Physics I

Moment of Inertia

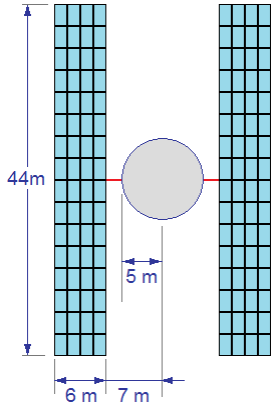
Moment of inertia for a distributed mass $I = \int r^2 dm$

Moment of inertia for discrete point masses $I = \sum m_i r_i^2$

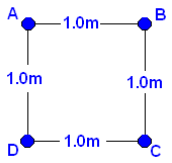
Moment of inertia of a disk about its center $I = \frac{1}{2} mR^2$

Parallel axes theorem $I = I_{CM} + mL^2$

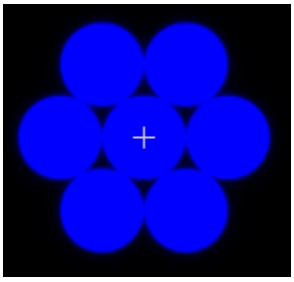
Problem 1.- A mini space station (MSS) can be modeled as a hollow sphere with radius R = 5m and mass 2,400 kg and two rectangular solar panels of mass 1,200 kg each, with the dimensions shown in the figure. Calculate the moment of inertia of the MSS with respect to an axis that passes through the center of the two solar panels.



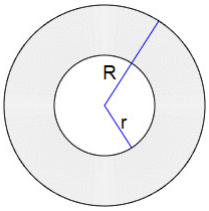
Problem 2.- Calculate the moment of inertia of four point masses arranged in a square shape shown in the figure. Take an axis of rotation that goes through point A perpendicular to the plane of the square. Each mass is 1.41 kg.



Problem 3.- Seven disks are arranged in a hexagonal pattern as shown in the figure below. Each disk has mass *m* and radius *R*. What is the moment of inertia of the system about an axis that passes through the center of the central disk and is normal to the plane?

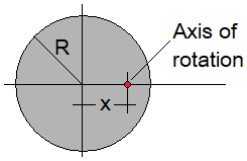


Problem 4.- Find the moment of inertia of a washer of mass *M,* external radius *R* and internal radius r, about its center.

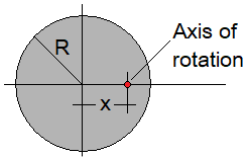


Problem 4a.- A washer has an internal radius of 0.01m and external radius of 0.02m and mass 0.004kg. Calculate the moment of inertia of the washer with respect to an axis of rotation located at its center.

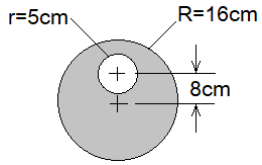
Problem 5.- A camshaft can be modeled as a disk of mass M = 1.5kg and radius R = 10cm, but whose axis of rotation is a distance *x* from the center of the disk. Calculate *x*, so the moment of inertia is twice the value with respect to the center of the disk.



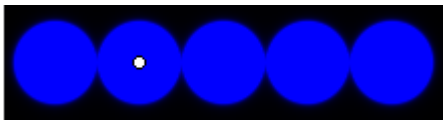
Problem 5a.- A camshaft can be modeled as a disk of mass M = 1.5kg and radius R = 10cm, but whose axis of rotation is a distance x = 6cm from the center of the disk. Calculate the moment of inertial with respect to this axis.



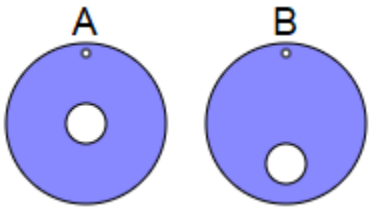
Problem 6.- Part of a camshaft consists of a solid disk of radius 16cm, where a circle of radius 5cm has been removed as shown in the figure below. Calculate the moment of inertia with respect to an axis that goes through the center of the large circle. The mass of the object is 4kg.



Problem 7.- A mechanical piece is made of five identical disks of mass m each and radius R. The disks are welded together as shown in the figure below. Calculate the moment of inertia with respect to an axis of rotation perpendicular to the plane of the disks and that passes through the center of the second one.



Problem 8.- Consider the disks shown in the figure. They have identical circles removed from them and are to rotate with respect to the small circles close to their border.



If the disks have the same mass, which one has larger moment of inertia with respect to the axis of rotation?

(a) *Disk A* (b) *Disk B* (c) They are the same.