Section 3.7

I. Related Rate Problems – Strategy

The General Situation

1. Draw picture is possible. Assign variables to represent the quantities that change.

1a. Specifically identify, via the representing variables in Step 1, the known rate of change and the unknown rate of change.

2. Find an equation to relate the variables in Step 1 (specifically, the variables in Step 1a).

3. Differentiate the above equation with respect to time.

The Specific Situation

4. Substitute in specific (known) numerical values and solve algebraically for the unknown rate.

II. Examples

1. Truck leaves Lubbock at 8 am, heading east on Hwy 114 at a speed of 50 mph. Car leaves Lubbock at 10 am, heading north on I-25 at a speed of 75 mph. At noon how fast is the distance between the truck and the car changing?

2. A spherical balloon is being filled by a vendor with helium at a rate of 8 cubic centimeters per second. When the volume reaches 288π cubic centimeters, how fast is the radius increasing?

3. A spherical balloon is being filled by a vendor with helium at a rate of 8 cubic centimeters per second. When the volume reaches 288π cubic centimeters, how fast is the surface area increasing?

4. A right circular conical storage tank (30 ft = height, 20 feet = upper diameter) is being filled by pumping water into the tank at a rate of 12 cubic feet per minute. When the level of water in the tank reaches the 15 foot mark, how fast is the water in the tank rising?

5. A right circular conical storage tank (30 ft = height, 20 feet = upper diameter) is being filled by pumping water into the tank at a rate of 12 cubic feet per minute. When the tank is half full, how fast is the water in the tank rising?

6. A winch (on a dock) sits 10 feet above the water. The winch is pulling a boat towards the dock. The winch pulls in the rope at a constant speed of 13 ft per minute. When the boat is 24 feet from the dock, how fast is the boat being pulled towards the dock?

7. A light is mounted on a bridge (over the right hand lane of traffic) 20 ft above the road below. A bicyclist is riding towards the bridge (in the right hand lane of traffic). The bicyclist's head is 4 feet above the road. As the bicyclist approaches the bridge, a shadow follows the bicyclist (cast because of the mounted light) which grows shorter with the approach to the bridge. The bicyclist is traveling 15 mph (= 22 feet per second). When the bicyclist is 40 feet from the bridge, how fast is the length of the shadow shrinking?