Word Question Review Sheet
Applications of Derivative

1. Determine the point on the line with the equation $2x + y = 3$ that is closest to the point $(2,1)$.
2. Find the positive number with the property that the sum of the number and twice the square of its reciprocal is a minimum.
3. Find the dimensions of the largest rectangle that can be placed inside a right triangle with the sides of 5, 12, 13 in. if one vertex of the rectangle is at the right angle and another is on the hypotenuse.
4. A closed rectangular box with a square base is constructed with a top costing twice as much as the sides and bottom. The box is to contain 96 cubic inches. What should be the dimensions of the box in order to minimize the building cost?
5. Find the dimensions of the right circular cylinder of greatest volume that can be placed inside a right circular cone with a radius of 6 in. and a height of 12 in.
6. An angler has a fish at the end of a line. The line is reeled in at the rate of 2 ft/sec from a bridge 30 ft above the water. At what rate is the fish moving through the water when the length of the line is 50 ft.?
7. Water flows at the rate of 2 cubic ft/min into a tank in the shape of an inverted right circular cone of altitude 6 ft and radius 2 ft. At what rate is the surface of the water rising with then tank is half full?
8. When a circular metal plate is heated, its radius increases at the rate of 1 mm/sec. At what rate is the area of the plate increasing when the radius is 4cm.
9. The edges of an equilateral triangle are increasing at the rate of 1 mm/sec. How fast is the area of the triangle increasing when the area is $14mm^2$?
10. A 15 ft. ladder is leaning against a wall, and its base is pushed toward the wall at the rate of 2 ft/sec. How fast is the top of the ladder moving up the wall when the top is 9 ft. from the ground?
11. For the situation described in problem 10, find how fast the angle between the ladder and the ground is changing when the top of the ladder is 9 ft. from the ground.
12. Two ships sail from the same port. The first ship leaves port at 1:00am and travels eastward at a rate of 15 knots. The second ship leaves port at 2am and travels northward at a rate of 10 knots. Determine the rate at which the ships are separating at 3am. (Note: knots are nautical miles per hour, just use as you normally would mph.)
13. Andy, who is 6 feet tall is walking away from a street light pole 30 feet high at a rate of 2 feet per second.
    a) How fast is his shadow increasing in length when Andy is 24 feet from the pole? 30 feet?
    b) How fast is the tip of his shadow moving?
    c) To follow the tip of his shadow, at what angular rate must he lift his head when his shadow is 6 feet long?

13 A covered box is to be made from a rectangular sheet of cardboard measuring 5 feet by 8 feet. This is done by cutting out the shaded regions of Figure 20 and then folding on the dotted lines. What are the dimensions x, y, and z that maximize the volume?
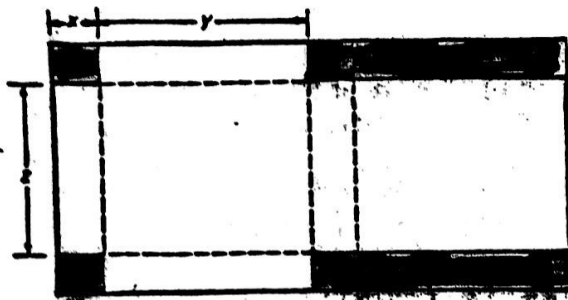

FIGURE 20

$x = 1, y = 3, z = 3$

14. Andy, who is 6 feet tall, is walking away from a street light pole 30 feet high at a rate of 2 feet per second.

(a) How fast is his shadow increasing in length when Andy is 24 feet from the pole? 30 feet?

(b) How fast is the tip of his shadow moving?

(c) To follow the tip of his shadow, at what angular rate must he lift his head when his shadow is 6 feet long?

a) $\frac{1}{2}$ ft/sec in both cases

b) $\frac{5}{2}$ ft/sec

c) 0.0417 Rad/sec

Answers

1) (6/5, 3/5) 2) $\sqrt[3]{4}$ 3) 6 by 5/2 4) 4 by 4 by 6 height

5) $r = h = 4$ in, $v = 64\pi$ in^3 6) 5/2 ft/sec

7) $\sqrt[3]{4}/(2\pi) \approx .25$ ft/min 8) 80π mm^2/sec or $.8\pi$ cm^2/sec

9) 4.9 mm^2/sec

10) 8/3 ft/sec 11) 2/9 rad/sec 12) 17.4 knots