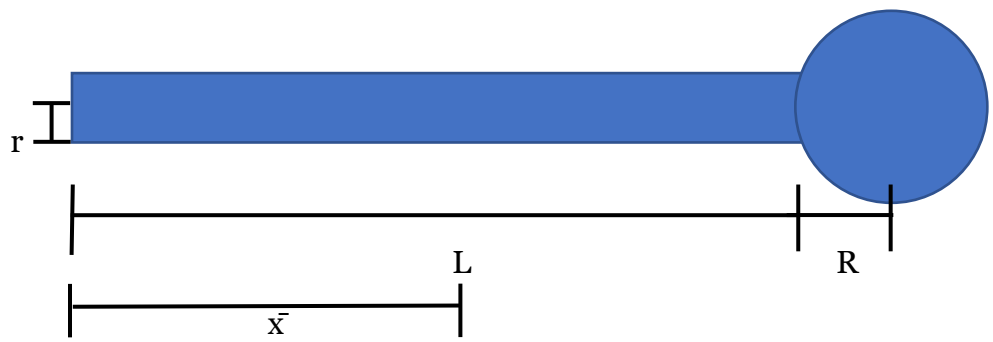
PHYS 2211- Center of Mass and Moment of Inertia
Reading Day Review

<u>Problem 1</u>

An object consists of a rod with length L and radius r and a sphere of radius R at one end of the rod. The object is shown below.



a) Assuming r = 15 cm, L = 1.5 m, R = 30 cm, and the entire object has constant uniform density of δ_0 = 10 kg/m^3, what is $\bar{x}$, the distance from the left end of the rod to the center of mass of the object?

b) What is the moment of inertia of the object about the left end of the rod?

c) Now assume the density of the rod is instead given by the function $\delta = \delta_0 \frac{x}{L}$, where x is the distance from the left end of the rod. Assuming r, L, R, and $\bar{x}$ are the same as in part (a), find δ_1, the new density of the sphere.

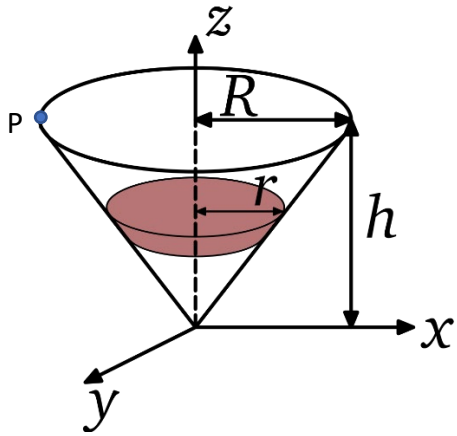
Problem 2

In which of the following cases does Object 2 have a greater moment of inertia than Object 1 about their given axes? Select all that apply

Choice	Object 1	Object 2
A	A sphere of mass M about an axis through its center of mass	A hollow sphere of mass M about an axis through its center of mass
B	A sphere of density δ about an axis through its center of mass	A hollow sphere of density δ about an axis through its center of mass
C	A solid cube of density δ and side length s about an axis through an edge.	A solid cube of density δ and side length $2s$ about an axis through an edge.
D	A cone of mass M about an axis perpendicular to the cone's base and passing through its tip.	A cone of mass M about an axis parallel to cone's base and passing through its tip.
E	Three balls each of mass M connected by massless rods of length l about an axis through the center of one of the balls.	Three balls each of mass M connected by massless rods of length l about an axis through the center of the formed triangle.

Problem 3

The moment of inertia of the cone pictured below about the z axis is I_z .



$$I_z = \frac{3}{10} MR^2$$

The cone begins at rest, then begins rotating with constant angular acceleration α for a time t_1. Then it stops accelerating and an external constant force F is applied parallel the base of the cone at point P until the rotation stops.

(a) Find t_2, the amount of time required to bring the cone back to rest in terms of M, R, t_1, α, and F.

(b) What is the work done by the force?

(c) How does the work change if F is doubled? How does the total angular distance traveled change if F is doubled?