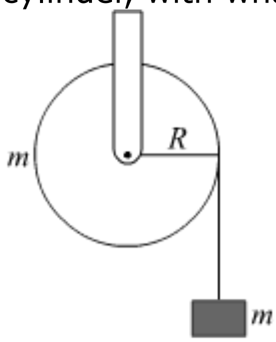
Systems of Particles and Rotational Motion

Q.No.1: A mass '*m*' is supported by a massless string wound around a uniform hollow cylinder of mass *m* and radius *R.* If the string does not slip on the cylinder, with what acceleration will the mass fall on release?



A. $\frac{5g}{6}$

B. g

C. $\frac{2g}{3}$

D. $\frac{g}{2}$

Q.No.2: A bob of mass *m* attached to an inextensible string of length *l* is suspended from a vertical support. The bob rotates in a horizontal circle with an angular speed ω rad/s about the vertical. About the point of suspension, the

A. angular momentum changes in direction but not in magnitude

B. angular momentum changes both in direction and magnitude

C. angular momentum is conserved

D. angular momentum changes in magnitude but not in direction

Q.No.3: From a solid sphere of mass *M* and radius *R* a cube of maximum possible volume is cut. Moment of inertia of cube about an axis passing through its centre and perpendicular to one of its faces is: **JEE 2015**

A. $\frac{MR^2}{32\sqrt{2}\pi}$

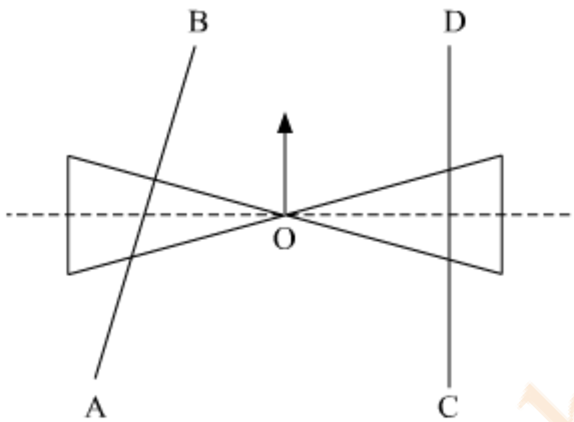
B. $\frac{MR^2}{16\sqrt{2}\pi}$

C. $\frac{4\,MR^2}{9\sqrt{3}\pi}$

D. $\frac{4\,MR^2}{3\sqrt{3}\pi}$

Q.No.4: A roller is made by joining, together two cones at their vertices O. It is kept on two rails AB and CD which are placed asymmetrically (see figure), with its axis perpendicular to CD and its centre O at the centre of line joining AB and CD (see figure). It is given a light push so that it starts rolling with its centre *O* moving parallel to CD in the direction shown. As it moves, the roller will tend to:

JEE 2016



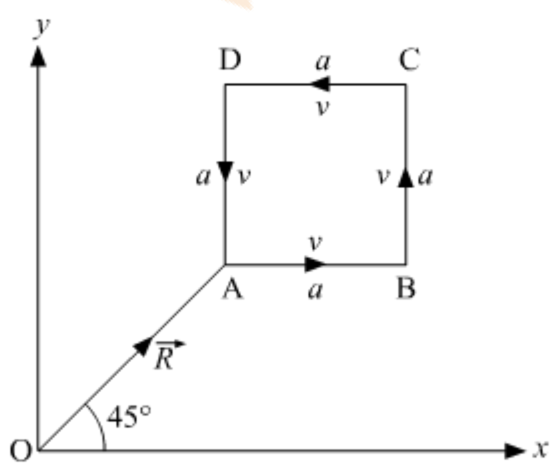
A. turn right.

B. go straight.

C. turn left and right alternately.

D. turn left.

Q.No.5: A particle of mass *m* is moving along the side of square of side '*a*', with a uniform speed *v* in the *x*-*y* plane as shown in the figure:



Which of the following statements is false for the angular momentum $\vec{L}$ about the origin? **JEE 2016**

A. $\vec{L} = mv\left[\frac{R}{\sqrt{2}} - a\right]\hat{k}$ when the particle is moving from C to D.

B. $\vec{L} = mv\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$ when the particle is moving from B to C.

C. $\vec{L} = -\frac{mv}{\sqrt{2}}R\hat{k}$ when the particle is moving from D to A.

D. $\vec{L} = -\frac{mv}{\sqrt{R}}R\hat{k}$ when the particle is moving from A to B.

Q.No.6: The moment of inertia of a uniform cylinder of length *l* and radius *R* about its perpendicular bisector is I. What is the ratio *l*/*R* such that the moment of inertia is minimum? **JEE 2017**

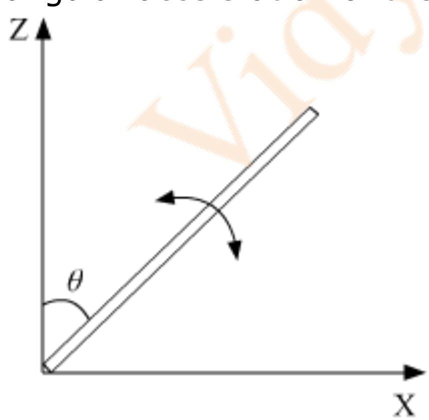
A. $\frac{3}{\sqrt{2}}$

B. $\sqrt{\frac{3}{2}}$

C. $\sqrt{\frac{3}{2}}$

D. 1

Q.No.7: A slender uniform rod of mass M and length *l* is pivoted at one end so that it can rotate in a vertical plane (see figure). There is negligible friction at the pivot. The free end is held vertically above the pivot and then released. the angular acceleration of the rod when it makes an angle θ with the vertical is **JEE 2017**



A. $\frac{2g}{3l}\cos\,\theta$

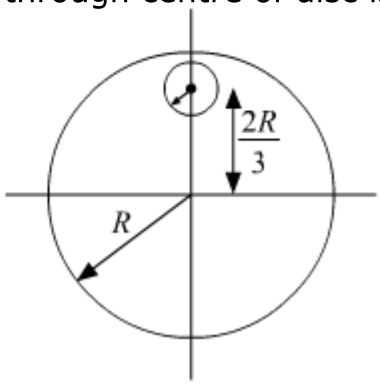
B. $\frac{3g}{2l}\sin\,\theta$

C. $\frac{2g}{3l}\sin\,\theta$

D. $\frac{3g}{2l}\cos\ \theta$

Q.No.8: From a uniform circular disc of radius R and mass 9 M, a small disc of radius $\frac{\mathrm{R}}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through centre of disc is :

JEE 2018



A. 10 MR^2

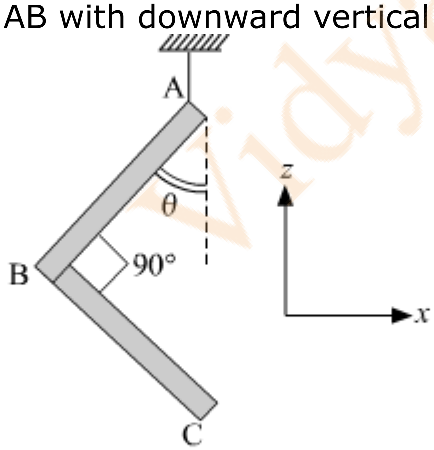
B. $\frac{37}{9}$ MR^2

C. 4 MR^2

D. $\frac{40}{9}$ MR^2

Q.No.9: An L-shaped object, made of thin rods of uniform mass density, is suspended with a string as shown in figure. If AB = BC, and the angle made by AB with downward vertical is θ, then:

JEE 2019



A. $\tan\ \theta=\frac{1}{2\sqrt{3}}$

B. $\tan\ \theta=\frac{1}{2}$

C. $\tan\ \theta=\frac{2}{\sqrt{3}}$

D. $\tan\ \theta = \frac{1}{3}$

Q.No.10: If the angular momentum of a planet of mass m, moving around the Sun in a circular orbit is L, about the center of the Sun, its areal velocity is:

JEE 2019

A. $\frac{\mathrm{L}}{\mathrm{m}}$

B. $\frac{4\mathrm{L}}{\mathrm{m}}$

C. $\frac{\mathrm{L}}{2\mathrm{m}}$

D. $\frac{2\mathrm{L}}{\mathrm{m}}$