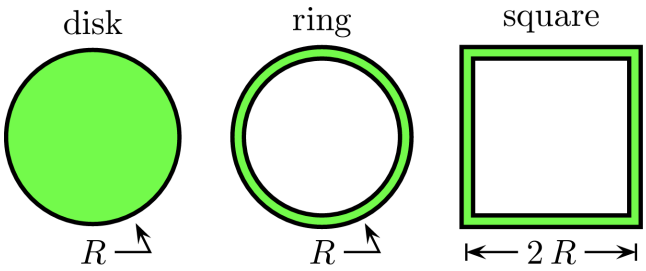
PHY 303K Discussion Session - Week 8

1. Consider three objects of equal masses but different shapes: a solid disk, a thin ring, and a thin hollow square. The ring and the square are hollow and their perimeters carry all the mass, but the disk is solid and has uniform mass density over its whole area. Compare the three objects' moments of inertia when rotated around their respective centers of mass.

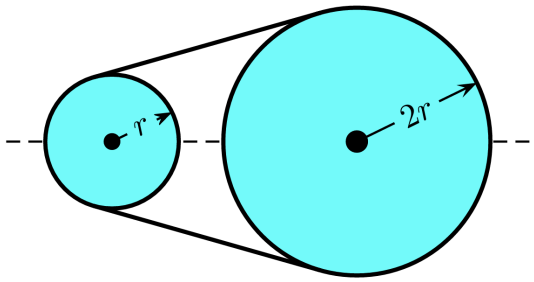
Idisk = (1/2)mR^2



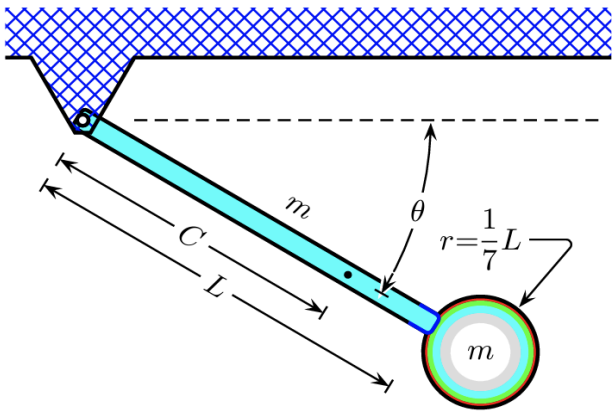
The square's radius is double the radius of the hollow ring and the solid disk.

2. A large wheel is coupled to a smaller wheel as shown. How does the rotational speed of the smaller wheel compare with that of the larger wheel? How do the tangential speeds at the rims compare (assuming the belt doesn't slip)?

I think the tangential speeds are greater on the smaller wheel than the larger wheel due to the angular velocity ratio of both.



3. Consider a thin rod of length L which is pivoted at one end. A uniformly dense spherical object with mass m and radius $r = \frac{1}{7}L$ is attached to the free end of the rod. The moment of inertia of the rod about an end is $I_{rod} = \frac{1}{3}mL^2$ and the moment of inertia of the sphere about its center of mass is $I_{sphere} = \frac{2}{5}mr^2$. Find the moment of inertia of the rod plus mass system with respect to the pivot point.



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Problem 4 - 11.2.14 :

A force $\vec{F} = (2.01\,\hat{i} + (-4.99)\hat{j} + 1.01\,\hat{k})$ N is applied at a point whose position is $\vec{r} = (-3.99\,\hat{i} + 2.01\,\hat{j})$ m.

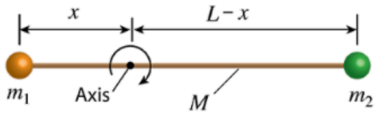
Part (a) **What is the magnitude of the torque, in units of newton meters, generated by this force about the origin?**

When given the force and position vectors in terms of unit vectors, the torque can be determined by means of the cross product. This can be written as a determinant:

16.499

Problem 17 - 10.5.31 :

Two small spheres, with masses m_1 and m_2 are attached to the ends of a rod of mass M and length L. The system rotates about an axis that is a distance x from the sphere with mass m_1 as shown in the diagram. The system is initially at rest, but then a constant torque is applied until the angular speed of the system attains a specified value.



Part (a) **Write an expression for x so that the work done by the applied torque to achieve the specified angular speed has its smallest possible value. Treat the spheres as point masses. Your answer will be in terms of m_1, m_2, M, and L.**