Math 131 - March 2, 2016
Solutions

Steps for solving a related rates problem:

–1– Read and understand the problem (understand the story)
–2– Draw a picture.
What is changing in the picture and what is constant?
–3– List the information given (write information in "math", not English).
What rates have you been given and what rates do you need to find?
–4– Find an equation relating the quantities.
–5– $\frac{d}{dt}$
Use the chain rule!
–6– Solve for the rate you want to find.
–7– Plug in.

Warm-up Problems
Lecture Problems

1. Air is being pumped into a spherical balloon at a rate of 20 in^3/min. How fast is the radius of the balloon increasing when the radius is 6 inches?

   Solution: $5/(36\pi)$ inches per minute.

2. A 25 foot ladder is leaning against a vertical wall. The bottom of the ladder slips away from the wall at a rate of 0.2 inches per second. How fast is the top of the ladding slidding down the wall when the top is 20 feet above the floor?

   Solution: $-3/20$ inches per second

3. A conical water tank with vertex pointed down, has radius of 10 feet at the top and is 24 feet high. The tank starts full and water flows out at a rate of 20 cubic feet per miute. How fast is the depth of the water decreasing when the water is 16 feet deep.

   (Volume of a cone is $V = \frac{1}{3}\pi r^2 h$)

   Solution: $-9/(20\pi)$ feet per minute

4. Ship A is 32 miles north of ship B. Ship A is sailing due south at 16 miles per hour. Ship B is sailing due east at 12 miles per hour. At what rate is the distance between them changing at the end of 1 hour?

   Solution: $-224/40$ mph

5. Two sides of a triangle have lengths 12 meters and 15 meters. The angle between them is increasing at a rate of 2 degrees per minute. How fast is the area of the triangle changing when the angle between the sides of fixed length is 60°.

   Solution: $90 \cdot (cos(60°)) \cdot (0.035) \approx 1.575$ square meters per minute.

6. Sand is falling from a chute and forms a conical pile of sand whose height is always equal to 4/3 the radius of the base. The radius of the base is increasing at a rate of 3 inches per minute. How fast is the volume of the pile changing when the radius of the base is 3 feet?

   Solution: 3π cubic feet per minute

7. A lighthouse is located on a small island 3 km away from the nearest point P on a straight shoreline. If the lighthouse beacon rotates at a constant rate of 4 revolutions per minute, how fast is the beam of light moving along the shoreline when it is 1 km from the nearest point P?

   Solution: $80\pi/3$