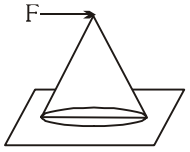
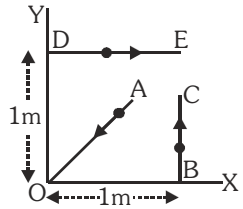
1. A cone of radius r and height h rests on a rough horizontal surface, the coefficient of friction between the cone and the surface being μ. A gradually increasing horizontal force F is applied to the vertex of the cone. The largest value of μ for which the cone will slide before it topples is



(A) $\mu = \frac{r}{2h}$ (B) $\mu = \frac{2r}{5h}$ (C) $\mu = \frac{r}{h}$ (D) $\mu = \sqrt{\frac{r}{h}}$

2. A particle of mass m moves with a constant velocity. Which of the following statements is not correct about its angular momentum about point O :

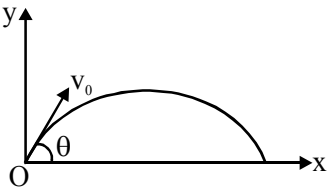


(A) it is zero when it is at A and moving along OA
(B) is the same at all points along the line DE
(C) is of the same magnitude but oppositely directed at B and D
(D) increases as it moves along the line BC

3. A rod of mass M & length ℓ stands along z-axis. Its lower end is hinged at the centre of a disc of same mass M and radius R. The whole arrangement is rotating freely about z-axis with an angular velocity ω_0. The rod falls on disc & rotates with disc. Find the angular speed of the arrangement.

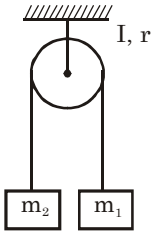
(A) $\frac{\omega_0 R^2}{\ell^2 + R^2}$ (B) $\frac{3\omega_0 R^2}{2\ell^2 + 3R^2}$ (C) $\frac{6\omega_0 R^2}{\ell^2 + 6R^2}$ (D) $\frac{6\omega_0 R}{\ell + 6R}$

4. A projectile of mass 'm' is thrown from the origin O with a velocity v_0 at an angle θ. Identify the **CORRECT** statement :-



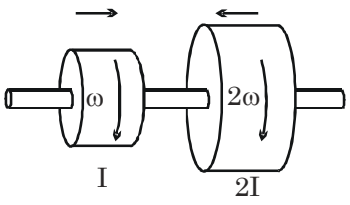
(A) Angular momentum of the particle about O is always zero
(B) Angular momentum of the particle about O increases with time.
(C) A constant torque acts on the particle about O in the clockwise sense.
(D) Angular momentum of the particle is least when it is at the highest position.

5. Pulley is rotating with angular velocity ω. Pulley is sufficiently rough so that string does not slip on the pulley. Then angular momentum of system (pulley + blocks) about axle of pulley is :-



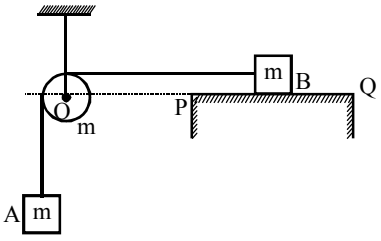
(A) Iω (B) $(m_1 + m_2 + I)\omega r$ (C) $(m_1 + m_2)r^2\omega + I\omega$ (D) $(m_1 r^2 + m_2 r^2 + I)\omega^2$

6. Two disks are mounted on low-friction bearings on a common shaft. The first disc has rotational inertia I and is spinning with angular velocity ω. The second disc has rotational inertia 2I and is spinning in the same direction as the first disc with angular velocity 2ω as shown. The two disks are slowly forced toward each other along the shaft until they couple and have a final common angular velocity of :



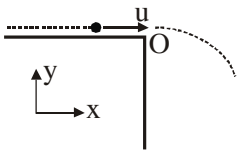
(A) $\frac{5\omega}{3}$ (B) $\frac{\omega}{\sqrt{3}}$ (C) $\omega\sqrt{7/3}$ (D) 3ω

7. In the figure shown, a uniform block B is on a horizontal smooth surface PQ . O is the centre of the pulley (assume it as a uniform disc) of radius R. The horizontal part of the string is connected to middle of the left face of the block B. String does not slip on the pulley . Points O, P and Q are in the same horizontal line. The masses of A, B and the pulley are same and equal to 'm' . The system is released from rest. Find the angular momentum of the system comprising of A , B and the pulley at time 't' about 'O'.



(A) $\frac{mgRt}{2}$ (B) mgRt (C) 2mgRt (D) $\frac{5}{2}$mgRt

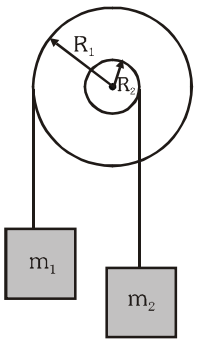
8. A particle of mass m is projected from point O with a horizontal velocity 'u' at time t = 0. What is its angular momentum relative to point O as a function of time?



(A) $-\frac{1}{2}mgut^2\hat{k}$ (B) $\frac{1}{2}mgut^2\hat{k}$ (C) $-mgut^2\hat{k}$ (D) $+mgut^2\hat{k}$

Paragraph for Questions no. 9 & 10

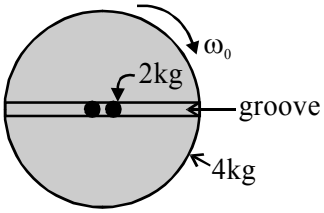
Two objects are attached to ropes that are attached to wheels on a common axle so that they rotate together as shown in figure. The total moment of inertia of the two wheels is 0.25 kg-m^2. The radii of the wheels are R_1 = 3 R, R_2 = R and R = $\frac{1}{12}$m .



9. If m_1 = 24 kg, find m_2 (in kg) such that there is no angular acceleration of the wheels.
(A) 24 (B) 8 (C) 72 (D) 48

10. If 12 kg is gently added to the top of m_1, find the angular acceleration (in rad/sec^2) of the wheels.
(A) 10 (B) 17 (C) 14 (D) 12

11. A disc of mass 4kg and radius 6 metre is free to rotate in horizontal plane about a vertical fixed axis passing through its centre. There is a smooth groove along the diameter of the disc and two small balls of mass 2kg each are placed in it on either side of the centre of the disc as shown in figure. The disc is given initial angular velocity ω_0 = 12 rad/sec released. Find the angular speed of disc (in radian/sec) when the balls reach the ends to disc.



N_Race # 58			ANSWER KEY
1. Ans. (C)	**2. Ans. (D)**	**3. Ans. (B)**	**4. Ans. (B)**
5. Ans. (C)	**6. Ans. (A)**	**7. Ans. (B)**	**8. Ans. (A)**
9. Ans. (C)	**10. Ans. (A)**	**11. Ans. 4**	