angular momentum $\left(\vec{L}\right)$ is

A. $\vec{L} = \vec{\times}\,\vec{r}$

B. $\vec{L} = \vec{r} \times \vec{p}$

C. $\vec{L} = \vec{p} \,.\, \vec{r}$

D. $\vec{L} = \vec{r} . \vec{p}$

Answer: B

View Text Solution

3. A thin circular ring of mass M and radius R is rotating about an axis perpendicular to the plane of the ring and passing through the centre with an angular velocity ω. Two bodies each of mass m are placed gently on the ring.

The angular velocity with which the ring is rotating now is given by

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

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

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

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

Answer: C

View Text Solution

4. A particle of mass m is moving with a uniform velocity along a straight path parallel to the x -axis. Angular momentum of the particle with respect to the origin will be

A. zero

B. constant

C. increased gradually

D. decreased gradually

Answer: B

Watch Video Solution

Watch Video Solution

5. Angular velocity of a smooth sphere A moving on a frictionless horizontal surface is ω and the velocity of its centre of mass is v. When it undergoes elastic head on collision with another identical sphere B at rest then the angular velocities of the two spheres become ω_A and ω_B respectively. If friction is neglected, the relation between ω_A and ω_B will be

A. $\omega_A < \omega_B$

B. $\omega_A = \omega_B$

C. $\omega_A \omega$

D. $\omega_B \omega$

Answer: C

View Text Solution

6. Angular momentum of a moving body remains constant if

A. an external force acts on the body

B. a pressure acts on the body

C. an external torque acts on the body

D. no external torque acts on the body

Answer: D

Watch Video Solution

7. Angular momentum is

A. moment of momentum

B. product of mass and angular velocity

C. product of moment of inertia and velocity

D. moment in angular motion

Answer: A

 Watch Video Solution

8. A particle performs uniform circular motion with an angular momentum $L_,$. If the frequency of the particle motion is doubled the angular momentum becomes

A. 2 L

B. 4 L

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

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

Answer: A

Watch Video Solution

9. If r denotes the distance between the sun and the earth, then the angular momentum of the earth around the sun is proportional to

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

B. r

C. $\sqrt{r}$

D. r^2

Answer: D

Watch Video Solution

Exercise Based On Torque

1. Dimensional formula of torque is

A. ML^2T^{-2}

B. M^2LT^{-1}

C. MLT^{-2}

D. ML^2T^{-1}

Answer: A

Watch Video Solution

2. The torque of a force $\vec{F} = 6\hat{i}$ acting at a point $\vec{r} = 4\hat{j}$ about origin will be

A. $-24\hat{k}$

B. $24\hat{k}$

C. $24\hat{j}$

D. $24\hat{i}$

Answer: A

Watch Video Solution

Exercise Based On Moment Of Inertia

1. Moment of inertia of a circular ring of mass m and radius r about the normal axis passing through its centre is

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

B. mr^2

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

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

Answer: B

View Text Solution

2. Moment of inertia of a circular wire of mass m and radius r about its diameter is

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

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

C. mr^2

D. $2mr^2$

Answer: A

Watch Video Solution

3. Thicknesses of two iron discs of radii r and 4r are t and $\frac{t}{4}$ respectively. If their moments of inertia are I_1 and I_2 respectively then

A. $I_2 = 64I_1$

B. $I_2 = 32I_1$

C. $I_2 = 16I_1$

D. $I_2 = I_1$

Answer: A

Watch Video Solution

4. 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. $\frac{2}{5}Mr^2$

C. Mr^2

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

Answer: C

Watch Video Solution

5. The moment of inertia of a disc is 100 g . cm^2 . The disc rotates with an angular velocity 2 rad/s. The rotational kinetic energy of the disc is

A. 100 erg

B. 200 erg

C. 400 erg

D. 50 erg

Answer: B

Watch Video Solution

6. The moment of inertia of a circular disc of mass m and radius r about an perpendicular axis passing through its centre is

A. mr^2

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

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

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

Answer: C

View Text Solution

7. Radius of gyration of a ring of radius R about an axis passing through its centre and perpendicular to its plane is

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

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

C. R

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

Answer: C

Watch Video Solution

8. Radius of gyration of a disc of mass 50 g and radius 0.5 cm about an axis passing through its centre of gravity and perpendicular to the plane is

A. 6.54 cm

B. 3.64 M

C. 0.35 cm

D. 0.88 cm

Answer: C

Watch Video Solution

Exercise Based On Rotational Kinetic Energy

1. Moment of inertia of a disc is 100 g.cm^2. If the disc rotates with an angular velocity of 2 rad . s^{-1} the rotational kinetic energy of the disc is

A. 100 erg

B. 200 erg

C. 400 erg

D. 50 erg

Answer: B

 Watch Video Solution

2. A man stands on a rotating table stretching his arms. He is rotating with a definite angular velocity. Now the man draws his arms closer. His moment of inertia is reduced to 75% of its

initial value. The angular kinetic energy of the man

A. will increase by 33.3 %

B. will decrease by 33.3 %

C. will increase by 25%

D. will decrease by 25%

Answer: A

Watch Video Solution

3. Total KE of sphere of mass M rolling with velocity v 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

Watch Video Solution

4. A body of mass 10 kg moves with a velocity of 2 m/s along a circular path of radius 8 m. The power produced by the body will be

A. 10 j /s

B. 98 j/s

C. 49 j/s

D. zero

Answer: A

Watch Video Solution

5. If a sphere is rolling then the ratio of its rotational kinetic energy to the total kinetic energy is

A. $1:2$

B. $2:5$

C. $2:7$

D. $5:7$

Answer: C

Watch Video Solution

Exercise Miscellaneous

1. If no torque acts on a rotating body and if its moment of inertia decreases the angular velocity ω of the body increases such a manner that

A. $\frac{1}{2}I\omega^2$ remains constant

B. $I\omega$ remains constant

C. $\frac{I}{\omega}$ remains constant

D. $I\omega^2$ remains constant

Answer: B

Watch Video Solution

2. Angular momentum of a particle revolving with uniform speed is L. If the frequency of the particle is doubled and its kinetic energy is halved then its angular momentum becomes

A. 2.5 L

B. 0.25 L

C. 5.0 L

D. 0.50 L

Answer: B

3. A particle is revolving along a circular path with decreasing speed. Which one of the following is true for the particle?

A. angular momentum of the particle is constant

B. only the diretion of angular momentum of the particle is fixed

C. acceleration of the particle is always towards the centre

D. the particle travels along a spiral path

Answer: B

Watch Video Solution

4. Analogue of mass in rotational motion is

A. moment of inertia

B. angular momentum

C. gyration

D. none of these

Answer: A

 Watch Video Solution

5. A constant torque of 3.14 N.m is 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. $0.25kg. m^2$

B. $2.5kg. m^2$

C. $4.5kg. m^2$

D. $25kg. m^2$

Answer: A

Watch Video Solution

6. A small object of mass m is attached to a light string which passes through a hollow tube. The tube is hold by one hand and the string by the other. The object is set into rotation in a circle of radius R and velocity v. The string is then pulled down shortening the radius of path of r. What is conserved?

A. angular momentum

B. linear momentum

C. kinetic energy

D. none of these

Answer: A

View Text Solution

7. The moment of inertia of a disc of radius 5 cm is 0.02 $\mathrm{kg.m}^2$. A tangential force of 20 N is applied along the circumference of the disc. The angular acceleration of the disc will be (in unit rad . s^{-2})

A. 2.5

B. 10

C. 20

D. 50

Answer: D

 Watch Video Solution

8. A body of mass 10 kg and radius 0.5 m is moving in a circular path. The rotational kinetic energy of the body is 32.8 J. Radius of gyration of the body is

A. 0.25 m

B. 0.2 m

C. 0.5 m

D. 0.4 m

Answer: D

View Text Solution

9. Two discs of moment of inertia I_1 and I_2 are rotating separately with angular velocities ω_1 and ω_2 respectively about perpendicular axis

passing through their centres. If these two rotating discs are connected coaxially then the rotational kinetic energy of the composite system will be

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

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

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

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

Answer: C

View Text Solution

Very Short Answer Type Questions

1. What is the unit of angular momentum ?

Watch Video Solution

2. State whether the length of a day will increase or decrease if the radius of the earth becomes half of its present value keeping its mass constant.

View Text Solution

3. What is the dimension of angular momentum?

Watch Video Solution

4. What is the vector relation of linear momentum and angular momentum ?

Watch Video Solution

5. A girl is standing at the centre of a rotating horizontal platform with her hands drawn inwards. What will happen if she stretches her hands horizontally?

View Text Solution

Very Short Answer Type Questions Based On Torque

1. Write down the dimension of torque.

Watch Video Solution

2. When we turn on a tap we apply a _____ on it with the help of our fingers . [Fill in the blank]

Watch Video Solution

Very Short Answer Type Questions Based On Moment Of Inertia

1. What is the CGS unit of moment of inertia ?

Watch Video Solution

2. Write down the expression of moment of inertia of a circular disc (mass = m, radius = r) about the perpendicular axis passing through its centre.

Watch Video Solution

3. Two spheres have equal masses and their external radii are the same. One of them is

solid and the other hollow. Which one will have a greater radius of gyration?

Watch Video Solution

4. Is radius of gyration a constant quantity ?

Watch Video Solution

5. What is the moment of inertia of a solid sphere (radius = r mass =m) about an axis passing through any of its diameters ?

Watch Video Solution

6. What is the radius of gyration of a solid sphere with respect to its diameter?

Watch Video Solution

Very Short Answer Type Questions Based On Rotational Kinetic Energy

1. What is the kinetic energy of a rotating body about its axis of rotation ?

Watch Video Solution

Very Short Answer Type Questions Miscellaneous

1. What is needed to produce pure rotation ?

View Text Solution

2. Write down the vector equation relating torque and angular momentum.

Watch Video Solution

3. If the moment of inertia of a body rotating about an axis is increased, state whether its angular velocity increases or decreases when no external torque acts on the body.

Watch Video Solution

4. If the ice at the polar regions were to melt completely, state whether the length of a day would increase or decrease.

Watch Video Solution

5. What is the rotational analogue of the impulse of a force?

Watch Video Solution

6. Which physical quantity is represented by the product of motion of inertia and angular velocity?

View Text Solution

7. What is the relation between torque and moment of inertia?

Watch Video Solution

8. Torque $\times$ time = change of _____ of the body in that time. [Full in the blank]

Watch Video Solution

9. Rotational analogue of force is _____ . [Fill in the blank]

Watch Video Solution

Short Answer Type Questions

1. A particle of mass m is revolving along a circular path of radius r with uniform angular velocity ω. What will be the magnitude and direction of the angular momentum of that particle ?

Watch Video Solution

2. Explain why it is difficult to open a door by pushing or pulling it near the hinge.

Watch Video Solution

3. If no external torque acts on a body will its angular velocity remain conserved ?

Watch Video Solution

4. A circular ring and a disc have same mass and radius. Which has larger moment of inertia?

Watch Video Solution

Problem Set I Based On Angular Momentum

1. A circular ring of mass 20 g is rotating about its own axis with an angular velocity of 30 rpm. Two bodies of equal masses are placed simultaneously at the two extreme points along its diameter. Mass of each of these two bodies is 5 g. In this situation what will be the angular velocity of the system?

Watch Video Solution

2. During revolution around an atomic nucleus an electron transits from one orbit to another. The radius of the present orbit is 4 times that of the former orbit, while the linear velocity is reduced to half of its initial value. Determine the ratio of its angular momentum in the two orbits.

 Watch Video Solution

3. In a merry-go-round a boy of mass 20 kg is revolving along a circular path of radius 10 m with an angular velocity of 6 rpm. What is the angular momentum of the boy?

Watch Video Solution

4. A circular ring of diameter 40 cm and mass 1 kg is rotating about an axis normal to its plane and passing through the centre with a

frequency of 10 rps. Calculate the angular momentum about its axis of rotation.

Watch Video Solution

5. Mass of an electron is 9×10^{-31} kg. It revolves round the nucleus of an atom in a circular orbit of radius 4.0 Å with a speed of $6 \times 10^{6} m.\, s^{-1}$. Calculate the linear kinetic energy and the angular momentum of the electron .

Watch Video Solution

6. Moment of inertia of a wheel is 0.004 kg.m^2. If its number of revolutions is increased from 60 rpm to 150 rpm in 3 s, determine the magnitude of the torque acting on it.

Watch Video Solution

7. A string wound aroung a solid cylinder is unwound by applying a force of 20 N. Calculate the torque acting on the cylinder

and angular acceleration produced in the cylinder of mass 2.5 kg and of radius 50 cm.

Watch Video Solution

Problem Set I Based On Rotational Kinetic Energy

1. A material particle of mass m is revolving along a horizontal circular path of radius r under the influenece of the centripetal force = $-\frac{k}{r^2}$(k = constant). What will be the total kinetic energy of the particle ?

Watch Video Solution

2. A solid sphere of mass 10 kg rolls on a flat surface with out slipping with a speed of 50 cm.s^{-1}. Calculate its energy.

Watch Video Solution

3. A uniform disc is rolling on a horizontal surface at a uniform speed of 3 rps. The radius of the disc is 10 cm and its mass is 1.2 kg.

Calculate its (i) angular velocity , (ii) linear velocity and (iii) kinetic energy of rotation.

Watch Video Solution

Problem Set Ii Based On Angular Velocity

1. A small body of mass m is attached to a light thread which passes through a hole at the centre of a smooth table. The body is set into rotation in a circle of radius r_1 with a speed v_1 . The thread is pulled down so that the radius

of the path is changed to r_2 . What will be the new linear speed and the new angular speed of the body ?

View Text Solution

Problem Set Ii Based On Conservation Of Angular Momentum

1. Keeping the diameter unaltered , if the mass of the earth is doubled , then what will be the length of a day ?

Watch Video Solution

2. A small block is rotating in a horizontal circle at the end of a thread which passes down through a hole at the centre of table top. If the system is rotating at 2.5 rps in a circle of 30 m radius what will be the speed of rotation when the thread is pulled inwards to decrease the radius to 10 m?

View Text Solution

3. The maximum and minimum distance of a comet from the sun are 1.4×10^{12}m and 7×10^{10} m. If its velocity nearest to the sun is $6 \times 10^{4} m.\, s^{-1}$, what is the velocity at the farthest position?

Watch Video Solution

Problem Set Ii Based On Moment Of Inertia

1. 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. What will be the moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through the centre?

Watch Video Solution

2. A round uniform body of radius R , mass M and moment of inertia I rolls down (without

slipping) an inclined plane making an angle θ with the horizontal. Then what will be its acceleration ?

View Text Solution

3. Calculate the radius of gyration of a uniform thin rod of mass M and length L about an axis of rotation perpendicular to its length and passing through its centre.

Watch Video Solution

4. Uniform circular ring of radius 0.5 m has a mass 10 kg and a uniform circular disc of the same radius has a mass 10 kg. Calculate their moment of inertia about an axis passing through the centre and perpendicular to the plane of a ring or a disc.

Watch Video Solution

Problem Set Ii Miscellaneous

1. To maintain a rotor at a uniform angular speed of 200 rad.s^{-1}, an engine needs to transmit a torque of 180 N. m . What is the power required by the engine? (Note: uniform angular velocity in the absence of friction implies zero torque. In practice, applied torque is needed to counter frictional torque) Assume that the engine is 100% efficient.

View Text Solution

2. A wheel of mass 5 kg and radius 0.4 m is rolling on a road without sliding with angular velocity 10 rad.s^{-1}. The moment of inertia of the wheel about the axis of rotation is 0.65 kg . m^2. What is the percentage of the kinetic energy of rotation in the total kinetic energy of the wheel ?

Watch Video Solution

3. A rod of mass 100 g and length 1.0 m makes an angle 30° with the axis passing through its centre. Find (i) the moment of inertia of the rod about the give axis. (ii) If the rod rotates with an angular velocity of 2.0 rad. $^{-1}$ about the given axis find the rotational kinetic energy of the rod.

View Text Solution

Hots Numerical Problems

1. A rope remains wrapped over the circumference of a wheel of radius r and of moment of inertia I about its axis. If a mass m is suspended from the lower end of the rope what will be the angular acceleration of the wheel ?

View Text Solution

2. The moment of inertia of a wheel of radius 0.2 m about an axis passing through its centre is 0.1 kg. m^2. It is now allowed from rest to roll

down a plane inclined at 30°. What will be its angular velocity after it rolls down a distance of 2 m along the inclined plane ? Given mass of the disc = 5 kg.

Watch Video Solution

3. A solid cylinder of mass M and radius R can rotate about a horizontal axis. A long but light cord is wound over the surface of the cylinder and a mass m is suspended from its free end. If the mass is released from rest what will be

its acceleration ? Also determine the tension in the cord.

View Text Solution

4. A rope is wound on a circular disc of moment of inertia 0.1 kg . m^2. A tangential force of 20 N on the rope rotates the disc about its axis. If the radius of the wheel is 0.1 m, calculate its acceleration. Now a mass of 2 kg is suspended at the lower end of the rope.

What will be the angular acceleration? g = 10 $m.\ s^{-2}$

View Text Solution

5. A thin circular ring of mass M and radius R is rotating about its own axis with a constant angular velocity ω. Two object each of mass m are placed gently on the opposite ends of a diameter of the ring. What will be the angular velocity of the ring?

Watch Video Solution

Hots Numerical Problems Based On Torque

1. Two thin circular disc of mass 2 kg and radius 10 cm each are joined by a rigid massless rod of length 20 cm. The axis of the rod is passing through the centres of the disc Fig. The whole arrangement is kept on a moving truck in such a way that the axis of the arrangement is horizontal and perpendicular to the direction of the motion of the truck. The friction of the floor is such that the

arrangement can roll on the floor of the truck without slipping. Take x-axis along the direction of motion of the truck and z-axis along the vertically upward direction. If the truck has an acceleration of 9 $m.s^{-2}$ calculate (i) the force of friction of each disc (ii) the magnitude and the direction of the frictional torque acting on each disc about the centre of mass O of the arrangement. Express the torque in the vector form in terms of unit vectors $\hat{i}, \hat{j} \text{and} \hat{k}$ along the x, y and z directions respectively.

View Text Solution

2. A drill machine made of steel is rotating at the rate of 180 rpm to make a hole on a steel plate. Total mass of the drill and the plate is 180 g. If the whole part of the mechanical energy is converted into heat and if the temperature of the plate rises by 0.5° C, then determine the power of the drill machine and the magnitude of the torque acting. [Specific heat capacity of steel = 0.10 cal. $g^{-1}.\ ^{\circ}C^{-1}$]

View Text Solution

Hots Numerical Problems Miscellaneous

1. The moment of inertia of a disc is $5 \times 10(-4) kg.\, m^2$. It is rotating freely about a vertical axis passing through its centre at a speed of 40 rpm. A piece of wax of mass 20 g is attached at a distance of 8 cm from its centre. Calculate its new speed.

Watch Video Solution

2. A particle of mass m is tied with a rope and is rotated along a horizontal circular path. The length of the rope is r_0 and the velocity of the particle is v_0. What amount of work should be done to decrease the length of the rope to r ?

View Text Solution

3. A ring of mass 0.3 kg and radius 0.1 m and a solid cylinder of mass 0.4 kg and of the same radius are given the same kinetic energy and released simultaneously on a flat horizontal

surface such that they begin to roll towards a wall at the same distance from both of them. If the rolling friction in both the cases are negligible, which one of them will reach the wall first ?

Watch Video Solution

4. A man stands on a rotating platform, with his arms stretched horizontally holding a weight of 5 kg in each hand. The angular speed of the platform is 30 revolutions per

minute. The man then brings his arms close to his body such that the distance of each weight from the axis changes from 90 cm to 20 cm. The moment of inertia of the man together with the platform may be taken as constant and equal to 7.6 kg. m^2.

What is his new angular speed ? (Neglect friction.)

View Text Solution

5. Is kinetic energy conserved in the process ? If not from where does the conserved in the process? If not form where does the change come about ?

View Text Solution

6. Explain why friction is necessary to make the disc in Fig roll in the direction indicated.

Give the direction of frictional force at B, and

the sense of frictional torque, before perfect rolling begins.

View Text Solution

7. A bullet of mass 10 g and speed 500 $m.\ s^{-1}$ is fired into a door and it gets embedded exactly at the centre of the door. The door is 1.0 m wide and of mass 12 kg. It is hinged at one end and it rotates about a vertical axis practically without friction. Find the angular

speed of the door just after the bullet gets embedded into it.

View Text Solution

Entrance Corner Assertion Reason Type

1. These questions have statement I and statement II. Of the four choices given below, choose the one that best describes the two statements.

Statement I : Moment of inertia of a circular

ring about a given axis is more than moment of inertia of a circular disc of same mass and same size, about the same axis.

Statement II : The circular ring is hollow, so its moment of inertia is more than circular disc which is solid.

A. Statement I is true, statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true , statement II is not a correct explanation

for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: B

View Text Solution

2. Statement I : If earth shrinks (without change in mass) to half its present size length of the day would become 6 hours.

Statement II : As size of earth changes its moment of inertia changes.

A. Statement I is true, statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true , statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

Watch Video Solution

3. Statement I : Many great rivers flow towards the equator. The sediments that that they carry increase the time of rotation of the earth about its own axis.

Statement II : The angular momentum of the earth about its rotation axis is conserved.

A. Statement I is true, statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true , statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

Watch Video Solution

4. Statement I : The mass of a body cannot be considered to be concentrated at the centre of mass of the body for the purpose of computing its moment of inertia.

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

A. Statement I is true, statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true , statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

 Watch Video Solution

5. Statement I : Moment of inertia of uniform disc and solid cylinder of equal mass and radius about an axis passing through the centre and perpendicular to the plane will be same.

Statement II : Moment of inertia depends upon distribution of mass from the axis of rotation, i.e., perpendicular distance from the axis.

A. Statement I is true, statement II is true , statement II is a correct explanation for

statement I.

B. Statement I is true, statement II is true , statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

Watch Video Solution

6. Statement : I The angular velocity of a rigid body in motion is defined for the whole body.

Statement II : All points on a rigid body performing pure rotational motion are having same angular velocity.

A. Statement I is true, statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true , statement II is not a correct explanation

for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: B

View Text Solution

7. Statement : I Moment of inertia about an axis passing through centre of mass is minimum.

Statement : II Theorem of parallel axis can be

applied only for two dimensional body of negligible thickness.

A. Statement I is true, statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true , statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: C

View Text Solution

8. Statement I : In rotational plus translational motion of a rigid body different particles of the rigid body may have different velocities but they will have same accelerations.

Statement II : Translational motion of a particle is equivalent to the translational motion of rigid body.

A. Statement I is true, statement II is true , statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true , statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

View Text Solution

Entrance Corner Multiple Correct Answers Type

1. In which of the following cases is the angular momentum conserved ?

A. The planet Neptune moves in an elliptical orbit with the sun at one of the foci of the ellipse.

B. An electron describes a Sommerfield elliptical orbit round the nucleus.

C. An α- particle, approaching a nucleus, is scattered by the force of electronstatic repulsion between the two.

D. A boy hurls a stone tied to a string in a horizontal circle.

Answer: A::B::C

View Text Solution

2. 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 about the point of projection, when it is at its maximum height h, is

A. zero

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

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

D. $\frac{mv}{2gh^3}$

Answer: B

Watch Video Solution

3. Choose the correct alternatives

A. for a general rotational motion, angular momentum L and angular velocity ω need not be parallel

B. for a rotational motion about a fixed axis angular momentum L and angular

velocity ω are always parallel

C. for a general translational motion momentum $\overrightarrow{p}$ and velocity $\overrightarrow{v}$ are always parallel

D. for a general translational motion acceleration $\overrightarrow{a}$ and velocity $\overrightarrow{v}$ are always parallel

Answer: A::C

View Text Solution

4. Net external torque on a system of particles about an axis is zero. Which of the following are compatible with it ?

A. the forces may be acting radially from a point on the axis

B. forces may be acting on the axis of rotation

C. force may be acting parallel to the axis of rotation

D. the torque caused by some forces may be equal and opposite to that caused by other forces

Answer: A::B::C::D

Watch Video Solution

Entrance Corner Comprehension Type

1. Two discs A and B are mounted co-axially on a vertical axie. The discs have moments of

inertia I and $2I$, respectively, about the common axis. Disc A is imparted an initial angular velocity 2ω using the entire potential energy of a spring compressed by a distance x_1. Disc B is imparted an angular velocity ω by a spring having the same spring constant and compressed by a distance x_2. Both the discs rotate in the clockwise direction.

The ratio $\frac{x_1}{x_2}$ is

A. 2

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

C. $\sqrt{2}$

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

Answer: C

View Text Solution

2. Two discs A and B are mounted co-axially on a vertical axie. The discs have moments of inertia I and $2I$, respectively, about the common axis. Disc A is imparted an initial angular velocity 2ω using the entire potential energy of a spring compressed by a distance

x_1. Disc B is imparted an angular velocity ω by a spring having the same spring constant and compressed by a distance x_2. Both the discs rotate in the clockwise direction.

When disc B is brought in contact with disc A, they acquire a common angular velocity in time t. The average frictional torque on one disc by the other during this period is

A. $\frac{2I\omega}{3t}$

B. $\frac{9I\omega}{2t}$

C. $\frac{9I\omega}{4t}$

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

Answer: A

View Text Solution

3. Two discs A and B are mounted co-axially on a vertical axie. The discs have moments of inertia I and $2I$, respectively, about the common axis. Disc A is imparted an initial angular velocity 2ω using the entire potential energy of a spring compressed by a distance

x_1. Disc B is imparted an angular velocity ω by a spring having the same spring constant and compressed by a distance x_2. Both the discs rotate in the clockwise direction.

The loss of kinetic energy during the above process is

A. $\frac{I\omega^2}{2}$

B. $\frac{I\omega^2}{3}$

C. $\frac{I\omega^2}{4}$

D. $\frac{I\omega^2}{6}$

Answer: B

View Text Solution

4. A uniform solid sphere is released from the top of a fixed inclined plane of inclination 30° and height h. It rolls without sliding.

The acceleration of the centre of the sphere is

A. $\frac{3g}{5}$

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

C. $\frac{4g}{7}$

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

Answer: D

View Text Solution

5. A uniform solid sphere is released from the top of a fixed inclined plane of inclination 30° and height h. It rolls without sliding.

The speed of the point of contact of the sphere with the inclined plane when the sphere reaches the bottom of the incline is

A. $\sqrt{2gh}$

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

C. zero

D. $2\sqrt{2gh}$

Answer: C

Watch Video Solution

6. A uniform solid sphere is released from the top of a fixed inclined plane of inclination 30° and height h. It rolls without sliding.

The time taken by the sphere to reach the bottom is

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

B. $\sqrt{\frac{70h}{9g}}$

C. $\sqrt{\frac{25h}{18g}}$

D. $\sqrt{\frac{25h}{6g}}$

Answer: B

View Text Solution

Entrance Corner Integer Answer Type

1. A wheel has angular acceleration of 2.0 rad. s^{-2} and an initial angular speed of 1.0 rad . s^{-1}. What will be the angular displacement (in radian) in 2 s ?

Watch Video Solution

2. For two rings of radii R and nR made up of same material. The ratio of moments of inertia

about axes passing through their centres is $1:8$. What should be the value of n?

Watch Video Solution

Examination Archive With Solutions Wbchse

1. Define angular momentum $\left(\vec{L}\right)$ and torque $\left(\vec{\tau}\right)$ Show that $\frac{d\vec{L}}{dt} = \vec{\tau}$.

Watch Video Solution

2. State the principle of conservation of angular momentum.

Watch Video Solution

3. A disc of mass M and radius R is rolling without slipping down an inclined plane. Show that the acceleration of the centre of mass of the disc is $\frac{2}{3}$g sin θ. Given angle of inclination of the plane is θ and moment of inertia of the disc is $\frac{MR^2}{2}$.

Watch Video Solution

4. Show that the angular momentum of a particle under the action of the force $\vec{F} = k\vec{r}$ is conserved , where K is a constant quantity.

Watch Video Solution

5. If the moment of inertia of a solid sphere of mass M and radius R is $\frac{2}{5}MR^2$, what will be the radius of gyration?.

Watch Video Solution

6. State the parallel-axes theorem of moment of Inertia. Using this theorem, calculate the moment of Inertia of solid sphere about a tangential axis.

Watch Video Solution

7. Find the change in length of a day if the radius of earth changes by $\frac{1}{2}\%$ considering the mass constant. Assume that earth is

uniform sphere and its moment of inertia is I = $\frac{2}{3}MR^2$, where M = mass of earth and R - radius of earth.

Watch Video Solution

8. Define radius of gyration.

Watch Video Solution

9. Four point masses, each of mass m, are arranged in the xy-plane at the points (0,0),

(a,a),(a,- a) and (2a, 0) respectively . What is the moment of inertia of this array of masses about y-axis?

Watch Video Solution

10. The moment of inertia of a uniform circular disc of mass M and radius R about its diameter is $\frac{1}{4}MR^2$. What is the moment of inertia of the disc about an axis passing through its centre and perpendicular to the plane of the disc?

Watch Video Solution

11. Define angular momentum $\left(\vec{L}\right)$ and torque $\left(\vec{\tau}\right)$ Show that $\frac{d\vec{L}}{dt} = \vec{\tau}$.

Watch Video Solution

12. A uniform solid sphere of mass M and radius R rolls down an inclined plane making an angle θ with the horizontal without slipping. Show that the acceleration of the

sphere is $\frac{5}{7}g\sin\theta$. [Given: moment of inertia of the sphere is $\frac{2}{5}MR^2$]

Watch Video Solution

Examination Archive With Solutions Wbjee

1. A uniform solid spherical ball is rolling down a smooth inclined plane form 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 thrwn vertically upwards with the same

velocity v. the maximum height to which the ball will rise is

A. $\frac{5h}{8}$

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

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

D. $\frac{7h}{9}$

Answer: C

Watch Video Solution

2. A solid uniform sphere resting fon a rough horizontal plane is given a horizontal impulse directed through its centre so that it starts sliding with an initial velocity v_0. When it finally starts rolling without slipping the speed of its centre is

A. $\frac{2}{7}v_0$

B. $\frac{3}{7}v_0$

C. $\frac{5}{7}v_0$

D. $\frac{6}{7}v_0$

Answer: C

View Text Solution

3. A thin rod AB is held horizontally so that it can freely rotate in a vertical plane about the end A as shown in the the potential energy of the rod when it hangs vertically is taken to be zero. The end B of the rod is released from rest from a horizontal position. At the instant the rod makes an angle θ with the horizontal,

A. the speed fo end B is proportional to $\sqrt{\sin\theta}$

B. the potential energy is proportional to (1 - cos θ)

C. the angular acceleration is proportional to cosθ

D. the torque about A remains the same as its initial value

Answer: A::C

View Text Solution

4. Three identical square plates rotate about the axes shown in the. In such a way that their kinetic energies are equal. Each of the rotation axes 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: B

View Text Solution

5. Two particles A and B are moving as shown in the figure. Their total angular momentum about the point O is

A. 9.8 kg $\cdot$ m^2/s

B. zero

C. 52.7 kg $\cdot m^2/s$

D. 37.9 kg $\cdot m^2/s$

Answer: A

View Text Solution

6. A solid spherical ball and a hollow spherical ball of two different materials of densities ρ_1 and ρ_2 respectively have same outer radii and same mass. What will be the ratio of the

moment of inertia (about an axis passing through the centre) of the hollow sphere to that of the solid sphere?

A. $\frac{\rho_2}{\rho_1}\left(1-\frac{\rho_2}{\rho_1}\right)^{5/3}$

B. $\frac{\rho_2}{\rho_1}\left[1-\left(1-\frac{\rho_2}{\rho_1}\right)^{5/3}\right]$

C. $\frac{\rho_2}{\rho_1}\left(1-\frac{\rho_1}{\rho_2}\right)^{5/3}$

D. $\frac{\rho_2}{\rho_1}\left[1-\left(1-\frac{\rho_1}{\rho_2}\right)^{5/3}\right]$

Answer: D

Watch Video Solution

Examination Archive With Solutions Jee Main

1. A mass m supported by a massless string would around a uniform hollow cylinder of mass m and radius R. If the string does not slip on the cylinder, with what acceleration will the mass fall on the release?

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

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

C. $\frac{5g}{6}$

D. g

Answer: B

View Text Solution

2. A block of mass m is placed on a surface with a vertical cross- section given by y = $x^3/6$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is

A. $\frac{1}{6}$ m

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

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

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

Answer: A

View Text Solution

3. A bob of mass m attached to an inextensible string of length l is suspended from a vertical support. The bob rotates in a horizontal circle with an angular speed ω rad/s about the

vertical support. About the point of suspension

A. angular momentum is conserved

B. angular momentum changes in magnitude but not in direction

C. angular momentum changes in direction but not in magnitude

D. angular momentum changes both in direction and magnitude

Answer: A

View Text Solution

4. From a solid sphere of mass M and radius R a cube of maximum possible volume is cut. Moment of inertia of cube about an axis passing through its centre and perpendicular to one of its faces is

A. $\frac{MR^2}{32\sqrt{2}\pi}$

B. $\frac{MR^2}{16\sqrt{2}\pi}$

C. $\frac{4MR^2}{9\sqrt{3}\pi}$

D. $\frac{4MR^2}{3\sqrt{3}\pi}$

Answer: C

Watch Video Solution

5. A particle of mass m is moving along the side of a square of side a_1 with a uniform speed v in the xy- plane as shown in the figure. Which of the following statements is false for the angular momentum $\vec{L}$ about the origin?

A. $\vec{L} = \frac{mvR}{\sqrt{2}}\hat{k}$ when the particle is moving form A to B

B. $\vec{L} = mv\left[\frac{R}{\sqrt{2}} - a\right]\hat{k}$ when the particle is moving from C to D

C. $\vec{L} = mv\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$ when the particle is moving from B to C

D. $\vec{L} = \frac{mv}{\sqrt{2}}R\hat{k}$ when the particle is moving from D to A

Answer: B::D

View Text Solution

6. A roller is made by joining together two cones at their vertices O. It is kept on two rails AB and CD which are placed asymmetrically (see figure), With its axis perpendicular to CD and its centre O at the centre of line joining AB and CD (see figure). It is given a light push so that it starts rolling with its centre o moving parallel to CD in the direction shown. As it moves, the roller will tend to

A. turn left

B. turn right

C. go straight

D. turn left and right alternately

Answer: A

View Text Solution

7. The moment of inertia of a uniform cylinder of length l and radius R about its

perpendicular bisector is l. What is the ratio $\frac{I}{R}$ such that moment of inertia is minimum ?

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

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

C. 1

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

Answer: D

View Text Solution

8. A slender uniform rod of mass M and length l is pivoted at one end so that it can rotate in a vertical plane (see figure). There is negligible friction at the pivot. The free end is held vertically above the angular acceleration of the rod when it makes an angle θ with the vertical is :

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

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

C. $\frac{3g}{2l}\cos\theta$

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

Answer: A

View Text Solution

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

passing through centre of the disc is

A. $10MR^2$

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

C. $4MR^2$

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

Answer: C

View Text Solution

10. Seven identical circular planar discs. Each of mass M and radius R are welded symmetrically as shown. The moment of inertia of the arrangement about the axis normal to the plane and passing through the point P is

A. $\frac{73}{2}MR^2$

B. $\frac{181}{2}MR^2$

C. $\frac{19}{2}MR^2$

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

Answer: B

View Text Solution

Examination Archive With Solutions Aipmt

1. The ratio of the acceleration 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

2. A mass m moves in a circle on a smooth horizontal plane with velocity v_0 at a radius R_0. The mass is attached to a string which

passes through a smooth hole in the plane as shown.

the tension in te string is increased gradually and finally m moves in circle of radius $\frac{R_0}{2}$. The final value of the kinetic energy is

A. mv_0^2

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

C. $2mv_0^2$

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

Answer: C

View Text Solution

3. Three indentical shperical shells, each of mass m and radius r are placed as shown in figure. Consider an axis xx' which is touching to 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. $\frac{11}{5}mr^2$

B. $3mr^2$

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

D. $4mr^2$

Answer: D

Watch Video Solution

Examination Archive With Solutions Neet

1. 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. $\frac{13MR^2}{32}$

B. $\frac{11MR^2}{32}$

C. $\frac{9MR^2}{32}$

D. $\frac{15MR^2}{32}$

Answer: A

Watch Video Solution

2. A disc 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. sphere

B. both reach at the same time

C. depends on their masses

D. disc

Answer: A

Watch Video Solution

3. The angular momentum of a rigid body of mass m about an axis is n times the linear momentum (P) of the body. Total kinetic energy of the rigid body is

A. $\frac{n^2p^2}{2}$

B. $\frac{P^2\left[1+n^2\right]}{2m}$

C. $\frac{n^2P^2}{2m}$

D. $n^2P^2 \times 2\text{m}$

Answer: A::C

Watch Video Solution

4. A thin uniform rod of mass M and length L is rotating about a perpendicular axis passing through its centre with a constant angular velocity ω. Two objects each of mass $\frac{M}{3}$ are attached gently to the two end of the rod.

The rod will now rotate with an angular velocity of

A. $\frac{1}{3}\omega$

B. $\frac{1}{7}\omega$

C. $\frac{1}{6}\omega$

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

Answer: A

Watch Video Solution

5. The rotational kinetic energy of a solid sphere of mass 3 kg and radius 0.2 rolling down an inclined plane of height 7 m is

A. 42 J

B. 60 J

C. 36 J

D. 70 J

Answer: B

Watch Video Solution

6. Three objects , A (a solid sphere), B (a thin circular disc) 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. $W_B > W_A > W_C$

B. $W_A > W_B > W_C$

C. $W_C > W_B > W_A$

D. $W_A > W_C > W_B$

Answer: C

Watch Video Solution

7. 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. Rotational kinetic energy

B. Moment of inertia

C. Angular velocity

D. Angular momentum

Answer: D

Watch Video Solution

8. A solid sphere is in rolling motion. In rolling motion a body possesses translational kinetic energy (K_t) simultaneously. The ratio $K_1 : (K_t + K_r)$ for the sphere is

A. $10 : 7$

B. $5 : 7$

C. $7 : 10$

D. $2:5$

Answer: B

 Watch Video Solution

Cbse Scanner

1. A solid sphere of mass m and radius r is rolling on a horizontal surface. What ratio of total energy of the sphere is:

Kinetic energy of rotation ?

Kinetic energy of translation ?

Watch Video Solution

2. Find (i) the moment of inertia of a rod of mass 100 g and length 100 cm about and axis passing through its centre and perpendicular to its length and (ii) the radius of gyration.

Watch Video Solution

3. Find the moment of inertia of a ring of mass m and radius r about an axis passing through the tangent to the circle of the ring.

Watch Video Solution

4. Write the expression for work done in rotational motion of an object about a fixed axis.

Watch Video Solution

5. Given the moment of inertia of a disc of radius R mass M about an axis along its diameter to be $\left(MR^2\right)/4$ find its moment of inertia about an axis normal to the disc and passing through a point on its edge.

Watch Video Solution

6. If no external force is acting on a two body system, what will happen to (i) velocity of centre of mass and (ii) angular momentum ?

View Text Solution

7. State parallel -axes theorem of moment of inertia. The moment of inertia of a circular ring about its diameter is $\frac{1}{2}MR^2$. Calculate the moment of inertia of the ring about its tangent lying in its plane.

Watch Video Solution

8. Using the formula of torque $\tau = xF_y - yF_x$, derive the polar formula of

torque.

Watch Video Solution

9. Calculate the moment of inertia of a ring about an axis passing through centre of the ring and perpendicular to the plane of the ring.

Watch Video Solution

10. Derive an expression for torque in polar coordinate system ,with the help of appropriate figure.

View Text Solution