# Section 2.6

**Guidelines for Solving Related-Rate Problems**

1. Identify all *given* quantities and quantities *to be determined*. Make a sketch and label the quantities.
2. Write an equation involving the variables whose rates of change are either given or are to be determined.
3. Using the Chain Rule, implicitly differentiate both sides of the equation *with respect to time t*.
4. *After* completing Step 3, substitute into the resulting equation all known values for the variables and their rates of change. Then solve for the required rate of change.

1) Suppose $x$ and $y$ are both differentiable functions of $t$ and are related by the equation $y = 2x^3 - 30x$. Find $\frac{dy}{dt}$ when $x = 2$, given that $\frac{dx}{dt} = -1$ when $x = 2$.

2) The radius $r$ of a circle is increasing at a constant rate of 4 centimeters per second. When the radius is 3 centimeters, at what rate is the total area $A$ of the circle changing?

3) Air is being pumped into a balloon so that its radius is increasing at a constant rate of 2 inches per minute. Find the rate of change of the volume of the balloon when the radius is 5 inches.

4) An 8 foot long ladder is leaning against a wall.  The top of the ladder is sliding down the wall at the rate of 2 feet per second.  How fast is the bottom of the ladder moving along the ground at the point in time when the bottom of the ladder is 4 feet from the wall.

5) A searchlight rotates 5 times per minute and is 30 feet from a wall.  How fast is the light beam moving along the wall when the beam makes an angle of $\theta = 45°$ with the line perpendicular from the light to the wall?

6) A fish is reeled in at a rate of 1 foot per second from a point 10 feet above the water.  At what rate is the angle between the line and the water changing when there is a total of 25 feet of line out?

Homework for this section:  Read the section and watch the videos/tutorials. Then do these problems in preparation for the quiz:  #4, 14, 15, 17, 21, 26, 27