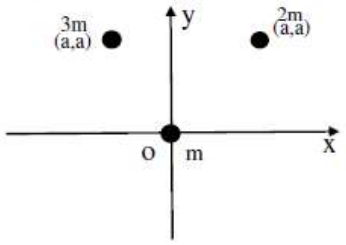
Class : 11 Assignment 4: System of particles

1. When a system of particles rotate about a fixed axis the one among the following which remains constant for all the particles is
   (1) angular speed (2) Linear Speed
   (3) Linear momentum (4) angular momentum
2. Fig shows a system of particles in x-y plane. The position vector of the center of mass of this system with respect to the origin O is
   (1) $\frac{a}{6}\hat{i}+\frac{5a}{6}\hat{j}$
   (2) $\frac{-a}{6}\hat{i}+\frac{5a}{6}\hat{j}$
   (3) $\frac{5a}{6}\hat{i}+a\hat{j}$
   (4) $\frac{-a}{6}\hat{i}-\frac{5a}{6}\hat{j}$



3. Two particles of masses 1 kg and 2 kg move with velocities of 9 ms^{-1} along +x axis and 15 ms^{-1} along the negative y-axis. The velocity of the center of mass of the system is
(1) -3i+10j (2) 10i + 3j (3) 9i −30j (4) 3i-10j
4. A body at rest explodes in to three unequal masses which fly off with different velocities. The center of mass of the system now
   (1) remains at rest
   (2) moves with a constant velocity in the direction of heavier fragment.
   (3) moves with a constant acceleration along the heavier mass.
   (4) Moves with a constant momentum along the direction of heavier mass.
5. The instantaneous angular momentum associated with a body is given by $\vec{L}=(4t^2\hat{i}+3t\hat{j})$ kgm^2s^{-1} the torque acting on it at the instant t = 2s is (in Nm).
   (1) $8\hat{i}+3\hat{j}$ (2) $16\hat{i}+3\hat{j}$ (3) $16\hat{i}+6\hat{j}$ (4) $4\hat{i}+3\hat{j}$
6. A hollow cylinder and a ring of same radii but of different masses roll down a smooth inclined plane without slipping. When they reach the bottom.
   (1) ring will have greater speed compared to cylinder
   (2) cylinder will have greater speed compared to ring
   (3) both will have the same speed
   (4) both will have the same kinetic energy.
7. A hollow and a solid cylinder of same radii roll down from rest on a smooth incline without slipping. The ratio of the time in which they reach the bottom is
   (1) 1 : 1 (2) $2:\sqrt{3}$ (3) $\sqrt{3}:2$ (4) $1:\sqrt{2}$

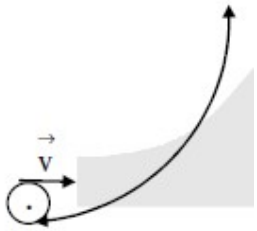
8. If the polar ice caps of the earth completely melt then the length of the day on the earth
   (1) increases
   (2) decreases
   (3) remains same as before
   (4) may increase or decrease depending on the mass of the ice.

9. A hollow sphere of radius R and mass M at rest is hit with the tip of a long stick at a height h from its center. The sphere moves with a constant velocity v on a smooth horizontal surface. The angular velocity of the sphere is
   (1) $\frac{2hv}{5R^2}$ (2) $\frac{2hv}{3R^2}$ (3) $\frac{3hv}{2R^2}$ (4) $\frac{5hv}{2R}$

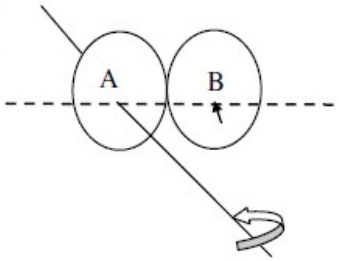
10. A circular frame of mass M and radius R is rotating about an axis perpendicular to its plane and passing through its center with a angular velocity ω. If two identical masses m each are attached gently at two diametrically opposite points to the frame, its angular velocity becomes
   (1) $\frac{\omega(M-2m)}{(M+2m)}$ (2) $\frac{M\omega}{M+m}$ (3) $\frac{M\omega}{M+2m}$ (4) $\frac{(M+2m)\omega}{M}$

11. A sphere rolling with a velocity v on a horizontal surface then climbs up a continuous curved track as shown in the figure. If h_1 is the height of climb when the surface is smooth and h_2 is that when the surface is rough enough, the ratio $\frac{h_1}{h_2}$ is (assume that it does not slip).

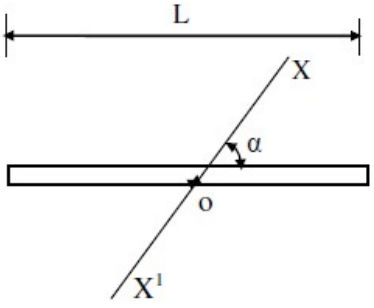
(1) 5 : 7
(2) 7 : 5
(3) 3 : 5
(4) 1 : 1



12. Two thin circular rings each of mass M and radius R to form a rigid body. The moment of inertia of this system about an axis as shown in the fig is
   (1) $2MR^2$
   (2) $3MR^2$
   (3) $\frac{3MR^2}{2}$
   (4) $6MR^2$



13. A uniform thin rod of linear mass density λ is rotated about an axis XX^1 inclined at an angle α about its center O. The moment of inertia of the rod about this axis is
   (1) $\frac{\lambda L^3 \sin^2\alpha}{12}$
   (2) $\frac{\lambda L^3 \sin^2\alpha}{12}$
   (3) $\frac{\lambda L^2 \sin^2\alpha}{3}$
   (4) $\frac{\lambda L^2 \sin^2\alpha}{3}$



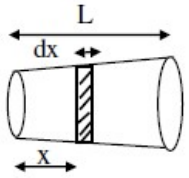
14. Two particles of masses 3 kg and 6kg are joined by a rigid rod of negligible mass and of length 2m. The moment of inertia of this system about an axis perpendicular to the length and passing through its center of mass is

(1) 3 kg m^2 (2) 4 kg m^2 (3) 8 kg m^2 (4) 9 kg m^2

15. A variable torque $\tau = 4t$ acts on a body. The angular momentum of the body at an instant of 2s from the start is (in kg $m^2 s^{-1}$).

(1) 2 (2) 4 (3) 6 (4) 8

16. Fig shows a rod of non uniform cross section whose linear mass density varies with the distance from the thin end as $\lambda \alpha x$. The position of the center of mass of the rod from the thin end is



(1) $\frac{L}{3}$ (2) $\frac{2}{3}L$

(3) $\frac{L}{2}$ (4) $\frac{2L}{5}$

17. A uniform rod of mass m and length l is suspended by means of two light inextensible strings as shown in the figure. If the string at the end B is cut down, the tension developed by the string at A immediately after it is

(1) mg

(2) $\frac{mg}{2}$

(3) $\frac{mg}{4}$

(4) $\frac{2mg}{3}$

18. A tangential force F applied at the rim of a disc rotates it about an axis passing through its center with a angular velocity $\omega = (4+5t)$ rad s^{-1}. If the mass and radius of the disc are 5 kg and 0.2 m respectively then the value of F is

(1) 1.5 N (2) 2.0 N (3) 3.0 N (4) 2.5 N

19. A particle accelerates at a rate of 0.4 $rads^{-2}$ from rest around a circle of radius 3m for 5s the distance moved by the particle during this time interval is

(1) 4.25 m (2) 8.5 m (3) 12.5 m (4) 15.0 m

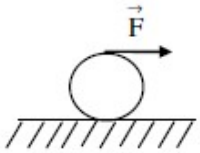
20. A particle is projected with a speed of 10 ms^{-1} at an angle of 30^0 with the horizontal. The average angular velocity of the particle from the instant of projection to the impact is ($g = 10ms^{-1}$)

(1) $\frac{\pi}{2} rads^{-1}$ (2) $\frac{2\pi}{3} rads^{-1}$ (3) $\frac{\pi}{3} rads^{-1}$ (4) $\frac{\pi}{6} rads^{-1}$

21. A rigid body rotates about a fixed axis with the variable velocity $\omega = a - bt$ where a and b are constants. The angular displacement of the body before it comes to rest is

(1) $\frac{a^2}{2b}$ (2) $\frac{b^2}{2a}$ (3) $\frac{a^2 - b^2}{2a}$ (4) $\frac{a(a-b)}{2}$

22. A force F is applied at the top of a disc of mass M and radius R on a horizontal surface. The friction is sufficient to prevent it from slipping. Frictional force acting on the ring is



(1) $\frac{F}{2}$ towards right (2) $\frac{F}{2}$ towards left

(3) F towards right (4) $\frac{F}{3}$ towards right

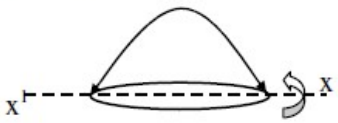
23. A spinning machine revolving at 15rps slows down to 5rps while making 40 revolutions. How much time it takes to stop if its angular retardation is constant?

(1) 6.0 s (2) 5.0 s (3) 4.5 s (4) 3.2 s

24. Moment of inertia of a ring about an axis tangent to the ring in its plane is

(1) $2MR^2$ (2) $\frac{3}{2}MR^2$ (3) MR^2 (4) $\frac{MR^2}{2}$

25. A solid hemisphere of mass m and radius R rotates about the axis $x\,x^1$ passing through its diameter with a angular speed ω. The angular momentum of this body is



(1) $\frac{2}{5}MR^2\omega$ (2) $\frac{MR^2\omega}{5}$

(3) $\frac{4}{5}MR^2\omega$ (4) $\frac{4}{15}MR^2\omega$

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