PHYSICS

BOOKS - MODERN PUBLICATION

Moment of Inertia

Example

1. The moment of inertia of a thin rod about an axis passing through its centre and perpendicular to its length is $1,200 g cm^2$. If length of the rod is 20 cm, find its moment of inertia about an axis passing through its one end and perpendicular to its length.

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2. The moment of inertia of a circular ring about an axis passing through its centre and perpendicular to its plane is $200 g cm^2$ If radius of the ring is 5 cm, find the mass of the ring.

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3. The moment of inertia of a uniform circular disc about a tangent of the disc in its own plane is given aby $\frac{5}{4}MR^2$, where the symbols have their usual meanings. 4 Using this relation, find its M.I. about an axis through its centre and perpendicular to the plane.

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4. The moment of inertia of a solid sphere about a tangent is $\frac{5}{3}MR^2$, where M is mass and R is radius of the sphere. Find the M.I. of the sphere about its diameter.

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5. A solid cylinder of moment of inertia $0.625 kgm^2$ rotates about its axis with angular speed $100 rads^{-1}$. What is the magnitude of the angular momentum of the cylinder about its axis ?

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6. If the earth suddenly contracts, what will be the effect on the duration of the day? Substantiate your answer with proper reasoning.

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7. A sphere is rolling on a level surface. Find the ratio of the kinetic energy due to the translational motion to the total energy of the sphere.

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8. A ring, a disc and a sphere all of the same radius and mass roll down an inclined plane of inclinationθ from the same height h. Which of the three reaches the bottom earliest?

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9. A ring, a disc and a sphere all of the same radius and mass roll down an inclined plane of inclination θ from the same height h. Which of the three reaches the bottom latest?

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10. Three mass points m_1, m_2, m_3 are located at the vertices of an equilateral triangle of length a. What is the moment of inertia of the system about an axis along the altitude of the triangle passing through m_1

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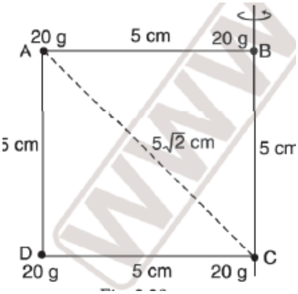
11. Four small bodies A, B, C and D which can be considered as particles are connected by rods of negligible masses as shown in Fig. Find the M.I. of the system about an axis coinciding with rod BC.



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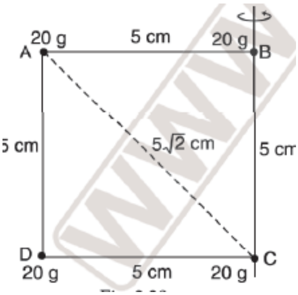
12. Four small bodies A, B, C and D which can be considered as particles are connected by rods of negligible masses as shown in Fig. Find the M.I. of the system about an axis passing through A and perpendicular to the plane of diagram.



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13. Calculate the moment of inertia about a transverse axis through the centre of a disc, whole radius is 20 cm. Its density is $9gcm^{-3}$ and its thickness is 7cm.

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14. Calculate the M.I. of a uniform circular disc of mass 500 g and radius 10 cm about diameter of the disc

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15. Calculate the M.I. of a uniform circular disc of mass 500 g and radius 10 cm about the axis tangent to the disc'and parallel to its diameter

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16. Calculate the M.L. of a uniform circular disc of mass 500 g and radius 10 cm about the axis through the centre of the disce and perpendicular to its plane.

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

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18. What is the moment of inertia of a uniform circular disc of radius R and mass M about an axis passing through a point on its edge and normal to the disc? The moment of inertia of the disc about any of its diameter is given to be $\frac{MR^2}{4}$

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19. A constant torque of 400 Nm turns a wheel of moment of inertia $100kgm^2$ about an axis through its centre. Find the gain in angular velocity in 4 s

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20. A flywheel of mass 25 kg has a radius of 0.2 m. It is making 240 r.p.m. What is the torque necessary to bring it to rest in 20 s? Assume that mass of the flywheel is concentrated at its rim.

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21. A flywheel of mass 25 kg has a radius of 0.2 m. It is making 240 r.p.m.What is the torque necessary to bring it to rest in 20sec. If the torque is due to a force applied tangentially on the rim of the flywheel, what is magnitude of the force ? Assume that mass of the flywheel is concentrated at its rim.

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22. A cord is wound around the circumference of a wheel of diameter 0.3 m. The axis of the wheel is horizontal. A mass of 0.5 kg is attached at the end of the cord and it is allowed to fall from rest. If the weight falls 1.5 m in 4s, what is the angular acceleration of the wheel?

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23. A cord is wound around the circumference of a wheel of diameter 0.3 m. The axis of the wheel is horizontal. A mass of 0.5 kg is attached at the end of the cord and it is allowed to fall from rest. If the weight falls 1.5 m in 4s, find out the moment of inertia of the wheel.

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24. A circular ring of diameter 40cm and mass 1kg is rotating about an axis normal to its plane passing through the centre with a frequency of 10rps. calculate the angular momentum about the axis of rotation

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25. compute the ratio of Earth's Orbital angular momentum and its rotational angular momentum about its axis. Given that radius of the earth is $6.4 \times 10^6 m$ and the radius of the orbit of the earth = $1.5 \times 10^{11} m$.

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26. Energy of 484 J is spent in increasing the speed of a flywheel from 60 r.p.m. to 360 r.p.m. find moment of inertia of the flywheel.

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27. A particle performing uniform circular motion has angular momentum L. What will be its angular momentum if its angular frequency is halved and kinetic energy is doubled.

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28. A horizontal disc rotating about a vertical axis makes 100 revolutions per minute. A small piece of wax of mass 10 g falls vertically on the disc and adheres to it at a distance of 9 cm from the axis. If the number of revolutions per minute is there by reduced to 90, calculate the moment of inertia of the disc.

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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 omega. Four objects each of mass m, are kept gently to the opposite ends of two perpendicular diameters of the ring. What will be the angular velocity of the ring?

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30. A ball at the end of a string is being swung in a horizontal circle of radius 0.3m at a speed of $2.8ms^{-1}$. What will be the tangential speed of the ball if the string is pulled down so as to reduce the radius of the circle to 0.2m

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31. What will be the duration of the day of earth if the earth suddenly shrinks to $\frac{1}{27}$ of its original volume, mass remains unchanged ?

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32. A cylindrical hoop is released from rest at a height of 0.7 m near the top of an inclined plane. If the hoop rolls down the inclined plane without slipping and there is no loss of energy due to friction, find the linear speed of the hoop, when it reaches the bottom of the plane? Given, moment of inertia of cylindrical hoop about its axis = M R^2.

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33. A solid cylinder rolls down an inclined plane. Its mass is 2kg and radius 0.1 m. If the height of the inclined plane is 4m, what is its rotational kinetic energy, when it reaches the foot of the plane? Assume that the surfaces are smooth. M.I of cylinder about its axis = $\frac{1}{2}MR^2$

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34. A cylinder of mass 10 kg and radius 15 cm is rolling perfectly on a plane of inclination 30°. The co-efficient of static friction $\mu s = 0.25$:- How much is the force of friction acting on the cylinder ?

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35. A cylinder of mass 10 kg is rolling perfectly on a plane of inclination 30° Find the force of friction between the cylinder and the surface of the inclined plane

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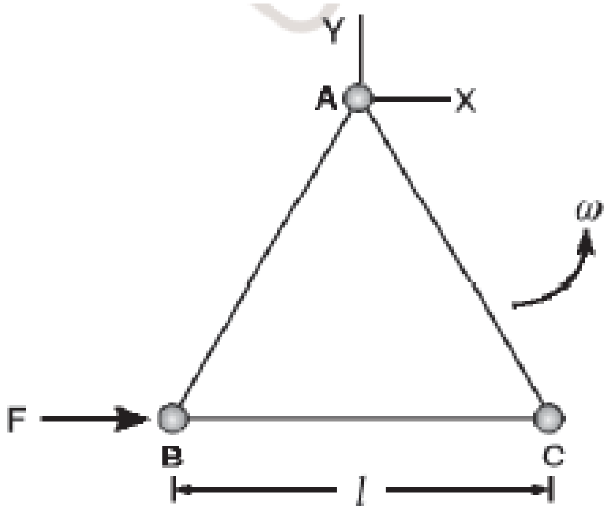
36. Three particles A, B and C, each of mass m, are connected to each other by three massless rigid rods to form a rigid equilateral triangular body of side l. This body is placed on a horizontal frictionless table and is hinged to it at the point A, so that it can move without friction about the vertical axis through A. The body is set into rotational motion on the table about A with a constant angular velocity ω. Find the magnitude of the horizontal force exerted by the hinge on the body.



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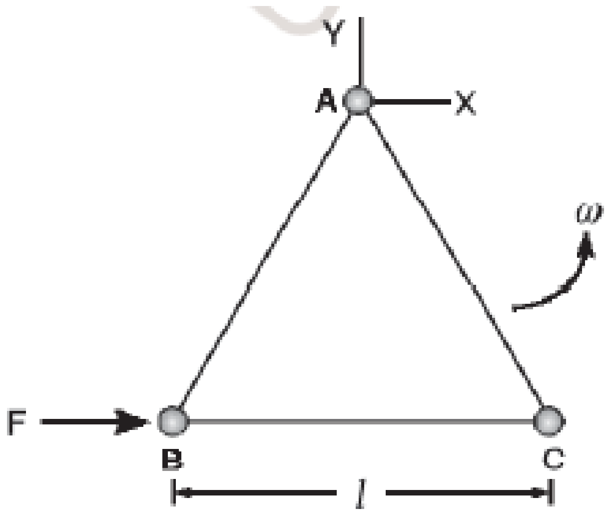
37. Three particles A, B and C, each of mass m, are connected to each other by three massless rigid rods to form a rigid equilateral triangular body of side l. This body is placed on a horizontal frictionless table and is hinged to it at the point A, so that it can move without friction about the vertical axis through A. The body is set into rotational motion on the table about A with a constant angular velocity ω. Find the magnitude of the horizontal force exerted by the hinge on the body.



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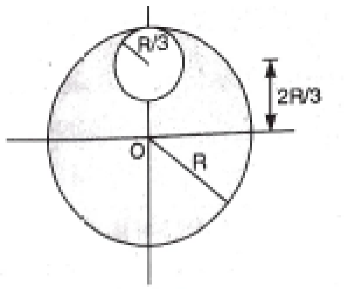
38. From a circular disc of radius r and mass 9M a small disc of radius r/3 is removed from the disc as shown in figure. find the moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through the point O.



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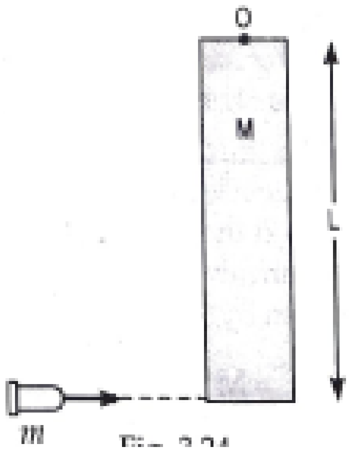
39. A rod of length l and mass m is hinged at point O. A small bullet of mass m hits the rod as shown in the figure. the bullet gets embedded in the rothed. find angular velocity of the system just after impact.



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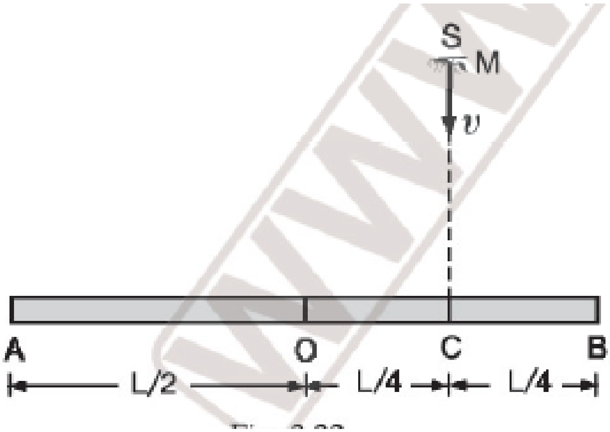
40. A homogeneous rod AB of length L= 1.8 m and mass M is pivoted at the centre O in such a way that it can rotate freely in the vertical plane. The rod is initially in the horizontal position. An insect S of the same mass M falls vertically with speed v on the point C, mid-way between the points O and B. Immediately after falling, the insect moves towards the end B, such that the rod rotates with a constant angular velocity ω.

Determine the angular velocity.



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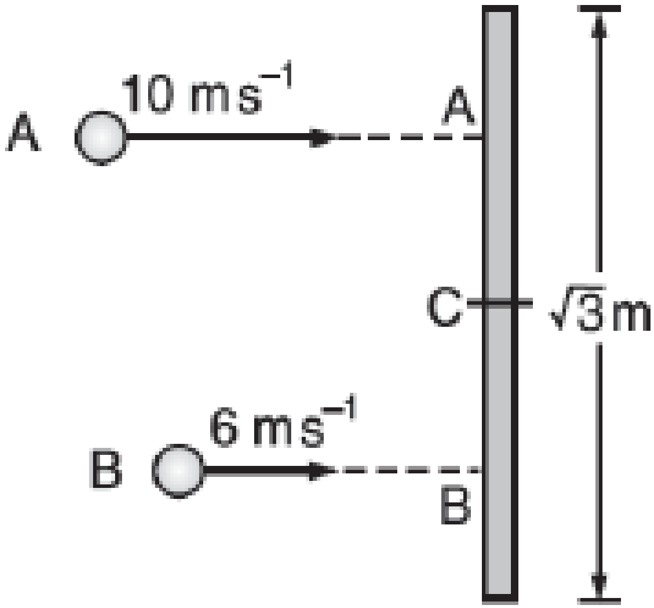
41. A thin uniform bar lies on a frictionless horizonta surface and is free to move in any way on th surface. Its mass is 0.16 kg and length $\sqrt{3}$ meters. Two particless, each of mass 0.08 kg, are moving on the same surface and towards the bar in a direction perpendicular to the bar, one with a velocity of 10 m/s, and other with 6m/s as shown in fig. The first particle strikes the bar at point A and the other at point B. Points A and B are at a distane of 0.5m from the centre of the bar. The particles strike the bar at the same instant of time and stick to the bar on collision. Calculate the loss of the kinetic energy of the system in the above collision process.



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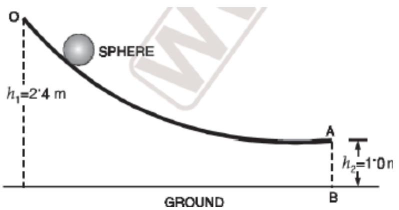
42. A small sphere rolls down without slipping from the top of a track in a vertical plane. The track has an elevated section and a horizontal part, The horizontal part, is 1.0 metre above the ground level and the top of the track is 2.4 meters above the ground. Find the distance on the ground with respect to the point B (which is vertically below the end of the track as shown in fig.) where the sphere lands. During its flight as a projectlie, does the sphere continue to rotate about its centre of mass?



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43. A carpet of mass M made of inextensible material is rolled along its length in the form of a cylinder of radius R and kept on a rough floor. The carpet starts unrolling without sliding on the floor, when a negligibly small push is given to it. Calculate the horizontal velocity of the axis of a cylindrical part of the carpet, when its radius reduces to R/2.

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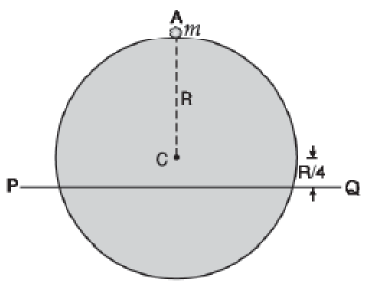
44. A uniform circular disc has radius R and mass m. A particle also of mass m is fixed at a point A on the wedge of the disc as in fig. The disc can rotate freely about a fixed horizontal chord PQ that is at a distance R/4 from the centre C of the disc. The line AC is perpendicular to PQ. Initially the disc is held vertical with the point A at its highest position. It is then allowed to fall so that it starts rotating about PQ. Find the linear speed of the particle at it reaches its lowest position.



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45. Define moment of inertia

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46. Is there any difference between moment of inertia and rotational inertia?

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47. Why M.I. of called rotational inertia?

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48. Define the term electric dipole moment. Is it a scalar or a vector quantity?

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49. Does M.I. change with change of the axis of rotation?

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50. How does M.I. change with speed of rotation.

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51. The moment of inertia of a rigid body, depends upon

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52. What is physical significnce of moment of inertia?

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53. Define radius of gyration.

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54. Is radius of gyration of a body a constant quantity?

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55. What is the moment of inertia of a ring

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56. What is the moment of inertia of a disc about their diameters?

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57. Which physical quantities are represented by the following ?

i) Product of moment of inertia and the angular velocity:

ii) Product of moment of inertia and the angular acceleration.

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58. Which physical quantities are represented by the following ?

i) Product of moment of inertia and the angular velocity:

ii) Product of moment of inertia and the angular acceleration.

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59. Derive an expression for kinetic energy of rotation.

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60. Which physical quantities are represented by the following ?

i) Product of moment of inertia and the angular velocity:

ii) Product of moment of inertia and the angular acceleration.

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61. Define radius of gyration.

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62. Is radius of gyration of a body a constant quantity?

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63. Two satellites of equal masses are revolving around at different heights. Will their moment of inertia same or different?

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64. Prove the theorem of parallel axes.

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65. Derive the expression for moment of inertia of a circular disc

about an axis passing through its centre and perpendicular to its plane

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66. In a flywheel most of mass is concentrated at the rim. Explain why?

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67. Two spheres of the same radii, one solid and other hollow are charged to the same potential, which one has greater charge?

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68. Derive relation between kinetic energy of rotation and moment of inertia.

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

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70. There is a stick half of which is woode half is of steel. It is pivoted at the wooden end and a force applied at the steel end at right angles to its length. Next it is pivoted at the steel end and the same force is app the wooden end. In which case is the angular accelen more and why?

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71. Why is it more difficult to revolve a stone it to a longer string than by tying it to a shorter string?

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

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73. How will you distinguish between a hard boiled egg and a raw egg by spinning each on a table top?

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74. Why angular speed of rotation of earth around the sun the increases, when it comes near the sun ?

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75. The speed of inner layer of the whirl wind in a tornado is alarmingly high. Explain why

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76. How does an ice-skater, a ballet dancer or an acrobat take advantage of the principle of conservation of angular momentum?

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77. How the diver leaves the diving board, why he brings his hands and feet close together in order to make a sommersault?

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78. If the ice on the polar caps of the earth melts, how will it affect the duration of the day? Explain.

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79. Explain how a cat is able to land gently on its feet after a fall taking the advantage of the law of conervation of angular momentu?

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80. Explain how a cat is able to land gently on its feet after a fall taking the advantage of the law of conervation of angular momentu?

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81. If the angular momentum is conserved in a system whose MI is decreased, will its rotational KE be also conserved? Explain.

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82. Give the location of the centre of mass of a :-

sphere.

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83. In the HC1 molecule, the separation between the nuclei of the two atoms is about $1.27\overset{\circ}{A}$ ($1\overset{\circ}{A} = 10^{-10}m$). Find the approximate location of the CM of the molecule, given that a chlorine atom is about 35.5 times as massive as a hydrogen atom and nearly all the mass of an atom is concentrated in its nucleus.

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84. A child sits stationary at one end of a long trolley moving uniformly with a speed V on a smooth horizontal floor. If the child gets up and runs about on the trolley in any manner, what is the speed of the CM of the (trolley + child) system ?

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85. Show that the area of the triangle contained between the vectors $\vec{a}$ and $\vec{b}$ is one half of the magnitude of $\vec{a} \times \vec{b}$.

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86. Show that $\vec{A}.\left(\vec{B} \times \vec{C}\right)$ is equal in magnitude to the volume of the parallelopiped formed on the three vectors $\vec{A}, \vec{B}$ and $\vec{C}$.

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87. Find the components along the x, y, z axes of the angular momentum 1 of a particle, whose position vector is r with components x, y, z and momentum is p with components p_x, p_y and p_z. Show that if the particle moves only in the x-y plane the angular momentum has only a z-component.

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88. Two particles, each of mass mand speed v, travel in opposite directions along parallel lines separated by a distance d. Show that the vector angular momentum of the two particle system is the same whatever be the point about which the angular momentum is taken.

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89. A non-uniform bar of weight W is suspended at rest by two strings of negligible weight as shown in Fig.7.39. The angles made by the strings with the vertical are 36.9° and 53.1° respectively. The bar is 2 m long. Calculate the distance d of the centre of gravity of the bar from its left end.

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

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91. 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.

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92. Given the moment of inertia of a disc of mass M and radius R about any of its diameters to be $MR^2/4$, find its moment of inertia about an axis normal to the disc and passing through a point on its edge.

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93. Torques of equal magnitude are applied to a hollow cylinder and a solid sphere, both having the same mass and radius. Hie cylinder is free to rotate about its standard axis of symmetry, and the sphere is free to rotate about an axis passing through its centre. Which of the two will acquire a greater angular speed after a given time.

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94. A solid cylinder of mass 20 kg rotates about its axis with angular speed $100 rad s^{-1}$. The radius of the cylinder is 0.25 m. 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?

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95. A solid cylinder of mass 20 kg rotates about its axis with angular speed $100 rad s^{-1}$. The radius of the cylinder is 0.25 m. 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?

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96. A child stands at the centre of a turntable with his two arms outstretched. The turntable is set rotating with an angular speed of $40 rev / \min$. How much is the angular speed of the child if he folds his hands back and thereby reduces his moment of inertia to $2/5$ times the initial value ? Assume that the turntable rotates without friction.

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97. A child stands at the centre of a turntable with his two arms outstretched. The turntable is set rotating with an angular speed of 40 rev/min. How much is the angular speed of the child if he folds his hands back and thereby reduces his moment of inertia to 2/5 times the initial value ? Assume that the turntable rotates without friction.

Show that the child's new kinetic energy of rotation is more than the initial kinetic energy of rotation. How do you account for this increase in kinetic energy?

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98. A rope of negligible mass is wound round a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30 N ? What is the linear acceleration of the rope ? Assume that there is no slipping.

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99. To maintain a rotor at a uniform angular speed of $200 rads^{-l}$, 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.

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100. From a uniform disk of radius R, a circular hole of radius $R/2$ is cut out. The centre of the hole is at $R/2$ from the centre of the original disc. Locale the centre of gravity of the resulting flat body.

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101. A solid sphere rolls down two different inclined planes of the same heights but different angles of inclination:- Will it reach the bottom with the same speed in each case?

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102. A solid sphere rolls down two different inclined planes of the same heights but different angles of inclination:- Will it take longer to roll down one plane than the other?

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103. A hoop of radius 2 m weighs 100 kg. It rolls along a horizontal floor so that its centre of mass has a speed of $20cm/s$. How much work has to be done to stop it?

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104. The oxygen molecule has a mass of $5.30 \times 10^{-26} kg$ and a moment of inertia of $1.94 \times 10^{-46} kgm^2$ about an axis through its centre perpendicular to the lines joining the two atoms. Suppose the mean speed of such a molecule in a gas is $500 m / s$ and that its kinetic energy of rotation is two thirds of its kinetic energy of translation. Find the average angular velocity of the molecule.

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105. A solid cylinder rolls up an inclined plane of angle of inclination 30°. At the bottom of the inclined plane the centre of mass of the cylinder has a speed of $5m/s$:- How far will the cylinder go up the plane?

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106. A solid cylinder rolls up an inclined plane of angle of inclination 30°. At the bottom of the inclined plane the centre of mass of the cylinder has a speed of $5m/s$:- How long will it take to return to the bottom?

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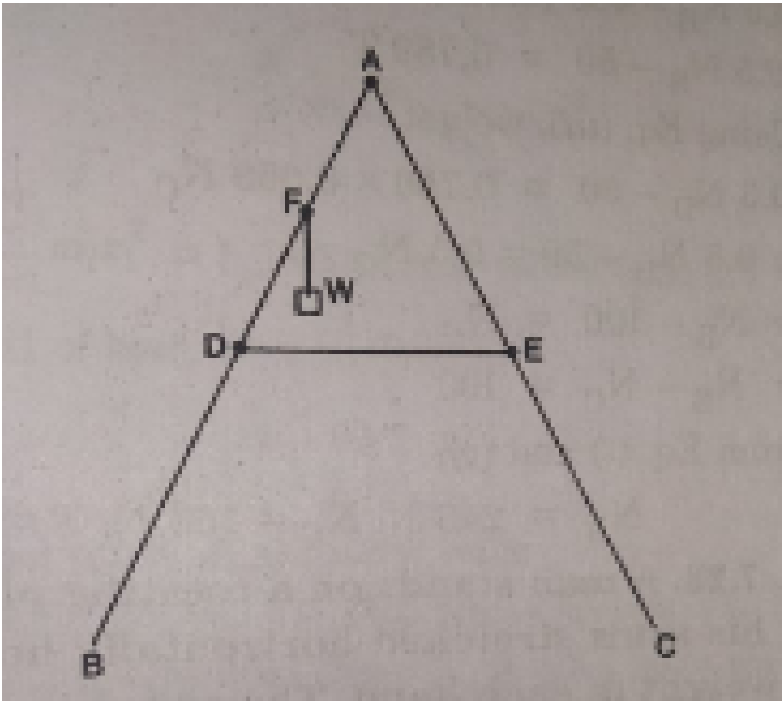
107. As shown in the given figure. the two sides of a step ladder BA and CA are 1.6 m long and hinged at A.A rope DE, 0.5 m is tied half way up. A weight 40 kg is suspended from a point F, 1,2 m from B along the ladder BA. Assuming the floor to be frictionless and neglecting the weight of the ladder, find the tension in te rope and forces exerted by the floor on the ladder. (Take g = $9.8 ms^{-2}$) (Hint: consider the equilibrium of each side of the ladder separately).



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108. A man stands on a rotating platform, with his arms stretched horizontally holding a 5 kg weight in each hand. The angular speed of the platform is 30 revolutions per minute. The man then brings his arms close to his body with the distance of each weight from the axis changing from 90cm to 20cm. The moment of inertia of the man together with the platform may be taken to be constant and equal to $7.6 kgm^2$:- What is his new angular speed? (Neglect friction.)

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109. A man stands on a rotating platform, with his arms stretched horizontally holding a 5 kg weight in each hand. The angular speed of the platform is 30 revolutions per minute. The man then brings his arms close to his body with the distance of each weight from the axis changing from 90cm to 20cm. The moment of inertia of the man together with the platform may be taken to be constant and equal to $7.6kgm^2$:- Is kinetic energy conserved in the process? If not, from where does the change come about?

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110. A bullet of mass 10 g and speed $500m/s$ is fired into a door and gets embedded exactly at the centre of the door. The door is 1.0 m wide and weighs 12 kg. It is hinged at one end and rotates about a vertical axis practically without friction. Find the angular speed of the door just after the bullet embeds into it.

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111. Two dics of moments of inertia I_1 and I_2 about their respective axes (normal to the disc and passing through the centre), and rotating with angular speed ω_1 and ω_2 are brought into contact face to face with their axes of rotation coincident. Find the angular speed of the two-disc system.

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112. The discs of moments of inertia I_1 and I_2 about their respective axis (normal to the disc and passing through the centre), and rotating with agnular speeds ω_1 and ω_2 are brought into contact face to face with their axis of rotation coincident.

Show that the kinetic energy of the combined system is less than the sum of the initial kinetic energies of the two discs. How do you account for this loss in energy ? Take $\omega_1 \neq \omega_2$.

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113. Prove the theorem of perpendicular axes. (Hint: Square of the distance of a pint (x,y) in the x - y plane from an axis perpendicular to the plane through the origin is $x^2 + y^2$)

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114. Prove the theorem of parallel axes.

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115. Prove the result that the velocity v of translation of a rolling body (like a ring, disc, cylinder or sphere) at the bottom of an inclined plane of a height h is given by $v^2 = \frac{2gh}{1 + k^2 / R^2}$ using dynamical consideration (i.e. by consideration of forces and torques). Note k is the radius of gyration of the body about its symmetry axis, and R is the radius of the body. The body starts from rest at the top of the plane.

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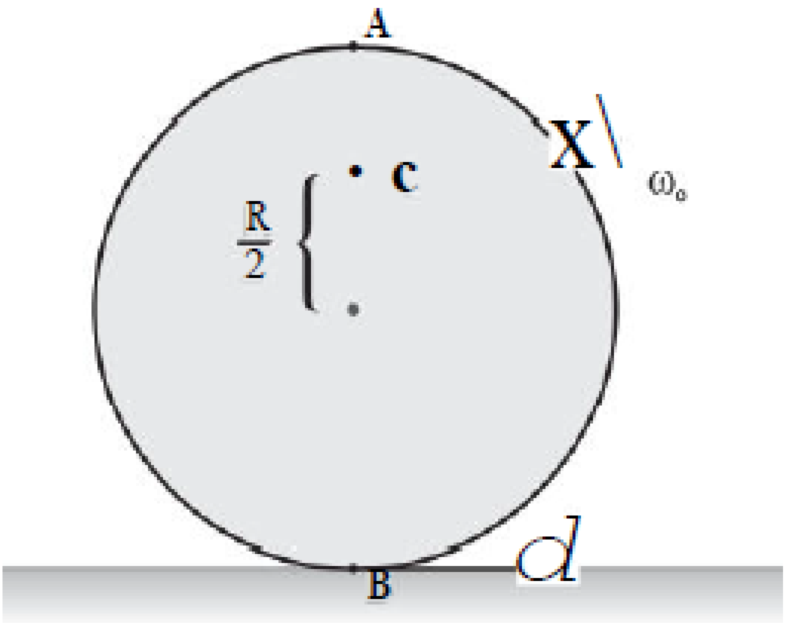
116. A disc rotating about its axis with angular speed ω_0 is placed lightly (without any translational push) 011 a perfectly frictionless table. The radius of the disc is R. What are the linear velocities of the points A, B and C on the disc shown in Fig. 7.41? Will the disc roll in the direction indicated ?



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

Given the direction of friction force at B, and the sense of frictional torque, before perfect rolling begins.

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

Given the direction of friction force at B, and the sense of frictional torque, before perfect rolling begins.

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119. What is the force of friction after perfect rolling begins?

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120. A solid disc and a ring, both of radius 10 cm are placed on a horizontal table simultaneously, with initial angular speed equal to $10\pi rads^{-1}$. Which of the two will start to roll earlier ? The co-efficient of kinetic friction is $\mu_k = 0.2$.

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121. A cylinder of mass 10 kg and radius 15 cm is rolling perfectly on a plane of inclination 30°. The co-efficient of static friction $\mu s = 0.25$:- How much is the force of friction acting on the cylinder ?

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122. A cylinder of mass 10 kg and radius 15 cm is rolling perfectly on a plane of inclination 30°. The co-efficient of static friction $\mu s = 0.25$:-

What is the work done against friction during rolling ?

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123. A cylinder of mass 10 kg and radius 15 cm is rolling perfectly on a plane of inclination 30°. The co-efficient of static friction $\mu s = 0.25$:- If the inclination θ of the plane is increased, at what value of θ does the cylinder begin to skid, and not roll perfectly ?

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124. Read each statement below carefully, and state, with reasons, if it is true or false :- During rolling, the force of friction acts in the same direction as the direction of motion of the CM of the body.

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125. Read each statement below carefully, and state, with reasons, if it is true or false :- The instantaneous speed of the point of contact during rolling is zero.

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126. Read each statement below carefully, and state, with reasons, if it is true or false :- The instantaneous acceleration of the point of contact during rolling is zero.

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127. Read each statement below carefully, and state, with reasons, if it is true or false :- For perfect rolling motion, work done against friction is zero.

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128. Read each statement below carefully, and state, with reasons, if it is true or false :- A wheel moving down a perfectly frictionless inclined plane will undergo slipping (not rolling) motion.

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129. Two men stand facing each other on two boats floating on still water at a short distance apart. A rope is held at its ends by both. The two boats are found to meet always at the same point, whether each man pulls tw separately or both pull together. Why? Neglect friction

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130. A wheel stays in the upright position while rolling,whereas it falls from its upright position when stationary .Why?

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131. Two balls of masses $3m$ and m are separated by a distance I. Find the position of the centre of mass.

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132. Two balls of masses $3m$ and m are separated by a distance I. Find the position of the centre of mass.

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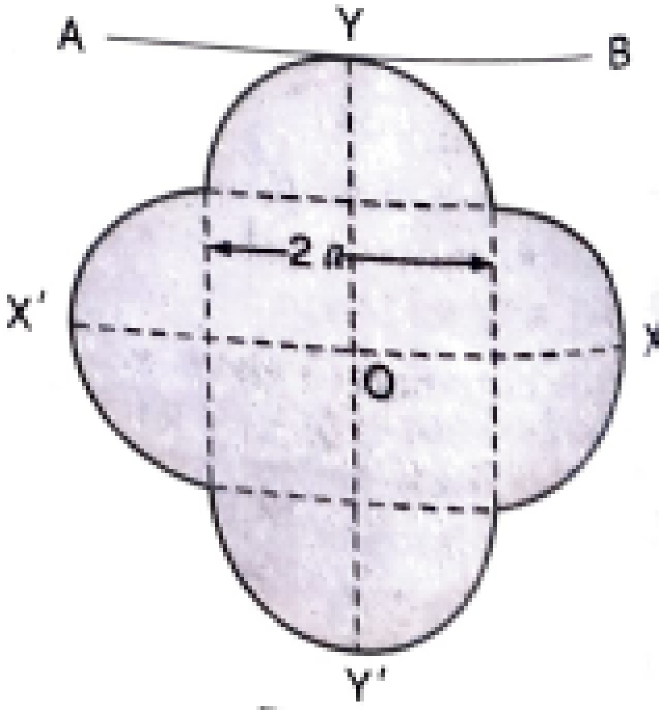
133. A symmetric lamina of mass M consists of a square shape with a semicircular section over of the edge of the square as shown in fig. The side of the square is 2a. The moment of inertia of the lamina about an axis through its centre of mass and perpendicular to the plane is $1.6Ma^2$.The moment of inertia of the lamina about the tangent AB in the plane of lamina is.



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134. A cylinder of mass 5 kg and radius 30 cm and

free to rotate about its axis receives an angular impulse of $3kgm^2s^{-1}$ initially, followed by a similar impulse after every 4 second. What is the angular speed of the cylinder 30 s after the initial impulse ? The cylinder is at rest initially.

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135. A body A of mass M, while falling vertically downwards under gravity, breaks into two parts: a body B of mass $\frac{M}{3}$ and a body C of mass $2\frac{M}{3}$. How does the centre of mass of bodies B and C taken together shift compared to that of body A?

A. depends on height of breaking

B. does not shift

C. body C

D. body B

Answer:

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136. Two identical particles move towards each other with velocity 2 v and v respectively. The velocity of centre of mass is:

A. v

B. v/3

C. v/2

D. 0

Answer:

Watch Video Solution

137. Consider a two - particle system with the particles having masses M_1 and M_2 .If the first particle is pushed towards the centre of mass through a distance a,by what distance whould the second particle be moved,so as t keep the centre of mass at the same position?

A. $\left(\frac{M_1}{M_2}\right)d$

B. $\left(\frac{M_2}{M_1}\right)d$

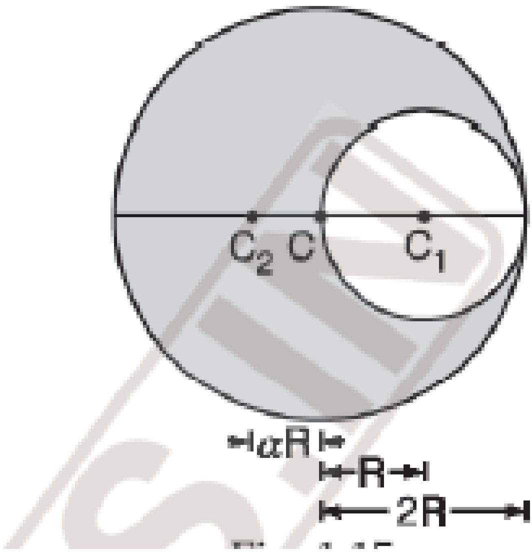
C. d

D. $\frac{M_1}{M_1+M_2}d$

Answer:

Watch Video Solution

138. A circular disc of radius R is removed from a bigger circular dise of radius 2 R from one edge of the disc as shown in Fig. The centre of mass of the new disc is $\alpha R$from the centre of the bigger disc. Find the value of α.



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

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

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

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

Answer:

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139. Two spherical bodies of mass M and 5 M and radii R and 2 R respectively are released in free space with initial separation between their centres equal to 12 R. If they attract each other due to gravitation force only, then the distance covered by the smaller body just before collision is

A. 4.5R

B. 7.5R

C. 1.5R

D. 2.5R

Answer:

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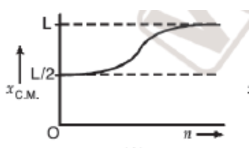
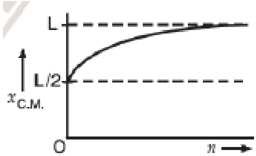
140. A thin rod of length L is lying along the x-axis with its ends at x = 0 and x = L. Its linear density (mass/length) varies with x as $k\left(\frac{x}{L}\right)^n$ where n can be zero or any positive number. If the position X_{CM} of the centre of mass of the rod is plotted against n, which of the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

A.

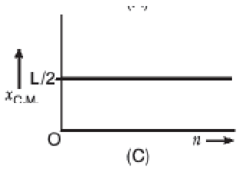


(A)

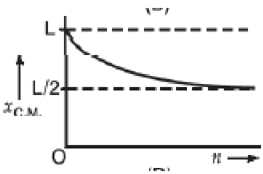
B.



C.



D.



Answer:

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141. If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$, then the angle between $\vec{A}$ and $vevB$ is

A. π

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

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

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

Answer:

Watch Video Solution

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

A. $F\left(\hat{i}+\hat{j}\right)$

B. `-F(hat i + hat j)

C. $F\left(\hat{i}-\hat{j}\right)$

D. $F\left(-\hat{i}-\hat{j}\right)$

Answer:

Watch Video Solution

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

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

B. $\overrightarrow{r}.\overrightarrow{F}$ gt 0 and $\overrightarrow{F}.\overrightarrow{\tau} < 0$

C. $\overrightarrow{r}.\overrightarrow{F}$ = 0 and $\overrightarrow{F}.\overrightarrow{\tau} = 0$

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

Answer:

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

A. constant force

B. constant linear momentum

C. zero torque

D. constant torque

Answer:

Watch Video Solution

145. 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. L/4

B. 2L

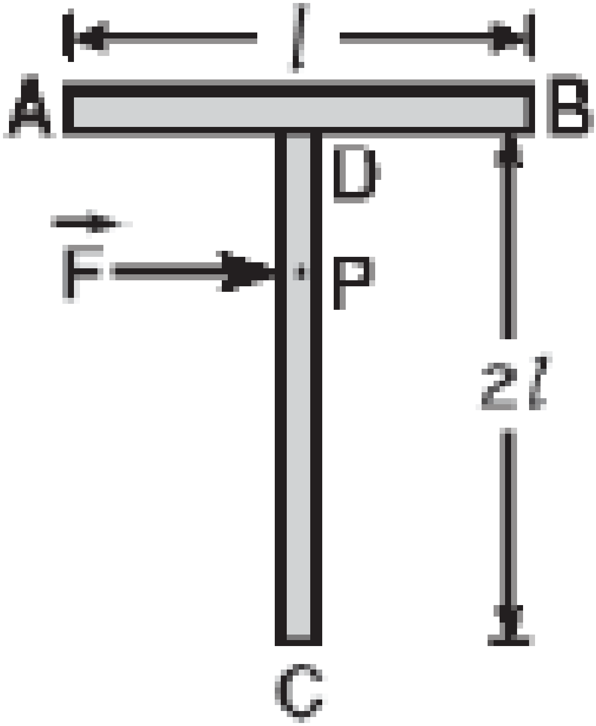
C. 4L

D. L/2

Answer:

Watch Video Solution

146. A 'T' shaped object with dimensions shown in the figure, is lying on a smooth floor. A force $\vec{F}$ is applied at the point P parallel to AB, such that the object has only the translational motion without rotation. Find the location of P with respect C.



A. 2l/3

B. 3l/2

C. 4l/3

D. I

Answer:

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147. Four point masses, each of mass M, are placed at the corners of a square ABCD of side L. The moment of inertia of this system about an axis passing through A and parallel to BD is :

A. $3ML^2$

B. ML^2

C. $2ML^2$

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

Answer:

Watch Video Solution

148. Consider a uniform square plate of side a and mass M. The moment of inertia of this plate about an axi perpendicular to its plane and passing through one of its corners is

A. $\left(\frac{2}{3}\right)Ma^2$

B. $\left(\frac{5}{6}\right)Ma^2$

C. $\left(\frac{1}{12}\right)Ma^2$

D. $\left(\frac{7}{12}(Ma^2\right.$

Answer:

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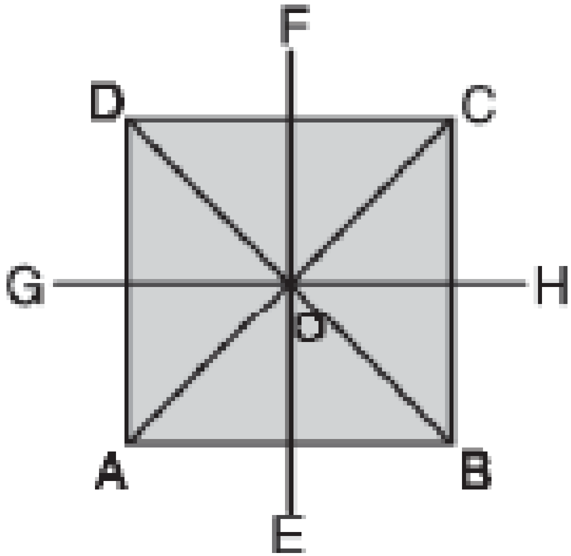
149. For a given uniform square lamina ABCD, whose centre is 0,



A. $\sqrt{2}I_AC = I_EF$

B. $I_AD = 3I_EF$

C. $I_AC = I_EF$

D. $I_AC = \sqrt{2}I_EF$

Answer:

150. Moment of inertia of a circular wire of mass M and radius R about is its diameter is

A. $\left(\frac{1}{2}\right)MR^2$

B. $\left(\frac{1}{4}\right)MR^2$

C. $2MR^2$

D. $(MR^2$

Answer:

151. A circular disc X of radius R is made from an iron plate of thickness t and another disc Y of radius 4 R is made from an iron plate of thinkness t/4. Then, the relation between the moment of inertia I_x and l_y is

A. $I_Y = I_X$

B. $I_Y = 16 I_X$

C. $I_Y = 32 I_X$

D. $I_Y = 64 I_X$

Answer:

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152. The moment of inertia of a uniform semi-circular disc of mass M and radius R about a line perpendicular to the plane of the disc through the centre is

A. $\left(\frac{1}{4}\right)Mr^2$

B. $\left(\frac{2}{5}\right)Mr^2$

C. Mr^2

D. $\left(\frac{1}{2}\right)Mr^2$

Answer:

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153. One solid sphere A and another hollow sphere B are of same mass and same outer radii. Their moment of inertia about their diameters are respectively I_A, and l_B, such that

A. $I_A = I^B$

B. $I_A > I^B$

C. $I_A < I^B$

D. $\frac{I_A}{I_B} = \frac{\rho_A}{\rho_B}$

Answer:

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154. A solid sphere is rotating in free space. If the radius of the sphere is increased keeping mass same, which one of the following will nt be affected?

A. Moment of Inertia

B. Angular momentum

C. Angular velocity

D. Rotational kinetic energy

Answer:

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155. A thin circular ring of mass M and radius R is rotating about its axis with a constant angular velocity omega. Four objects each of mass m, are kept gently to the opposite ends of two perpendicular diameters of the ring. What will be the angular velocity of the ring?

A. $\frac{M+m}{M}\omega_1$

B. $\frac{M}{M+m}\omega_1$

C. $\frac{M}{M+4m}\omega_1$

D. $\frac{M}{M+2m}\omega_1$

Answer:

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156. 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. $\frac{l^2\omega^2}{3}g$

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

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

D. $\frac{l\omega}{6}g$

Answer:

Watch Video Solution

157. A thin circular ring of mass M and radius R is rotating about its axis with a constant angular velocity omega. Four objects each of mass m, are kept gently to the opposite ends of two perpendicular diameters of the ring. What will be the angular velocity of the ring?

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

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

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

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

Answer:

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158. A solid sphere, a hollow sphere and a ring are released from top of an inclined plane (frictionless) so that they slide down the plane. Then, maximum acceleration down the plane is for (no rolling):

A. solid sphere

B. hollow sphere

C. ring

D. all same

Answer:

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159. A uniform round 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 the acceleration is

A. `(g sin theta)/(I+I/(MR^2))

B. $\dfrac{g\sin\theta}{I+\frac{MR^2}{I}}$

C. `(g sin theta)/(I-I/(MR^2))

D. $\dfrac{g\sin\theta}{I-\frac{MR^2}{I}}$

Answer:

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160. A thin horizontal circular disc is rotating 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. remains uncharged

B. continuously decrease

C. continuously increase

D. first increases and then decreases

Answer:

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161. A mass m hangs with the help of a string wrapped around a pulley on a frictionless bearing. The pulley has mass m and radius R. Assuming pulley to be a perfect uniform circular disc, the acceleration of the mass m, if the string does not slip on the pulley, is

A. g/3

B. (2g)/3

C. (3g)/2

D. g

Answer:

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162. A pulley of radius 2 m is rotated about its axis by a force $F = (20t - 5t^2)$ newton (where t is measured in seconds) applied tangentially. If the moment of inertia of the pulley about its axis of rotation is $10 kgm^2$, the number of rotations made by the pulley before its direction of motion is reserved, is

A. less than 3

B. more than 3 but less than 6

C. more than 3 but less than 9

D. more than 9

Answer:

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163. The centre of mass of a system of particles does not depend on

A. masses of the particles

B. forces on the particles

C. position of the particles

D. relative distances between the particles

Answer:

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164. Three identical spheres each of radius R are placed touching each oother on a horizontal table. Where is the centre of mass of the system located?

A. horizontal surface

B. centre of one of the balls

C. line joining of any two balls

D. opint of intersection of the medians

Answer:

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165. A rod of length 3m and its mass per unit length is directly proportional to the distance x from its one end . The centre of gravity of the rod from that end will be at

A. 1.5m

B. 2m

C. 2.5m

D. 3m

Answer:

Watch Video Solution

166. Two particle which are initially at rest move towards each other under the action of their internal attraction. If their speeds are v and 2 v at any instant, then the speed of centre of mass of the system will be

A. v

B. 2v

C. 1.5v

D. 0

Answer:

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

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

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

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

D. `-2hat i + 2hat j

Answer:

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168. A solid sphere of radius R is placed on a smooth horizontal surface. A horizontal force F is applied at heighth from the lowest point. For the maximum acceleration of centre of mass, which is correct?

A. h=R

B. h=2R

C. h=0

D. No relation between h and R

Answer:

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169. The angle between the $\vec{A}$ and $\vec{B}$ is θ The value of triple product $\vec{A} . \vec{B} \times \vec{A}$ is

A. $A^2 B$

B. zero

C. $A^2 + B \sin\theta$

D. $A^2 B \cos\theta$

Answer:

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170. If the angle between the vectors A and B is theta, the value of the product $\left(\vec{B} \times \vec{A}\right) . \vec{A}$ is equal to

A. $BA^2 \sin\theta$

B. zero

C. $BA^2 \sin\theta$

D. $BA^2 \cos\theta \sin\theta$

Answer:

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171. If $|A \times B| = \sqrt{3}\left(\vec{A} . \vec{B}\right)$, then the value of $|A + B|$ is:

A. `sqrt(A^2 + B^2 + AB)

B. `sqrt(A^2 + B^2 + 3 AB)

C. `sqrt(A^2 + B^2 - AB)

D. A+B

Answer:

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172. $\vec{A}$ and $\vec{B}$ are two vectors and is the angle between them. If $\left|\vec{A} \times \vec{B}\right| = \sqrt{3}\left(\vec{A} . \vec{B}\right), thenthevalueof$ theta` is

A. 60°

B. 45°

C. 30°

D. 90°

Answer:

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

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

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

C. $4\hat{i} - 13\hat{j} + 6\hat{k}$

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

Answer:

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174. Find the torque of a force $\overrightarrow{F} = -3\hat{i} + \hat{j} + 5\hat{k}$ acting at the point $\overrightarrow{r} = 7\hat{i} + 3\hat{j} + \hat{k}$

A. $14\hat{i} - 38\hat{j} + 16\hat{k}$

B. $4\hat{i} + 4\hat{j} + 6\hat{k}$

C. $-21\hat{i} + 4\hat{j} + 4\hat{k}$

D. $-14\hat{i} + 34\hat{j} - 16\hat{k}$

Answer:

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175. Find the torque of a force $\overrightarrow{F} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ acting point $\overrightarrow{r} = 3\hat{i} - 2\hat{j} + 3\hat{k}$

A. $\hat{i} - 6\hat{j} - 5\hat{k}$

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

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

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

Answer:

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176. A couple produces a

A. purely linear motion

B. purely rotational motion

C. linear and rotational

D. no motion

Answer:

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177. Angular momentum is

A. axial vector

B. polar vector

C. scalar

D. none of these

Answer:

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178. A particle of mass m = 2 kg is moving with a uniform speed $3\sqrt{2}ms^{-1}$ in the XOY plane along the line y = x + 6. Find the magnitude of the angular momentum of the particle about the origin.

A. 60 units

B. 0

C. $40\sqrt{2}$ units

D. 7.5 units.

Answer:

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179. A wheel of radius 1 m rolls on ground without slipping. The displacement of the contact point of the wheel with ground, when the wheel completes half rotation is

A. 2 m

B. πm

C. $\sqrt{\pi^2 + 2}$

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

Answer:

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180. A disc is rotating with angular speed w. If a child sits on it, what is conserved ?

A. Linear momentum

B. Potential energy

C. Angular momentum

D. Kinetic energy

Answer:

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

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182. 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

A. t=1s

B. t=0.5s

C. t=0.25s

D. t=2s

Answer:

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183. Find the expression for moment of inertia of a thin uniform rod about an axis passing through its one end and perpendicular to its length.

A. $I_0 + \frac{ML^2}{2}$

B. $I_0 + \frac{ML^2}{4}$

C. $I_0 + \left(2ML^2\right)$

D. $I_0 + \left(4ML^2\right)$

Answer:

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184. Four identical thin rods, each of length L and mass M, form a square frame. The moment of inertia of this frame about an axis passing through the centre of the square and perpendicular to its plane is

A. $\left(\frac{1}{3}\right)(ML^2)$

B. $\left(\frac{2}{3}\right)(ML^2)$

C. $\left(\frac{4}{3}\right)(ML^2)$

D. $\left(\frac{13}{3}\right)(ML^2)$

Answer:

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185. 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. $\left(\frac{1}{6}\right)ML^2$

B. $\left(\frac{1}{12}\right)ML^2$

C. $\left(\frac{1}{24}\right)ML^2$

D. $\left(\frac{\sqrt{2}}{24}\right)ML^2$

Answer:

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

A. aluminium at interior and iron surrounding it.

B. iron at interior and aluminium surrounding it.

C. using iron and aluminium layers in alternate order.

D. sheet of iron is used at both external surface and aluminium sheet as internal layers.

Answer:

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187. Show that the radii of gyration of a circular ring and circular disc of the same radius about an axis passing through their centres and perpendicular to their plane are in the ratio $\sqrt{2} : 1$

A. $1:\sqrt{2}$

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

C. $\sqrt{2}:1$

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

Answer:

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188. show that the radii of gyration of a circular disc and a circular ring of the same radius about a tangential axis in the plane of the ring is $\sqrt{5}:\sqrt{6}$

A. $2:3$

B. $2:1$

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

D. $1:\sqrt{2}$

Answer:

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189. 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. $\left(\frac{1}{2}\right)MR^2$

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

D. $\left(\frac{7}{2}\right)MR^2$

Answer:

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190. The moment of inertia of a disc of Radius R and mass M about an axis which is tangential to the circumference of the disc and parallel to the diameter is

A. $\left(\frac{3}{2}\right)MR^2$

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

C. $\left(\frac{5}{4}\right)MR^2$

D. $\left(\frac{4}{5}\right)MR^2$

Answer:

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191. The 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 the rim will be

A. 5I

B. 6I

C. 3I

D. 4I

Answer:

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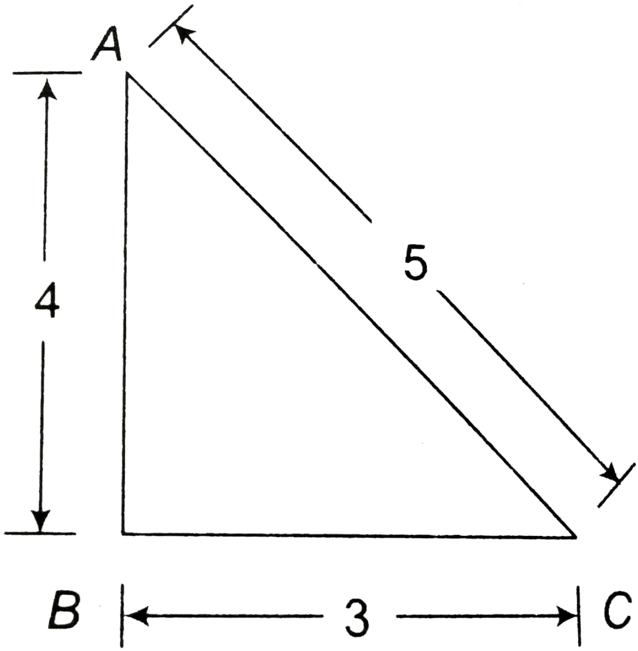
192. ABC is a traiangular plate of uniform thickness. The sides are in the ratio shown in the figure. I_(AB), I_(BC) and I_(CA) are the moments of inertia of the plate about AB, BC and CA repectively. Which one of the following relations is correct?



A. $I_AB + I_BC = I_CA$

B. I_CA is maximum

C. $I_AB > I_BC$

D. $I_BC > I_AB$

Answer:

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193. There is a flat uniform triangular plate ABC, sides AB= 4 cm, BC= 3 cm and $\angle ABC = 90^{\circ}$. The moment of inertia of the plate about AB, BC and CA as axis are I_1, I_2 and I_3 respectively. Which one of the following is true?

A. $1_3 > 1_1$

B. $1_3 > 1_2$

C. $I_1 > 1_2$

D. $1_2 > I_3$

Answer:

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194. A wheel having moment of inertia 2 kg m^2 about its axis ,rotates at 50 rpm .About this axis .Find the torque that can stop te wheel in one minute.

A. $2\frac{\pi}{15}$Nm

B. $\frac{\pi}{15}$Nm

C. $\frac{\pi}{12}$Nm

D. $\frac{\pi}{18}$Nm

Answer:

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195. A constant torque of 31.4 N-m is exterted on a pivoted wheel. If the angular acceleration of the wheel is $4\pi rad/s^2$, then the moment of inertia will be.

A. $2.5kgm^2$

B. $3.5kgm^2$

C. $4.5kgm^2$

D. $5.5kgm^2$

Answer:

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196. A flywheel rotating about a fixed axis has a kinetic energy of 360J when its angular speed is $30 radians^{-1}$. The moment of inertia of the wheel about the axis of rotation is

A. $0.6kgm^2$

B. $0.8kgm^2$

C. $0.15kgm^2$

D. $0.75kgm^2$

Answer:

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197. The moment of inertia of a body about a given axis is $1.2kgm^2$. Initially, the body is at rest. In order to produce a rotational KE of 1500 J, for how much duration, an acceleration of $25 rad s^{-2}$ must be applied about that axis ?

A. 4s

B. 2s

C. 10s

D. 8s

Answer:

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198. A ring of mass m and radius r rotates about an axis passing through its centre and perpendicular to its plane with angular velocity ω. Its kinetic energy is

A. $\left(\frac{1}{2}\right)m\left(r^2\right)\left(\omega^2\right)$

B. $\left(\frac{1}{2}\right)mr\left(\omega^2\right)$

C. $m\left(r^2\right)\left(\omega^2\right)$

D. $mr\left(\omega^2\right)$

Answer:

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199. A solid sphere is rolling on a frictionless plane surface about its axis of symmetry. Find the ratio of its rotational energy to its total energy

A. $7:10$

B. $2:5$

C. $10:7$

D. $2:7$

Answer:

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200. A spherical ball rolls on a horizontal surface without slipping .then the fraction of its total energy associated with rotatio is :

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

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

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

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

Answer:

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201. A thin uniform circular ring is rolling of inclination 30° without slipping. Its linear acceleration down an inclined plane along the inclined plane will be

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

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

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

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

Answer:

Watch Video Solution

202. The speed of a homogeneous solid sphere after rolling down an inclined plane of vertical height & from rest without sliding is

A. $\sqrt{10g\frac{h}{7}}$

B. $\sqrt{gh}$

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

D. $\sqrt{4g\frac{h}{3}}$

Answer:

Watch Video Solution

203. A solid sphere and a hollow sphere (both of the same mass and same external diameter) are released from the same height at the same time on an inclined plane. Both roll down without slipping. Which one will reach the bottom first?

A. Solid sphere

B. Hollow sphere

C. One with higher density

D. Both together

Answer:

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204. A thin circular ring of mass M and radius R is rotating about its axis with a constant angular velocity omega. Four objects each of mass m, are kept gently to the opposite ends of two perpendicular diameters of the ring. What will be the angular velocity of the ring?

A. $\frac{M\omega}{4}m$

B. $\frac{(M+4m)\omega}{M}$

C. $\frac{M\omega}{M+4m}$

D. $\frac{(M-4m)\omega}{M+4m}$

Answer:

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205. Two bodies have their moments of inertia I and 2I respectively about their axis of rotation. If their kinetic energy of rotation are equal, their angular momentum will be in the ratio of:

A. $2:1$

B. $1:2$

C. $\sqrt{2}:1$

D. $1 : \sqrt{2}$

Answer:

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

A. ω

B. $\dfrac{I_2\omega}{I_1 + I_2}$

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

D. $\dfrac{(I_1 + I_2)\omega}{I_1}$

Answer:

Watch Video Solution

207. A circular disc of moment of inertia I_t, is rotating ina horizontal plane about its symmetry axis with a constant angular speed ω, Another disc of of moment of inertia I_b, is dropped coaxially onto the rotating disc. Initially the second disc has zero angular speed. Eventually both the discs rotate with a constant angular speed ω_f. The energy lost by the initially rotating disc to friction is

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

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

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

D. $\frac{I_b-I_t}{I_t+I_b}\omega_i^2$

Answer:

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208. A uniform rod of length l and mass M is free to rotate in a vertical plane about the point A. The moment of inertia of the rod about A is $M\frac{l^2}{3}$. The rod initially in horizontal position is released. The initial angular acceleration of the rod is

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

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

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

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

Answer:

Watch Video Solution

209. Statement 1. Centre of gravity (CG) of a body is the point at which the weight of the body acts Statement 2. Centre of mass coincides with the centre of gravity, if the earth is assumed to have infinitely large radius. Statement 3. To evaluate the gravitational field intensity due to any body at an external point, the entire mass of the body can be considered to be concentrated at its C.G.

Statement 4. The radius of gyration of any body rotating about an axis is the length of the perpendicular dropped from the CG. of the body to the axis. Which one of the following pairs of statements is correct?

A. 1 and 2

B. 2 and 3 (0) 3 and 4 (D) 4 and 1 (CBSE-Mains

2010) Ans. The statements 1 and 4 are correct. Q.5.02.

C. 3 and 4

D. 4 and 1

Answer:

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210. write the dimensions of the following physical quantities

A. Force

B. Angular momentum

C. Torque

D. Energy

Answer:

Watch Video Solution

211. Establish the relation between torque and angular acceleration.

Watch Video Solution

212. Establish relationship between torque and angular momentum.

Watch Video Solution

213. find the angle between angular momentum and linear momentum

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214. Prove that if two particles are moving along parallel directions with equal and opposite momentum, their total angular momentum about any point remains constant.

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215. A ring of mass 0.8 kg and radius 0.1 m makes $5/\pi$ rotations per second about an axis perpendicular to its plane through centre. Calculate angular momentum and kinetic energy of the ring

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216. A thin circular ring of mass M and radius R is rotating about its axis with a constant angular velocity omega. Four objects each of mass m, are kept gently to the opposite ends of two perpendicular diameters of the ring. What will be the angular velocity of the ring?

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

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

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

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

Answer:

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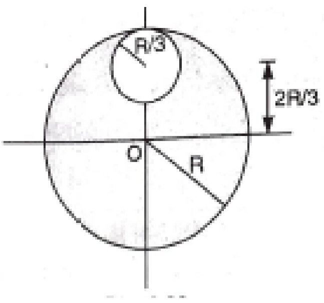
217. From a circular disc of radius r and mass 9M a small disc of radius r/3 is removed from the disc as shown in figure. find the moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through the point O.



A. $\left(\frac{40}{9}\right)MR^2$

B. $\left(\frac{4}{9}\right)MR^2$

C. $4MR^2$

D. MR^2

Answer:

Watch Video Solution

218. A solid cylinder and a hollow cylinder, both of the same mass and same external diameter are released from the same height at the same time on an inclined plane. Both roll down without slipping. Which one will reach the bottom first?

A. solid cylinder

B. hollow cylinder

C. Both together

D. Both together, only when angle of inclination of is 45°

Answer:

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219. Two spheres of masses M and 2 M are initially at rest at a distance R apart. Due to mutual force of attraction, they approach each other. When they are at separation R/2, the acceleration of their centre of mass would be

A. 0g

B. g

C. 3g

D. 12g

Answer:

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220. Two particles of masses m_1 and m_2 ($m_1 > m_2$), initially at rest, move towards each other under the inverse square law force of attraction. Pick out the correct statement about the centre of mass (C. M.) of the system

A. The CM. moves towards m_1

B. The CM. moves towards m_2

C. The CM. remains at rest.

D. the motion of C.M. in accelerated.

Answer:

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221. Angular momentum is

A. parallel to the linear momentum

B. in the orbital plane

C. along the radius vector

D. perpendicular to the orbital plane

Answer:

Watch Video Solution

222. The motion of planets in the solar system is an example of the conservation of

A. mass

B. linear momentum

C. angular momentum

D. energy

Answer:

Watch Video Solution

223. The angular momentum of a moving body remains content i constant, if

A. net external force is applied

B. net pressure is applied

C. net external torque is applied

D. net external torque is not applied

Answer:

Watch Video Solution

224. A constant torque acting on a uniform circular wheel changes its angular momentum from L to 4 L in 4 seconds.The magnitude of torque is :

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

B. 1J

C. $\left(\frac{5}{4}\right)J$

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

Answer:

Watch Video Solution

225. A body in projected from the ground with some angle to the horizontal. What happens to the angular momentem about the initial position in this motion?

A. decreases

B. increases

C. remains same

D. first increases and then decreases

Answer:

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226. A rod of length 1.4 m and negligible mass has two masses of 0.3kg and 0.7 kg tied to its two ends. Find the location of the point on this rod, where the rotational energy in minimum, the when the rod is rotated about the point.

A. 0.98 m from 0.3kg

B. 0.98 m from the 0.7 kg

C. 0.7m from 0.3 kg

D. 0.7 m from 0.7kg

Answer:

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227. Radius of gyration of a body depends upon

A. axis of rotation

B. translational motion

C. shape of the body

D. area of the body

Answer:

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

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

C. $\sqrt{\omega_2^2} : \sqrt{\omega_1^2}$

D. $\sqrt{\omega_2^3} : \sqrt{\omega_1^3}$

Answer:

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229. The moment of inertia of a rod about an axis through its centre and perpendicular to its length is $ML^2/12$ (where M is the mass and L is the lenth of the rod).The rod is bent in the middle so that the two halves make an angle 60° .The moment of inertia of the bent rod about the same axis would be :

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

B. $\frac{1}{8\sqrt{3}ML^2}$

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

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

Answer:

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230. A wire of mass m and length l is bent in the form of circular ring. The moment of inertia of the ring about its axis is

A. ml^2

B. $m\frac{l^2}{2\pi^2}$

C. $m\frac{l^2}{4\pi^2}$

D. $m\frac{l^2}{8\pi^2}$

Answer:

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231. A solid sphere is rolling on a frictionless plane surface about its axis of symmetry. Find the ratio of its translational energy to rotational energy

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

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

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

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

Answer:

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

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

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

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

Answer:

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233. Assertion: The position of the centre of mass of a body depends upon e shape and size of the body. Reason: The centre of mass of a body always lie at the centre of the body.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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234. Prove that the centre of mass of two particles divides the line joining the particles in the inverse ratio of their masses

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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235. Should the centre of mass of a body necessarily lie inside the body?

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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236. Assertion: The rate of change of angular momentum is directly proportional to applied external torque. Reason: It corresponds to Newton's second law of rotational motion.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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237. Assertion: The torque due to a force always acts perpendicular to the force vector Reason: $\overrightarrow{\tau} = \overrightarrow{r} \times \overrightarrow{F}$

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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238. Assertion: A judo fighter in order to throw his opponent on to the mat tries to initially bend his opponent and then rotate him around his hip.

Reason: As the mass of the opponent is brought closer to the fighter's hip, the force required to throw the opponent is reduced.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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239. Assertion: The angular momentum of a body always acts perpendicular to the position vector. Reason: $\overrightarrow{L} = \overrightarrow{r} x \overrightarrow{p}$

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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240. Assertion : For a system of particles under central force field the total angular momentum is conserved. Reason : The torque acting on such a system is zero

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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241. Assertion: A helicopter must necessarily have two propellers. Reason : Two propellers are provided in helicopter in order to conserve momentum.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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242. Assertion : Moment of inertia of a body depends on its mass and size only. Reason :

Irrespective of the location of the axis of rotation, inertness to the rotational motion (on applying an external torque) is determined by the mass and size of the body.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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243. Assertion : Moment of inertia of a body depends on the manner, in which mass is distributed about the axis of rotation Reason : Moment of inertia of a body will be more, if the heavier mass is distributed away from the axis of rotation and the lighter mass near it

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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244. Assertion: When a sphere slips down an inclined plane, its kinetic energy is partly translational and partly rota tional in nature. Reason: When a sphere slips down an inclined plane, it possesses both translational and rotational motions.

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

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

assertion.

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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245. Assertion: When a sphere slips down an inclined plane, its kinetic energy is partly translational and partly rota tional in nature. Reason: When a sphere slips down an inclined plane, it possesses both translational and rotational motions.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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246. Assertion: The velocity of a body at the bottom of an inclined plane of given height is more than when it slides down the plane, compared to, when it rolls down the same plane.

Reason: In rolling down, a body acquires, both kinetic energies of translational and rotational motions.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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247. Assertion: There are very small sporadic changes in the period of rotation of the earth

Reason: Shifting of large air masses in the earth's atmosphere produce a change in the moment of inertia of the earth causing its period of rotation to change

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

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

assertion.

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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248. Assertion: The earth is slowing down and as a result the moon is coming nearer to it. Reason: The angular momentum of the earth moon system is not conserved.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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249. Assertion: If polar ice melts, the days will be shorter. Reason: Moment of inertia decreases and thus angular velocity increases.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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250. Assertion: If ice caps of the pole melts, the day length will shorten. Reason: Ice flows towards the equator and decreases the moment of inertia of the earth and hence increases the frequency of rotation of the earth.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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251. Assertion: If polar ice melts, the days will be shorter. Reason: Moment of inertia decreases and thus angular velocity increases.

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

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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252. Assertion: The speed of a whirlwind in a tornado is alarmingly high. Reason: If no external torque acts on a body, its angular velocity remains conserved.

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

assertion.

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

C. if assertion is true, but reason is false.

D. if both assertion and reason are false.

Answer:

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253. A small disc of radius 2 cm is cut from a disc of radius 6cm. If the distance between their centres is 3.2 cm, what is the shift in the centre of mass of the disc?

A. 0.4 cm

B. 2.4 cm

C. 1.8 cm

D. 1.2 cm

Answer:

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254. If vectors $\vec{A}$ and $\vec{B}$ have angle between them, then the vector product has magnitude

A. $AB\cos\theta$

B. $AB\sin\theta$

C. AB

D. $A \times B\cos\theta$

Answer:

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255. In which of the following cases, the use of angular velocity is useful?

A. When velocity is in a straight lines

B. When a body is rotating

C. When with a constant linear acceleration

D. none of these

Answer:

256. A solid cylinder of mass 20 kg rotates about its axis with angular speed $100 rad s^{-1}$. The radius of the cylinder is 0.25 m. 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. 3025 J

B. 3125 J

C. 3225 J

D. 3250 J

Answer:

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257. A satellite of mass m in is circulating around the earth with constant angular velocity ω. If radius of the orbit is R and mass of earth is M, then angular momentum of satellite is

A. $M\sqrt{G\frac{m}{R}}$

B. $m\sqrt{G\frac{m}{R}}$

C. $m\sqrt{GmR}$

D. $M\sqrt{GmR}$

Answer:

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258. The moment of inertia of a body comes into play

A. in motion along a curved path.

B. in linear motion

C. in rotational motion

D. none of the above

Answer:

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259. The moment of inertia of a rigid body, depends upon

A. distribution of mass from axis of rotation

B. angular velocity of the body

C. angular acceleration of the body

D. mass the body

Answer:

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260. The moment of inertia of a regular circular disc of mass 0.4 kg and radius 1 m about the axis perpendicular to the plane of the disc and passing through its centre is

A. $0.002kgm^2$

B. $0.02kgm^2$

C. $0.2kgm^2$

D. $2.0kgm^2$

Answer:

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261. A cylinder of 500 g and radius 10 cm has the moment of inertia about its natural axis passing through its centre and parallel to its length is

A. $6.5 \times 10^{-3} kgm^2$

B. $2.5 \times 10^{-3} kgm^2$

C. $5.2 \times 10^{-3} kgm^2$

D. $7.1 \times 10^{-3} kgm^2$

Answer:

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262. 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. ML^2

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

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

D. $\left(\frac{3}{4}\right)ML^2$

Answer:

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263. A wheel of 6 kg mass and 0.40 m radius of gyration is making 300 r.p.m. Its moment of inertia will be

A. $9.6kgm^2$

B. $2.4kgm^2$

C. $0.96kgm^2$

D. $96kgm^2$

Answer:

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264. A cord is wound round the circumference of wheel of radius r. The axis of the wheel is horizontal and fixed and moment of inertia about it is I. A weight mg is attached to the end of the cord and falls from rest. After falling through a distance h, the angular velocity of the wheel will be.

A. $\sqrt{2gh}$

B. $\sqrt{\dfrac{2Mgh}{1+2MR^2}}$

C. $\sqrt{\dfrac{2Mgh}{1+MR^2}}$

D. $\sqrt{\dfrac{2gh}{1+MR}}$

Answer:

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265. If radius of the earth contracts to half of its present value without change in its mass, what will be the new duration of the day?

A. 6h

B. 12h

C. 18h

D. 48h

Answer:

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266. A circular disc is rotating with angular velocity ω. If a man standing at the edge of the disc walks towards its centre then the angular velocity of the disc will.

A. decrease

B. increase

C. be halved

D. no changes

Answer:

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

A. $30ms^{-1}$

B. $20ms^{-1}$

C. $10ms^{-1}$

D. $5ms^{-1}$

Answer:

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268. A smooth sphere A is moving on a frictionless horizontal plane with angular speed omega and centre of mass velocity v . It collides elastically and head on with an identical sphere B at rest. Neglect friction everywhere. After the collision, their angular speeds are ω_A and ω_B respectively. Then

A. $\omega_A < \omega_B$

B. $\omega_A = \omega_B$

C. $\omega_A = \omega$

D. $\omega_B < \omega$

Answer:

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

A. the radius

B. the tangent to the orbit

C. line at an angle of 45° to the axis of rotation

D. the axis of rotation

Answer:

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270. A mass M is moving with a constant velocity parallel to X-axis. Its angular momentum w.r.t origin

A. goes on increasing

B. goes on decreasing

C. remains constant

D. is zero.

Answer:

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271. A particle of mass m is projected with 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 the particle is at maximum height is :

A. 0

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

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

D. $m\sqrt{2gh^3}$

Answer:

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272. The torque $\vec{\tau}$ on a body about a given point is found to be equal to $\vec{A}\,x\,\vec{L}$, where A is a constant vector and L is the angular momentum of the body about that point. From this it follows that

A. $\frac{\overrightarrow{dL}}{dt}$ is perpendicular to `vec L at all instants of time

B. the component of $\vec{L}$ in the direction of A does not change with time.

C. the magnitude of L does not change with time

D. $\overrightarrow{L}$ does not change with time

Answer:

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273. A particle moves in a circular path with decreasing speed. Choose the correct statement:

A. Angular momentum remains constant

B. Acceleration $\overrightarrow{a}$ is towards the centre

C. Particle moves in a spiral path with decreasing radius

D. The direction of angular momentum remains constant

Answer:

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274. 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. 2L

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

C. 4L

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

Answer:

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275. The kinetic energy K of the particle moving in a circle of radius R depends upon the distance (s) covered as $K = as^2$. The force acting on the particle is :

A. $\left(2aS^2\right)/R$

B. $\left(2aR^2\right)/S$

C. 2aS

D. $2aS\left(1+S^2/R^2\right)^{\frac{1}{2}}$

Answer:

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276. The driver of a car suddenly sees a broad wall in front of him. He should

A. brake sharply

B. turn sharply.

C. (A) and (B) both

D. None of the above

Answer:

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277. A thin ring of mass 2kg and radius 0.5 m is rolling without slipping on a horizontal plane with velocity $1\frac{m}{s}$. A small ball of mass 0.1kg, moving with velocity $20\frac{m}{s}$ in the opposite direction hits the ring at a height of 0.75m and goes vertically up with velocity $10\frac{m}{s}$.

Immediately after the collision

A. the ring has pure rotation about its stationary C. M.

B. the ring comes to a complete stop.

C. friction between the ring and the ground is to the left.

D. There is no friction between the ring and the ground

Answer:

Watch Video Solution

Watch Video Solution

278. A solid cylinder rolls up an inclined plane of angle of inclination 30°. At the bottom of the inclined plane the centre of mass of the cylinder has a speed of $5m/s$:- How far will the cylinder go up the plane?

A. up the incline, while ascending and down the incline, while descending

B. up the incline, while ascending as well as descending

C. down the incline, while ascending and up the incline, while descending

D. down the incline, while ascending as well as descending

Answer:

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279. Statement 1. Two cylinders, one hollow (metal) and the other solid (wood) with the same mass and identical dimensions are simultaneously allowed to roll without slipping down an inclined plane from the same height. The hollow cylinder will reach the bottom of the inclined plane first. Statement 2. By the principle of conservation of energy, the total kinetic energies of both the cylinders are identical, when they reach the bottom of the inclined plane.

A. Statement 1 is true, statement 2 is true, statement 2 is correct explanation for statement 1

B. Statement 1 is true, statement 2 is true, statement 2 is not a correct explanation for statement 1.

C. Statement 1 is true, statement 2 is false

D. Statement 1 is false, statement 2 is true.

Answer:

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280. A particle undergoes uniform circular motion. About which point on the plane of the circle, will the angular momentum of the particle remain conserved?

A. centre of the circle

B. inside the circle

C. outside the circle

D. on the circumference of the circle

Answer:

Watch Video Solution

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

A. I

B. $I \sin^2 \theta$

C. $I \cos^2 \theta$

D. $I \cos^2$theta/2

Answer:

Watch Video Solution

282. A circular platform is free to rotate in a horizontal plane about a vertical axis passing through its centre. A tortoise is sitting at the edge of the platform. Now the platform is given an angular velocity ω_0. When the tortoise move along a chord of the platform with a constant velocity (with respect to the platform), the angular velocity of the platform will vary with time t as

A.

B.

C.

D.

Answer:

$(\#\#MDN_SKG_PHY_XI_P2_UT_{05}-S07_{031}-O01\#\#)$

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283. 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. 2K

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

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

D. 4K

Answer:

Watch Video Solution

284. If the distance between the earth and the sun were half its present value the number of days in a year would have been

A. 64.5

B. 129

C. 182.5

D. 730

Answer:

Watch Video Solution

285. The centre of mass of a system shall be

A. at the centre of system

B. outside the system

C. inside the system

D. inside or outside the system

Answer:

Watch Video Solution

Watch Video Solution

286. Unit of centre of mass in SI in

A. m

B. kgm^2

C. kg m

D. kg

Answer:

Watch Video Solution

287. A shell at rest explodes. The centre of mass of the fragments

A. moves along a parabolic path

B. moves along an elliptical path

C. moves along a straight line

D. remains at rest

Answer:

Watch Video Solution

288. The separation between carbon and oxygen molecules in CO is 0.12 m. What is the distance of the centre of mass from the carbon atom.

A. 0.03nm

B. 0.05nm

C. 0.07nm

D. 0.06nm

Answer:

Watch Video Solution

289. Consider a system of two identical particles. One of the particles is at rest and the other has and acceleration $\vec{a}$. The centre of mass has acceleration

A. zero

B. $\left(\frac{1}{2}\right)\vec{a}$

C. $\vec{a}$

D. $2\vec{a}$

Answer:

Watch Video Solution

290. Two balls are thrown simultaneously in air. The acceleration of centre of mass of the two balls while in air

A. depends on the direction of the motion of the balls

B. depends on the masses of the two balls

C. depends on the speeds of the two balls

D. is equal to g

Answer:

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291. The magnitude of the vector product of two vectors $\overrightarrow{A}$ and $\overrightarrow{B}$ may be

A. greater than AB

B. equal to AB

C. less than AB

D. equal yo zero

Answer:

Watch Video Solution

292. If $\vec{A}.\vec{B} = \left|\vec{A} \times \vec{B}\right|$ then the angle between $\vec{A}$ and $\vec{B}$ is

A. 0

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

C. π

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

Answer:

Watch Video Solution

293. The magnitude of the vector product of two vectors $\vec{A}$ and $\vec{B}$ equals the scalar product. The square of some of these vectors is

A. $\left(\frac{1}{\sqrt{2}}\right)(A+B)$

B. $A^2+B^2+\left(\frac{1}{\sqrt{2}}\right)AB$

C. "$A^2+B^2+\sqrt{2}AB$ "

D. "$A^2+B^2+\left(\frac{1}{2}\right)AB$ "

Answer:

Watch Video Solution

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

A. continues in its state of rest or uniform motion along the straight line

B. gets linear acceleration

C. gets angular acceleration

D. rotates at a constant speed

Answer:

Watch Video Solution

295. If there is no external force acting on a nonrigid body, which of the followhng quantities must remain constant?

A. angular momentum

B. linear momentum

C. kinetic energy

D. moment of inertia

Answer:

Watch Video Solution

296. The moment of momentum is called

A. couple

B. torque

C. impulse

D. angular momentum

Answer:

Watch Video Solution

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

A. mass and angular velocity

B. centripetal force and radius

C. linear velocity and angular velocity

D. moment of inertia and angular velocity

Answer:

Watch Video Solution

298. The unit of angular momentum is

A. Nm

B. $kgm^{-1}s^{-1}$

C. kgm^2s^{-1}

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

Answer:

Watch Video Solution

299. Relation between torque and angular momentum is similar to the relation between

A. Energy and displacement

B. Acceleration and velocity

C. Mass and moment of inertia

D. Force and linear momentum

Answer:

Watch Video Solution

300. In the absence external torque on a system, which of the following will not change

A. linear momentum only

B. angular momentum only

C. both linear and angular momentum

D. neither linear and angular momentum

Answer:

Watch Video Solution

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

A. force

B. linear momentum

C. angular momentum

D. linear impulse

Answer:

Watch Video Solution

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

A. 3

B. 6

C. 9

D. 12

Answer:

Watch Video Solution

303. A sphere is rolled on a rough horizontal surface. It gradually slows down and then stops. The force of friction tries to

A. decrease the linear velocity

B. increase the angular velocity

C. increase the linear velocity

D. decrease the angular velocity

Answer:

Watch Video Solution

304. The moment of inertia of a body does not depend upon

A. axis of rotation

B. mass

C. distribution of mass

D. angular velocity

Answer:

Watch Video Solution

305. The mass of a flywheel is concentrated at its rim so as to have

A. to increase the moment of inertia

B. to decrease the moment of inertia

C. to obtain stable equilibrium

D. to obtain a strong wheel

Answer:

Watch Video Solution

306. The radius of gyration of a body having uniform distribution of mass is independent of

A. mass of the body

B. nature of distribution of mass

C. axis of rotation

D. none of the above

Answer:

Watch Video Solution

307. If M is the mass of the disc and R is radius of gyration then moment of inertia is given by

A. MR^2

B. $\left(\frac{1}{2}\right)MR^2$

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

D. $\left(\frac{5}{2}\right)MR^2$

Answer:

Watch Video Solution

308. The radius of gyration of a ring of radius R about an axis through its centre and perpendicular to its plane is

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

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

C. R

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

Answer:

Watch Video Solution

309. Which of the following type of wheels of the same mass and radius will have largest moment of inertia?

A. ring

B. annular disc

C. solid disc

D. cylindrical disc

Answer:

Watch Video Solution

310. Find the expression for moment of inertia of a thin uniform rod about an axis passing through its centre and perpendicular to its length

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

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

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

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

Answer:

Watch Video Solution

311. Two circular disc have masses in the ratio 1:2 and diameter in the ratio 2:1. The ratio of their moment of inertia

A. 1

B. 2

C. 4

D. 8

Answer:

Watch Video Solution

312. 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.

A. $\left(\frac{2}{3}\right)MR^2$

B. $\left(\frac{2}{5}\right)MR^2$

C. $\left(\frac{7}{5}\right)MR^2$

D. $\left(\frac{5}{3}\right)MR^2$

Answer:

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313. A homogeneous disc of mass 2 kg and radius 15 cm is rotating about its axis(which is fixed) with an angular velocity $4 rad s^{-1}$. The linear momentum of the disc is

A. $1.2 kg m s^{-1}$

B. $1.0 kg m s^{-1}$

C. $0.6 kg m s^{-1}$

D. none of the above

Answer:

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314. If I, α and τ are moment of inertia, angular acceleration and torque respectively of a body rotating about an axis with angular velocity o, then

A. $\tau = I\alpha$

B. $\tau = I\omega$

C. $I = \tau\omega$

D. $\alpha = I\omega$

Answer:

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315. The angular momentum of a body of moment of inertia I is L. its kinetic energy is

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

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

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

D. $\left(\frac{1}{2}\right)IL^2$

Answer:

Watch Video Solution

316. The total kinetic energy of a thin circular ring of mass M rolling on a smooth horizontal table with uniform linear speed v is

A. $\left(\frac{1}{2}\right)Mv^2$

B. $\left(\frac{1}{4}\right)Mv^2$

C. $\left(\frac{3}{4}\right)Mv^2$

D. Mv^2

Answer:

Watch Video Solution

317. If a gymnast sitting on a rotating stool with his arms stretched suddenly lower his hands,

A. the angular velocity decreases

B. his moment of inertia decreases

C. the angular velocity stays constant

D. the angular velocity increases

Answer:

Watch Video Solution

318. A man is standing at the centre of a rotating turn table with his arms stretched. If he draws his arms inwards and hereby reduces its moment of inertia by a factor k the angular speed of the turn table

A. remains constant

B. increases by a factor k

C. decreases by a factor of k

D. decreases by a factor of k^2

Answer:

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319. Spokes are used in cycle wheel

A. to increase the strength of the wheel

B. to increase the moment of inertia of the wheel

C. to give better shape to the wheel

D. none of these

Answer:

Watch Video Solution

320. The moment of inertia about the symmetry axis of a solid circular disc of radius r equals that of a hollow disc (same material and same mass) with internal and external radii r and R respectively. Then

A. R=1.189r

B. R=1.414r

C. R=1.257r

D. R=0

Answer:

Watch Video Solution

321. Statement 1. Two cylinders, one hollow (metal) and the other solid (wood) with the same mass and identical dimensions are simultaneously allowed to roll without slipping down an inclined plane from the same height. The hollow cylinder will reach the bottom of the inclined plane first. Statement 2. By the principle of conservation of energy, the total kinetic energies of both the cylinders are identical, when they reach the bottom of the inclined plane.

A. the solid sphere reaches the bottom first

B. the solid sphere reaches the bottom last

C. disc will reach the bottom first

D. all reach the bottom at the same time

Answer:

Watch Video Solution

322. A sphere cannot roll on

A. a smooth and horizontal surface

B. a rough and horizontal surface

C. a smooth inclined surface

D. a rough inclined surface

Answer:

Watch Video Solution

323. A disc is rolling, the velocity of its centre of mass is $v_{c.m.}$. Which one of the following will be correct?

A. the velocity of the highest point is $2v_{c.m.}$ and that of the point of contact is zero

B. the velocity of both the highest point and the point of contact is $v_{c.m.}$.

C. the velocity of the highest point is $2v_{c.m.}$ and that of the point of contact is $v_{c.m.}$

D. the velocity of the highest point and the point of contact is $2v_{c.m.}$

Answer:

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Exercise

1. Define moment of inertia

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2. What is the moment of inertia of a ring

Watch Video Solution

3. Define radius of gyration.

Watch Video Solution

4. What do you mean by radius of gyration? Derive an expression for it.

Watch Video Solution

5. Define moment of inertia

Watch Video Solution

6. Define radius of gyration.

Watch Video Solution

7. What is physical significnce of moment of inertia?

Watch Video Solution

8. Define moment of inertia

Watch Video Solution

9. On what factors does the moment of inertia depend?

Watch Video Solution

10. On what factors does the moment of inertia depend?

Watch Video Solution

11. Explain, what do you mean by the moment of inertia of a body.

Watch Video Solution

12. Define moment of inertia

Watch Video Solution

13. Prove the theorem of parallel axes.

Watch Video Solution

14. State Theorem of perpendicular axis.

Watch Video Solution

Watch Video Solution

15. Derive the expression for moment of inertia of a circular disc about an axis passing through its centre and perpendicular to its plane

Watch Video Solution

16. Derive the expression for moment of inertia of a circular disc about an axis passing through its centre and perpendicular to its plane

Watch Video Solution

17. Derive the expression for moment of inertia of a circular disc

about the diameter of the disc.

Watch Video Solution

18. Derive the expression for moment of inertia of a circular disc

about an axis passing through its centre and perpendicular to its plane

Watch Video Solution

19. State the two theorems of moment of inertia. Give an example of the application in each case.

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20. Define perpendicular axis theorem of moment of inertia.

Watch Video Solution

21. give the relation between moment of inertia and torque on a rigid body.

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22. Which physical quantities are represented by the following ?

i) Product of moment of inertia and the angular velocity:

ii) Product of moment of inertia and the angular acceleration.

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23. Establish the relation between torque and angular acceleration.

Watch Video Solution

24. Find the relation between angular momentum and lever arm.

Watch Video Solution

25. Deduce the relation between torque and moment of inertia.

Watch Video Solution

26. Deduce the relation between torque and moment of inertia.

Watch Video Solution

27. Derive the expression for angular momentum in three dimensions.

Watch Video Solution

28. Derive relation between kinetic energy of rotation and moment of inertia.

Watch Video Solution

29. Find an expression for the rotational kinetic energy of a body.

Watch Video Solution

30. Derive relation between kinetic energy of rotation and moment of inertia.

Watch Video Solution

31. Show that the moment of a body about the given axis of rotation is equal to twice of the kinetic energy of rotation of the body rotating with unit angular velocity.

Watch Video Solution

32. Define moment of inertia

Watch Video Solution

33. Derive a relation between angular momentum and torque.

Watch Video Solution

34. In rotational motion power is the product of torque and -----

Watch Video Solution

35. A body of moment of inertia I is rotating with an angular velocity ω_1, about a certain axis. Derive an expression for work done by a torque in increasing its angular velocity ω_2 about the same axis of rotation.

Watch Video Solution

36. State the principle of conservation of angular momentum.

Watch Video Solution

37. Write the unit of angular momentum.

Watch Video Solution

38. Define radius of gyration.

Watch Video Solution

39. State the law of conservation of angular momentum.

Watch Video Solution

Watch Video Solution

40. State the principle of conservation of angular momentum.

Watch Video Solution

41. State the principle of conservation of angular momentum.

Watch Video Solution

42. A block is in limiting equilibrium on an inclined plane of angle theeta ,Then ,the coefficient of friction is :

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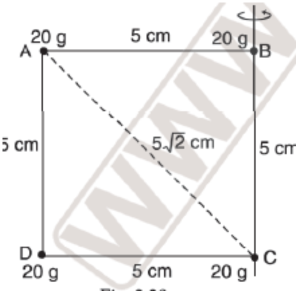
43. Four small bodies A, B, C and D which can be considered as particles are connected by rods of negligible masses as shown in Fig. Find the M.I. of the system about an axis passing through A and perpendicular to the plane of diagram.



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44. Four masses each of 2 kg are placed on a horizontal disc of negligible mass, which can be rotated about a vertical axis passing through its centre. If all the masses be equidistant from the axis and at the distance of 10 cm from it, what is moment of inertia of the whole system?

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45. Find the moment of inertia of a rod of length 0.5 m and mass 0.2 kg about an axis passing through its centre and being perpendicular to its length.

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46. Find the moment of inertia of a rod of length 0.5 m and mass 0.2 kg about an axis through one end of the rod, the axis being perpendicular to its length.

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47. The mass of a straight uniform rod is 40 g. Find the length of the rod, whose moment of inertia about an axis passing through its centre and perpendicular to its length is $1,080 gcm^2$. Also calculate the radius of gyration of the rod about the same axis.

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48. Find the moment of inertia of a rod of length 0.5 m and mass 0.2 kg about an axis passing through its centre and being perpendicular to its length.

Watch Video Solution

49. Use the theorem of parallel axis to calculate moment of inertia of a disc of mass 400 g and radius 7 cm about an axis passing through its edge and perpendicular to the plane of the disc.

Watch Video Solution

50. The moment of inertia of a thin rod about an axis passing through its centre and perpendicular to its length is $1,200gcm^2$. If length of the rod is 20 cm, find its moment of inertia about an axis passing through its one end and perpendicular to its length.

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51. Show that the radii of gyration of a circular ring and circular disc of the same radius about an axis passing through their centres and perpendicular to their plane are in the ratio $\sqrt{2} : 1$

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52. show that the radii of gyration of a circular disc and a circular ring of the same radius about a tangential axis in the plane of the ring is $\sqrt{5} : \sqrt{6}$

Watch Video Solution

53. A torque of 10^8 dyne - cm is applied to a fly wheel of mass 10 kg and radius of gyration 50 cm. What is the resultant angular acceleration ?

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54. A grindstone has a moment of inertia of $50kgm^2$. A constant torque is applied and the grindstome is found to have a speed of 150 rpm 10 s after starting from rest. Calculate the torque applied.

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55. A constant torque of 20 N m is exerted on a pivoted wheel for 10 seconds during which, the angular velocity of the wheel changes from zero to 100 r.p.m. When torque is removed, it is stopped by friction in 110s. Find the M.I. of the wheel

Watch Video Solution

56. A constant torque of 20 N m is exerted on a pivoted wheel for 10 seconds during which, the angular velocity of the wheel changes from zero to 100 r.p.m. When torque is removed, it is stopped by friction in 110s. Find the M.I. of the wheel

Watch Video Solution

57. A constant torque of 20 N m is exerted on a pivoted wheel for 10 seconds during which, the angular velocity of the wheel changes from zero to 100 r.p.m. When torque is removed, it is stopped by friction in 110s. Find the M.I. of the wheel

Watch Video Solution

58. A symmetrical body is rotating about its axis its moment of inertia about the axis of rotation being $1kgm^{-2}$ and its rate of rotation 2 r.p.s. What is the angular momentum?

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59. A symmetrical body is rotating about its axis its moment of inertia about the axis of rotation being $1kgm^{-2}$ and its rate of rotation 2 r.p.s. What is the angular momentum?

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60. How much tangential force would be needed to stop the earth in one year, if it were rotating with angular velocity of $7.3 \times 10^{-5} rads^{-1}$? Given the moment of inertia of the earth = $9.3 \times 10^{37} kgm^2$ and radius of the earth = $6.4 \times 10^6 m$

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61. An automobile moves on a road with a speed of $54kmh - 1$ .The radius of its wheels is 0.45 m. What is the torque transmitted by its brakes to a wheel, if the vehicle is brought to rest in 15 s. The moment of inertia of the wheel about its axis of rotation is $3kgm^2$

Watch Video Solution

62. A 40 kg flywheel in the form of a uniform circular disc 1 m in radius is making 120 revolutions per minute. Calculate the angular momentum. Given that M.I. of a disc= $\frac{1}{2} \times mass \times radius^2$

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63. Calculate the angular momentum of the spherical earth rotating about its own axis, if the mass of earth is5.98x10^24 kg and mean radius of the earth is 6.38 x 10^6 m. Given that M.I. of a sphere =$\frac{2}{5} \times mass \times radius^2$

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64. A rod revolving 60 times in a minute about an axis passing through an end at right angles to the length has kinetic energy of 400 J. Find moment of inertia of the rod.

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65. A disc of mass 200 kg and radius 0-5 m is rotating at the rate of 8 r.p.s. Find the work done to bring the disc to rest. If the disc is stopped in 11 rotations, calculate the breaking torque.

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66. A solid circular disc of mass 2500 kg and 0.5 m radius is rotating about an axis passing through its centre and perpendicular to its plane making 120 r.p.m. Calculate its kinetic energy.

Watch Video Solution

67. A solid circular disc of mass 2500 kg and 0.5 m radius is rotating about an axis passing through its centre and perpendicular to its plane making

120 r.p.m. Find the torque required, if the disc is brought to rest in 2 s.

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68. The earth has a mass of $6 \times 10^{24} kg$ and a radius of $6.4 \times 10^{6} m$. Calculate the amount of work done, if its rotation were to be slowed down so that the duration of the day becomes 30 h.

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69. Calculate the angular momentum and the rotational kinetic energy of the earth about its own axis. How long could this amount of energy supply 1 kW power to each of $3.5x10^9$ persons on earth? Given, mass of the earth = $6.0 \times 10^{24} kg$, radius of the earth = $6.4 \times 100 m$.

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70. A disc of mass 5 kg and radius 0.5 m rolls on the ground at the rate of $10 ms^{-1}$ Calculate the kinetic energy of the disc.

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71. A solid sphere is rolling on a frictionless plane surface about its axis of symmetry. Find the ratio of its rotational energy to its total energy

Watch Video Solution

72. A solid sphere is rolling on a frictionless plane surface about its axis of symmetry. Find the ratio of its translational energy to rotational energy

Watch Video Solution

73. A star of mass 2 M, (two solar masses) and radius 10 ^6km rotates about its axis with an angular speed of 10^-6 rad s What is the angular speed of the star, when it collapses (due to inward gravitational forces) to a radius of 10^4 km?

Watch Video Solution

74. If the earth suddenly contracts to one third of its present radius, calculate by how much would

the day be shortened?

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75. The sun rotates around itself once in 27 days. What will be the period of its revolution, if the sun were to expand twice its present radius? Consider the sun to be a sphere of the uniform density.

Watch Video Solution

76. A rope of negligible mass is wound round a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30 N ? What is the linear acceleration of the rope ? Assume that there is no slipping.

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77. A rope of negligible mass is wound round a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30 N ? What is the linear acceleration of the rope ? Assume that there is no slipping.

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78. A cylinder of mass 5 kg is rolling on a plane of inclination 45° Find the force of friction between the cylinder and the surface of the inclined plane.

Watch Video Solution

79. A diatomic molecule consists of two atoms of masses m_1 and m_2. The two atoms are separated by a distance from each other. Calculate the M.I of the system about an axis passing through the centre of mass of the system and perpendicular to the line joining the atoms.

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80. Four sphere each of mass 10 kg and of radius 20 cm are placed at the four cornes of a square of side 100 cm. Calculate the moment of inertia of the system about an axis coinciding with side of the square (given moment of inertia of sphere $= \frac{2}{5}MR^2)$

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81. A point mass is tied to one end of a cord, whose other end passes through a vertical hollow tube, caught in one hand The point mass is being rotated in a horizontal circle of radius 2 m with a speed of $4ms^{-1}$. The cord is then pulled down, so that the radius of the circle reduces to 1 m Compute the new linear and angular velocities of the point mass and compare the kinetic energy under the final and initial states

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82. A uniform solid sphere rolls on a horizontal surface at $20ms^{-1}$ It, then, rolls up a plane inclined at 30° to the horizontal. Find the height up to which the sphere will rise Friction losses may be neglected

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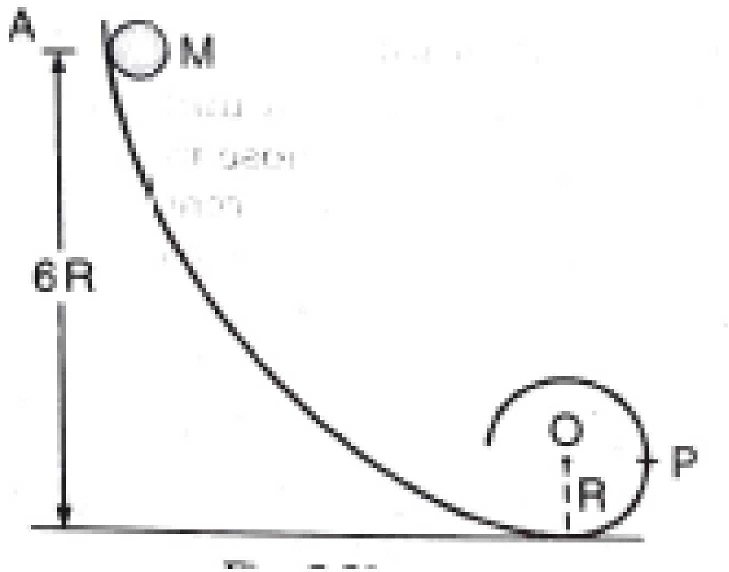
83. The Fig. shows a loop track, whose lower part ends into a circular track of radius R and centre O. A small solid sphere of mass M rolls without slipping along the loop track from the end A at height 6 R from the bottom of the track. Calculate the horizontal and vertical forces acting on the sphere, when it rises up to the point P in level with the centre O of the circular part.



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84. A metre stick is held vertically with one end on the floor and then allowed to fall.The speed of the other end when it hits the floor(assuming that the lower end does not slip) is :

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