b. Find the center of mass of the nose of the submarine (i.e. the shape of the first 5 meters of our model). Note *it is only necessary to set up, but not calculate*, (an) integral(s).

3. (60 points) The following two questions refer to the submarine described in problem #2.
   a. The buoyancy properties of the empty submarine described in problem 1 cause the submarine to begin moving upward through the ocean water. This motion, in conjunction with the ocean water, creates a *damping force* that begins to slow the submarine. Assume that the damping force is proportional to the square of the velocity of the submarine, and that when the velocity is 5m/s the force is 100N. For our model submarine, the velocity at t seconds can be described by $v(t) = \left(25 - 25\sin\left(\frac{\pi t}{60}\right)\right)^{\frac{1}{3}}$ (in meters per second). Find the amount of work the damping force does on the submarine over the first 30 seconds of motion.

b. The *sail* of a submarine is a tower that houses the command and communications center, periscope(s), radar and antennae. We will additionally assume our model submarine has a sail that is a circular cylinder with radius of 2m and a height of 3m. Determine the total force on the sail (i.e. top and side) due to water pressure when the top of the sail is at a depth of 75m.