This homework on related rates is due on Friday, April 10.

1. Suppose that x and y are functions of t. For each part of this problem, apply $\frac{d}{dt}$ to both sides of the equation to find an equation that relates x, y, $\frac{dx}{dt}$, and $\frac{dy}{dt}$. (You are not being asked to simply the resulting equations or to solve for anything.)

a) $x^2 + y^2 = x^3$

b) $xe^y + ye^x = 10$

c) $\sin(xy) = \frac{1}{2}$

2. Suppose that x and y are related by the equation $x^2y^3 + y = 40$, and that x and y are changing with time. Use the related rates technique to find $\frac{dx}{dt}$ at the time when $y = 2$ and $\frac{dy}{dt} = 4$

3. The radius of a sphere is increasing at a rate of 2 inches per second. How fast is the volume of the sphere increasing when the radius is 20 inches? (Note: The volume of a sphere of radius r is $\frac{4}{3}\pi r^3$.

4. [Problem 6 from Section 4.1] A 25-foot ladder is leaning against a wall. If we push the bottom of the ladder towards the wall at a rate of 1 ft/sec, and the bottom of the ladder is initially 20 feet from the base of the wall, how fast does the top of the ladder move up the wall 5 seconds after we start pushing?

5. Two people leave the same point at the same time. One walks north at a constant rate of 3 miles per hour. The other walks west at a constant rate of 4 miles per hour. How fast is the distance between the two people changing two hour after they start walking?

6. Fred and Wilma are walking on opposite sides of a 30-foot wide street, headed in opposite directions. Fred's speed is 3 feet per second, and Wilma's is 7 feet per second. At what rate is the distance between them changing 2 seconds after the time when they are directly across the street from each other?

7. [Problem 12 from Section 4.1] A 5-foot tall person walks towards a wall at a rate of 2 ft/sec. A spotlight is located on the ground 40 feet from the wall. How fast does the height of the person's shadow on the wall change when the person is 10 feet from the wall?

8. Barney is six feet tall and is standing in the middle of a clear, flat plane. The sun is setting. How fast is Barney's shadow growing, in inches per second, when the sun is 5° (this is, $\frac{5}{180}\pi$ radians) above the horizon?