BC Calculus

Review #3 – Derivative Applications

1. Water is flowing into a cylindrical tank of radius 5 meters at the rate of 16 cubic meters per minute. How fast is the water level rising?

2. Water is running out of a conical funnel at the rate of 1 cubic in per second. If the radius of the base of the funnel is 4 inches and the height is 8 inches, find the rate at which the water level is dropping when it is 2 inches from the top.

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

   b) How fast is the radius increasing when it is 6 feet and the volume is increasing at the rate of 24 cubic feet per minute?

4. Two parallel sides of a rectangle are being lengthened at the rate of 2 cm/sec, while the other two sides are being shortened in such a way that the figure remains a rectangle with constant area of 50 sq cm. What is the rate of change of the perimeter when the length of an increasing side is
   a) 5 cm?

   b) 10 cm?

   c) What are the dimensions when the perimeter ceases to decrease?

5. A balloon is rising vertically over a point A at the rate of 15 ft/sec. Point B on the ground is level with point A and is 30 ft from point A. At what rate is the distance between B and the balloon changing when the balloon is 40 ft high?

6. A barge whose deck is 10 ft below the level of a dock is being pulled into the dock by means of a cable attached to the deck and passing through a ring on the dock. The barge is approaching the dock at ¾ feet per second. How fast is the cable being pulled in when the boat is 24 feet from the dock?

7. Ship A is sailing due south at 16 km/hr and ship B, 32 km south of ship A, is sailing due east at 12 km/hr.

   a) At what rate are they separating after 1 hour?

   b) At what rate are they separating after 2 hours?

   c) When do they cease to approach each other and how far apart are they at that time?

8. A floodlight is on the ground 45 meters from a building. A person 2 meters tall runs from the floodlight directly towards the building at the rate of 5 meters/second. How fast is the length of his shadow changing when he is 15 meters from the building?

9. A cube is changing in such a way that the volume is increasing at the rate of 3 m^3/sec. Let t_0 be the instant when the numerical rate of change of the volume is equal to the numerical rate of change of the surface area.

a) Find the value of t_0.

b) What is the rate of change in the length of a side at that same moment?

10. A water tank is being drained for cleaning. If $G(t)$ represents the number of gallons of water in the tank after t minutes and $G(t) = 20(30 - t)^2$, find the following

a) How fast is the water draining at $t = 10$ minutes?

b) Find t_0 if the average rate at which water is draining between t_0 and $2t_0$ is 60 gallons per minute.