PHYSICS

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MOTION OF SYSTEM OF PARTICLES AND BODIES

Textbook Questions Answers Multiple Choice Questions

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

A. position of particles

B. relative distance between particles

C. masses of particles

D. force acting on particle

Answer: D

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2. A couple produces _______ motion.

A. pure rotation

B. pure translation

C. rotation and translation

D. no motion

Answer: A

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3. A particle is moving with a contant velocity along a line parallel to positive X-axis. The magnitude of its angular momentum with respect of the origin is

A. zero

B. increasing with x

C. decreasing with x

D. remaining constant

Answer: D

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4. A rope 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.

A. $0.25 \text{rad} s^{-2}$

B. $25 \text{rad} s^{-2}$

C. $5 ms^{-2}$

D. $25 ms^{-2}$

Answer: B

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5. A closed cylindrical container is partially filled with water. As the container rotates in a horizontal plane about a perpendicular bisector, its moment of inertia.

A. increases

B. decreases

C. remains constant

D. depends on direction of rotation

Answer: A

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6. A rigid body rotates with an angular momentum L. If its kinetic energy is halved, the angular momentum becomes,

A. L

B. L/2

C. 2L

D. $L/\sqrt{2}$

Answer: D

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7. A particle undergoes uniform circular motion. The angular momentum of the particle remain conserved about:

A. the centre point of the circle

B. the point on the circumference of the circle

C. any point inside the circle

D. any point outside the cicle

Answer: A

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

A. a line perpendicular to the plane of rotation

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

C. the radius

D. tangent to the path

Answer: A

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9. Two discs of same moment of inertia rotating about their regular axis passing through centre and perpendicular to the plane of disc with angular velocities ω_1 and ω_2. They are brought in to contanct face to face coinciding the axis of rotation. The expression for loss of energy during this process is

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

B. $1(\omega_1 - \omega_2)^2$

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

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

Answer: A

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10. From a disc of radius R a mass M, a circular hole of diameter R, whose rim passes through the centre is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis passing through it

A. $15MR^2/32$

B. $13M\frac{R^2}{32}$

C. $11M\frac{R^2}{32}$

D. $9MR^2/32$

Answer: B

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11. The speed of a solid sphere after rolling down from rest without sliding on an inclined plane of vertical height h is

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

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

C. $\sqrt{2gh}$

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

Answer: B

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12. The speed of the centre of a wheel rolling on a horizontal horizontal surface is v_0. A point on the rim in level with the centre will be moving at a speed of speed of:

A. zero

B. v_0

C. $\sqrt{2}v_0$

D. $2v_0$

Answer: C

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13. A round object of mass M and radius R rolls down without slipping along an inclined plane. The fractional force:

A. dissipates kinetic energy as heat

B. decreases the rotational motion

C. decreases the rotational and transnational motion

D. converts transnational energy into rotational energy

Answer: D

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A. zero

B. v_0

C. $\sqrt{2}v_0$

D. $2v_0$

Answer: C

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26. A drum of radius R and mass M, rolls down without slipping along an inclined plane of angle θ. The frictional force-

A. dissipates kinetic energy as heat

B. decreases the rotational motion

C. decreases the rotational and transnational motion

D. converts transnational energy into rotational energy

Answer: D

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Textbook Questions Answers Short Answer Questions

1. Define the center of mass of a body.

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2. Find out the center of mass for the given geometrical structures.

(a) Equilateral triangle

(b) Cylinder

(c) Square

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3. Define torque and mention its unit.

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4. What are the conditions in which force can not produce torque ?

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5. Give any two examples of torque in day-to-day life.

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6. What is the relation between torque and angular momentum?

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7. What is equilibrium ? (or) Define mechanical equilibrium of a rigid body.

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8. How do you distinguish between stable and unstable equilibrium?

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9. Define couple.

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10. State the principle of moments .

Watch Video Solution

11. Define centre of gravity.

Watch Video Solution

12. Mention any two physical significance of moment of inertia.

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13. What is the radius of gyration?

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14. State conservation of angular momentum.

Watch Video Solution

15. What are the rotational equivalents for the physical quantities (i) mass and (ii) force?

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16. What is the condition for perfect inelastic collision ?

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17. What is the difference between sliding and slipping ?

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33. What is the condition for pure rolling ?

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34. What is the difference between sliding and slipping ?

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Textbook Questions Answers Long Answer Questions

1. Explain the types of equilibrium with suitable examples

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2. Explain the method to find the centre of gravity of irregularly shaped lamina.

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3. Explain why a cyclist bends while negotiating a curve road?

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4. The moment of inertia of a Thin rod about and axis passing through the centre and perpendicular to the length is _______.

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5. Derive the expression for moment of inertia of a uniform ring about an axis passing thorugh the centre and perpendicular to the plane.

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6. Derive the expression for moment of inerita of a uniform disc about an axis passing through the centre and perpendicular to the plane.

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7. State conservation of angular momentum.

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8. State and prove parallel axis theorem

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9. State and prove perpendicular axis theorem.

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Textbook Questions Answers Conceptual Questions

1. When a tree is cut, the cut is made on the side facing the direction in which the tree is required to fall. Why?

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2. Why does a porter bend forward while carrying a sack of rice on his back ?

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3. Why is it much easier to balance a meter scale on your finger tip than balancing on a match stick ?

Watch Video Solution

4. Two identical water bottles one empty and the other filled with water are allowed to roll down an inclined plane. Which one of them reaches the bottom first ? Explain your answer.

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5. Write the relation between angular momentum and rotational kinetic energy. Draw a graph for the same. For two objects of same angular momentum, compare the moment of inertia using the graph.

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6. A rectangle block rests on a horizontal table. A horizontal force is applied on the block at a height h above the table to move the block. Does the line of action of the normal force N exerted by the table on block depend on h?

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7. Three identical solid spheres move doen through three inclined planes A,B and C all same dimensions. A is without friction B is undergoing pure rolling and C is rolling with slipping. Compare the kinetic energies E_A, E_B and E_C at the bottom.

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8. Give an example to show that the following statement is false. Any two forces acting on a body can be combined into single force that would have same effect.

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Textbook Questions Answers Numerical Problems

1. A uniform disc of mass 100 g has a diameter of 10 cm. Calculate the total energy of the disc when rolling along a horizontal table with a velocity of 20 cm s^{-1}. (take the surface of table as reference).

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2. A particle of mass 5 units is moving with a uniform speed of $v = 3\sqrt{2}$ units in the XOY plane along the line y = x + 4. Find the magnitude of angular momentum.

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3. A fly wheel rotates with a uniform angular acceleration. If its angular velocity increases form 20π rad/s to 40π rad/s in 10 seconds. Find the number of rotations in that period.

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4. A uniform rod of mass m and lengh l makes a constant angle θ with an axis of rotation which passes through one end of therod. Find the moment of inertia about this axis.

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5. Two particles P and Q of mass 1 kg and 3 kg respectively start moving towards each other form rest under mutual attraction. What is the velocity of their center of mass ?

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6. Find the moment of inertia of a hydrogen molecule about an axis passing through its center of mass and perpendicular to the interatomic axis. Given : mass of hydrogen atom 1.7×10^{-27} kg and inter atomic distance is equal to 4×10^{-10} m.

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Other Important Questions Answer Multiple Choice Questions

1. Centre of mass of the earth-moon system lies

A. closer to the earth

B. closer to the moon

C. at the mid point of line joining the earth and the moon

D. cannot be predicted

Answer: C

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2. Three masses 2kg, 4kg and 6kg are placed in the XY plane with respective coordinates (0,0), (0,2) and (2,2). The coordinate of their centre of mass is

A. (1,2)

B. (1,1.67)

C. (2,1.67)

D. (1.67,3)

Answer: B

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3. The Centre of mass of a solid cone along the line from the centre of the base to the vertex is at

A. one fourth of the height

B. one -third of the height

C. one-fifth of the height

D. none of these

Answer: A

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4. A particle undergoes uniform circular motion. The angular momentum of the particle remain conserved about:

A. inside the circle

B. outside the circie

C. centre of the circle

D. one the circumference of the circle

Answer: C

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5. The reduced mass of two particles having masses m and 2m is

A. 2m

B. 3m

C. 2m/3

D. m/2

Answer: C

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6. A couple produces _______ motion.

A. linear and rotational motion

B. no motion

C. purely linear motion

D. purely rotational motion

Answer: D

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7. 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 surround to it

B. iron at interior and aluminium surround to it

C. using iron and aluminiuml layers in alternate order

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

Answer: A

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8. A fly wheel is attached to an engine on order to

A. increase its speed

B. decrease its speed

C. help in overcoming the dead point

D. decrease its energy

Answer: C

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9. Which of the following statements is incorrect with reference to angular momentum?

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

A. constant force

B. constant linear momentum

C. constant torque

D. zero torque

Answer: D

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

A. $1/2MR^2$

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

C. $2MR^2$

D. MR^2

Answer: B

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11. Moment of inertia depends upon.................. and it does not depend upon................

A. torque applied and axis of rotation.

B. axis of rotation and point of application of force.

C. angular velocity and point of application of force.

D. angular momentum and distribution of mass

Answer: B::D

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12. Two discs of same material have the same mass. If their thickness are in the ratio $1:3$, then their moment of inertia are in the ratio

A. $1 : \sqrt{3}$

B. $1 : 3$

C. $3 : 1$

D. $1 : 9$

Answer: C

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13. M.I. of an object does not depend upon

A. mass of object

B. mass distribution

C. angular velocity

D. axis of rotation

Answer: C

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14. If a solid sphere and solid cylinder of same mass and radius rotate about their own axis the M.I. will be greater for

A. solid sphere

B. solid cylinder

C. both a and b

D. equal both

Answer: B

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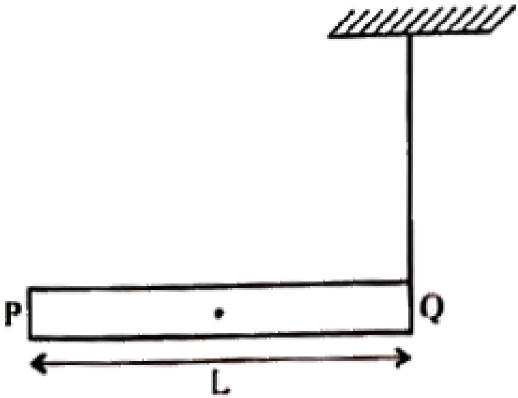
15. A rod PQ of mass M and length L is hinged at end P. The rod is kept horizontal by a mass less than string tied at a point Q as shown in figure. When string is cut, the initial acceleration rod is:



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

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

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

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

Answer: A

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16. 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: A

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17. If the external forces acting on a system have zero resultant, the centre of mass

A. may move but not accelerate

B. may not move

C. must not move

D. none of these

Answer: A

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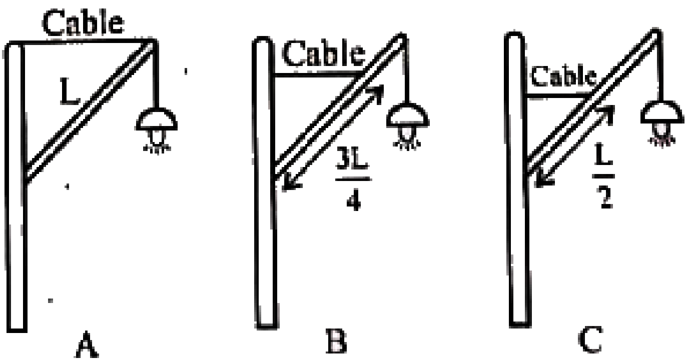
18. If a street light of mass M is suspended from the end of a uniform rod of length L in different possible patterns as shown in figure, then:



A. pattern A is more sturdy

B. pattern B is more sturdy

C. pattern C is more sturdy

D. all will have same sturdiness

Answer: A

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

A. position of the particles

B. relative distance between the particles

C. masseses of the particles

D. forces acting on the particles

Answer: D

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20. Assertion : If there is no external torque on a body about its centre of mass, then the velocity of the centre of mass remains constant.

Reason : The linear momentum of an isolated system remains constant.

A. Assertion and Reason are true and Reason is a correct explanation for Assertion.

B. Assertion and Reason are true and Reason is not a correct explanation for Assertion.

C. Assertion is true and Reason is false.

D. Assertion is false and Reason is true.

Answer: D

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21. A point in the system at which whole mass of the body is supposed to be concentrated is called:

A. centre of gravity

B. centre of mass

C. centre of energy

D. centre of buoyancy

Answer: B

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22. The location of the centre of mass of a sphere is at:

A. its top

B. its bottom

C. geometric centre

D. all the above

Answer: C

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23. when a child sits stationary at one end of a long trolley moving uniformly with some speed on a smooth horizontal plane. The speed of the centre of mass of system (child and trolley),

A. increases

B. decreases

C. remains same

D. changes

Answer: C

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24. Centre of mass of the body practically coincides with:

A. its centre of gravity

B. its centre of buoyancy

C. orthocentre

D. metacentre

Answer: A

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25. A fly wheel of moment of inertia $4 \times 10^{-3} kgm^2$ is makign 10 revolution per second. The torque required to stop it in 5 second is:

A. $4\pi \times 10^{-3} Nm$

B. $2\pi \times 10^{-4} Nm$

C. $8\pi \times 10^{-4} NM$

D. $16\pi \times 10^{-3} Nm$

Answer: D

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26. The mass of a body measures:

A. density

B. centre of mass

C. moment of inertia

D. inertia

Answer: D

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27. Identify the vector quantity among the following:

A. distance

B. angular momentum

C. heat

D. energy

Answer: B

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28. Angular momentum is .... Vector.

A. axial

B. polar

C. unit

D. unlike

Answer: A

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29. A diver in a swimming pool bends his head before diving. It

A. increases his linear velocity

B. decreases his angular velocity

C. increases his moments of inertia

D. decreases his moment of inertia

Answer: D

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30. Which one of the following statement is not correct?

A. Net torque produces turning motion in rigid object

B. when external torque is acting on a rigid body, the angular momentum remains constant.

C. Torque, is equal to rate of change of angular momentum.

D. Torque is the product of moment of inertia and angular acceleration of a body.

Answer: B

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31. When a steady torque is acting on a body, the body:

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

B. gets linear acceleration

C. gets angular acceleration

D. rotates at a constant speed

Answer:

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32. A circular turn table has a block of ice placed at its centre. The system rotates with an angular speed ω about an axis passing through the centre of the table. If the ice melts on its own without any evaporation, the speed of rotation of the system:

A. becomes zero

B. remains constant at the same value ω

C. increases to a value greater than ω

D. decreases to a value less than ω

Answer: D

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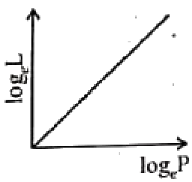
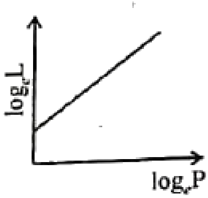
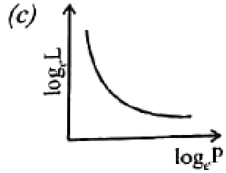
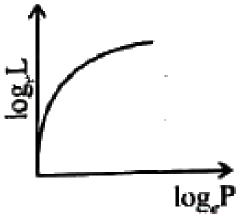
33. The curve betwee $\log_e L$ and $\log_e P$ is (L is the angular momentum and P is the linear momentum):

A. 

B. 

C. 

D. 

Answer: B

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34. A couple produces _______ motion.

A. pure linear motion

B. pure rotational motion

C. no motion

D. both linear and rotational motion

Answer: B

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35. A wheel is rotating at the rate of 10 revolutions per second about an axis about which the radius of gyration is 0.2m. If the mass of the wheel is 5 kg then its rotational kinetic energy is

A. 395 J

B. 295 J

C. 195 J

D. 250 J

Answer: A

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36. A particle is moving with a contant velocity along a line parallel to positive X-axis. The magnitude of its angular momentum with respect of the origin is

A. zero

B. remains constant

C. goes on increasing

D. goes on decreasing

Answer: B

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37. A particle undergoes uniform circular motion. The angular momentum of the particle remain conserved about:

A. centre of the circle

B. one the circumference of the circle

C. inside the circle

D. outside the circle

Answer: A

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38. A particle is confined to rotate in a circular path with decreasing linear speed. Then which of the following is correct?

A. $\vec{L}$ (angular momentum) is conserved about the centre

B. only direction of angular momentum $\vec{L}$ is conserved

C. it spirals towards the centre

D. its acceleration is towards the centre

Answer: B

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39. A solid sphere is rotationg in free space. If the radius of the sphere is increased keeping mass same, which one of the following will not be affected ?

A. Moment of inertia

B. Angular momentum

C. Angular velocity

D. Rotational kinetic energy

Answer: B

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40. A couple is acting on a two particle system. The resultant motion will be:

A. Purely rotational motion

B. purely linear motion

C. both a and b

D. neither a nor b

Answer: A

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41. Different types of equilibrium are given in column I. Match the types given in column I with conditions given in column II.

Column I	Column II
1. Translational	*(i)* Net torque and force are zero.
2. Rotational	*(ii)* Linear momentum is zero
3. Dynamic	*(iii)* Potential energy is minimum
4. Stable	*(iv)* Angular momentum is zero
	(v) Net torque is zero
	(vi) Net force is zero

A. i-iii, 2- I, 3-v, 4-vi

B. 1-vi,2-v,3-I,4-iii

C. 1-I,2-ii,3-iii,4-iv

D. 1-v,2-iii,3-I,4-ii

Answer: B

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42. Angular momentum is ....

A. moment of momentum

B. product of mass and angular velocity

C. product of M.I and velocity

D. moment of angular motion

Answer: A

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43. Which of the following is a vector quantity?

A. Angular momentum

B. Work

C. Potential energy

D. Electric current

Answer: A

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44. The dimensions of angular momentum are:

A. $[MLT^{-2}]$

B. $[ML^2T^{-1}]$

C. $[ML^2T^{-2}]$

D. $[ML^2T]$

Answer: B

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45. Analogue of mass in rotational motion is

A. gyration

B. angular momentum

C. moment of inertia

D. none of the above

Answer: C

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46. Identify the incorrect odd man out from the following expressions for moment of inertia,

A. Moment of inertia $I = Mk^2$

B. As per parallel axis theorem Moment of inertia $I = I_c + Md^2$

C. As per perpendicular axis theorem moment of inertia $I_Z = I_X + I_Y$

D. Moment of inertia $=$ Force/acceleration $= \frac{F}{a}$

Answer: D

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47. The angular momentum of a system of particles is conserved:

A. When no external force acts upon the system

B. When no external torque acts upon the system

C. When no external impulse acts upon the system

D. When axis of rotation remains the same

Answer: B

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48. If a person standing on a rotating disc stretches out his hands, the angular speed will

A. increases

B. decreases

C. remain same

D. none of these

Answer: B

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49. What quantities are conserved in this collision?

A. linear and angular momentum, but not kinetic energy

B. linear momentum only

C. angular momentum only

D. linear and angular momentum and linear but not rotational kinetic energy

Answer: B

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

A. 6

B. 6

C. 8

D. 7

Answer: C

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51. In an orbital motion, the angular momentum vector is

A. along the radius vector

B. parallel to the linear momentum

C. in the orbital plane

D. perpendicular to the orbital plane

Answer: D

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52. Statement 1: The angular momentum of a body moving in a circle with constant velocity remains conserved about any point on the circumference of the circle.

Statement 2: If the torque acting on the body is zero than its angular momentum is conserved.

Which one of thefollowing options is correct?

A. Statement 1 and 2 are true and statement 2 is a correct explanation for statement 1.

B. Statements 1 and 2 are true and statement 2 is not a correct explanation for statement 1.

C. Statement 1 is true and statement 2 is false.

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

Answer: D

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53. The direction of angular velocity vector is along:

A. the tagent to the circular path

B. the inward radius

C. the outward radius

D. the axis of rotation

Answer: D

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54. The angular momentum of a moving body remains constant if

A. net external force is applied

B. net pressure is applied

C. net external torque is applied

D. net external torqu is not applied

Answer: D

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55. Assertion: Friction is necessary for abody to roll on a surface.

Reason:Friction provides the necessary tangential force and torque.

Which one of the following statement is correct?

A. Assertion and reason are treu and reason explains assertion correctly.

B. Assertion and reason are true. But reason does not explain assertion correctly.

C. Assertion is true but reason is false.

D. Assertion is false but reason is true.

Answer: A

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56. A body is projected from the ground with some angle to the horizontal. What happens to the angular momentum about the initial position in tis motion?

A. decreases

B. increases

C. remains the same

D. first increases and then decreases

Answer: B

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57. Kgm^2 is the unit of .... Of a body.

A. momentum

B. mass distribution

C. moment of inertia

D. torque

Answer: C

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58. Select the correct expression from the following:

Moment of inertia of a solid cylinder having radius R_0 is:

A. MR_0^2

B. $MR_0^{\frac{2}{3}}$

C. $MR_0^{\frac{2}{4}}$

D. $\frac{1}{2}MR_0^2$

Answer: D

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59. Moment of inertia of solid sphere of radius r_0 is

A. Mr_0^2

B. $\frac{1}{5}Mr_0^2$

C. $\frac{2}{5}Mr_0^2$

D. $\frac{3}{5}Mr_0^2$

Answer: C

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60. Select the odd man out from the following conditions for a body to be in stable equilibrium.

A. Linear Momentum is zero.

B. Angular momentum is zero.

C. Potential energy of the body is maximum

D. The body tries to come back to equilibrium.

Answer: C

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61. If I, α and τ are MI, angular acceleration and torque respectively of a body rotating about any axis with angular velocity ω, then

A. $\tau = \frac{1}{\alpha}$

B. $\tau = I\alpha$

C. $\tau = \frac{\alpha}{1}$

D. $\tau u = \frac{1}{\alpha^2}$

Answer: B

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62. Statement 1 refers assertion and statement 2 referes reason in the following question.

Statement 1: A stone is tied to a string is whirled in a circle with uniform velocity. If the string suddely breaks, the angular momentum of the stone becomes zero.

Statement 2: The torque acting on the stone equals the rate of change of angular momentum.

Which one of the following statements is correct?

A. Statement 1 and 2 are true and statement 2 is a correct explanation for statement 1.

B. Statements 1 and 2 are true and statement 2 is not a correct explanation for statement 1.

C. Statement 1 is true and statement 2 is false.

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

Answer: D

Watch Video Solution

63. The dimension of torque is

A. ML^2T^{-2}

B. $M^2L^2T^{-2}$

C. ML^2T^{-1}

D. MLT^{-2}

Answer: B

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64. If τ is the torque and θ is the angular displacement then work done is given by

A. $\frac{\tau}{\theta}$

B. $\tau\theta$

C. $\frac{\theta}{\tau}$

D. $\frac{\tau}{\theta^2}$

Answer: B

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65. If a gymnast sitting on a rotating stool, with his arms out stretched, suddenly lowers his hands, what will happen?

A. the angular velocity decreases

B. his moment of inertia decreases

C. the angular velocity stays constant

D. the angular momentum increases

Answer: B

Watch Video Solution

66. The physical quantities related to linear motion and the physical quantities related to angular motioin are given in column I and column II respectively.

Match the physical quantities in both column.

Column I	Column II
1. Force (F)	*(i)* Work done $W = \vec{r} \times \hat{\tau}$
2. Linear momentum	*(ii)* $\tau = I\alpha$
3. Mass	*(iii)* Angular momentum $L = I\omega$
4. Work done $W = F \cdot S$	*(iv)* Moment of inertia I
	(v) Torque τ

A. 1-I,2-v,3-iv,4-ii

B. 1-v,2-iv,3-I,4-ii

C. 1-v,2-iii,3-iv,4-i

D. 1,ii,2-iv,3-I,4-v

Answer: C

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67. If the moment of inertia of a body is I and its mass be M the, its radius of gyration would be

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

B. $\sqrt{\frac{I}{M}}$

C. $\frac{M}{I}$

D. $\sqrt{\frac{M}{I}}$

Answer: B

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68. Which one of the following is correct?

According to perpendicular axes theorem:

A. $I_x = I_y + I_z$

B. $I_z = I_x + I_y$

C. $I_z = I_x - I_y$

D. $I_y = I_x + I_z$

Answer: C

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69. If a disc is given a linear velocity on a rough horizontal surface, then its angular momentum is

A. conserved about COM only

B. conserved about the point of contact only

C. conserved about all the points.

D. not conserved about any point.

Answer: B

View Text Solution

70. For the following situation select the correct statement.

Abody is pojected from ground with some angle to the horizontal. The angualr momentum about the initial position will:

A. decreases

B. increases

C. remains same

D. first increases and then decreases

Answer: B

View Text Solution

71. A body cannot roll without slipping on a

A. rough horizontal surface

B. smooth horizontal surface

C. rough inclined surface

D. smooth inclined surface

Answer: D

Watch Video Solution

72. Select the correct statement from the following

A. The angular momentum of a comet revolving around a star remains conserved.

B. A stone is tied to a string is whirled in a circle with a uniform sped. If the string is suddenly cut, its angular momentum will not change from its initial value.

C. The centre of mass of a solid may be outside the body of the solid.

D. In sliding the translational motion is less than rotational motion.

Answer: B

View Text Solution

73. A cylinder rolls up an inclined plane, reaches some height, and then rolls done (without slipping throughout these motions) the direction of the frictional force acting on the cylinder are:

A. a) up the incline, while ascending and down the icline, while descending.

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

C. c) down the incline, while ascending and up the incine,while descending

D. d) down the incine, while ascending as well as descending.

Answer: B

Watch Video Solution

74. A solid sphere of mass m and radius r is released from rest at the top of smooth inclined plane of inclinationθ.

The ratio of acceleration when it rolls down the plane without slipping and when it slipping down the plane is

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

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

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

D. $\frac{8}{7}$

Answer: B

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75. 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 the diameter of the disc to reach its other end.

During the journey of the insect.

The angular speed of the disc:

A. remains unchanged

B. continuously decreases

C. continuously increases

D. first increased

Answer: D

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76. The motion of planets in the solar system is an exmaple of the conservation of

A. conservation of kinetic energy

B. conservation of linear momentum

C. conservation of angular momentum

D. none

Answer: C

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77. As disc is rotating with angular speed ω. If a child sits on it, what is conserved?

A. Linear Momentum is zero.

B. Angular momentum

C. Kinetic energy

D. Potential energy

Answer: B

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78. If a sphere is rolling, the ratio of translational energy to total kinetic energy is given by:

A. $7:10$

B. $2:5$

C. $10:7$

D. $5:7$

Answer: D

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79. For a hollow cylinder and a solid cylinder rolling without slipping on a inclined plane, then which of these reaches earlier:

A. solid cylinder

B. hollow cylinder

C. both simultaneously

D. can't say anything

Answer: A

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80. Statement-1: Friction is necessary for a body to roll purely on a level horizontal ground.

Statement-2: When the body is rolling purely, the velocity of the point of contact should be zero relative to the surface in contact.

A. Statement 1 and 2 are true and statement 2 is a correct explanation for statement 1.

B. Statements 1 and 2 are true and statement 2 is not a correct explanation for statement 1.

C. Statement 1 is true and statement 2 is false.

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

Answer: A

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81. A solid sphere, disc solid cylinder all of the same mass and made of the same material are allowdd to roll down (from rest) on the inclined plane, then:

A. solid spher reaches the bottom first

B. solid sphere reaches the bottom last

C. disc will reach the bottom first

D. all reach the bottom at the same time

Answer: A

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82. A drum of radius R and mass M, rolls down without slipping along an inclined plane of angle θ. The frictional force:

A. a) dissipates energy as heat

B. b) decreases the rotational motion

C. c) decreases the rotational and translational motion

D. d) converts translational energy into rotational energy

Answer: D

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83. A disc is rolling the velocity of its centre of mass is V_{CM}. Which one will be correct?

A. The velocity of highest point is $2V_{CM}$ and point of contact is zero.

B. The velocity of highest point in V_{CM} and point of contact is V_{CM}.

C. The velocity of highest point is $2V_{CM}$ and point of contact is V_{CM}.

D. The velocity of highest point is $2V_{CM}$ and point of contact is $2V_{CM}$

Answer: A

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84. In pure rolling, the velocity at the point of contact:

A. ωr

B. $> \omega r$

C. $< \omega r$

D. zero

Answer: D

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85. If a body moves through a distance greater than 2πR in one full rotation then

A. $V_{CM} > R\omega$

B. $V_{CM} < R\omega$

C. $V_{CM} = R\omega$

D. $R\omega < V_{CM}$

Answer: A

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86. Select the incorrect statement from the following

A. Rolling motion is the combination of translational and rotation motions.

B. In pure rolling the total kinetic energy is the sum of kinetic energies of translational and rotational motion.

C. In sliding translational motion is less than rotational motion.

D. In slipping the rotational motion is more than translation motion.

Answer: C

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87. Select odd man out (incorrect) from the following expressions for kinetic energy in pure rolling.

A. In pure rolling K.E.

$$= (K.E.)_{\text{Trans}} + (K.E.)_{\text{Rot}}$$

B. In pure rolling K.E.

$$= \frac{1}{2}mv_{CM}^2 + \frac{1}{2}I_{CM}\omega^2$$

C. In pure rolling $K.E. = \frac{1}{2}mv^2$

D. In pure rolling kinetic energy with reference to centre of mass is K.E. $= \frac{1}{2}mv^2_{CM}(1 + K^2 / R^2)$

Answer: C

View Text Solution

88. For a hollow cylinder and a solid cylinder rolling without slipping on a inclined plane, then which of these reaches earlier:

A. Hollow cylinder

B. solid cylinder

C. Same for both

D. One whose density is more

Answer: A

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89. A body is rolling down in inclined plane. Its translational and rotational kinetic energies are equal. The body is a

A. solid sphere

B. hollow sphere

C. solid cylinder

D. hollow cylinder

Answer: D

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90. Centre of mass of the earth-moon system lies

A. closer to the earth

B. closer to the moon

C. at the mid point of line joining the earth and the moon

D. cannot be predicted

Answer: C

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91. Three masses 2kg, 4kg and 6kg are placed in the XY plane with respective coordinates (0,0),(0,2) and (2,2). The coordinate of their centre of mass is

A. (1,2)

B. (1,1.67)

C. (2,1.67)

D. (1.67,3)

Answer: B

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92. The Centre of mass of a solid cone along the line from the centre of the base to the vertex is at

A. one fourth of the height

B. one -third of the height

C. one-fifth of the height

D. none of these

Answer: A

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93. A particle undergoes uniform circular motion. The angular momentum of the particle remain conserved about:

A. inside the circle

B. outside the circie

C. centre of the circle

D. one the circumference of the circle

Answer: C

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94. The reduced mass of two particles having masses m and 2m is

A. 2m

B. 3m

C. 2m/3

D. m/2

Answer: C

Watch Video Solution

95. A couple produces _______ motion.

A. linear and rotational motion

B. no motion

C. purely linear motion

D. purely rotational motion

Answer: D

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96. 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 surround to it

B. iron at interior and aluminium surround to it

C. using iron and aluminiuml layers in alternate order

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

Answer: A

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97. A fly wheel is attached to an engine on order to

A. increase its speed

B. decrease its speed

C. help in overcoming the dead point

D. decrease its energy

Answer: C

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

A. constant force

B. constant linear momentum

C. constant torque

D. zero torque

Answer: D

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

A. $1/2MR^2$

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

C. $2MR^2$

D. MR^2

Answer: B

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100. Moment of inertia depends upon..................

and it does not depend upon................

A. torque applied and axis of rotation.

B. axis of rotation and point of application of force.

C. angular velocity and point of application of force.

D. angular momentum and distribution of mass

Answer: B::D

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101. Two discs of same material have the same mass. If their thickness are in the ratio $1:3$, then their moment of inertia are in the ratio

A. $1:\sqrt{3}$

B. $1:3$

C. $3:1$

D. $1:9$

Answer: C

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102. M.I. of an object does not depend upon

A. mass of object

B. mass distribution

C. angular velocity

D. axis of rotation

Answer: C

Watch Video Solution

103. If a solid sphere and solid cylinder of same mass and radius rotate about their own axis the M.I. will be greater for

A. solid sphere

B. solid cylinder

C. both a and b

D. equal both

Answer: B

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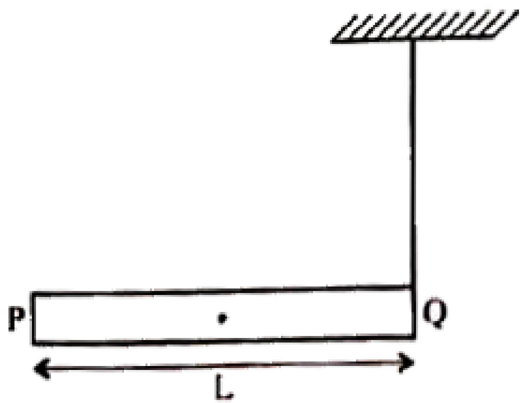
104. A rod PQ of mass M and length L is hinged at end P. The rod is kept horizontal by a mass less than string tied at a point Q as shown in figure. When string is cut, the initial acceleration rod is:



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

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

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

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

Answer: A

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105. Radius of gyration of a body depends upon:

A. axis of rotation

B. translational motion

C. shape of the bdoy

D. area of the body

Answer: A

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106. If the external forces acting on a system have zero resultant, the centre of mass

A. may move but not accelerate

B. may not move

C. must not move

D. none of these

Answer: A

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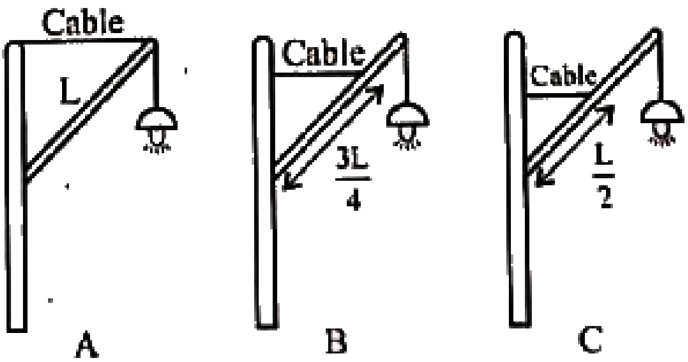
107. If a street light of mass M is suspended from the end of a uniform rod of length L in different possible patterns as shown in figure, then:



A. pattern A is more sturyd

B. pattern B is more sturdy

C. pattern C is more sturdy

D. all will have same sturdiness

Answer: A

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

A. position of the particles

B. relative distance between the particles

C. masseses of the particles

D. forces acting on the particles

Answer: D

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109. In the following question, statement 1 refers assertion and statement 2 refers reason.

Statement 1: If there is no external torque on a body about its centre of mass, then the velocity of the centre of mass remains constant.

Statement 2: The linear momentum of an isolated system remains constant.

Which one of the following statement is correct?

A. Statement 1 and 2 are true and statement 2 is a correct explanation for statement 1.

B. Statements 1 and 2 are true and statement 2 is not a correct explanation for statement 1.

C. Statement 1 is true and statement 2 is false.

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

Answer: D

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110. A point in the system at which whole mass of the body is supposed to be concentrated is called:

A. centre of gravity

B. centre of mass

C. centre of energy

D. centre of buoyancy

Answer: B

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111. The location of the centre of mass of a sphere is at:

A. its top

B. its bottom

C. geometric centre

D. all the above

Answer: C

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112. 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 ?

A. increases

B. decreases

C. remains same

D. changes

Answer: C

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113. Centre of mass of the body practically coincides with:

A. its centre of gravity

B. its centre of buoyancy

C. orthocentre

D. metacentre

Answer: A

Watch Video Solution

114. A fly wheel of moment of inertia $4 \times 10^{-3} kgm^2$ is makign 10 revolution per second. The torque required to stop it in 5 second is:

A. $4\pi \times 10^{-3} Nm$

B. $2\pi \times 10^{-4} Nm$

C. $8\pi \times 10^{-4} NM$

D. $16\pi \times 10^{-3} Nm$

Answer: D

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115. The mass of a body measures:

A. density

B. centre of mass

C. moment of inertia

D. coefficient of inertia

Answer: D

Watch Video Solution

116. Identify the vector quantity among the following:

A. distance

B. angular momentum

C. heat

D. energy

Answer: B

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117. Angular momentum is .... Vector.

A. axial

B. polar

C. unit

D. unlike

Answer: A

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118. A diver in a swimming pool bends his head before diving. It

A. increases his linear velocity

B. decreases his angular velocity

C. increases his moments of inertia

D. decreases his moment of inertia

Answer: D

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119. Which one of the following statement is not correct?

A. Net torque produces turning motion in rigid object

B. when external torque is acting on a rigid body, the angular momentum remains constant.

C. Torque, is equal to rate of change of angular momentum.

D. Torque is the product of moment of inertia and angular acceleration of a body.

Answer: B

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120. When a steady torque is acting on a body, the body:

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

B. gets linear acceleration

C. gets angular acceleration

D. rotates at a constant speed

Answer: C

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121. A circular turn table has a block of ice placed at its centre. The system rotates with an angular speed w about an axis passing through the centre of the table. If the ice melts on its own without any evaporation, the speed of rotation of the system

A. becomes zero

B. remains constant at the same value ω

C. increases to a value greater than ω

D. decreases to a value less than ω

Answer: D

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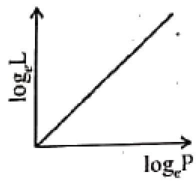
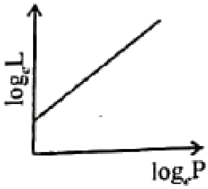
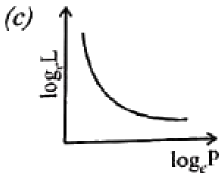
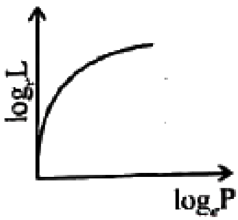
122. The curve between $\log_e$ L and $\log_e$ P is (L is the angular momentum and P is the linear momentum).

A. 

B. 

C. 

D. 

Answer: B

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123. A couple produces _______ motion.

A. pure linear motion

B. pure rotational motion

C. no motion

D. both linear and rotational motion

Answer: B

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124. A wheel is rotating at the rate of 10 revolutions per second about an axis about which the radius of gyration is 0.2m. If the mass of the wheel is 5 kg then its rotational kinetic energy is

A. 395 J

B. 295 J

C. 195 J

D. 250 J

Answer: A

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125. A particle is moving with a contant velocity along a line parallel to positive X-axis. The magnitude of its angular momentum with respect of the origin is

A. zero

B. remains constant

C. goes on increasing

D. goes on decreasing

Answer: B

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126. A particle undergoes uniform circular motion. The angular momentum of the particle remain conserved about:

A. centre of the circle

B. one the circumference of the circle

C. inside the circle

D. outside the circle

Answer: A

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127. A particle is confined to rotate in a circular path decreasing linear speed, then which of the following is correct?

A. $\overrightarrow{L}$ (angular momentum) is conserved about the centre

B. only direction of angular momentum $\overrightarrow{L}$ is conserved

C. it spirals towards the centre

D. its acceleration is towards the centre

Answer: B

Watch Video Solution

128. A solid sphere is rotationg in free space. If the radius of the sphere is increased keeping mass same, which one of the following will not be affected ?

A. Moment of inertia

B. Angular momentum

C. Angular velocity

D. Rotational kinetic energy

Answer: B

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129. A couple is acting on a two particle system. The resultant motion will be:

A. Purely rotational motion

B. purely linear motion

C. both a and b

D. neither a nor b

Answer: A

Watch Video Solution

130. Different types of equilibrium are given in column I. Match the types given in column I with conditions given in column II.

Column I	Column II
1. Translational	*(i)* Net torque and force are zero.
2. Rotational	*(ii)* Linear momentum is zero
3. Dynamic	*(iii)* Potential energy is minimum
4. Stable	*(iv)* Angular momentum is zero
	(v) Net torque is zero
	(vi) Net force is zero

A. i-iii, 2- I, 3-v, 4-vi

B. 1-vi,2-v,3-I,4-iii

C. 1-I,2-ii,3-iii,4-iv

D. 1-v,2-iii,3-I,4-ii

Answer: B

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131. Angular momentum is .... Vector.

A. moment of momentum

B. product of mass and angular velocity

C. product of M.I and velocity

D. moment of angular motion

Answer: A

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132. Which of the following is a vector quantity?

A. Angular momentum

B. Work

C. Potential energy

D. Electric current

Answer: A

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133. The dimensions of angular momentum are:

A. $[MLT^{-2}]$

B. $[ML^2T^{-1}]$

C. $[ML^2T^{-2}]$

D. $[ML^2T]$

Answer: B

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134. Analogue of mass in rotational motion is

A. gyration

B. angular momentum

C. moment of inertia

D. none of the above

Answer: C

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135. Identify the incorrect odd man out from the following expressions for moment of inertia,

A. Moment of inertia $I = Mk^2$

B. As per parallel axis theorem Moment of inertia $I = I_c + Md^2$

C. As per perpendicular axis theorem moment of inertia $I_Z = I_X + I_Y$

D. Moment of inertia = Force/acceleration $= \frac{F}{a}$

Answer: D

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136. The angular momentum of a system of particles is conserved:

A. When no external force acts upon the system

B. When no external torque acts upon the system

C. When no external impulse acts upon the system

D. When axis of rotation remains the same

Answer: B

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137. If a person standing on a rotating disc stretches out his hands, the angular speed will

A. increases

B. decreases

C. remain same

D. none of these

Answer: B

Watch Video Solution

138. What quantities are conserved in this collision?

A. linear and angular momentum, but not kinetic energy

B. linear momentum only

C. angular momentum only

D. linear and angular momentum and linear but not rotational kinetic energy

Answer: B

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

A. 6

B. 5

C. 8

D. 7

Answer: C

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140. In an orbital motion, the angular momentum vector is

A. along the radius vector

B. parallel to the linear momentum

C. in the orbital plane

D. perpendicular to the orbital plane

Answer: D

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141. The angular momentum of a moving body remains constant if

A. Assertion and Reason are true and Reason is a correct explanation for Assertion

B. Assertion and Reason are true and Reason is not a correct explanation for Assertion.

C. Assertion is true and Reason is false.

D. Assertion is false and Reason is true.

Answer: D

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142. The direction of angular velocity vector is along:

A. the tagent to the circular path

B. the inward radius

C. the outward radius

D. the axis of rotation

Answer: D

Watch Video Solution

143. The angular momentum of a moving body remains constant if

A. net external force is applied

B. net pressure is applied

C. net external torque is applied

D. net external torqu is not applied

Answer: D

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144. Assertion: Friction is necessary for abody to roll on a surface.

Reason:Friction provides the necessary tangential force and torque.

Which one of the following statement is correct?

A. Assertion and reason are treu and reason explains assertion correctly.

B. Assertion and reason are true. But reason does not explain assertion correctly.

C. Assertion is true but reason is false.

D. Assertion is false but reason is true.

Answer: A

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145. A body is projected from the ground with some angle to the horizontal. What happens to the angular momentum about the initial position in tis motion?

A. decreases

B. increases

C. remains the same

D. first increases and then decreases

Answer: B

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146. Kgm^2 is the unit of .... Of a body.

A. momentum

B. mass distribution

C. moment of inertia

D. Energy

Answer: C

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147. Select the correct expression from the following:

Moment of inertia of a solid cylinder having radius R_0 is:

A. MR_0^2

B. $MR_0^{\frac{2}{3}}$

C. $MR_0^{\frac{2}{4}}$

D. $MR_0^{\frac{2}{2}}$

Answer: D

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148. Moment of inertia of solid sphere of radius r_0 is

A. Mr_0^2

B. $\frac{1}{5}Mr_0^2$

C. $\frac{2}{3}Mr_0^2$

D. $\frac{3}{5}Mr_0^2$

Answer: C

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149. Choose the odd man out from the following :

A. Linear Momentum is zero.

B. Angular momentum is zero.

C. Potential energy of the body is maximum

D. The body tries to come back to equilibrium.

Answer: C

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150. If I is the moment of ienrtia, α is the angular acceleration and τ is torque then they are related by:

A. $\tau = \frac{1}{\alpha}$

B. $\tau = I\alpha$

C. $\tau = \frac{\alpha}{1}$

D. $\tau u = \frac{1}{\alpha^2}$

Answer: B

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151. A stone is tied to the end of a string of length 1 and whirled in a horizental circle. When the string breaks then stone

A. Assertion and Reason are true and Reason is a correct explanation for Assertion.

B. Assertion and Reason are true and Reason is not a correct explanation for Assertion.

C. Assertion is true and Reason is false.

D. Assertion is false and Reason is true.

Answer: D

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152. The dimension of torque is

A. ML^2T^{-2}

B. $M^2L^2T^{-2}$

C. ML^2T^{-1}

D. MLT^{-2}

Answer: B

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153. If τ is the torque and θ is the angular displacement then work done is given by

A. $\frac{\tau}{\theta}$

B. $\tau\theta$

C. $\frac{\theta}{\tau}$

D. $\frac{\tau}{\theta^2}$

Answer: B

Watch Video Solution

154. If a gymnast sitting on a rotating stool, with his arms out stretched, suddenly lowers his hands, what will happen?

A. the angular velocity decreases

B. his moment of inertia decreases

C. the angular velocity stays constant

D. the angular momentum increases

Answer: B

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155. The physical quantities related to linear motion and the physical quantities related to angular motioin are given in column I and column II respectively.

Match the physical quantities in both column.

Column I	Column II
1. Force (F)	(i) Work done $W = \vec{r} \times \hat{\tau}$
2. Linear momentum	(ii) $\tau = I\alpha$
3. Mass	(iii) Angular momentum $L = I\omega$
4. Work done $W = F \cdot S$	(iv) Moment of inertia I
	(v) Torque τ

A. 1-I,2-v,3-iv,4-ii

B. 1-v,2-iv,3-I,4-ii

C. 1-v,2-iii,3-iv,4-i

D. 1,ii,2-iv,3-I,4-v

Answer: C

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156. If the moment of inertia of a body is I and its mass be M the, its radius of gyration would be

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

B. $\sqrt{\frac{I}{M}}$

C. $\frac{M}{I}$

D. $\sqrt{\frac{M}{I}}$

Answer: B

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157. Which one of the following is correct?

According to perpendicular axes theorem:

A. $I_x = I_y + I_z$

B. $I_z = I_x + I_y$

C. $I_z = I_x - I_y$

D. $I_y = I_x + I_z$

Answer: C

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158. A disc rotates with angular velocity ω and kinetic energy E. Then its angular momentum

A. conserved about COM only

B. conserved about the point of contact only

C. conserved about all the points.

D. not conserved about any point.

Answer: B

Watch Video Solution

159. A body is projected from the ground with some angle to the horizontal. What happens to the angular momentum about the initial position in tis motion?

A. decreases

B. increases

C. remains same

D. first increases and then decreases

Answer: B

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160. A body cannot roll without slipping on a

A. rough horizontal surface

B. smooth horizontal surface

C. rough inclined surface

D. smooth inclined surface

Answer: D

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161. Select the correct statement from the following .

A. The angular momentum iof a comet revolving around a star remains conserved.

B. A stone is tied to a string is whirled in a circle with a uniform sped. If the string is suddenly cut, its angular momentum will

not change from its initial value.

C. The centre of mass of a solid may me

outside the body of the solid.

D. In sliding the translational motion is less

than rotational motion.

Answer: B

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162. A cylinder rolls up an inclined plane, reaches some height, and then rolls done (without slipping throughout these motions) the direction of the frictional force acting on the cylinder are:

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

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

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

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

Answer: B

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163. A solid sphere of mass m and radius r is released from rest at the top of smooth inclined plane of inclinationθ.

The ratio of acceleration when it rolls down the plane without slipping and when it slipping down the plane is

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

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

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

D. $\frac{8}{7}$

Answer: B

164. 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 the diameter of the disc to reach its other end. During the journey of the insect.

The angular speed of the disc:

A. remains unchanged

B. continuously decreases

C. continuously increases

D. first increased

Answer: D

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165. Planetary motion in the solar system is based on

A. conservation of kinetic energy

B. conservation of linear momentum

C. conservation of angular momentum

D. none

Answer: C

Watch Video Solution

166. As disc is rotating with angular speed ω. If a child sits on it, what is conserved?

A. Linear Momentum is zero.

B. Angular momentum

C. Kinetic energy

D. Potential energy

Answer: B

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167. If a sphere is rolling, the ratio of translational energy to total kinetic energy is given by:

A. $7:10$

B. $2:5$

C. $10:7$

D. $5:7$

Answer: D

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168. For a hollow cylinder and a solid cylinder rolling without slipping on a inclined plane, then which of these reaches earlier:

A. solid cylinder

B. hollow cylinder

C. both simultaneously

D. can't say anything

Answer: A

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169. In the following question, statement 1 refers assertion and statement 2 refers reason.

Statement 1: During perfect rolling, the frictional force is zero.

Statement 2: The velocity at the point of contact becomes zero.

Select the correct option.

A. Statement 1 and 2 are true and statement 2 is a correct explanation for statement 1.

B. Statements 1 and 2 are true and statement 2 is not a correct explanation for statement 1.

C. Statement 1 is true and statement 2 is false.

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

Answer: A

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170. A solid sphere, disc solid cylinder all of the same mass and made of the same material are allowdd to roll down (from rest) on the inclined plane, then:

A. solid spher reaches the bottom first

B. solid sphere reaches the bottom last

C. disc will reach the bottom first

D. all reach the bottom at the same time

Answer: A

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171. A drum of radius R and mass M, rolls down without slipping along an inclined plane of angle θ. The frictional force-

A. dissipartes energy as heat

B. decreases the rotational motion

C. decreases the rotational and transnational motion

D. converts transnational energy into rotational energy

Answer: D

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172. A disc is rolling the velocity of its centre of mass is V_{CM}. Which one will be correct?

A. The velocity of highest point is $2V_{CM}$ and point of contact is zero.

B. The velocity of highest point in V_{CM} and point of contact is V_{CM}.

C. The velocity of highest point is $2V_{CM}$ and point of contact is V_{CM}.

D. The velocity of highest point is $2V_{CM}$ and point of contact is $2V_{CM}$

Answer: A

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173. In pure rolling, the velocity at the point of contact:

A. ωr

B. $> \omega r$

C. $< \omega r$

D. zero

Answer: D

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174. If a body moves through a distance greater than 2πR in one full rotation then

A. $V_{CM} > R_{\omega}$

B. $V_{CM} < R_{\omega}$

C. $V_{CM} = R_{\omega}$

D. $R_{\omega} < V_{CM}$

Answer: A

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175. Select the incorrect statement from the following

A. Rolling motion is the combination of translational and rotation motion.

B. In pure rolling the total kinetic energy is the sum of kinetic energies of translational and rotational motion.

C. In sliding translational motion is less than rotational motion.

D. In slipping the rotational motion is more than translation motion.

Answer: C

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176. Select odd man out (incorrect) from the following expressions for kinetic energy in pure rolling.

A. In pure rolling K.E.

$$= (K.E.)_{\text{Trans}} + (K.E.)_{\text{Rot}}$$

B. In pure rolling K.E.

$$= \frac{1}{2} m v_{CM}^2 + \frac{1}{2} I_{CM} \omega^2$$

C. In pure rolling $K.E. = \frac{1}{2} m v^2$

D. In pure rolling kinetic energy with reference to centre of mass is K.E.

$$= \frac{1}{2} m v_{CM}^2 \left(1 + K^2 / R^2\right)$$

Answer: C

View Text Solution

177. For a hollow cylinder and a solid cylinder rolling without slipping on a inclined plane, then which of these reaches earlier:

A. Hollow cylinder

B. solid cylinder

C. Same for both

D. One whose density is more

Answer: A

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178. A body is rolling down in inclined plane. Its translational and rotational kinetic energies are equal. The body is a

A. solid sphere

B. hollow sphere

C. solid cylinder

D. hollow cylinder

Answer: D

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Other Important Questions Answer Very Short Answer Questions

1. What do you mean by Rigid body?

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

Watch Video Solution

3. State the factors on which the position of the CM of a rigid body depends.

Watch Video Solution

4. When an equation for velocity and acceleration of CM.

Watch Video Solution

5. Does moment of inertia of a body change with the change of the axis of rotation?

Watch Video Solution

6. If a body is rotating, is it necessarily being acted upon by an external torque ?

Watch Video Solution

7. On what factors does the turning effect of a force depend?

Watch Video Solution

8. A system is in stable equilibrium. What can we say about its potential energy?

Watch Video Solution

9. What effect does couple have on a body?

Watch Video Solution

10. Write an expression for mechanical advantage.

Watch Video Solution

11. Factors on which radius of gyration of the body depends.

Watch Video Solution

12. What is rolling motion?

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17. Does the moment of inertia of a body change with the speed of rotation ?

Watch Video Solution

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19. On what factors does the turning effect of a force depend?

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20. A system is in stable equilibrium. What can we say about its potential energy?

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21. What effect does couple have on a body?

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22. Write an expression for mechanical advantage.

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23. Factors on which radius of gyration of the body depends.

Watch Video Solution

24. What is rolling motion?

Watch Video Solution

Other Important Questions Answer Short Answer Questions

1. Distinguish between internal and external forces.

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2. Write the Cartesian co -ordinate (x,y,z) of the centre of mass for these distributed point masses.

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3. Write the equation for the CM of two point masses when (i) Masses are on positive x-axis, (ii) Origin coincides with any one of the masses, (iii) origin coincides with CM itself.

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4. Distinguish between centre of mass and centre of gravity.

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5. Write an expression for Cartesian co-ordinates of the CM for uniform distribution of mass.

View Text Solution

6. Show that in the absence of any external force, the velocity of CM remains constant.

Watch Video Solution

7. Does the radius of gyration depend upon the speed of rotation of the body?

Watch Video Solution

8. Explain Right hand rule to find the direction of Torque.

Watch Video Solution

9. Why a force is applied at right angles to the heavy door at the outer edge while closing or opening it?

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10. List the points to be considered while calculating the torques on rigid bodies.

Watch Video Solution

11. Deduce the relation between torque and angular acceleration.

Watch Video Solution

12. Can the couple acting on a rigid body produce translatory motion?

Watch Video Solution

13. Define angular momentum.

Watch Video Solution

14. Which physical quantities are expressed by the following?

(i) moment of linear momentum.

(ii) rate of change of angular momentum.

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15. List of condition on which angular momentum is zero.

Watch Video Solution

16. Distinguish between translational and rotatinal equilibrium.

Watch Video Solution

17. Inertia of the body depends on

Watch Video Solution

18. Find the relation between power and torque.

Watch Video Solution

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38. What do you understand by the term precession?

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Other Important Questions Answer Long Answer Questions

1. Explain the principle of moments of rotational equilibrium? Hence define mechanical advantage?

Watch Video Solution

2. Determine the centre of gravity of plane lamina by pivoting method.

Watch Video Solution

3. Calculate the work done by the torque.

Watch Video Solution

4. Find the expression of KE of the rigid body in rotational motion.

Watch Video Solution

5. Derive the relation between rotational KE and angular momentum.

Watch Video Solution

6. Deduce the relation between angular momentum and angular velocity.

Watch Video Solution

7. List the six point difference between translational and rotational quantities.

Watch Video Solution

8. Discuss the motion of a disc rolling without slipping on a level surface. Hence find the condition for rolling without slipping?

Watch Video Solution

9. Write an expression for the KE of a body rolling without slipping with centre of mass as reference.

Watch Video Solution

10. Write an expression for the KE of a body rolling without slipping with point of contact as reference.

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Watch Video Solution

15. The relation between Rotation Kinetic Energy and angular momentum is

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16. Deduce the relation between angular momentum and angular velocity.

Watch Video Solution

17. Distinguish between translational and rotatinal equilibrium.

Watch Video Solution

18. Discuss the motion of a disc rolling without slipping on a level surface. Hence find the condition for rolling without slipping?

Watch Video Solution

19. Write an expression for the KE of a body rolling without slipping with centre of mass as reference.

Watch Video Solution

20. Write an expression for the KE of a body rolling without slipping with point of contact as reference.

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Other Important Questions Answer Conceptual Questions

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

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2. Is centre of mass a reality?

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3. Why in hand driven grinding machine, handle is put near the circumference of the stone or wheel?

Watch Video Solution

4. Is a body in circular motion in equilibrium?

Watch Video Solution

5. A labourer standing near the top of an old wooden step ladder feels unstable. Why?

Watch Video Solution

6. Can a body in equilibrium while in motion? If yes state an example.

Watch Video Solution

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

Watch Video Solution

8. The bottom of a ship is made heavy. Why?

Watch Video Solution

9. Why does a boy lean towards right hand side while carrying a bag in his left hand?

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10. Some heavy boxes are to be loaded along with some empty boxes on a cart. Which boxes should be put on the cart first and why?

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11. About which axis, the moment of inertia of a body is minimum?

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12. A disc is recast into a thin walled cylinder of same radius. Which will have large moment of inertia?

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13. A cat is able to land on its feet after a fall. Why?

Watch Video Solution

14. Give examples where the centre of mass coincides with the geometrical centre of the body.

Watch Video Solution

15. Why spokes are provided in a bicycle wheel?

Watch Video Solution

16. Two boys of the same weight sit at the opposite ends of a diameter of a rotating circular table. What happens to the speed of rotation if they move nearer to axis of rotation?

Watch Video Solution

17. What is the power needed to maintain uniform circular motion?

Watch Video Solution

18. A particle moves in a circular path with decreasing speed. What happens to its angular momentum?

Watch Video Solution

19. Why centripetal force cannot do work?

Watch Video Solution

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

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21. Is centre of mass of reality ?

Watch Video Solution

22. Why in hand driven grinding machine, handle is put near the circumference of the stone or wheel?

Watch Video Solution

23. Is a body in circular motion in equilibrium?

Watch Video Solution

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

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

Watch Video Solution

25. Can a body in equilibrium while in motion? If yes state an example.

Watch Video Solution

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

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Other Important Questions Answer Numerical Problems

1. The distance between the centres of carbon and oxyen atoms in the carbonmonoxid gas molecule is 1.13Å. Locate the centre of amss of the gas molecule relative to the carbon atom.

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2. Three blocks of uniform thickness and masses m,m and 2m placed at three corners of a triangle having co-ordinates (2.5,1.5),(3.5,1.5) and (3,3) respectively.

Find the centre of mass of the system.

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

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4. Three mass points $m_1 m_2$ amd 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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5. Calculate the moment of inertia of a cylinder of length $1.5m$, radius 0.05m and density

$8 \times 10^3 kgm^{-3}$ about the axis of the cylinder.

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6. A uniform circular disc of mass m is set rolling on a smooth horizontal table with a uniform linear velocity v. Find the total K.E., of the disc.

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7. The diameter of a solid solid disc is 0.5 m and its mass is 16 kg. What torque will increase its angular velocity from zero to 120 rotations/minute in 8 seconds?

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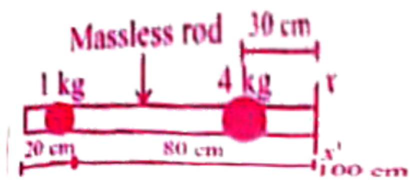
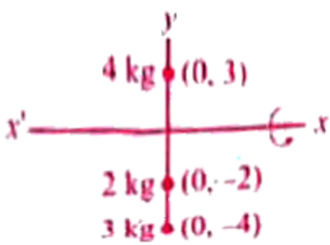
8. Calculate moment of inertia with respect to rotational axis xx' in following figures a and b.





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9. Four bodies of masses 5 kg, 2 kg, 3k kg and 4 kg are respectively placed at position (0,0,0), (2,0,0), (0,3,0) and (-2,-2,0). Calculate the moment of inertia about x-axis, y-axis and z-axis.

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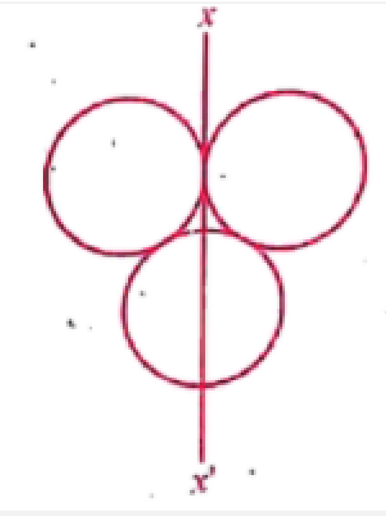
10. Adjoining diagram has three disc, inwhcih each has mass M and radius R. Find the moment of inertia of this system about axis xx'.



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11. Two rings have their moemnts of inertia in the ratio of 4:1 and their diameters are in the ratio of 4:1. Find the ratio of their masses.

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12. The power out put of an automobile engine is advertised to be 200 ap at 6000rpm. What is the corresponding torque?

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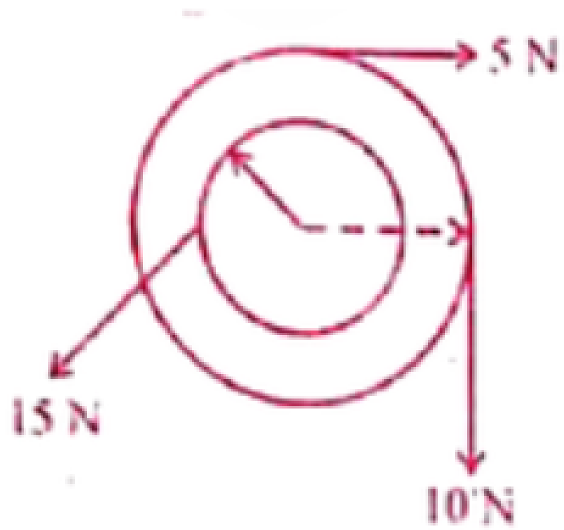
13. In the following figure radii r_1 and r_2 are 10 cm and 20 cm respectively. If the moment of inertia of the wheel is 1500 kg m^2, then determine its angular acceleration.



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14. Find the torque of a corce $7\hat{i} - 3\hat{j} - 5\hat{k}$ about the origin which acts on a particle whose position vector is $\hat{i} + \hat{j} - \hat{k}$

Given: $\overrightarrow{F} = 7\hat{i} - 3\hat{j} - 5\hat{k}$

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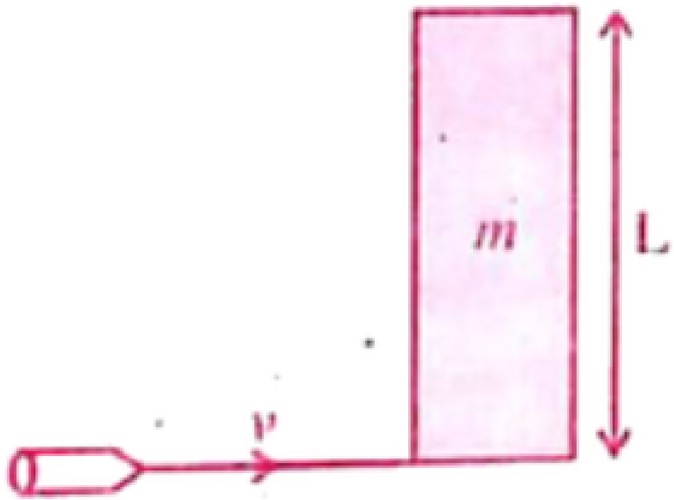

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31. The distance between the centres of carbon and oxyen atoms in the carbonmonoxid gas molecule is 1.13Å. Locate the centre of amss of the gas molecule relative to the carbon atom.

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32. Three blocks of uniform thickness and masses m,m and 2m placed at three corners of a triangle having co-ordinates (2.5,1.5),(3.5,1.5) and (3,3) respectively.

Find the centre of mass of the system.

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

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34. Three mass points $m_1 m_2$ amd 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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35. Calculate the moment of inertia of a cylinder of length $1.5m$, radius 0.05m and density $8 \times 10^3 kgm^{-3}$ about the axis of the cylinder.

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36. A uniform circular disc of mass m is set rolling on a smooth horizontal table with a uniform linear velocity v. Find the total K.E., of the disc.

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37. The diameter of a solid solid disc is 0.5 m and its mass is 16 kg. What torque will increase its angular velocity from zero to 120 rotations/ minute in 8 seconds?

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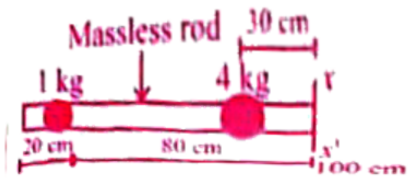
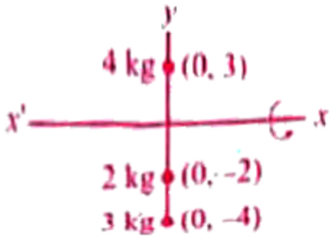
38. Calculate moment of inertia with respect to rotational axis xx' in following figures a and b.





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39. Four bodies of masses 5 kg, 2 kg, 3k kg and 4 kg are respectively placed at position (0,0,0), (2,0,0), (0,3,0) and (-2,-2,0). Calculate the moment of inertia about x-axis, y-axis and z-axis.

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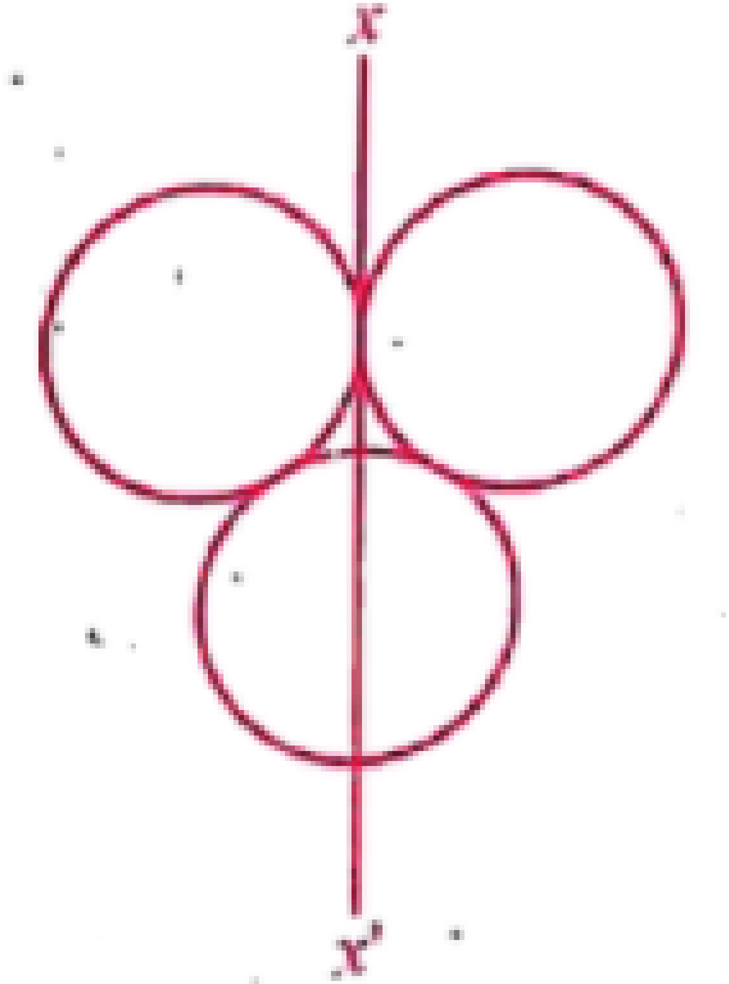
40. Adjoining diagram has three disc, inwhcih each has mass M and radius R. Find the moment of inertia of this system about axis xx'.



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41. Two rings have their moemnts of inertia in the ratio of 4:1 and their diameters are in the ratio of 4:1. Find the ratio of their masses.

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42. The power out put of an automobile engine is advertised to be 200 ap at 6000rpm. What is the corresponding torque?

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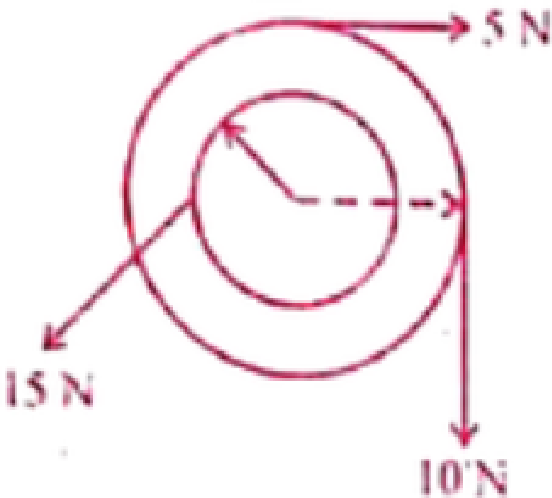
43. In the following figure radii r_1 and r_2 are 10 cm and 20 cm respectively. If the moment of inertia of the wheel is 1500 kg m^2, then determine its angular acceleration.



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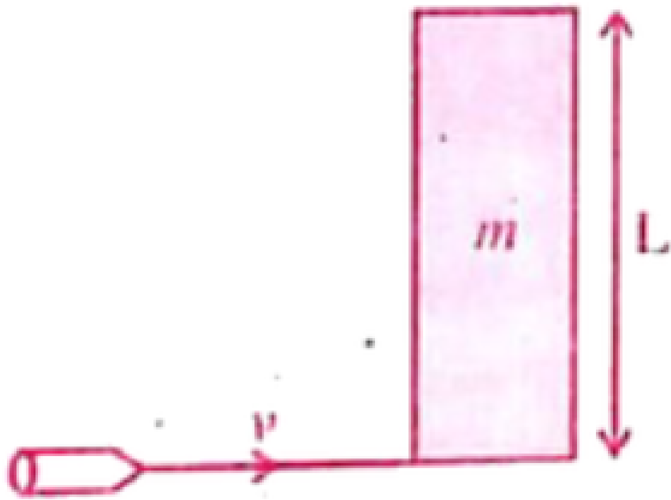

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