Episode No.-1

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A uniform rod AB of length L and mass M is free to rotate about a horizontal axis through the end A. The rod is released from rest in the horizontal position. Given that the M.I of the rod about the end A is $ML^2/3$, the initial angular acceleration of the rod is

(A) 3g/2L (B) 2g/3L
(C) MgL/2 (D) 3gL/2

Ans : A

Imagine a uniform rod of mass m and length L being carried horizontally by two people, supporting it on their shoulders, at its ends, on a horizontal road. If one lets go, the immediate normal reaction at the shoulder of the other is

(A) More than earlier (B) less than earlier (C) equal to earlier (D) can't say

This is a problem on pure rotation.

Ans : B

The ratio of radii of gyration of a circular disc to that of a circular ring of the same mass and radius about their respective axes is

(A) √2: √3 (B) √3: √2
(C) 1: √2 (D) √2: 1

This helps you understand what is radius of gyration and how is it written.

Ans : C

A thin rod of length L and mass M is bent at its midpoint into two halves such that angle between them is 90^0. The M.I of the bent rod about an axis passing through the bend and perpendicular to the plane defined by the two halves of the rod is

(A) $\sqrt{2}ML^2/24$ (B) $ML^2/24$
(C) $ML^2/12$ (D) $ML^2/6$

Ans : C

A thin circular ring of mass M and radius R is rotating in a horizontal plane about a vertical axis passing through its center with an angular velocity ω. If two objects each of mass m are attached to the opposite ends of the diameter of the ring gently, the ring will rotate with an angular velocity

(A) $\frac{\mu M}{M+2m}$ (B) $\frac{\mu(M+2m)}{M}$
(C) $\frac{\mu M}{M+m}$ (D) $\frac{\mu(M-2m)}{M}$

This is on C.O.A.M

Ans : A

If $\vec{F}$ is the force acting on a particle whose position vector is $\vec{r}$ and $\vec{\tau}$ is the torque due to this force about the origin

(A) $\vec{r}\cdot\vec{\tau} > 0 \,\&\, \vec{F}\cdot\vec{\tau} < 0$

(B) $\vec{r} \cdot \hat{2} = 0 \; \& \; \vec{F} \cdot \hat{2} = 0$

(C) $\vec{r} \cdot \hat{2} = 0 \; \& \; \vec{F} \cdot \hat{2} \neq 0$

(D) $\vec{r} \cdot \hat{2} \neq 0 \; \& \; \vec{F} \cdot \hat{2} = 0$

This will remind you of what is torque and dot and cross products. But I have to tell you that there can be a force without a torque and torque without a force.

Ans : B

A circular disk of M.I I_1 is rotating horizontally with angular velocity ω_1 about its axis. Another disk of M.I I_2 is dropped coaxially on to the rotating disk. The second disk has initially zero speed but eventually both will rotate will a common angular speed ω owing to friction. The energy lost due to friction is

(A) $\frac{I_2^2 \mu_1^2}{2(I_1 + I_2)}$ (B) $\frac{I_1^2 \mu_1^2}{2(I_1 + I_2)}$

(C) $\frac{(I_2 - I_1) \; \mu_1^2}{(I_1 + I_2)}$ (D) $\frac{(I_2 - I_1) \; \mu_1^2}{2(I_1 + I_2)}$

C.O.A.M

Ans : B

The instantaneous angular position of a point on a rotating wheel is given by$\bar{\ } = 2t^3 - 6t^2$. The torque on the wheel becomes zero at

(A) t = 2 s (B) t = 1 s

(C) t = 0.1 s (D) t = 0.25 s

On kinematics of rotational motion

Ans : B

A circular platform is mounted on a frictionless vertical axle. Its radius is 2 m and M.I about the axle is 200 kg-m^2. It is initially at rest when a man of mass 50 kg starts walking along the edge of the platform with a speed of 1 m/s w.r.t the ground. Time taken by the man to complete one rev. is

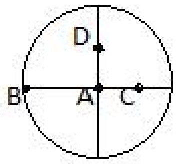
(A) π/2 s (B) π s

(C) 3π/2 (D) 2π s

A very important problem that reminds us that while conserving angular momentum, angular velocities have to be absolute. Even when we conserve linear momentum also, the linear velocities have to be absolute.

Ans : D

The M.I of a circular disk is maximum about an axis perpendicular to the disk and passing through



(A) A

(B) B

(C) C

(D) D

This reminds you the fact that M.I of a body is least when the axis is taken passing through the center of mass.

Ans : B

A small object of uniform density rolls up a curved surface with an initial velocity v. It reaches up to a maximum height of $(3v^2/4g)$ w.r.t the initial position. The object is

(A) Ring

(B) solid sphere

(C) Hollow sphere

(D) disc

Pure rolling and conservation of energy.

Ans : A

The ratio of accelerations of a solid sphere of mass m and radius r rolling down an incline of inclination θ without slipping and slipping down the incline without rolling is

(A) 5: 7

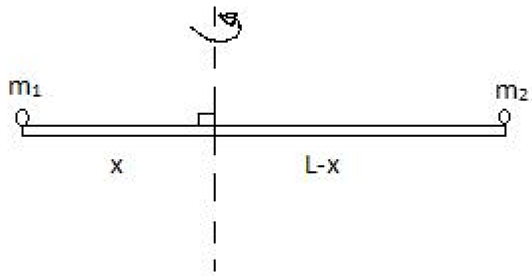
(B) 2: 3

(C) 2: 5

(D) 7: 5

Rolling without slipping and slipping without rolling.

Ans : A



Point masses m_1 and m_2 are placed at the opposite ends of a rigid rod of negligible mass and length L. The rod is set rotating about an axis perpendicular to it. The position of the point on the rod through which the axis has to pass so that the work required to set it rotating at an angular velocity ω is minimum is

(A) $x = \frac{m_1 L}{m_2}$ (B) $x = \frac{m_2 L}{m_1}$

(C) $x = \frac{m_2 L}{m_1 + m_2}$ (D) $x = \frac{m_1 L}{m_1 + m_2}$

M.I is minimum when the axis is taken passing through the center of mass.

Ans : C

M.I of a uniform circular disc about a diameter is I. It's M.I about an axis perpendicular to its plane and passing through a point on its rim is

(A) 5I (B) 3I (C) 6I (D) 4I

Ans : C

M.I of a uniform rod of mass m and length L about an axis through a point on the rod at a distance L/4 from one end and perpendicular to its length is

(A) $\frac{7}{36}mL^2$ (B) $\frac{7}{48}mL^2$ (C) $\frac{19}{48}mL^2$ (D) $\frac{1}{12}mL^2$

Ans : B