Homework #7

Due Friday, Apr. 1 (no fooling!)

1. Find the center of mass of a uniform wire of mass m bent into the shape of a semicircle with radius r.

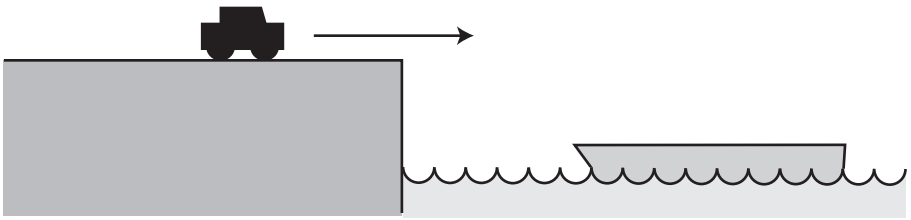
2. A solid cone has height h and radius r, and total mass m. The density of the cone is constant.

(a) Find the volume of the cone by integration.

(b) Find the center of mass of the cone by integration.

3. Chapter 9, problem 38.

4. James Bond is driving his $1,800$ kg Austin-Martin car at 230 km/hr. He drives the car off a horizontal dock onto a yacht with mass $5,800$ kg that is initially at rest. He comes to a screeching halt, leaving skid marks of length 2.2 m. How far does the yacht move during the time it takes the car to come to rest on the deck? How fast is the yacht moving after the car has stopped on yacht?



5. A 80 kg astronaut is stranded away from her space station, and is at rest relative to the space station. She is carrying two tools of mass 0.80 kg and 1.2 kg. She plans to propel herself toward the space station by throwing the tools in the opposite direction. She is able to throw them with a speed of 8.0 m/s relative to herself. What is her final speed if she throws the tools (a) simultaneously, (b) first the lighter tool, and (c) first the heavier tool?

6. A trucker with a sealed truck full of chickens is on a scale at a weigh station. The truck without the chickens weighs $9,200$ lb, and the chickens weigh a total of $1,200$ lb. He knows that his truck is just a little over the maximum legal weight, but he has an idea: just as the scale is being read, he bangs against the back of the truck, momentarily causing the chickens to fly into the air. He reasons that this will make the truck a little lighter

for a short time, and allow him to pass the inspection. Suppose that all the chickens are in the air and freely falling at the instant the truck is weighed. What does the scale read? Qualitatively, what happens to the scale reading if the scale is read at an instant where all the chickens are accelerating upward? Explain this using Newton's laws and the center of mass.