AP Calculus AB: Related Rates Practice (SWOK)

1. As a circular metal griddle is being heated, its diameter changes at a rate of 0.01 cm/min. Find the rate at which the area of the top is changing when the diameter is 30 cm.
2. A fire has started in a dry, open field and spreads in the form of a circle. The radius of the circle increases at the rate of 6 ft/min. Find the rate at which the fire area is increasing when the radius is 150 ft.
3. Gas is being pumped into a spherical balloon at a rate of 5 ft3/min. Find the rate at which the radius is changing when the diameter is 18 inches.
4. Suppose a spherical snowball is melting and the radius is decreasing at a constant rate, changing from 12 inches to 8 inches in 45 minutes. How fast was the volume changing when the radius was 10 inches.
5. A ladder 20 feet long leans against a vertical building. If the bottom of the ladder slides away from the building horizontally at a a rate of 3 ft/sec, how fast is the ladder sliding down the building when the top of the ladder is 8 feet from the ground?
6. A girl starts at a point A and runs east at a rate of 10 ft/sec. One minute later, another girl starts at A and runs north at a rate of 8 ft/sec. At what rate is the distance between them changing 1 minute after the second girl starts?
7. A light is at the top of a 16 ft pole. A boy 5 feet tall walks away from the pole at a rate of 4 ft/sec. At what rate is the tip of his shadow moving when he is 18 feet from the pole? At what rate is the length of his shadow increasing?
8. The top of a silo has the shape of a hemisphere of diameter 20 feet. If it is coated uniformly with a layer of ice and if the thickness is decreasing at a rate of ¼ in/hr, how fast is the volume of the ice changing when the ice is 2 inches thick?
9. As sand leaks out of a hole in a container, it forms a conical pile whose altitude is always the same as its radius. If the height of the pile is increasing at a rate of 6 in/min, find the rate at which the sand is leaking out when the altitude is 10 inches.
10. A person flying a kite holds the string 5 feet above ground level, and the string is payed out at a rate of 2 ft/sec as the kite moves horizontally at an altitude of 105 feet. Assuming there is no sag in the string, find the rate at which the kite is moving when 125 feet of string has been payed out.
11. Boyle’s law for confined gases states that if the temperature is constant, pv = c, where p is pressure, v is volume, and c is a constant. At a certain instant the volume is 75 in3, the pressure is 30 lb/in2, and the pressure is decreasing at a rate of 2 lb/in2 every minute. At what rate is the volume changing at this instant?
12. A 100 foot long cable of diameter 4 inches is submerged in seawater. Because of corrosion, the lateral surface area decreases at a rate of 750 in2/year. Find the rate at which the diameter is decreasing.
13. The area of an equilateral triangle is decreasing at a rate of 4 cm2/min. Find the rate at which the length of a side is changing when the area of the triangle is 200 cm2.
14. Gas is escaping from a spherical balloon at a rate of 10 ft3/hr. At what rate is the radius changing when the volume is 400 ft3?
15. A stone is dropped into a lake, causing circular waves whose radii increase at a constant rate of 0.5 m/sec. At what rate is the circumference of a wave changing when its radius is 4 meters?
16. An airplane at an altitude of 10000 feet is flying at a constant speed on a line that will take it directly over an observer on the ground. If, at a given instant, the observer notes that the angle of elevation of the airplane is 600 and is increasing at a rate of 10 per second, find the speed of the airplane.
17. A ladder 20 feet long leans against a vertical building. If the bottom of the ladder slides away from the building horizontally at a rate of 2 ft/sec, at what rate is the angle between the ladder and the ground changing when the top of the ladder is 12 feet above the ground?

Ans:

1. 0.471 cm2/min 2. 1800ft2/min 3. 0.707 ft/mi 4. -111.701 in3/min 5. -6.874 ft/sec 6. 12.256 ft/sec 7. tip: 5.818 ft/sec length: 1.818 ft/sec 8. -23379.733 in3/hr 9. 1884.956 in3/min 10. 3.333 ft/sec 11. 5 in3/min 12. 0.1989 in/yr 13. -0.2149 cm/min

14. -0.038 ft/hr 15.  m/sec 16. 232.711 ft/sec (positive b/c asking for **speed**) 17. -0.167 rad/sec