Optimization and Related Rates review problems

2010

1. Air is being pumped into a spherical balloon at a rate of 4.5 cubic feet per minute. Find the rate of change of the radius when the radius is 2 feet.

2. At a sand and gravel plant, sand is falling off a conveyor and onto a conical pile at a rate of 10 cubic feet per minute. The diameter of the base of the cone is approximately three times the altitude. At what rate is the height of the pile changing when the pile is 15 feet high?

3. A ladder 25 feet long is leaning against the wall of a house. The base of the ladder is pulled away from the wall at a rate of 2 feet per second. How fast is the top moving down the wall when the base of the ladder is 7 feet from the wall?

4. An air traffic controller spots two planes at the same altitude converging on a point as they fly at right angles to each other. One plane is 150 miles from the point moving at 450 miles per hour. The other plane is 200 miles from the point moving at 600 miles per hour. At what rate is the distance between the planes decreasing?

5. A rancher has a young cow weighing 1000 lbs. If he sells today, he will get \$0.85 per lb. As the cow grows, the price will go down \$0.01per lb. At what weight should he sell the cow to maximize his profit?

6. A rectangular page is to contain 30 square inches of print. The margins on the side are to be 1 inch and 2 inches on the top and bottom. Find the dimensions of the page such that the least amount of paper is used.

7. A particle moves on a vertical line so that its coordinate at time t is $y = t^3 - 12t + 3, t \geq 0$.
   a. Find the velocity and acceleration functions.
   b. When is the particle moving upward and when is it moving downwards?
   c. When is the particle's speed increasing?
   d. Find the distance that the particle travels in the time interval $0 \leq t \leq 3$.

(Be sure to review the graphical example of Motion Worksheet 2)

8. The table below gives the approximate distance traveled in feet by a downhill skier after t seconds. Approximate $D'(2)$. Use linear approximation to predict D(11).

Time, t	0	1	2	3	4	5	6	7	8	9	10
Dist. Traveled, D(t)	0	3.3	13.3	29.9	53.2	83.2	119.8	163.0	212.9	269.5	332.7

9. Find the linearization of $f(x) = \sqrt{x^2 + 9}$ at $x = -4$ and use it to approximate $\sqrt{25.81}$.
10. Use tangent line approximation to approximate $\sqrt[3]{26}$ using the function $f(x) = \sqrt[3]{27 - x}$.