Math 102
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Related Rates

To solve a related rates problem:

1. Sketch a diagram if possible.
2. Write down all the variables along with the rates given.
3. Write down the equation that relates all the variables.
4. Differentiate the equation (use implicit differentiation if necessary).
5. Solve for the unknown rate.

Practice problems.

1. Suppose a spherical balloon is inflated at the rate of 10 cubic centimeters per minute. How fast is the radius of the balloon increasing at the time when the radius is 5 cm? Recall that the formula for the volume of a sphere is $V = 4/3\ \pi r^3$.
2. A 20-foot ladder is leaning against the wall. If the base of the ladder is sliding away from the wall at the rate of 3 feet per second, find the rate at which the top of the ladder is sliding down when the top of the ladder is 8 feet from the ground.
3. Water leaking onto a floor creates a circular puddle with an area that increases at the rate of 3 square centimeters per minute. How fast is the radius of the puddle increasing when the radius is 10 cm? Recall that the formula for the area of a circle is $A = r^2\pi$.
4. Pat walks at the rate of 5 feet per second towards a 24-feet-tall street lamp. If Pat is 6 feet tall, how fast is the tip of Pat's shadow moves along the ground.
5. Assume that the number of bass in the pond is related to the level of polychlorinated biphenyls (PCBs, a group of industrial chemicals used in plasticizers, fire retardants and other materials) in the pond. The bass population is modeled by

$$y = \frac{2500}{1+x}$$

where x represents the PCB level in parts per million (ppm) and y represents the number of bass in the pond. If the level of PCBs is increasing at the rate of 40 ppm per year, find the rate at which is the number of bass changing when there are 100 bass in the pond.

Solutions: 1. $1/(10\pi)$ cm per min. 2. -6.87 ft per sec. 3. $3/(20\pi)$ cm per min. 4. $-5/3$ ft per sec. 5. -160 bass per year