

**2.8 Worksheet: Related Rates**

1. Let  $A(t)$  be the area of a circle with radius  $r(t)$ , at time  $t$  in minutes. Suppose the radius is changing at the rate of  $\frac{dr}{dt} = 3$  ft/min. Find the rate of change of the area at the moment in time when  $r = 9$  ft.

2. A stone dropped into a still pond sends out a circular ripple whose radius increases at a constant rate of 4 ft/s. How rapidly is the area enclosed by the ripple increasing when the radius is 2 feet?

3. A spherical snowball is melting in such a way that its diameter is decreasing at rate of 2 cm/min. At what rate is the volume of the snowball decreasing when the diameter is 8 cm?

**4.** You are blowing air into a spherical balloon at a rate of 11 cubic inches per second. Given that the radius of the balloon is 5 inches when  $t = 2$  seconds answer the following questions:

(a) How fast is the radius of the balloon growing at  $t = 2$  seconds?

(b) What is the rate of change of the surface area at  $t = 2$  seconds?

**5.** The height of a triangle is increasing at a rate of 1 cm/min while the area of the triangle is increasing at a rate of 6 square cm/min. At what rate is the base of the triangle changing when the height is 3 centimeters and the area is 9 square centimeters?

**6.** The top of a 5 foot ladder, leaning against a vertical wall, is slipping down the wall at the rate of 2 feet per second. How fast is the bottom of the ladder sliding along the ground away from the wall when the bottom of the ladder is 3 feet away from the base of the wall?

**7.** A boat is pulled into a dock by a rope attached to the bow (front end) of the boat and passing through a pulley on the dock that is 12 m higher than the bow of the boat. If the rope is pulled in at a rate of 3 m/s, at what speed is the boat approaching the dock when it is 5 m from the dock?

**8.** A street light is at the top of a pole that is 17 feet tall. A woman 6 ft tall walks away from the pole with a speed of 5 ft/sec along a straight path. How fast is the length of her shadow moving when she is 25 ft from the base of the pole?

**9.** Gravel is being dumped from a conveyor belt at a rate of 7 cubic feet per minute. It forms a pile in the shape of a right circular cone whose height and base diameter are always equal to each other. How fast is the height of the pile increasing when the pile is 9 feet high?

**10.** A filter filled with liquid is in the shape of a vertex-down cone with a height of 6 inches and a diameter of 4 inches at its open (upper) end. If the liquid drips out the bottom of the filter at the constant rate of 3 cubic inches per second, how fast is the level of the liquid dropping when the liquid is 1 inches deep?

**11.** At noon, person A is 3 miles east of person B. Person A is walking east at 6 miles per hour and person B is walking north at 7 miles per hour. How fast is the distance between the people changing at 2 PM?