Math 129 - Section 017
Exercises for section 8.4-8.5

Show all of your work.

1. A block of ice weighing 500 lbs. is to be lifted to the top of a 200 foot tall building. In the 20 minutes it will take to do this, the block will lose 12 lbs. Assume that the weight lost due to melting is a linear function of time. Find the work need to lift the block.

   Answer: $\displaystyle\int_0^{200} (500 - \frac{12}{200}h)dh = 95200$ ft-lbs.

2. A banner in the shape of an isosceles triangle is hung over the side of a building. The banner has a base of 25 feet (at the roof line) and a height of 20 feet. It weighs 40 lbs. Find the work needed to lift the banner onto the roof of the building.

   Answer: $\frac{5}{4}\displaystyle\int_0^{20} (20h - h^2)dh = \frac{5000}{3}$ ft-lbs.

3. A cylindrical form is filled with a slow-curing concrete. The base of the form is 10 ft. in radius, and the height is 25 ft. While the concrete hardens, gravity causes the density to vary from 90 lbs./ft^3 at the bottom to 50 lbs./ft^3 at the top. Assume that the density is a linear function of the height. Compute the total weight of the resulting concrete column.

   Answer: $100\pi\displaystyle\int_0^{25} \left(90 - \frac{40}{25}h\right) dh = 50000\pi$ lbs.

4. A conical tank (oriented point down) of height 8 ft. and radius 6 ft. is filled with kerosene. Kerosene is pumped out of (the top of) the tank until the level has dropped by 5 feet. Using the fact that the density of kerosene is 51.2 lbs./ft.^{3}, set up integrals to compute the work done if the variable is given by the following:

   a. the distance between the vertex (the point) of the cone and the "slice"

      Answer: $90.4\displaystyle\int_3^8 h^2(8-h)dh$ ft-lbs.

   b. the distance between the top of the cone and the "slice"

      Answer: $90.4\displaystyle\int_0^5 h(8-h)^2dh$ ft-lbs.

5. In June of 2004, I hiked to the top of Mt. Wrightson via Florida Canyon. My total elevation gain was approximately 1524 meters. I started with 3 liters of water in my backpack, and when I reached the top, I had 1 liter of water left. Assuming that I drank water at a constant rate and that I lost water (through evaporation) at the same rate that I drank it, how many calories did I burn in completing the vertical component of this hike? In other words, we are not counting the energy required to cover horizontal distance. Was I justified in eating approximately 1200 calories in one sitting when I got back? You will need the following information:

   a. Water weighs 1 kg/liter.
   b. With my backpack and hiking gear (not counting water), I weigh about 73 kg.
   c. 1 calorie = 4186.8 joules.

   Answer: Don't worry too much about this one. It's the same as #1.