Instructions: The purpose of this assignment is to develop your ability to formulate and communicate mathematical arguments. Your complete assignment should have your name and section number on each page, be stapled, and be neat and legible. *Unreadable work will receive no credit.*

You should provide well-written, complete answers to each of the questions. We will look for correct mathematical arguments, complete explanations, and correct use of English. Your solution should be formulated in complete sentences. As appropriate, you may want to include diagrams or equations written out on a separate line. You may read your textbook to find examples of how we communicate mathematics.

Students are encouraged to use word-processing software to produce high quality solutions. However, you may find that it is simpler to add graphs and equations using pen or pencil.

1. (5 points) A man of height 1.7 meters is standing x meters away from a 4-meter lamppost. Let L denote the length of the man's shadow.

   (a) Draw a diagram and label the diagram appropriately.

   (b) Use similar triangles to express L as a function of x.

   By similar triangles, $\dfrac{x+L}{4} = \dfrac{L}{1.7}$. Then $(1.7)(x+L) = 4L$, $(1.7)x = (2.3)L$, $L = \dfrac{1.7}{2.3}x$.

   (c) Find L when $x = 23$.

   $L = \dfrac{1.7}{2.3} \cdot 23 = 17$ meters.

2. (5 points) The height of a conical tank is 9 meters and the radius is 5 meters. The tank is partially filled with water. The height of the water is h meters and the radius of the water is r meters. A sketch of the cross section of the conical tank partially filled with water is shown.

   (a) Express the volume of the water in the tank as a function of h alone. (The formula for the volume V of a cone whose base is a circle of radius r and height h is $V = \dfrac{1}{3}\pi r^2 h$.)

   By similar triangles, $\dfrac{r}{h} = \dfrac{5}{9}$. Then $r = \dfrac{5}{9}h$. It follows that

   $$V(h) = \frac{1}{3}\pi\left(\frac{5}{9}h\right)^2 h = \frac{1}{3}\cdot\frac{25}{81}\pi h^3 = \frac{25}{243}\pi h^3.$$

   (b) If the height of the water in the tank is doubled, what happens to the volume of the water in the tank?

   If the height of the water in the tank is doubled, then the volume of the water is multiplied by $2^3 = 8$.