PHYSICS

BOOKS - SURA PHYSICS (TAMIL ENGLISH)

MOTION OF SYSTEM OF PARTICLES AND RIGID BODIES

Multiple Choice Questions

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

A. postion 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 rad s^{-2}

B. 25 rad s^{-2}

C. 5 m s^{-2}

D. 25 m s^{-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 center point of the circle

B. the point on the circumference of the circle

C. any point inside the circle

D. any point outside the circle

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

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

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

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

Answer: a

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10. A disc of moment of inertia la is rotating in a horizontal plane about its symmetry axis with constant angular speed co. Another discinitially at rest of moment of inertia I, is dropped coaxially on to the rotating disc. Then, both the discs rotate with same constant angular speed The loss of kinetic energy due to friction in this process is,

A. $\frac{1}{2}\frac{I_b^2}{(I_a+I_b)}\omega^2$

B. $\frac{I_b^2}{(I_a+I_b)}\omega^2$

C. $\frac{(I_b-I_a)^2}{(I_a+I_b)}\omega^2$

D. $\frac{1}{2}\frac{I_bI_b}{(I_a+I_b)}\omega^2$

Answer: d

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11. The ratio of the acceleration for a solid sphere (mass m and radius R) rolling down an incline of angle θ without slipping and slipping down the incline without rolling is,

A. $5:7$

B. $2:3$

C. $2:5$

D. $7:5$

Answer: a

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12. From a disc of radius R, a mass M, a circular hole of diameter R, whose rim passes through the center 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. $13MR^2/32$

C. $11MR^2/32$

D. $9MR^2/32$

Answer: b

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13. 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: a

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14. 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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15. 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 transational motion

D. converts transational energy into rotational energy

Answer: d

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16. Four round objects namely a ring, a disc, a hollow sphere and a solid sphere with same radius R and made of same material start to roll down an inclined plane at the same time. The object that will reach the bottom third is

A. Solid sphere

B. disc

C. hollow sphere

D. ring

Answer: c

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17. Obtain an expression for the power delivered by torque.

A. $P = \vec{\tau} . \vec{\theta}$

B. $P = \vec{\tau} \times \vec{\theta}$

C. $P = \tau\theta \sin\theta$

D. P = 0 (zero always)

Answer: a

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18. The center of mass for a uniform rod of mass M and length $\frac{1}{2}$ i.e., 0.5 l lies at the

A. l

B. 0.75 l

C. 0.5 l

D. 0.25 l

Answer: d

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19. Unit of Angular acceleration is _____

A. rad s^{-1}

B. rad m^{-1}

C. rad s^{-2}

D. rad m^2

Answer: c

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

A. $MI^2/3$

B. $MI^2/12$

C. $MI^3/12$

D. $M\left(I^2+b^2\right)/12$

Answer: b

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

A. postion of particles

B. relative distance between particles

C. masses of particles

D. force acting on particle

Answer: d

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22. Where will be the centre of mass on combining two masses m and M (M $>$ m) ?

A. Towards m

B. Towards M

C. Between m & M

D. away from m & M

Answer: b

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23. Two bodies of masses 2 kg and 3 kg have position vectors $\hat{i} + 2\hat{j} + \hat{k}$ and $-4\hat{i} - 3\hat{j} + 6\hat{k}$ respectively. The centre of mass of this system has a position vector.

A. $-3i - j$

B. $5i - j + 2k$

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

D. $-3\hat{i} - \hat{j} + 7\hat{k}$

Answer: c

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24. Four identical spheres each of mass m are placed at the corner of square of side 2 m. Taking the point of intersection of the diagonals as the orgin the coordinates of the centre of mass are ?

A. (1, 1)

B. (0, 0)

C. (1, -1)

D. (-1, 1)

Answer: b

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25. Two blocks of masses 20 kg and 5 kg are connected by a spring of negligible mass and placed on a frictionless horizontal surface. An impulse gives a velocity of 15 m/s to the heavier block in the direction of lighter block. The velocity of centre of mass is

A. 22 ms^{-1}

B. 30 ms^{-1}

C. 12 ms^{-1}

D. 15 ms^{-1}

Answer: c

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

A. 2×10^{6} Nm

B. 2×10^{-6} Nm

C. 2×10^{-3} Nm

D. 12×10^{-4} Nm

Answer: b

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

A. v

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

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

D. zero

Answer: c

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28. Two objects which are initally at rest, move towards each other under the action of their internal attraction. If their speeds are 4 v and 2 v at any instant, then the speed of centre of mass of the system will be

A. 2v

B. zero

C. v

D. 1.5 v

Answer: b

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29. If force acts on a body, whose line of action does not pass through its CG, then the body will experience

A. angular acceleration

B. lineal acceleration

C. both (a) and (b)

D. non

Answer: c

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30. A couple produces _____ motion.

A. linear and rotational

B. purely rotational

C. purely linear

D. no

Answer: a

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31. A solid cylinder of mass 2 kg and radius 50 cm rolls up an inclined plane of angle inclination 30^{o}. The centre of mass of cylinder has speed of 4 m/s. The distance travelled by the cylinder on the incline surface will be

(Take g = $10 m/s^2$).

A. 2.2 m

B. 1.6 m

C. 1.2 m

D. 2.4 m

Answer: d

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32. 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. $\tau = I\omega$

B. $\tau = I\alpha$

C. $I = r\omega$

D. $\alpha = r\omega$

Answer: b

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33. Which of the following has largest M.I

A. Ring about its axis perpendicular to its plane

B. Disc about its axis perpendicular to its plane

C. Solid sphere

D. Bar magnet

Answer: a

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34. A dancer on ice spins faster when she folds her arms. This is due to

A. decrease in energy & increase in angular momentum

B. increase in K.E & decrease in angular momentum

C. increase in K.E & constant in angular momentum

D. Decrease in friction at the skates

Answer: c

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35. A bomb travelling a parabolic path explodes in mid air. The C.M. Of fragments will

A. move vertically downwards

B. move irregularly

C. move vertically upwards & then downwards

D. move in parabolic path the unexploded bomb would have travelled

Answer: d

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

A. ½ $\vec{a}$

B. $\vec{a}$

C. 2 $\vec{a}$

D. zero

Answer: a

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37. The least coefficient of friction for an inclined plane inclined at an angle α with horizontal, in order that a solid cylinder will roll down it without slipping ?

A. ⅔ $\tan\alpha$

B. ⅓ $\tan\alpha$

C. ⅖ $\tan\alpha$

D. ⅘ $\tan\alpha$

Answer: b

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38. Three identical spherical shells, each of mass m and radius r are placed as shown in figur. Consider an axis XX^1 which is touching to two shells and passing through diameter of third shell. M.I of the system consisting of these three spherial shells about XX^1 axis is

A. $3mr^2$

B. $4mr^2$

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

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

Answer: b

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39. A ball rolls without slipping. The radius of gyration of the ball about about an axis passing through its center of mass is K. If radius of the ball be R, then the fraction of total energy associated with its rotational energy be

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

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

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

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

Answer: b

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40. The direction of angular velocity vector is along:

A. The tangent to the circular path

B. The outward radius

C. The inward radius

D. The axis of rotation

Answer: d

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41. If there is change of angular momentum from J to 4J in 4S, then the torque is

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

B. 1 J

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

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

Answer: a

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42. 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 radius

C. The tangent to the circle

D. An angle of 45° to the plane of rotation

Answer: a

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43. The ratio of the radii of gyration of a circular disc to that of circular ring, each of same mass and same radius about their axes is

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

B. $1:\sqrt{2}$

C. $\sqrt{2}:1$

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

Answer: b

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44. The M.I of a uniform circular disc is maximum about an axis perpendicular to the disc and passing through

A. B

B. D

C. A

D. C

Answer: a

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

A. increase

B. decrease

C. remain same

D. None

Answer: b

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46. A sphere of radius r is rolling without sliding. What is ratio of rotational K.E and total K.E associated with the sphere ?

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

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

C. 1

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

Answer: b

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47. A disc is rolling on the inclined plane. What is the ratio of its rotational KE to the total KE ?

A. $1:3$

B. $3:1$

C. $1:2$

D. $2:1$

Answer: a

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48. A sphere rolls down an inclined plane of inclination θ. What is the acceleration as the sphere reaches bottom ?

A. $\frac{5}{7}g\sin\theta$

B. $\frac{3}{5}g\sin\theta$

C. $\frac{2}{7}g\sin\theta$

D. $\frac{2}{5}g\sin\theta$

Answer: a

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49. Planetary motion in the solar system is based on

A. Conservation of energy

B. Conservation of linear momentum

C. Conservation of angular momentum

D. None

Answer: c

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50. Two rings of radii R & nR made from the same wire have the ratio of M.I about an axis passing through their centre equal to 1 : 8. The value of n is

A. 2

B. $2\sqrt{2}$

C. 4

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

Answer: a

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51. The M.I of a ring about one of its diameter is I. The M.I about a tangent parallel to the diameter is

A. 4I

B. 2I

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

D. 3I

Answer: d

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52. 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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53. The angular momentum of a system of particles is conserved:

A. Centre of the circle

B. On the circumference of the circle

C. Inside the circle

D. Outside the circle

Answer: a

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54. 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. M.I

B. Angular momentum

C. Angular velocity

D. Rotational K.E.

Answer: b

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55. Analogue of mass in rotational motion is

A. M.I.

B. Angular momentum

C. Gyration

D. Torque

Answer: a

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56. A particle of mass m is circulating on a circle of radius r having angular momentum L then the centripetal force will be

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

B. $\frac{L^2 m}{r}$

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

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

Answer: c

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

A. Mass of object

B. Angular Velocity

C. Mass distribution

D. Axis of rotation

Answer: b

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58. 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 same

Answer: b

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59. A system consisting of two masses connected by a massless rod lies along the x axis. If 0.2 kg mass is at a distance x = 0.5 m while a 0.3 kg mass is at a distance x = 1m, then the x-co-ordinate of the centre of mass will be at

A. 2.5 m

B. 5m

C. 22.5 m

D. 0.8 m

Answer: d

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60. If earth suddenly contracts to 0.5 times of its present radius, then the length of the day becomes

A. 12 hr

B. 18 hr

C. 15.5 hr

D. 6 hr

Answer: d

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61. The angular momentum of a rotating body is doubled, its K.E. of rotation becomes

A. Two times

B. Four times

C. Halved

D. Eight times

Answer: b

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Short Answer Questions

1. Write the formula for total kinetic energy of a rolling 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 moment of a couple.

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10. State the principle of moments .

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11. A man is sitting in a boat which is floating in a pond. If the man drinks some water from the pond, the level of water in the pond decreases.

Justify whether the given statement is True (or) False.

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12. Write the units for radius of gyration and it's dimensions.

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13. Distinguish between Translatory motion and Rotatory motion.

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14. State conservation of angular momentum.

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

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16. What is the condition for pure rolling ?

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17. What is the difference between sliding and slipping ?

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18. A constant torque is acting on a wheel. If starting from rest, the wheel makes n rotations in t seconds, Show that the angular acceleration is given by

$\alpha = \frac{4\pi n}{t^2}$ rad s^{-2}.

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19. Find Torque about an Axis.

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20. State and explain the principle of moments.

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21. Write the principle used in beam balance and define Mechanical Advantage.

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22. The dimensions of the radius of gyration are

A. $[M^1L^1T^0]$

B. $[M^0L^1T^0]$

C. $[M^0L^1T^1]$

D. $[M^2L^1T^0]$

Answer: b

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23. The mass per unit length of a non-uniform rod of length L is given by $\mu = \lambda x^2$, where λ is constant and x is distance from one end of the rod. The distance of the center of mass of rod from this end is

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

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

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

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

Answer: d

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24. How is angular momentum related to linear momentum ?

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25. Find the moment of inertia of a uniform rod about an axis which is perpendicular to the rod and touches any one end of the rod.

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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. Derive the expresssion for moment of inertia of a rod about its centre and perpendicular to the rod.

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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. Discuss conservation of angular momentum with example.

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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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10. Discuss the effect of rolling on inclined plane and derive the expression for the acceleration.

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11. Derive an expression for the position vector of the center of mass of particle system.

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12. Derive an expression for the center of mass of two point masses.

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

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14. Define Torque and derive its expression.

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15. The relation between torque and angular acceleration is

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16. Define angular momentum.

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17. What is rolling motion?

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18. What is the condition for pure rolling ?

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19. Derive an expression for kinetic energy in pure rolling.

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Conceptual Questions

1. Write the SI unit and dimensional formula for moment of Inertia.

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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 ?

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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. 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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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 I 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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7. A solid cylinder of mass 20 kg rotates about its axis with angular speed 100 rad/s. The radius of the cylinder is 0.25 m. 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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8. A spherical solid ball of 1 kg mass and radius 3 cm is rotating about an axis passing through its centre with an angular velocity of 50 rad/s. Calculate the kinetic energy of rotation.

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9. 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.

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10. Find the moment of inertia of a mass of 5 kg and another mass 10 kg about an axis of rotation which is 0.2 m from the 5 kg mass and 0.4 m from the 10 kg mass. Find the radius of gyration for the system.

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

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

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Match The Following

1.

(1)	Moment of Inertia of an Uniform Rod	(a)	$\frac{2}{5}MR^2$
(2)	Moment of Inertia of an Uniform Ring	(b)	$\frac{1}{2}MR^2$
(3)	Moment of Inertia of an Uniform Disc	(c)	$\frac{1}{12}Ml^2$
(4)	Moment of Inertia of an Uniform solid sphere	(d)	$I = MR^2$

A. $\begin{matrix}(1) & (2) & (3) & (4)\\ c & d & b & a\end{matrix}$

B. $\begin{matrix}(1) & (2) & (3) & (4)\\ d & c & b & a\end{matrix}$

C. $\begin{matrix}(1) & (2) & (3) & (4)\\ b & c & d & a\end{matrix}$

D. $\begin{matrix}(1) & (2) & (3) & (4)\\ d & a & b & c\end{matrix}$

Answer: a

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2.

	Rotational Motion about a fixed Axis		Expression
(1)	Power	(a)	$F.\ \Delta t$
(2)	Impulse	(b)	$\tau\theta$
(3)	Torque	(c)	$\tau\omega$
(4)	Work done	(d)	$I \propto$

A. $\begin{matrix}(1) & (2) & (3) & (4)\\ b & c & a & d\end{matrix}$

B. $\begin{matrix}(1) & (2) & (3) & (4)\\ d & c & a & b\end{matrix}$

C. $\begin{matrix}(1) & (2) & (3) & (4)\\ c & a & d & b\end{matrix}$

D.

(1)	(2)	(3)	(4)
b	d	c	a

Answer: c

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3.

	Type of Equilibrium		Conditions
(1)	Dynamic Equilibrium	(a)	Net force and Net torque are zero
(2)	Static Equilibrium	(b)	Linear Momentum is constant
(3)	Rotational Equilibrium	(c)	Linear Momentum and Angular momentum are constant
(4)	Translation Equilibrium	(d)	Net torque is zero

A.

(1)	(2)	(3)	(4)
b	c	d	a

B.

(1)	(2)	(3)	(4)
d	c	b	a

C.

(1)	(2)	(3)	(4)
b	a	d	c

D.

(1)	(2)	(3)	(4)
c	a	d	b

Answer: d

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4. | | | | |
|---|---|---|---|
| (1) | Angular Momentum | (a) | mr^2 |
| (2) | Torque | (b) | $I\omega$ |
| (3) | Angular Acceleration | (c) | $\frac{dL}{dt}$ |
| (4) | Moment of Inertia | (d) | $\frac{d\omega}{dt}$ |

A.
(1)	(2)	(3)	(4)
c	d	b	a

B.
(1)	(2)	(3)	(4)
b	c	d	a

C.
(1)	(2)	(3)	(4)
d	c	b	a

D.
(1)	(2)	(3)	(4)
c	a	b	d

Answer: b

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Fill In The Blanks

1. A _____ is the one in which the distances between different particles remain constant.

A. flexible body

B. Rigid body

C. Spring body

D. Slim body

Answer: b

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2. In _____ the translational motion is more than rotational motion.

A. Slipping

B. frictional motion

C. Circular motion

D. Sliding

Answer: d

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3. _____ can also be treated as the momentary rotation about the point of contact.

A. Sliding

B. Rolling

C. Slipping

D. Skating

Answer: b

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4. If the external torque acting on the body zero, the component of _____ along the axis of rotation is constant.

A. Velocity

B. Force

C. Angular Momentum

D. Momentum

Answer: c

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5. In _____ the rotational motion is more than translational motion.

A. Sliding

B. Slipping

C. Rolling

D. Skating

Answer: b

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6. Write the expression for impulse in terms of average force

A. $F.\ \Delta t$

B. $\tau.\ \Delta t$

C. $\tau.\ \Delta m$

D. $\tau.\ \Delta k$

Answer: b

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7. $\frac{1}{2}I\omega^2$ is the expression for _____

A. Moment of Inertia

B. Rotational kinetic Energy

C. Elastic Potential Energy

D. Kinetic Energy

Answer: b

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

A. $\frac{P^2}{2m}$

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

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

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

Answer: c

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9. State and prove perpendicular axis theorem.

A. $I = I_c + Md^2$

B. I_(Z) = I_(X) - I_(Y)`

C. $I_Z = I_X + I_Y$

D. $I_Y = I_X + I_Z$

Answer: b

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10. Moment of Inertia of an uniform Disc is _____

A. MR^2

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

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

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

Answer: c

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Choose The Odd One Out

1. Choose the odd one out :

A. Torque

B. Moment of force

C. couple

D. Rotational force

Answer: c

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2. Choose the odd one out

A. Translational Equilibrium

B. Rotational Equilibrium

C. Dynamic Equilibrium

D. Thermodynamic Equilibrium

Answer: d

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3. Choose the odd one out :

A. angular momentum

B. Angular Velocity

C. Torque

D. Inertia

Answer: d

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4. Choose the odd one out :

A. ma

B. $\frac{mV^2}{r}$

C. $mr\omega^2$

D. mr^2

Answer: d

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Choose The Correct Pair

1. Choose the correct pair :

A. $M.\ I - Mk^2$

B. $L - I \propto$

C. $\tau - I\omega$

D. $K.\ E - \frac{1}{2}m\omega^2$

Answer: a

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2. Choose the correct pair :

A. $(M.\ I)_{\text{Ring}} - \frac{MR^2}{4}$

B. $(M.\ I)_{\text{disc}} - \frac{1}{2}MR^2$

C. $(M.\ I)_{\text{rod}} - \frac{Ml^2}{3}$

D. $(M.\ I)_{\text{Solids sphere}} - \frac{3}{5}MR^2$

Answer: b

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Choose The Incorrect Pair

1. Choose the incorrect pair :

A. Work done - F.s

B. Torque - $I \propto$

C. Power - F/V

D. K.E - $\frac{1}{2}Mv^2$

Answer: c

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2. Choose the incorrect pair :

A. Parallel Axes Theorem - $I_C + Md^2$

B. Perpendicular Axis Theorem - $I_X + I_Y$

C. Work-Energy Theorem - Δ K.E

D. Centripetal theorem - $\frac{mv^2}{r}$

Answer: d

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Assertion Reason

1. Assertion : The moment of Linear Momentum is called Angular momentum (L) i.e.

$L = r \times p = (mv) \times r = mvr$

if V = $r\omega$ then.

$L = mr^2\omega(\text{ or })L = I\omega$

Reason : For conservation of Angular momentum, Torque (Rotational force applied externally) must be zero.

A. Assertion and Reason are correct and Reason is correct explanation of Assertion

B. Assertion and Reason are true but Reason is the false explanation of the Assertion

C. Assertion is true but Reason is false

D. Assertion is false but Reason is true

Answer: a

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2. Assertion : The Angular velocity of a planet in its orbit around the sun increases when it is nearer to the sin, as the moment of Inertia of the planet about the sun decreases. This is an example for conservation of Angular momentum.

Reason : The nearest position of the planet to the sun is called apogee and the farthest position is perigee.

A. Assertion and Reason are correct and Reason is correct explanation of Assertion

B. Assertion and Reason are true but Reason is the false explanation of the Assertion

C. Assertion is true but Reason is false

D. Assertion is false but Reason is true

Answer: c

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Choose The Correct Or Incorrect Statements

1. (I) Perpendicular Axis theorem holds good only for plane Laminar objects.

(II) The perpendicular distance between the Axis of Rotation of a body and the centre of gravity of the body is called Radius of Gyration.

Which one is correct ?

A. I only

B. II only

C. both are correct

D. None

Answer: c

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2. (I) Relation between rotational kinetic energy and Angular momentum is $\frac{L^2}{2I}$

(II) Rotational work done is $F\theta$

Which one is correct ?

A. I only

B. II only

C. both are correct

D. None

Answer: a

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3. (I) In slipping, the rotational motion is less than translational motion.

(II) In sliding, the rotational motion is more than translational motion

Which one is correct ?

A. I only

B. II only

C. both are correct

D. None

Answer: d

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4. (I) Net Torque produces linear motion in rigid object.

(II) Rolling motion is the combination of translational and rotational

motions.

Which statement is Incorrect ?

A. I only

B. II only

C. both are correct

D. None

Answer: a

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Very Short Answer Question

1. Find the workdone if a particle moves from position $\vec{r}_1 = \left(2\hat{j} + \hat{j} - 3\hat{k}\right)$ to a position $\vec{r}_2 = \left(4\hat{i} + 6\hat{j} - 7\hat{k}\right)$ under the effect of force $\vec{F} = \left(3\hat{i} + 2\hat{j} + 4\hat{k}\right)N.$

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2. A wheel of radius 0.5m is moving with a speed of 12m/s. Find its angular speed ?

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3. What is meant by an internal force & external force ?

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4. What is rigid body ?

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5. Define the center of mass of a body.

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6. What is point mass ?

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7. State the rule which is used to find the direction of torque.

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8. What is the moment of Inertia of a sphere of mass 20 kg and radius $\frac{1}{4}$ m about its diameter ?

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9. Obtain the equation $\omega = \omega_0 + \alpha t$.

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10. A torque of 10^3 Nm acting on a rigid body, turns it through 30° in 0.2 second. Calculate the work done by the torque on the body and power of torque.

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11. Obtain an expression for the power delivered by torque.

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12. What is meant by rolling friction ?

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13. Define centre of gravity.

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14. Define Lami's theorem.

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Creative Questions Hots

1. Explain Torque in vector from.

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2. Explain how the torque can be expressed as a vector product of two vectors ? How the direction and magnitude of torque is determined ?

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3. A constant couple of 500 Nm turns a wheel of moment of inertia 100 kg m^2 about an axis through its centre. What will be the angular velocity gained by the body after 2 seconds ?

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4. The moment of inertia of a thin rod of mass 'M' and length 'l' about an axis passig through its centre is $\frac{Ml^2}{12}$. Calculate the moment of inertia about a parallel axis through end of rod.

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5. A solid cylinder of mass 20 kg rotates about its axis with angular speed 100 rad/s. The radius of the cylinder is 0.25 m. 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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Value Based Questions

1. Dhivya was a talented cyclist. She used to go to school in her bicycle presented by her Dad. She used to ride faster, as she always goes late from home. When she was going by the road one day. She skid down from her cycle and got injured. That was a curved road where she has to take a turn, and as she was in hurry, this incident has happened. Why does Dhivya skid from her cycle ?

(i) What is the condition for skidding ?

(ii) Derive an equation for the Angle for safer riding.

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2. Ganesh is a champion in cricket in his school. When he is in the ground (for practice) and he used to whirl his bat in different style.

His coach was Mr. Gunalan. The coach asked Ganesh to hold the bat at its handle and roatate fastly. But Ganesh could not do as his coach said, Ganesh developed pain in his hands. Then his coach told him to rotate the bat by holding it at its mid point. When Ganesh rotated at this position, he was able to rotate the bat faster. Ganesh was surprised and asked his coach how.

(i) What was coach's explanation to Ganesh ?

(ii) What is Radius of Gyration ? Give an example.

(iii) How moment of Inertia is related with Angular velocity ?

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