Applications of Derivatives Practice

1. A rocket that is launched vertically is tracked by a radar station located on the ground 3 mi from the launch site.  
   What is the vertical speed of the rocket at the instant that its distance from the radar station is 5 mi and this  
   distance is increasing at the rate of 5000 mph?
2. A man 6 ft tall walks with a speed of 8 ft/s away from a street light that is atop an 18-ft pole. How fest is the tip  
   of his shadow moving along the ground when he is ] 00 ft from the pole? How fast is the length of his shadow  
   changing?
3. A circular oil slick of uniform thickness is caused by a spill of 1 m3 of oil. The thickness of the oil slick is  
   decreasing at the rate of 0.1 cm/h. At what rate is the radius of the slick increasing when the radius is 8m?
4. A water tank is in the shape of a cone with vertex down. The tank has a radius of 3 ft and is 5 ft high. At first  
   the tank is full of water, but at time t=0 (in seconds), a small hole at the vertex is opened and the water begins to  
   drain. When the height of the water in the tank has dropped to 3 ft, the water is flowing out at 2 ft3/s. At what  
   rate, in feet per second, is the water level dropping at that moment?
5. Two straight roads intersect at right angles. At 10 am a car passes through the intersection headed due east at 30  
   mph. At 11 am a truck heading due north at 40 mph passes through the intersection. Assume that the two  
   vehicles maintain the given speeds and directions. At what rate are they separating at 1 pm?
6. An open-topped rectangular box is to have a volume of 4500 cm3. If its bottom is a rectangle whose length is  
   twice its width, what dimensions would minimize the total amount of material?
7. Verify that the hypotheses are satisfied and use the Mean Value Theorem to find the value of c for the following:

a. y = x-l/x [1,3] b.y=  [1,4]

1. A fence, 8 feet high, is parallel to the wall of a building and 2 feet from the building. What is the shortest plank  
   that can go over the fence to prop the wall?
2. At 7 am, one ship was 60 miles due east from a second ship. If the first ship sailed west at 20 mph and the  
   second ship sailed south at 30 miles per hour, when were they closest together?

10. A manufacturer estimates that 100 units per month can be sold if the price is S250, and mat sales will increase  
by 20 units for each $10 decrease in price. What price will maximize the manufacturer's income?

11. Linearize f(x)=tan (x) at x = π and use the tangent line to approximate f(4).

13. A ball thrown upward at 24 ft/s from a platform 16 ft above the ground is s(t)=16+24t-16t2 feet above the  
ground t seconds after it has been thrown. Find:

a. The velocity and acceleration at any time t

b. The maximum height of the ball

c. How many seconds until the ball reaches the ground

d. The velocity of the ball when it strikes the ground.

14. Describe the motion on the interval:

a. S(t) = t3 - 3t2 + 4 [-2,4] b. s(t) = sin(t) - cos(t) [0,2π]

15. Determine the local maxima, minima, where f(x) is increasing, decreasing, concave up, concave down, and points of inflection.

a. f(x) = (3-x) b. f(x) = sin(2x)-2x [0,2π]