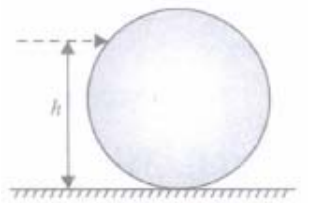
NEET PHYSICS PRACITCE PAPER

Time : 60 Mins **5 MOTION OF SYSTEM OF PARTICLES ANDRIGID BODY 1** **Marks : 200**

1. Which of the following statements is not correct?
   a) During rolling, the instantaneous speed of the point of contact is zero.
   b) During rolling, the instantaneous acceleration of the point of contact is zero.
   c) For perfect rolling motion, work done against friction is zero
   d) A wheel moving down a perfectly frictionless inclined plane will slip but not roll on the plane
2. A rod of we ight W is supported by two parallel knife edges A and B and is in equilibrium in a horizontal position. The knives are at a distance d from each other. The centre of mass of the rod is at distance x from l. The normal reaction on A is_____
   a) $\frac{Wd}{x}$ b) $\frac{W(d-x)}{x}$ c) $\frac{W(d-x)}{d}$ d) $\frac{Wx}{d}$
3. Two particles A and B are moving in uniform circular motion in concentric circles of radii r_A and r_B with speed v_A and v_B respectively. Their time period of rotation is the same. The ratio of angular speed of A to that of B will be_____
   a) $V_A : V_B$ b) $r_B : r_A$ c) 1 : 1 d) $r_A : r_B$
4. At any instant, a rolling body may be considered to be in pure rotation about an axis through the point of contact axis is translating forward with speed _____.
   a) equal to centre of mass b) zero c) twice of centre of mass d) None of the above
5. When a solid sphere rolls without slipping down an inclined plane making an angle 8 with the horizontal, the acceleration of its centre of mass is a. If the same sphere slides without friction, its acceleration a' will be
   a) $\frac{7}{2}a$ b) $\frac{5}{7}a$ c) $\frac{7}{5}a$ d) $\frac{5}{2}a$
6. An automobile engine develops 100 kW power when rotating at a speed of 1800 rpm. The torque delivered by the engine is
   a) $\frac{10^2}{6\pi}Nm$ b) $\frac{10^4}{6\pi}Nm$ c) $\frac{10^6}{6\pi}Nm$ d) $\frac{10^8}{6\pi}Nm$
7. A ring of radius R is rotating with an angular speed Wo about a horizontal axis. It is placed on a rough horizontal table. The coefficient of kinetic friction is μ_k.The time after which it starts rolling is
   a) $\frac{w_0\mu_k R}{2g}$ b) $\frac{w_0 g}{2\mu_k R}$ c) $\frac{2w_0 R}{\mu_k g}$ d) $\frac{w_0 R}{2\mu_k g}$
8. A circular platform is mounted on a frictionless vertical axle, its radius R=2 m and its moment of inertia about the axle is 200 kgm^2. It is initially at rest. A50 kg man stands on the edge of the platform and begins to walk along the edge at the speed of $1\ \mathrm{ms}^{-1}$ relative to the ground. Time taken by the man to complete one revolution is_____
   a) p s b) $\frac{3\pi}{2}s$ c) $2\mathrm{ps}$ d) $\frac{\pi}{2}s$
9. Angular momentum L and rotational kinetic energy K_R of a rigid body are related to each other by the relation. (I = moment of inertia)
   a) K_R=2IL b) $K_R = \frac{L^2}{2I}$ c) $K_R = \frac{2I}{L}$ d) $K_R = \frac{L^2}{I}$

10. A uniform sphere of mass M and radius R is placed on a rough horizontal surface h (Figure). The sphere is struck horizontally at a height h from the floor. Match Column I with Column II.



Column I		Column II	
(A)	$h = \frac{R}{2}$	(p)	Sphere rolls without slipping with a constant velocity and no loss of energy.
(B)	h=R	(q)	Sphere spins clockwise, loses energy by friction.
(C)	$h = \frac{3}{2}R$	(r)	Sphere spins anti-clockwise, loses energy by friction.
(D)	$h = \frac{7}{5}R$	(s)	Sphere has only a translational motion, loses energy by friction.

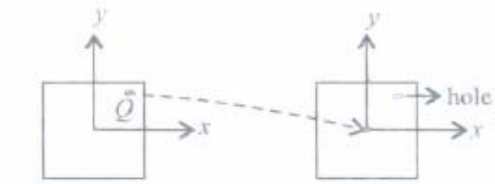
a) A - r, B - s, C - q, D - P b) A - s, B - p, C - r, D - q c) A - q, B - r, C - p, D - s d) A - p, B - q, C - s, D - r

11. Two bodies have their moment of inertia 1 and 21 respectively about their axis of rotation. If their kinetic energies ofrotation are equal, their angular momenta will be in the ratio ___
a) 2 : 1 b) 1 : 2 c) $\sqrt{2} : 1$ d) $1 : \sqrt{2}$

12. Two bodies of mass 1 kg and 3 kg have position vectors $\hat{i} + 2\hat{j} + \hat{k}$ and $-3\hat{i} - 2\hat{j} + \hat{k}$ respectively. The centre of mass of this system has a position vector_____
a) $-2\hat{i} - \hat{j} + \hat{k}$ b) $2\hat{i} - \hat{j} - 2\hat{k}$ c) $-\hat{i} + \hat{j} + \hat{k}$ d) $-2\hat{i} + 2\hat{k}$

13. The ratio of the radii or gyration of a circular disc to that of a circular ring, each of same mass and radius, around their respective axis is___
a) $\sqrt{3} : \sqrt{2}$ b) $1 : \sqrt{2}$ c) $\sqrt{2} : 1$ d) $\sqrt{2} : \sqrt{3}$

14. A uniform square plate has a small piece Q of an irregular shape removed and glued to the centre of the plate leaving a hole behind. The moment of inertia about the z-axis is then

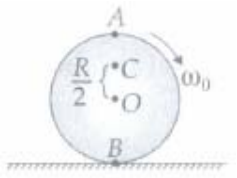


a) increased b) decreased c) the same d) changed in unpredicted manner

15. If the linear density (mass per unit length) of a rod of length 3 m is proportional to x, where x is the distance from one end of the rod, the distance of the centre of gravity of the rod from this end is_____
a) 25 m b) 1 m c) 1.5 m d) 2 m

16. A gramophone record is revolving with an angular velocity ω. A coin is placed at a distance r from the centre of the record. The static coefficient of friction is μ. The coin will revolve with the record if_____
a) $r = \mu g \omega^2$ b) $r < \frac{\omega^2}{\mu g}$ c) $r \leq \frac{\mu g}{\omega^2}$ d) $r \geq \frac{\mu g}{\omega^2}$

17. A rod of weight W is supported by two parallel knife edges A and B and is in equilibrium in a horizontal position. The knives are at a distance d from each other. The centre of mass of the rod is at distance x from A. The normal reaction on A is RA and on B is R_B, then $\frac{R_A}{R_B} is$:
    a) $\frac{d}{d-x}$ b) $\frac{d-x}{d}$ c) $\frac{d-x}{x}$ d) $\frac{x}{d-x}$
18. The ratio of the accelerations 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
19. If a flywheel makes 120 rev/min, then its angular speed will be__
    a) 8p rad/s b) 6 p rad/ s c) 4 p rad / s d) 2 p rad/s
20. A wheel has angular acceleration of $3.0\mathrm{rad}/\mathrm{sec}^2$ and an initial angular speed of $2.00\mathrm{rad}/\mathrm{sec}$. In a time of $2\mathrm{sec}$ it has rotated through an angle (in radian) of _____
    a) 10 b) 4 c) 12 d) 6
21. The instantaneous angular position of a point on a rotating wheel is given by the equation $\mathrm{q}(t) = 2t^3 - 6t^2$. The torque on the wheel becomes zero at _____ .
    a) t = 1 s b) t = 0.5 s c) t = 0.25 s d) t = 2 s
22. A child is standing with folded hands at the centre of a platform rotating about its central axis. The kinetic energy of the system is K. Now, the child stretches his arms so that moment of inertia of the system doubled. Now, the kinetic energy of the system is
    a) $\frac{K}{4}$ b) $\frac{K}{2}$ c) 2 K d) 4 K
23. A small object of uniform density rolls up a curved surface with an initial velocity ' v '. It reaches upto a maximum height of $\frac{3v^2}{4g}$ with respect to the initial position. The object is a_____
    a) solid sphere b) hollow sphere c) disc d) ring
24. Two particles which are initially at rest, move towards each other under the action of their internal attraction. If their speeds are v and 2 v at any instant, then the speed of centre of mass of the system will be _____ .
    a) 2 v b) zero c) 1.5 d) v
25. A disc rotating about its axis with angular speed w_0 is placed lightly R {"C ~ - (1)0 (without any translational push) on a perfectly frictionless table. The radius of the disc is R. Let v_A, v_B and v_C be the magnitudes of linear velocities of the points A, B and C on the disc as shown. Then



    a) $v_A > v_B > v_C$ b) $v_A < v_B < v_C$ c) $v_A = v_B < v_C$ d) $v_A = v_B > v_C$
26. The moment of inertia of a solid sphere of mass M and radius R about a tangent to the sphere is
    a) $\frac{2}{5}MR^2$ b) $\frac{6}{5}MR^2$ c) $\frac{4}{5}MR^2$ d) $\frac{7}{5}MR^2$
27. When an explosive shell travelling in a parabolic path under the effect of gravity explodes in the mid air, the centre of mass of the fragments will move
    a) vertically downwards b) along the original parabolic path
    c) vertically upwards and then vertically downwards d) horizontally followed by parabolic path
28. Assertion: The position of centre of mass does not depend upon the reference frame.
    Reason: Centre of mass depends only upon the rest mass of the body.
    a) If both assertion and reason are true and reason is the correct explanation of assertion
    b) If both assertion and reason are true but reason is not the correct explanation of assertion.
    c) If assertion is true but reason is false. d) If both assertion and reason are false.

29. Two rotating bodies A and B of masses m and 2 m with moments of inertia I_A *and* I_B ($I_B > I_A$) have equal kinetic energy of rotation. If L_A and L_B be their angular momenta respectively, then :
    a) $L_A = L_B/2$ b) $L_A = 2L_B$ c) $L_B > L_A$ d) $L_A > L_B$

30. A uniform rod of length 1 m and mass 4 kg is supported on two knife-edges placed 10 cm from each end. A 60 N weight is suspended at 30 em from one end. The reactions at the knife edges is :
    a) 60 N, 40 N b) 75 N, 25 N c) 65 N, 35 N d) 55 N, 45 N

31. A flywheel rotating at 420 rpm slows down at a constant rate of 2 rad S^{-2}. The time required to stop the flywheel is
    a) 22 s b) 11 s c) 44 s d) 12 s

32. A solid cylinder of mass M and radius R rolls without slipping down an inclined plane of length L and height h. What is the speed of its centre of mass when the cylinder reaches its bottom?
    a) $\sqrt{4gh}$ b) $\sqrt{2gh}$ c) $\sqrt{\frac{3}{4}gh}$ d) $\sqrt{\frac{4}{3}gh}$

33. Consider a particle of mass m having linear momentum $\vec{p}$ at position $\vec{r}$ relative to the origin *O*. Let $\vec{L}$ be the angular momentum of the particle with respect to the origin. Which of the following equations correctly relate(s) $\vec{r}$, $\vec{p}$ and $\vec{L}$?
    a) $\frac{d\vec{L}}{dt} + \vec{r} \times \frac{d\vec{p}}{dt} = 0$ b) $\frac{d\vec{L}}{dt} + \frac{d\vec{r}}{dt} \times \vec{p} = 0$ c) $\frac{d\vec{L}}{dt} - \frac{d\vec{r}}{dt} \times \vec{p} = 0$ d) $\frac{d\vec{L}}{dt} - \vec{r} \times \frac{d\vec{p}}{dt} = 0$

34. The density of a non-uniform rod oflength 1m is given by $p(x) = a(l + bx^2)$ where a and b are constants and $0 \le x \le 1$. The centre of mass of the rod will be at
    a) $\frac{3(2+b)}{4(3+b)}$ b) $\frac{4(2+b)}{3(3+b)}$ c) $\frac{3(3+b)}{4(2+b)}$ d) $\frac{4(3+b)}{3(2+b)}$

35. A man stands on a rotating platform with his arms stretched holding a 5 kg weight in each hand. The angular speed of the platform is 1.2 rev s^{-1}. The moment of inertia of the man together with the platform may be taken to be constant and equal to 6 kg m^2. If the man brings his arms close to his chest with the distance of each weight from the axis changing from 100 cm to 20 cm. The new angular speed of the platform is
    a) 2 rev s^{-1} b) 3 rev s^{-1} c) 5 rev s^{-1} d) 6 rev s^{-1}

36. Assertion: If there are no external forces, the centre of mass of a double star moves like a free particle.
    Reason: If we go to the centre of mass frame, then we find that the two stars are moving in a circle about the centre of mass, which is at rest.
    a) If both assertion and reason are true and reason is the correct explanation of assertion.
    b) If both assertion and reason are true but reason is not the correct explanation of assertion.
    c) If assertion is true but reason is false. d) If both assertion and reason are false

37. Assertion: The centre of gravity of a body coincides with its centre of mass only if the gravitational field does not vary from one part of the body to the other.
    Reason : Centre of gravity is independent of the gravitational field.
    a) If both assertion and reason are true and reason is the correct explanation of assertion.
    b) If both assertion and reason are true but reason is not the correct explanation of assertion.
    c) If assertion is true but reason is false. d) If both assertion and reason are false

38. The moments of inertia of two rotating bodies A and B are I_A and I_B ($I_A > I_B$). If their angular momenta are equal, then
    a) Kinetic energy of A = Kinetic energy of B b) Kinetic energy of A > Kinetic energy of B
    c) Kinetic energy of A < Kinetic energy of B
    d) Kinetic energy of the two bodies cannot be compared with the given data

39. A thin rod of length L and mass M is bent at its midpoint into two halves so that the angle between them is 90^o. The moment of inertia of the bent rod about an axis passing through the bending point and perpendicular to the plane defined by the two halves of the rod is_____
    a) $\frac{ML^2}{24}$ b) $\frac{ML^2}{12}$ c) $\frac{ML^2}{6}$ d) $\frac{\sqrt{2}ML^2}{24}$

40. Two particles of equal mass have velocities $\vec{v}_1 = 2\hat{i} ms^{-1} and\, \vec{v}_2 = 2\hat{j} ms^{-1}$ First particle has an acceleration $a_1 = (3\hat{i} + 3\hat{j}) ms^{-2}$ 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

41. Assertion: If the head of a right handed screw rotates with the body, the screw advances in the direction of the angular velocity.
    Reason: For rotation about a fixed axis, the angular velocity vector lies along the axis of rotation.
    a) If both assertion and reason are true and reason is the correct explanation of assertion.
    b) If both assertion and reason are true but reason is not the correct explanation of assertion.
    c) If assertion is true but reason is false. d) If both assertion and reason are false.

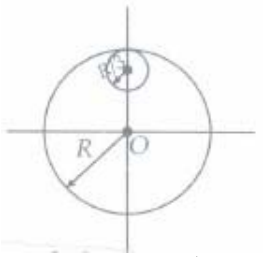
42. A light rod of length l has two masses m_1 *and* m_2 attached to its two ends. The moment of inertia of the system about an axis perpendicular to the rod and passing through the centre of mass is :
    a) $[m_1m_2/(m_1m_2)] \times l^2$ b) $[(m_1m_2)/m_1m_2] \times l^2$ c) $(m_1 + m_2) \times l^2$ d) $\sqrt{m_1m_2} \times I^2$

43. Assertion: To determine the motion of the centre of mass of a system, knowledge of internal forces of the system is required.
    Reason: For this purpose we need not to know the external forces on the system.
    a) If both assertion and reason are true and reason is the correct explanation of assertion.
    b) If both assertion and reason are true but reason is not the correct explanation of assertion
    c) If assertion is true but reason is false d) If both assertion and reason are false.

44. The reduced mass of two particles having masses m and 2 m is
    a) 2 m b) 3 m c) $\frac{2m}{3}$ d) $\frac{m}{2}$

45. To maintain a rotor at a uniform angular speed of 100 rad s^{-1}, an engine needs to transmit torque of 100 N m. The power of the engine is
    a) 10 kW b) 100 kW c) 10 MW d) 100 MW

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



    a) 4 MR^2 b) $\frac{40}{9}MR^2$ c) 40 MR^2 d) $\frac{37}{9}MR^2$

47. Which of the following is the correct relation between linear velocity $\vec{v}$ and angular velocity $\vec{w}$ of a particle?
    a) $\vec{v} = \vec{r} \times \vec{w}$ b) $\vec{v} = \vec{w} \times \vec{r}$ c) $\vec{w} = \vec{r} \times \vec{v}$ d) $\vec{w} = \vec{v} \times \vec{r}$

48. In the question number 62, the linear acceleration of the rope is
    a) 5 m s^{-2} b) 10 m s^{-2} c) 15 m s^{-2} d) 20 m s^{-2}

49. A solid cylinder of mass M and radius R rolls down an inclined plane of height h without slipping. The speed of its centre of mass when it reaches the bottom is_____
    a) $\sqrt{2gh}$ b) $\sqrt{\frac{4gh}{3}}$ c) $\sqrt{\frac{3gh}{4}}$ d) $\sqrt{\frac{4g}{h}}$

50. Two persons of masses 55 kg and 65 kg respectively, are at the opposite ends of a boat. The length of the boat is 3.0 m and weighs 100 kg. The 55 kg man walks upto the 65 kg man and sits with him. If the boat is in still water the centre of mass of the system shifts by_____

    a) 3.0 m b) 2.3 m c) zero d) 0.75 m