Name: _____ Period: _____

Worksheet 3.7-3.8
Related Rates Problems / Local Linear Approximation

Show all your work that lead to your answers.

1. A rock is dropped into a calm pond causing ripples in the form of concentric circles. The radius of the outer ripple is increasing at a constant rate of 1 foot per second. When the radius is 4 feet, at what rate is the total area of disturbed water increasing?

2. A spherical snowball is melting. Its radius is decreasing at 0.2cm per hour when the radius is 14cm. How fast is the volume changing at that time?

3. A small balloon is released at a point 150 feet away from an observer who is on level ground. If the balloon goes straight up at a rate of 8 ft/sec, how fast is the distance from the observer to the balloon increasing when the balloon is 50 feet high?

4. The sides of a square are increasing at a rate of 3cm per second. When the sides are 5cm long, at what rate is the area increasing?

5. Two roads cross at right angles. An observer stands on the road 50 meters south of the intersection and watches an eastbound car traveling at 45 meters per second. At how many meters per second is the car moving away from the observer 5 seconds after it passes through the intersection?

6. The radius and height of a cone both increase at a constant rate of ½ cm/sec. At what rate, in cubic centimeters per second, is the volume of the cone increasing when the height is 9 centimeters and the radius is 6 centimeters?

7. Water is being pumped into a conical tank that is 8 feet tall and has a diameter of 10 feet. If the water is being pumped in at a constant rate of 3/5 cubic feet per hour, at what rate is the depth of the water in the tank changing when the tank is half full?

8. An acute angle of a right triangle increases at a constant rate of 3 radians per minute. If the hypotenuse is 5cm, at what rate is the side opposite the acute angle increasing in centimeters per minute when the opposite side equals 3 cm?

9. A person 2 meters tall walks directly away from a streetlight that is 8 meters above the ground. If the person is walking at a constant rate and the person's shadow is lengthening at the rate of 4/9 meters per second, at what rate, in meters per second, is the person walking?

10. A pretzel maker forms dough into a cylinder. As he rolls it, if the length is increasing at a rate of 0.5 cm/sec, find the rate at which the radius is changing when the radius is 1cm and the length is 5 cm.

11. Find the linearization of $f(x) = sin(x)$ at $a = \frac{\pi}{2}$.

12. Find the linearization of $f(x) = x^{3/4}$ at $a = 16$.

13. Find the differential dy of $y = \frac{t^2}{1-t^5}$.

14. Find the differential dy of $y = e^x \cos^{-1}(x^2)$.

15. Use a linear approximation or differentials to estimate $e^{-0.01}$.

16. Use a linear approximation or differentials to estimate $\frac{1}{4.001}$.

17. Use a linear approximation or differentials to estimate $\sqrt{99.9}$.

18. The radius of circular disk is given as 24 cm with a maximum error in measurement of 0.2 cm. Use differentials to calculate the maximum error in the calculated area of the disk; what is the relative error?

19. Is there any difference between the approximation given by a differential and the approximation given by a linearization? Why or why not?

Answers:

1. $8\pi \frac{ft^2}{sec}$	2. $-156.8\pi \frac{cm^3}{hour}$	3. $\frac{4\sqrt{10}}{5} \frac{ft}{sec}$
4. $30 \frac{cm^2}{sec}$	5. $43.928 \frac{m}{sec}$	6. $24\pi \frac{cm^3}{sec}$
7. $0.012 \frac{ft}{hr}$	8. $12 \frac{cm}{min}$	9. $\frac{4}{3} \frac{m}{sec}$
10. $-0.05 \frac{cm}{sec}$	11. 1	12. $L(x) = \frac{3}{8}x + 2$
13. $dy = \frac{2t+3t^6}{(1-t^5)^2} dt$	14. $dy = e^x \cos^{-1} x^2 + \frac{-2xe^x}{\sqrt{1-x^4}} dx$	
15. 0.99	16. $\frac{3999}{16000}$	17. 9.995
18. Max error = $\frac{48\pi}{5}$ Rel error = $\frac{1}{60}$	19. No; they're both using the same tangent line. It's two different ways of looking at the same approximation	