Set *A*

Test Code: SB-P-07-16

INSTRUCTIONS

1. This paper has **15** questions.
2. All questions are compulsory.
3. Each question has four options, out of which **ONLY ONE** is correct.
4. Each question carries 4 marks.
5. The paper carries negative marking. 1 marks will be deducted for each wrong answer.

Maximum Time: 45 Minutes　　　　Total Marks: 60

Name:____________________________　　　　Roll Number:_________________

Q1. A uniform rod of mass m and length l is suspended by means of two light inextensible strings as shown in figure. Tension in one string immediately after the other string is cut is

A) $\frac{mg}{2}$　　B) mg

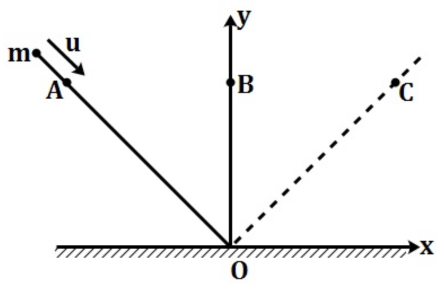
C) $2mg$　　D) $\frac{mg}{4}$

Q2. Two particles of masses m_1 and m_2 are connected by a rigid massless rod of length r to constitute a dumb-bell which is free to move in the plane. The moment of inertia of the dumb-bell about an axis perpendicular to the plane of rods passing through the centre of mass is

A) $\frac{m_1 m_2 r^2}{m_1+m_2}$　　B) $(m_1+m_2)\, r^2$

C) $\frac{m_1 m_2 r^2}{m_1-m_2}$　　D) $(m_1-m_2)\, r^2$

Q3. A ball is moving with constant velocity u collides with a smooth horizontal surface at O as shown in the figure given alongside. Neglect gravity and friction. The $y-$axis is drawn normal to the horizontal surface at the point of impact O and $x-$ axis is horizontal as shown. About which point will the angular momentum of ball be conserved?

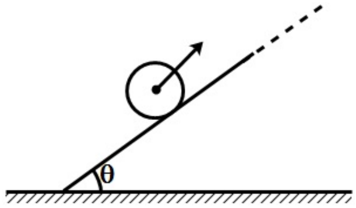


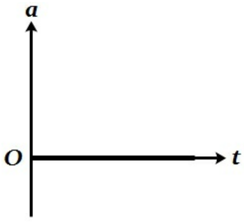
Smooth horizontal surface

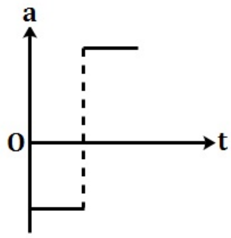
A) Point A　　B) Point B

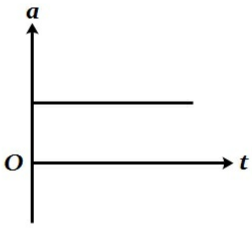
C) Point C　　D) None of these

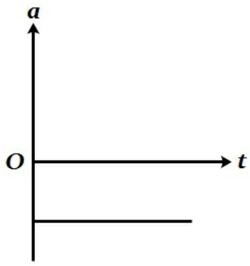
Q4. A uniform solid sphere rolls up (without slipping) the rough fixed inclined plane, and then back down. Which is the correct graph of acceleration a of centre of mass of solid sphere as function of time t (for the duration sphere is on the incline)? Assume that the sphere rolling up has a positive velocity.



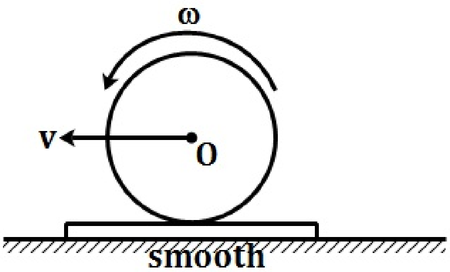
A) 

B) 

C) 

D) 

Q5. A cylinder executes pure rolling without slipping with a constant velocity on a plank, whose upper surface is rough enough, but lower surface is smooth. The plank is kept at rest on a smooth horizontal surface by the application of application of an external horizontal force F. Choose the correct alternative:



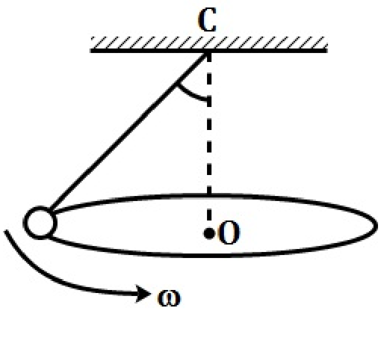
A) The direction of F is towards right.

B) The direction of F is towards left

C) The value of F is zero

D) The direction of F depends on the ratio of the relative masses of disc and plank.

Q6. A conical pendulum consists of a simple pendulum moving in a horizontal circle as shown in the figure. C is the pivot, O the centre of the circle in which the pendulum bob moves and ω the constant angular velocity of the bob. If $\vec{L}$ is the angular momentum about point C, then :



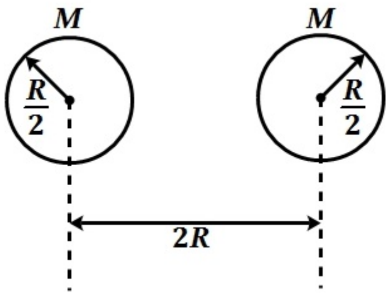
A) $\vec{L}$ is constant

B) only direction of $\vec{L}$ is constant

C) only magnitude of $\vec{L}$ is constant

D) None of the above

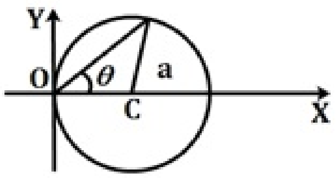
Q7. Two solid spheres each of mass M and radius $\frac{R}{2}$ are connected with a massless rod of length $2R$ as shown in the figure. What will be the moment of inertia of the system about an axis passing through the centre of one of the sphere and perpendicular to the rod?



A) $\frac{21}{5}MR^2$ B) $\frac{2}{5}MR^2$

C) $\frac{5}{2}MR^2$ D) $\frac{5}{21}MR^2$

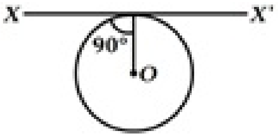
Q8. A particle of unit mass is moving in a circular path of radius a, with a constant velocity v as shown in the figure. The center of circle is marked by $'C'$. The angular momentum about the origin O can be written as:



A) $va(1+\cos 2\theta)$ B) $va(1+\cos\theta)$

C) $va\cos 2\theta$ D) va

Q9. A thin wire of length L and uniform linear mass density ρ is bent into a circular loop with centre at O as shown in the figure. The moment of inertia of the loop about the axis XX' is



A) $\frac{\rho L^3}{8\pi^2}$ B) $\frac{\rho L^3}{16\pi^2}$

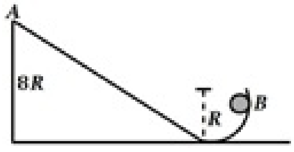
C) $\frac{5\rho L^3}{16\pi^2}$ D) $\frac{3\rho L^3}{8\pi^2}$

Q10. A solid body rotates with deceleration about a stationary axis with an angular deceleration $|\alpha| = k\sqrt{\omega}$; where k is a constant and ω is the angular velocity of the body. If the initial angular velocity is ω_0, then mean angular velocity of the body averaged over the whole time of rotation is

A) ω_0 B) $\frac{\omega_0}{2}$

C) $\frac{\omega_0}{3}$ D) $\frac{\omega_0}{4}$

Q11. A metal ball of mass m is put at the point A of a loop track and the vertical distance of A from the lower most point of track is 8 times the radius R of the circular part. The linear velocity of ball when it rolls upto the point B which is at a height R in the circular track will be



A) $[10gR]^{1/2}$ B) $7[\frac{gR}{10}]^{1/2}$

C) $[\frac{7gR}{5}]^{1/2}$ D) $[5gR]^{1/2}$

Q12. The torque $\vec{\tau}$ on a body about a given point is found to be $\vec{A} \times \vec{L}$ where $\vec{A}$ is a constant vector and $\vec{L}$ is angular momentum of the body about that point. From this is follows that

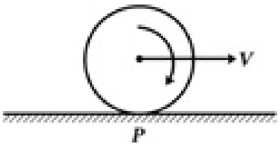
A) $\frac{d\vec{L}}{dt}$ is not perpendicular to $\vec{L}$ at all times.

B) the component of $\vec{L}$ in the direction of $\vec{A}$ changes with time.

C) the magnitude of $\vec{L}$ does not change with time.

D) $\vec{L}$ does not change with time

Q13. A spherical body of radius R rolls on a horizontal surface with linear velocity v. Let L_1 and L_2 be the magnitudes of angular momenta of the body about centre of mass and point of contact P. Then



A) $L_2 > 2L_1$ if radius of gyration $K = R$

B) $L_2 = 2L_1$ for all values of K

C) $L_2 > 2L_1$ if radius of gyration $K < R$

D) $L_2 > 2L_1$ if radius of gyration $K > R$

Q14. A force F acts tangentially at the highest point of a sphere of mass m kept on a rough horizontal plane. If the sphere rolls without slipping, find the acceleration of the centre of the sphere.

A) zero

B) $\frac{F}{m}$

C) $\frac{2F}{3m}$

D) $\frac{10F}{7m}$

Q15. A uniform solid cylinder of mass M and radius R is resting on a horizontal platform (which is parallel to $X-Y$ plane) with its axis along the $Y-$axis and free to roll on the platform. The platform is given a motion in X-direction given by $x = A\cos\omega t$. There is no slipping between the cylinder and the platform. The maximum torque acting on the cylinder as measured about its centre of mass

A) $\frac{1}{2}MRA\omega^2$

B) $MRA\omega^2$

C) $2mRA\omega^2$

D) $mR\omega A^2\cos^2\omega t$