proprep™

Physics 1

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Moment of Inertia

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

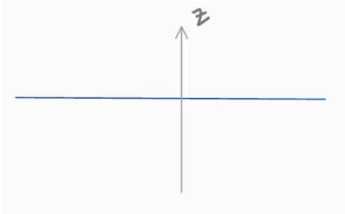
Questions:

1) I of Non Uniform Rod.

Calculate the moment of inertia of rod of density $\lambda(x) = \lambda_0 \frac{x}{L}$, rotating about the edge of the rod. L is the length of the rod, and x is the distance from the edge.

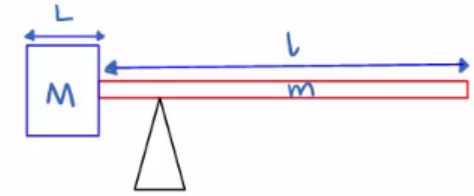
2) I of Non Uniform Rod Rotating at Center.

Calculate the moment of inertia of a rod of density $\lambda(x) = Ax^2$ rotating about the center of the rod. L is the length of the rod, x is the distance from the center of the rod.



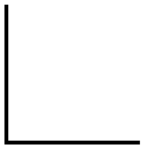
3) I of Electric Gate.

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.



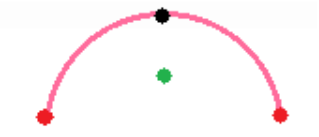
4) Moment of Inertia L.

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.

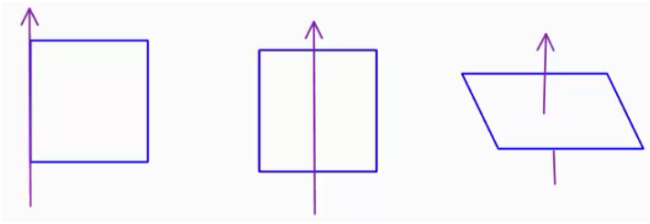


6) Moments of Inertia of Squares.

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

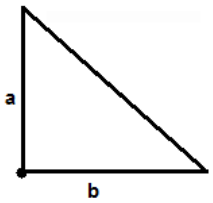
a. Axis of rotation is at the edge of the board.
b. Axis of rotation is parallel to edges and goes through the center of the board.
c. Axis of rotation is perpendicular to the board and goes through its center.

a: **b:** **c:**



7) Moment of Inertia Triangle.

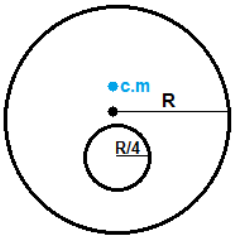
Calculate the triangles moment of inertia when its axis of rotation is located at the right-angled corner.



8) I of Disk with a Hole.

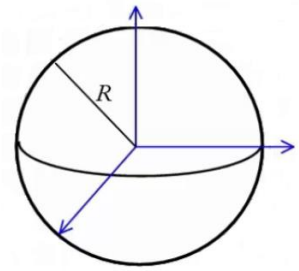
A disk of mass M and radius R has had a hole drilled in it at a distance of $\mathrm{R}/2$ from center. The hole has a radius of R.

a. The disk is rotating about its center.
   Calculate its moment of inertia.
b. 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) $I = M\dfrac{L^2}{2}$

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

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

4) Refer to the video.

5) Refer to the video.

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

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

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

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