

Workbook



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Moment of Inertia

Calculating the Moment of Inertia of a Disk about the Z and X-Axis

Questions

1) I of Non Uniform Rod.

Calculate the moment of inertia of rod of density

$$\lambda(x) = \lambda_0 \frac{x}{L}, \text{ rotating about the edge of the rod.}$$

L is the length of the rod, and x is the distance from the edge.

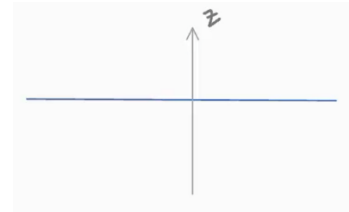


2) I of Non Uniform Rod Rotating at Center.

Calculate the moment of inertia of a rod of density

$$\lambda(x) = Ax^2 \text{ rotating about the center of the rod.}$$

L is the length of the rod, x is the distance from the center of the rod.

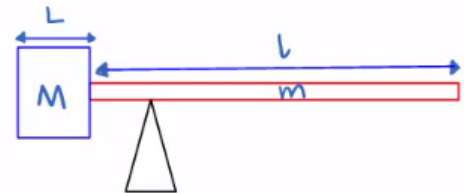


3) I of Electric Gate.

Calculate the moment of inertia of an electric gate of mass m and length l .

At the end of the gate, a mass of M and length L is attached.

The gate rotates about the center of mass.



4) Moment of Inertia.

There are two ways to calculate the value of I for the body in the sketch, centered around its center of mass.

Show both ways of calculating I .

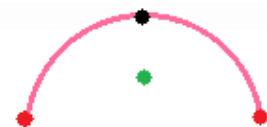
Each rod is of length l and mass m .



5) I of Half Hoop Two Masses.

Calculate the moment of inertia of a half hoop of radius R and mass M . At each edge, a mass of m is attached.

The hoop rotates about a screw at its center.

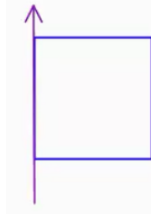


6) **Moments of Inertia of Squares.**

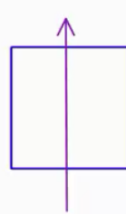
Calculate the moments of inertia of the square with mass M and sides of length a :

- Axis of rotation is at the edge of the board.
- Axis of rotation is parallel to edges and goes through the center of the board.
- Axis of rotation is perpendicular to the board and goes through its center.

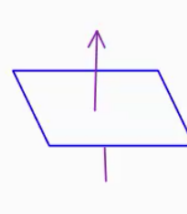
a:



b:

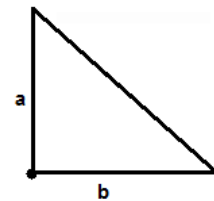


c:



7) **Moment of Inertia Triangle.**

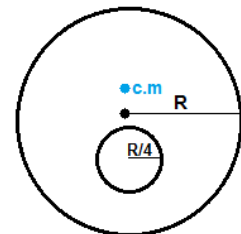
Calculate the triangles moment of inertia when its axis of rotation is located at the right-angled corner.



8) **I of Disk with a Hole.**

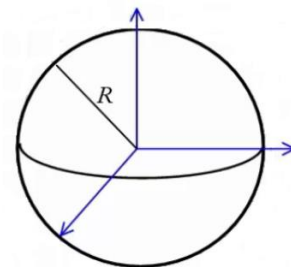
A disk of mass M and radius R has had a hole drilled in it at a distance of $\frac{R}{2}$ from center. The hole has a radius of $R/4$.

- The disk is rotating about its center. Calculate its moment of inertia.
- The disk is rotating about its center of mass. Calculate its moment of inertia.



9) **I of Sphere.**

Calculate the moment of inertia of full sphere of radius R , mass M and uniform density, about an axis which passes through the center of the sphere.



Answer Key

1) $I = M \frac{L^2}{2}$

2) $I = \frac{3}{20} mL^2$

3) $\frac{(m^2 + 15Mm + 2M^2)L^2}{12(M + m)}$

4) Solution in the recording.

5) Solution in the recording.

6) a. $I = \frac{Ma^2}{3}$ b. $I = \frac{Ma^2}{12}$ c. $I = \frac{Ma^2}{6}$

7) $I = \frac{1}{6}M(a^2 + b^2)$

8) $I = MR^2 \cdot \frac{3,697}{7,680}$

9) $I = \frac{2}{5}MR^2$