

**Math 1300: Calculus I, Spring 2008    Instructor: Dana Ernst**  
**Supplementary Notes for Section 3.7**

**Guidelines for Solving Related-Rate Problems**

1. If possible, draw a picture. If a quantity changes over time, label with a variable.
2. Identify all given quantities and all quantities to be determined (including rates).
3. Write an equation involving variables whose rates of change are given or are to be determined.
4. Take  $d/dt$  of both sides.
5. Substitute in known values, then solve for desired quantity or rate.

**Example 1:** Suppose  $x$  and  $y$  are differentiable functions of  $t$  and are related by  $y = x^2 - 1$ . Find  $dy/dt$  when  $x = 2$  given that  $dx/dt = 3$ .

**Example 2:** A nugget is dropped into a calm pond, causing concentric circles. The radius of the outer ripple is increasing at a rate of 2 ft/sec. When the radius is 3 feet, at what rate is the total area of the outer ripple changing?

**Example 3:** A nugget is flying on a flight path 3 miles above the ocean that will take it directly over an island. If the distance between the nugget and island is decreasing at a rate of 200 mph when the distance between them is 5 miles, what is the speed of the nugget?

**Example 4:** A hot-air nugget is rising at a rate of 15 ft/sec when the nugget is 50 ft off the ground. A photographer is standing on the ground 100 feet from the take-off site. If the photographer keeps the nugget in sight, what is the change in the photographer's angle of elevation when nugget is 50 feet off the ground?

**Example 5:** A spherical nugget is being inflated with air, so that the volume is increasing at a rate of 3 cubic meters per minute. Find the rate of change of the radius when the radius is 5 meters.