CHAPTER: ROTATIONAL MOTION

Multiple Choice Questions

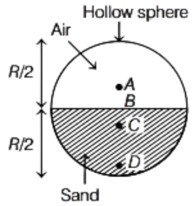
1. A system of particles is called a rigid body, when
(a) any two particles of system may have displacements in opposite directions under action of a force
(b) any two particles of system may have velocities on opposite directions under action of a force
(c) any two particles of system may have a zero relative velocity
(d) any two particles of system may have displacements in same direction under action of a force

2. The centre of mass of a system of particles does not depend on
(a) masses of the particles
(b) internal forces of the particles
(c) position of the particles
(d) relative distance between two particles

3. In pure rotation, all particles of the body
(a) move in a straight line
(b) move in concentric circles
(c) move in non-concentric circles
(d) have same speed

4. For n particles in a space, the suitable expression for the x-coordinate of the centre of mass of a system is
(a) $\frac{\sum m_i x_i}{m_i}$ (b) $\frac{\sum m_i x_i}{M}$ (c) $\frac{\sum m_i y_i}{M}$ (d) $\frac{\sum m_i z_i}{M}$

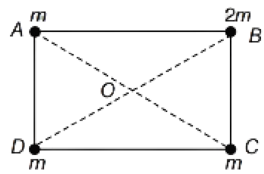
5. Which of the following points is the likely position of the centre of mass of the system shown in figure?
(a) A
(b) B
(c) C
(d) D



6. Two bodies of masses 1 kg and 2 kg are lying on x-y plane at (1 ,2) and (- 1, 3) respectively. What are the coordinates of centre of mass?
(a) (2, N-1) (b) $\left(\frac{8}{3}, -\frac{1}{3}\right)$ (c) $\left(-\frac{1}{3}, \frac{8}{3}\right)$ (d) None of these

7. Three identical spheres of mass M each are placed at the corners of an equilateral triangle of side 2m. Taking one of the corners as the origin, the position vector of the centre of mass is
(a) $\sqrt{3}(\hat{\imath} - \hat{\jmath})$ (b) $\frac{\hat{\imath}}{\sqrt{3}} + \hat{\jmath}$ (c) $\frac{\hat{\imath} + \hat{\jmath}}{3}$ (d) $\hat{\imath} + \frac{\hat{\jmath}}{\sqrt{3}}$

8. Centre of mass of the given system of particles will be at
(a) OD (b) OC
(c) OB (d) AO



9. Two particles of equal masses have velocities $V_1 = 4\,\hat{\imath}\ ms^{-1}$ and $V_2 = 4\,\hat{\imath}\ ms^{-1}$. First particle has an acceleration $a_1 = (2\hat{\imath} + 2\hat{\jmath})\ ms^{-2}$, while the acceleration of the other particle is zero. The centre of mass of the two particles moves in a path of

(a) straight line (b) parabola (c) circle (d) ellipse

10. The centre of mass of three particles of masses 1 kg, 2 kg and 3 kg is at (3, 3, 3) with reference to a fixed coordinate system. Where should a fourth particle of mass 4 kg be placed, so that the centre of mass of the system of all particles shifts to a point (1, 1, 1)?

(a) (- 1, - 1, - 1) (b) (- 2, - 2, - 2) (c) (2, 2, 2) (d) (1 ,1, 1)

11. A ball kept in a closed box moves in the box making collisions with the walls. The box is kept on a smooth surface. The velocity of the centre of mass

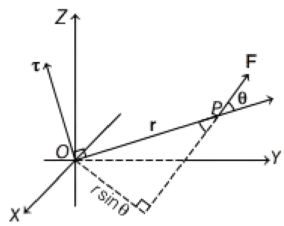
(a) of the box remains constant

(b) of the box and the ball system remains constant

(c) of the ball remains constant

(d) of the ball relative to the box remains constant

12. A force **F** is applied on a single particle P as shown in the figure. Here, **r** is the position vector of the particle. The value of torque τ is



(a) F× r

(b) r× F´

(c) r · F

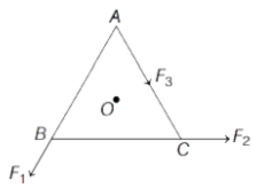
(d) F · r

13. A force $F = 5\hat{\imath} + 2\hat{\jmath} - 5\hat{k}$ acts on a particle whose position vector is $r = \hat{\imath} + 2\hat{\jmath} - \hat{k}$. What is the torque about the origin?

(a) $8\hat{\imath} + 10\hat{\jmath} + 12\hat{k}$ (b) $8\hat{\imath} + 10\hat{\jmath} - 12\hat{k}$

(c) $8\hat{\imath} - 10\hat{\jmath} + 8\hat{k}$ (d) $10\hat{\imath} - 10\hat{\jmath} - \hat{k}$

14. ABC is an equilateral triangle with O as its centre. F_1, F_2 and F_3 represent three forces acting along the sides AB, BC and AC, respectively. If the total torque about O is zero, then the magnitude of F_3 is



(a) $F_1 + F_2$

(b) $F_1 - F_2$

(c) $\frac{F_1 + F_2}{2}$

(d) $2(F_1 + F_2)$

15. The angular momentum **L** of a single particle can be represented as

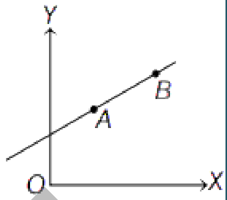
(a) r× p (b) $rp\ sin\theta\ \hat{n}$ (c) r$\rho\perp\hat{n}$ (d) Both (a) and (b)

($\hat{n}$ = unit vector perpendicular to plane of r, so that r, p and $\hat{n}$ make right-handed system)

16. Newton's second law for rotational motion of a system of particle can be represented as (**L** for a system of particles)

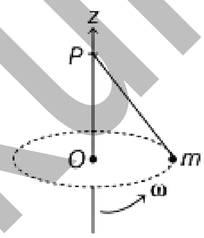
(a) $\frac{dp}{dt} = \tau_{ext}$ (b) $\frac{dL}{dt} = \tau_{int}$ (c) $\frac{dL}{dt} = \tau_{ext}$ (d) $\frac{dL}{dt} = \tau_{int}$

17. A particle of mass m moves in the xy-plane with a velocity v along the straight line AB. If the angular momentum of the particle with respect to origin O is L_A, when it is at A and L_B when it is at B, then



(a) $L_A > L_B$
(b) $L_A = L_B$
(c) the relationship between L_A and L_B depends upon the slope of the line AB
(d) $L_A < L_B$

18. A point mass m is attached to a massless string whose other end is fixed at P as shown in figure. The mass is undergoing circular motion in xy-plane with centre O and constant angular speed w. If the angular momentum of the system, calculated about O and P be L_O and L_P respectively, then



(a) L_O and L_P do not vary with time
(b) L_O varies with time while L_P remains constant
(c) L_O remains constant while L_P varies with time
(d) L_O and L_P both vary with time

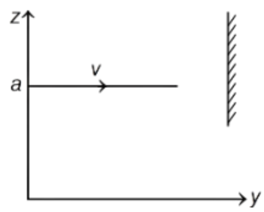
19. A child stands at the centre of a turntable with his two arms outstretched. The turntable is set rotating with an angular speed of 40 rev min $^{-1}$. How much is the angular speed of the child, if he folds his hands back and thereby reduces his moment of inertia to (2/5) times the initial value? Assume that the turntable rotates without friction.

(a) 40 rpm (b) 45 rpm (c) 55 rpm (d) 100 rpm

20. If the torque of the rotational motion will be zero, then the constant quantity will be

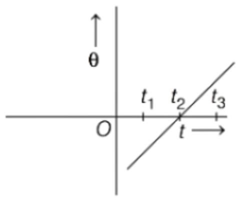
(a) angular momentum (b) linear momentum
(c) angular acceleration (d) centripetal acceleration

21. A particle of mass m is moving in yz −plane with a uniform velocity v with its trajectory running parallel to +ve y-axis and intersecting z-axis at $z = a$ in figure. The change in its angular momentum about the origin as it bounces elastically from a wall at $y =$ constant is



(a) $mva\ \hat{e}_x$ (b) $2\ mva\ \hat{e}_x$
(c) $ymv\ \hat{e}_x$ (d) $2\ ymv\ \hat{e}_x$

22. The variation of angular position θ of a point on a rotating rigid body with time t is shown in figure. In which direction, the body is rotating?

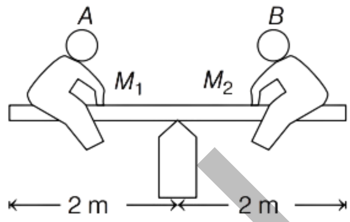


(a) Clockwise
(b) Anti-clockwise
(c) May be clockwise or anti-clockwise
(d) None of the above

23. A rigid body is said to be in partial equilibrium only, if

(a) it is in rotational equilibrium (b) it is in translational equilibrium
(c) Either (a) or (b) (d) None of the above

24. In the game of see-saw, what should be the displacement of boy B from right edge to keep the see-saw in equilibrium? (Given, $M_1 = 40$ kg and $M_2 = 60$ kg)

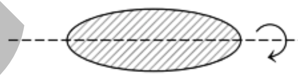


(a) $\frac{4}{3}$m
(b) 1m
(c) $\frac{2}{3}$m
(d) Zero

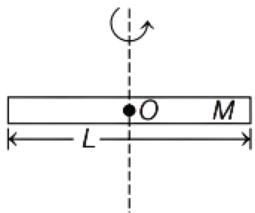
25. The centre of gravity of a homogeneous body is the point at which the whole
(a) volume of the body is assumed to be concentrated
(b) area of the surface of the body is assumed to be concentrated
(c) weight of the body is assumed to be concentrated
(d) All of the above

26. One solid sphere A and another hollow sphere B are of same mass and same outer radius. Their moments of inertia about their diameters are I_A and I_B respectively, such that
(a) $I_A = I_B$ (b) $I_A > I_B$ (c) $I_A < I_B$ (d) None of these

27. A disc of mass M and radius R is rotating about one of its diameters. The value of radius of gyration for the disc is
(a) R/4 (b) R/2
(c) R/ 6 (d) None of these



28. A rod is rotating about an axis passing through its centre and perpendicular to its length. The radius of gyration for the rod is



(a) L /12
(b) L /$\sqrt{12}$
(c) L / 6
(d) L / $\sqrt{6}$

29. A wheel is rotating at 900 rpm about its axis. When the power is cut-off, it comes to rest in 1 min. The angular retardation (in rad s^{-2}) is
(a) - $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{2}$

30. If object starts from rest and covers angle of 60 rad in 10 s in circular motion, then magnitude of angular acceleration will be
(a) 1.2 rad s^{-2} (b) 1.5 rad s^{-2} (c) 2 rad s^{-2} (d) 2.5 rad s^{-2}

31. When a ceiling fan is switched OFF, its angular velocity fall to half while it makes 36 rotations. How many more rotations will it make before coming to rest? (Assume uniform angular retardation)
(a) 36 (b) 24 (c) 18 (d) 12

32. A disc is rotating with angular velocity ω. A force F acts at a point whose position vector with respect to the axis of rotation is r. The power associated with torque due to the force is given by
(a) (r× F)· ω (b) (r× F)× ω (c) r×($F \cdot \omega$) (d) r ·($F \times \omega$)

33. A flywheel of moment of inertia 0.4 kg-m ^{2} and radius 0.2 m is free to rotate about a central axis. If a string is wrapped around it and it is pulled with a force of 10N, then its angular velocity after 4 s will be

(a) 10 rads $^{-1}$ (b) 5 rads $^{-1}$ (c) 20 rads $^{-1}$ (d) None of these

34. Two discs having mass ratio (1/2) and diameter ratio (2/1), then find ratio of moment of inertia.

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

35. A solid sphere is rotating freely about its symmetry axis in free space. The radius of the sphere is increased keeping its mass same. Which of the following physical quantities would remain constant for the sphere?

(a) Rotational kinetic energy (b) Moment of inertia

(c) Angular velocity (d) Angular momentum

36. A body having a moment of inertia about its axis of rotation equal to 3 kg-m ^{2} is rotating with angular velocity of 3 rad s $^{-1}$. Kinetic energy of this rotating body is same as that of a body of mass 27 kg moving with a velocity v. The value of v is

(a) 1 ms^{-1} (b) 0.5 ms^{-1} (c) 2 ms^{-1} (d) 1 .5 ms^{-1}

37. A disc of radius R is rotating with an angular speed ω_o about a horizontal axis. It is placed on a horizontal table. The coefficient of kinetic friction is μ_k. What was the velocity of its centre of mass before being brought in contact with the table?

(a) $\omega_o R$ (b) Zero (c) $\frac{\omega_o R}{2}$ (d) $2\omega_o R$

38. Two bodies have their moments of inertia I and $2I$ respectively about their axis of rotation. If their kinetic energies of rotation are equal, their angular momenta will be in the ratio

(a) 1 : 2 (b) $\sqrt{2}$ 1: (c)2 1: (d)1: $\sqrt{2}$

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

(a) remains constant (b) becomes half

(c) doubles (d) quadruples

40. If frictional force is neglected and girl bends her hand, then (initially girl is rotating on chair)

(a) I_{girl} will reduce

(b) I_{girl} will increase

(c) ω_{girl} will reduce

(d) None of the above

41. A merry-go-round, made of a ring-like platform of radius R and mass M, is revolving with angular speedω . A person of mass M is standing on it. At one instant, the person jumps off the round, radially away from the centre of the round (as seen from the round). The speed of the round of afterwards is

(a) 2 ω (b) ω (c) $\frac{\omega}{2}$ (d) zero

42. A wheel of radius R rolls on the ground with a uniform velocity v. The velocity of topmost point relative to the bottommost point is

(a) v (b) 2v (c) v /2 (d) zero

43. A hoop of radius 2 m weighs 100 kg. It rolls along a horizontal floor, so that its centre of mass has a speed of 20 cms $^{-1}$. How much work has to be done to stop it?

(a) 10 J (b) 12 J (c) 4 J (d) 3 J

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

(a) converts translational energy into rotational energy

(b) dissipates energy as heat

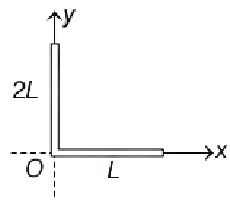
(c) decreases the rotational motion

(d) decreases the rotational and translational motion

45. The centre of mass lie outside the body of a ....

(a) pencil (b) shotput (c) dice (d) bangle

46. Figure shows a composite system of two uniform rods of lengths as indicated. Then the coordinates of the centre of mass of the system of rods are......... .



(a) $\left(\frac{L}{2}, \frac{2L}{3}\right)$ (b) $\left(\frac{L}{4}, \frac{2L}{3}\right)$

(c) $\left(\frac{L}{6}, \frac{2L}{3}\right)$ (d) $\left(\frac{L}{6}, \frac{L}{3}\right)$

47. Analogue of mass in rotational motion is ....

(a) moment of inertia (b) angular momentum

(c) gyration (d) None of the above

48. The angular acceleration of a flywheel of mass 5 kg and radius of gyration 0.5 m is ...., if a torque of 10N-m is applied on it.

(a) 2 rad s^{-2} (b) 4 rad s^{-2} (c) 8 rad s^{-2} (d) zero

49. When a disc rotates with uniform angular velocity, which of the following statements is incorrect.

(a) The sense of rotation remains same.

(b) The orientation of the axis of rotation remains same.

(c) The speed of rotation is non-zero and remains same.

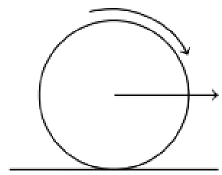
(d) The angular acceleration is non-zero and remains same.

50. A bicycle wheel rolls without slipping on a horizontal floor. Which one of the following statements is true about the motion of points on the rim of the wheel, relative to the axis at the wheel's centre?

(a) Points near the top move faster than points near the bottom.

(b) Points near the bottom move faster than points near the top.

(c) All points on the rim move with the same speed.



(d) All points have the velocity vectors that are pointing in the radial direction towards the centre of the wheel.

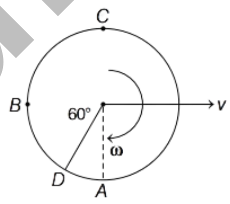
51. If radius of earth is reduced to half without changing its mass, then match the following columns and choose the correct option from the codes given below.

	Column I		Column II
A.	Angular momentum of earth	p.	Will become one fourth
B.	Time period of rotation of earth	q.	Will become four times
C.	Rotational kinetic energy of earth	r.	No change

Codes

	A	B	C		A	B	C
(a)	p	q	r	(b)	p	q	p
(c)	r	p	q	(d)	p	r	p

52. A rigid body is rolling without slipping on the horizontal surface, then match the Column I with Column II and choose the correct option from the codes given below.



	Column I		Column II
A.	Velocity at point A, i.e. v_A	p.	$v\sqrt{2}$
B.	Velocity at point B, i.e. v_B	q.	zero
C.	Velocity at point C, i.e. v_C	r.	v
D.	Velocity at point D, i.e. v_D	s.	$2v$

Codes

	A	B	C	D
(a)	q	p	s	r
(b)	p	r	s	q
(c)	s	r	q	p
(d)	q	r	s	p

Assertion-Reasoning MCQs

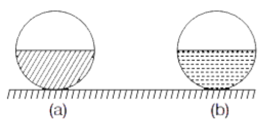
For question numbers 53 to 64, two statements are given-one labeled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) are as given below

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

53. **Assertion** The motion of the centre of mass describes the translational part of the motion.
Reason Translational motion always means straight line motion.

54. Assertion The centre of mass of a body must lie on the body.
Reason The centre of mass of a body does not lie at the geometric centre of body.

55. Assertion Two identical spherical spheres are half filled with two liquids of densities ρ_1 and ρ_2 $(> \rho_1)$. The centre of mass of both the spheres lie at same level.
Reason The centre of mass does not lie at centre of the sphere.



56. Assertion If a particle moves with a constant velocity, then angular momentum of this particle about any point remains constant.

Reason Angular momentum does not have the units of Planck's constant.

57. Assertion When a particle is moving in a straight line with a uniform velocity, its angular momentum is constant.
Reason The angular momentum is non-zero, when particle moves with a uniform velocity.

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

59. Assertion Inertia and moment of inertia are not same quantities.
Reason Inertia represents the capacity of a body that does not oppose its state of motion or rest.

60. Assertion Moment of inertia of a particle is different whatever be the axis of rotation.
Reason Moment of inertia does not depends on mass and distance of the particle from the axis of rotation.

61. Assertion The angular velocity of a rigid body in motion is defined for the whole body.
Reason All points on a rigid body performing pure rotational motion are having same angular velocity.

62. Assertion If bodies slide down an inclined plane without rolling, then all bodies reach the bottom simultaneously is not necessary.
Reason Acceleration of all bodies are equal and independent of the shape.

63. Assertion A solid sphere cannot roll without slipping on smooth horizontal surface.
Reason If the sphere is left free on smooth inclined surface, it can roll without slipping.

64. Assertion The work done against force of friction in the case of a disc rolling without slipping down an inclined plane is zero.
Reason When the disc rolls without slipping, friction is required because for rolling condition velocity of point of contact is zero

Case Based MCQs

Direction *Answer the questions from 65-69 on the following case.*

Centre of Mass:

The centre of mass of a body or a system of bodies is the point which moves as though all of the mass were concentrated there and all external forces were applied to it. Hence, a point at which the entire mass of the body or system of bodies is supposed to be concentrated is known as the centre of mass.

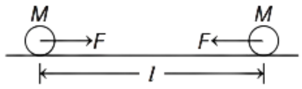
If a system consists of more than one particles (or bodies) and net external force on the system in a particular direction is zero with centre of mass at rest. Then, the centre of mass will not move along that direction. Even though some particles of the system may move along that direction.

65. The centre of mass of a system of two particles divides, the distance between them
(a) in inverse ratio of square of masses of particles
(b) in direct ratio of square of masses of particles
(c) in inverse ratio of masses of particles
(d) in direct ratio of masses of particles

66. Two bodies of masses 1 kg and 2 kg is lying in xy-plane at $(-1, 2)$ and $(2, 4)$, respectively. What are the coordinates of the centre of mass?

(a) $\left(1,\frac{10}{3}\right)$ (b) (1,0) (c) (0,1) (d) None of these

67. Two balls of same masses start moving towards each other due to gravitational attraction, if the initial distance between them is l. Then, they meet at



(a) $\frac{l}{2}$ (b) l
(c) $\frac{l}{3}$ (d) $\frac{l}{4}$

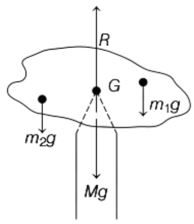
68. All the particles of a body are situated at a distance R from the origin. The distance of centre of mass of the body from the origin is
(a) $= R$ (b) $\leq R$ (c) $> R$ (d) $\geq R$

69. Two particles A and B initially at rest move towards each other under a mutual force of attraction. At the instant, when the speed of A is v and the speed of B is $2v$, the speed of centre of mass of the system is
(a) zero (b) v (c) 15. v (d) 3v

Direction Answer the questions from 70-74 on the following case.

Torque and Centre of Gravity:

Torque is also known as moment of force or couple. When a force acts on a particle, the particle does not merely move in the direction of the force but it also turns about some point. So, we can define the torque for a particle about a point as the vector product of position vector of the point where the force acts and with the force itself. In the given figure, balancing of a cardboard on the tip of a pencil is done. The point of support, G is the centre of gravity.



70. If the $\boldsymbol{F}_{\text{net, ext}}$ is zero on the cardboard, it means
(a) $R = Mg$ (b) $m_1 g = Mg$ (c) $m_2 g = Mg$ (d) $R = m_1/g$

71. Choose the correct option.
(a) τ_{Mg} about $CG = 0$ (b) τ_R about $CG = 0$
(c) Net τ due to $m_1 g,\ m_2 g$, ... , $m_n g$ about $CG = 0$ (d) All of the above

72. The centre of gravity and the centre of mass of a body coincide, when
(a) g is negligible (b) g is variable (c) g is constant (d) g is zero

73. If value of g varies, the centre of gravity and the centre of mass will
(a) coincide (b) not coincide
(c) become same physical quantities (d) None of the above

74. A body lying in a gravitational field is in stable equilibrium, if
(a) vertical line through CG passes from top
(b) horizontal line through CG passes from top
(c) vertical line through CG passes from base
(d) horizontal line through CG passes from base

Direction Answer the questions from **75-79** on the following case.

Moment of Inertia:

A heavy wheel called flywheel is attached to the shaft of steam engine, automobile engine etc., because of its large moment of inertia, the flywheel opposes the sudden increase or decrease of the speed of the vehicle. It allows a gradual change in the speed and prevents jerky motion and hence ensure smooth ride of passengers.

75. Moment of inertia of a body depends upon
(a) axis of rotation (b) torque (c) angular momentum (d) angular velocity

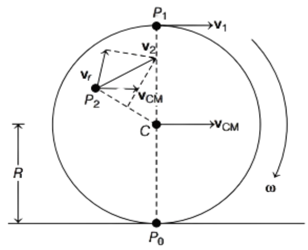
76. A particle of mass 1 kg is kept at (1m, 1m, 1m). The moment of inertia of this particle about Z −axis would be
(a) 1 kg m² (b) 2 kg m² (c) 3 kg m² (d) None of the above

77. Moment of inertia of a rod of mass m and length l about its one end is I. If one-fourth of its length is cut away, then moment of inertia of the remaining rod about its one end will be
(a) $\frac{3}{4}$ I (b) $\frac{9}{16}$ I (c) $\frac{27}{64}$ I (d) $\frac{I}{16}$

78. A circular disc is to be made by using iron and aluminium, so that it acquires maximum moment of inertia about its geometrical axis. It is possible with
(a) iron and aluminium layers in alternate order
(b) aluminium at interior and iron surrounding it
(c) iron at interior and aluminium surrounding it
(d) Either (a) or (c)

79. Three thin rods each of length L and mass M are placed along X , Y and Z -axes such that one end of each rod is at origin. The moment of inertia of this system about Z −axis is
(a) $\frac{2}{3} ML^2$ (b) $\frac{2ML^2}{3}$ (c) $\frac{5ML^2}{3}$ (d) $\frac{ML^2}{3}$

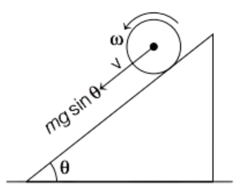
Direction Answer the questions from 80-84 on the following case.
Rolling Motion: The rolling motion can be regarded as the combination of pure rotation and pure translation. It is also one of the most common motions observed in daily life.
Suppose the rolling motion (without slipping) of a circular disc on a level surface. At any instant, the point of contact P_0 of the disc with the surface is at rest (as there is no slipping). If V_{CM} is the velocity of centre of mass which is the geometric centre C of the disc, then the translational velocity of disc is V_{CM} , which is parallel to the level surface.
Velocity of centre of mass, $V_{\mathrm{CM}} = R\omega$



80. A solid cylinder is sliding on a smooth horizontal surface with velocity $v_0$without rotation. It enters on the rough surface. After that it has travelled some distance, the friction force increases its
(a) translational kinetic energy
(b) rotational kinetic energy
(c) total mechanical energy
(d) angular momentum about an axis passing through point of contact of the cylinder and the surface

81. A cylinder rolls down an inclined plane of inclination 30°, the acceleration of cylinder is
(a) $\frac{g}{3}$ (b) g (c) $\frac{g}{2}$ (d) $\frac{2g}{3}$

82. Sphere is in pure accelerated rolling motion in the figure shown, Choose the correct option.
(a) The direction of f_s is upwards
(b) The direction of f_s is downwards
(c) The direction of gravitational force is upwards
(d) The direction of normal reaction is downwards



83. Kinetic energy of a rolling body will be

(a) $\frac{1}{2}mv_{CM}^2\,(1+k^2/R^2)$ (b) $\frac{1}{2}/\omega^2$ (c) $\frac{1}{2}mv_{CM}^2$ (d) None of the above

84. A body is rolling down an 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

ANSWERS

Multiple Choice Questions

01. (c) 02. (b) 03. (b) 04. (b) 05. (c) 06. (c) 07. (d) 08. (c) 09. (a) 10. (b)

11. (b) 12. (b) 13. (a) 14. (a) 15. (d) 16. (c) 17. (b) 18. (c) 19. (d) 20. (a)

21. (b) 22. (b) 23. (c) 24. (c) 25. (c) 26. (c) 27. (b) 28. (b) 29. (a) 30. (a)

31. (d) 32. (a) 33. (c) 34. (a) 35. (d) 36. (a) 37. (b) 38. (d) 39. (b) 40. (a)

41. (a) 42. (b) 43. (c) 44. (a) 45. (d) 46. (c) 47. (a) 48. (c) 49. (d) 50. (a) 51. (c) 52. (a)

Assertion-Reasoning MCQs

53. (c) 54. (d) 55. (c) 56. (c) 57. (b) 58. (a) 59. (c) 60. (c) 61. (b) 62. (c) 63. (d) 64. (a)

Case Based MCQs

65. (c) 66. (a) 67. (a) 68. (b) 69. (a) 70. (a) 71. (d) 72. (c) 73. (b) 74. (c) 75. (a) 76. (b)

77. (c) 78. (b) 79. (a) 80. (b) 81. (a) 82. (a) 83. (a) 84. (d)