Related Rate Problems Sheet 2

1) At 2 pm on a certain day, ship A is 100 km due north of ship B. At that moment, ship A begins to sail due east at a rate of 15 km/hr while ship B sails due north at a rate of 20 km/hr. How fast is the distance between the two ships changing at 5 pm? Is it increasing or decreasing?

2) A storage tank is 20 ft long and its ends are isosceles triangles having bases and altitudes of 3 ft. Water is poured into the tank at a rate of 4 cubic feet per minute. How fast is the water level rising when the water in the tank is 6 inches deep?

3) Two roads intersect at right angles. A car traveling 80 km/hr reaches the intersection half an hour before a bus that is traveling on the other road at 60 km/hr. How fast is the distance between the car and the bus increasing 1 hr after the bus reaches the intersection?

4) A rock is thrown into a pool of water. A circular wave leaves the point of impact and travels so that its radius increases at a rate of 25 cm/sec. How fast is the circumference of the wave increasing when the radius of the wave is 1 m?

5) The body of a snowman is in the shape of a sphere and is melting at a rate of 2 cubic feet per hour. How fast is the radius changing when the body is 3 ft in diameter (assuming that the body stays spherical)?

6) In problem 5, how fast is the surface area of the body changing when the diameter is 3 feet?

7) Water is leaking out of the bottom of a hemispherical tank with radius of 6 m at a rate of 3 cubic meters per hour. If the tank was full at noon, how fast is the height of the water level in the tank changing at 3 pm? [*Hint*: The volume of a segment of a sphere of radius r is $\pi h^2\left(r - h/3\right)$, where h is the height of the segment.]

8) A light is affixed to the top of a 12-ft lamppost. If a 6-ft man walks away from the lamppost at a rate of 5 ft per second, how fast is the length of his shadow increasing when he is 5 ft away?

9) Bacteria grow in circular colonies. The radius of one colony is increasing at a rate of 4 mm/day. On Wednesday, the radius of the colony is 1 mm. How fast is the area of the colony changing one week (that is, seven days) later?

10) A pill is in the shape of a right circular cylinder with a hemisphere on each end. The height (excluding its hemispherical ends) of the cylinder is half its radius. What is the rate of change of the volume of the pill with respect to the radius of the cylinder?

11) A spherical mothball is dissolving at a rate of 8π cc/hr (1 cc = 1 cubic centimeter). How fast is the radius of the mothball decreasing when the radius is 3 cm?

12) A particle moves along the parabola $y = x^2$ such that $dx/dt = 3$. Find the rate of change of the distance between the particle and the point (2,5)

a. when the particle is at $(-1, 1)$.

b. when the particle is at $(3, 9)$.

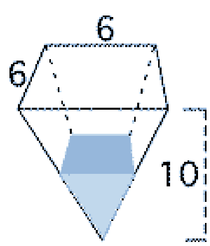
13) An airplane flies in still air with an airspeed of 500 mph. it climbs at an angle of 28° with the ground. Find the rate at which the plane gains altitude.

14) A screen saver displays the outline of a 3 cm by 2 cm rectangle and then expands the rectangle in such a way that the 2 cm side is expanding at the rate of 4 cm/sec and the proportions of the rectangle never change. How fast is the area of the rectangle increasing when its dimensions are 12 cm by 8 cm?

15) An FBI agent with a powerful spyglass is located in a boat anchored 400 meters offshore. A gangster under surveillance is walking along the shore. Assuming the shoreline is straight and that the gangster is walking at the rate of 2 km/hr, how fast must the FBI agent rotate the spyglass to track the gangster when the gangster is 1 km from the point on the shore nearest to the boat. Convert your answer to degrees/minute.

16) A flood lamp is installed on the ground 200 feet from a vertical wall. A six foot tall man is walking towards the wall at the rate of 30 feet per second. How fast is the tip of his shadow moving down the wall when he is 50 feet from the wall?

17) A receptacle is in the shape of an inverted square pyramid 10 inches in height and with a 6 x 6 square base. The volume of such a pyramid is given by: (1/3)(area of the base)(height). Suppose that the receptacle is being filled with water at the rate of 0.2 cubic inches per second. How fast is water rising when it is 2 inches deep?



18) Two runners are running on circular tracks each of which has a circumference of 1320 feet. The tracks are 100 feet apart and the runners start opposite each other and move at the same constant rate of 880 ft/min. How fast are the runners separating when each has run 165 feet?