Additional Problems

The following problems were taken from *Calculus: Early Vectors*, by J. Stewart, which is being used by the other sections of M151.

1. A ladder 10 ft long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a speed of 2 ft/s, how fast is the angle between the top of the ladder and the wall changing when the angle is $\frac{\pi}{4}$?

Answer: $\frac{\sqrt{2}}{5}$rad/s.

2. A baseball diamond is a square with sidelengths 90 ft. If a batter hits the ball and runs toward first base with a speed of 24 ft/s, at what rate is his distance from second base changing when he is half way to first?

Answer: -10.7331 ft/s.

3. A water trough is 10 m long and a cross section has the shape of an isosceles trapezoid that is 30 cm wide at the bottom, 80 cm wide at the top, and has a height of 50 cm. If the trough is being filled with water at the rate of .2 m^3/min, how fast is the water level rising when the water is 30 cm deep.

Answer: $\frac{1}{3}$m/min or $\frac{10}{3}$cm/min.

4. Gravel is being dumped from a conveyor belt at a rate of 30 ft^3/min and its coarseness is such that it forms a pile in the shape of a cone whose base diameter and height are always equal. How fast is the height of the pile increasing when the pile is 10 ft high?

Answer: $\frac{1.2}{\pi}$ ft/min.

5. A kite 100 ft above the ground moves horizontally at a speed of 8 ft/s. At what rate is the angle between the string and the horizontal changing when 200 ft of string have been let out?

Answer: $-\frac{1}{50}\frac{\text{rad}}{s}$.

6. A television camera is positioned 4000 ft from the base of a rocket launch pad. A rocket rises vertically and its speed is 600 ft/s when it has risen 3000 ft.

6a. How fast is the distance from the camera to the rocket changing at that moment?

Answer: 360 ft/s.

6b. If the camera is always kept focused on the rocket, how fast is the camera's angle of elevation changing at that same moment?

Answer: $\frac{24}{50}$ rad/s