Name ____ Period _____ Date ______________________

Assignment #17B.5: *More Related Rates Practice*

1. Find all points on the graph of the equation $x^2 - y^2 = 2x + 4y$ where the tangent line is horizontal. Does the graph have any vertical tangents? Why or why not?

2. The manager of a company determines that when q hundred units of a particular commodity are produced, the total cost of production is C thousand dollars, where $C^2 - 3q^3 = 4275$. When 1500 units are being produced, the level of production is increasing at the rate of 20 units per week. What is the total cost at this time, and at what rate is the total cost changing at that moment?

3. A storm at sea has damaged an oil rig. Oil spills from the rupture at the constant rate of 60 ft^3/min, forming a slick that is roughly circular in shape and 3 inches thick.
   (a) How fast is the radius of the slick increasing when the radius is 70 feet?
   (b) Suppose the rupture is repaired in such a way that the flow is shut off instantaneously. If the radius of the slick is increasing at the rate of 0.2 ft/min when the flow stops, what is the total volume of oil that spilled onto the sea?

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4. A lake is polluted by waste from a plant located on its shore. Ecologists determine that when the level of pollutant is x parts per million (ppm), there will be F fish of a certain species in the lake, where $F = \dfrac{32{,}000}{3+\sqrt{x}}$. When there are 4,000 fish left in the lake, the pollution is increasing at the rate of 1.4 ppm/year. At what rate is the fish population changing at that time?

5. When the price of a certain commodity is p dollars per unit, the manufacturer is willing to supply x thousand units, where $x^2 - 2x\sqrt{p} - p^2 = 31$. How fast is the supply changing when the price is \$9 per unit and is increasing at the rate of 20 cents per week?

6. A tiny spherical balloon is inserted into a clogged artery and is inflated at the rate of 0.002π mm^3/min. How fast is the radius of the balloon growing when the radius is $R = 0.005$ mm? (Note that a sphere of radius R has volume $V = \frac{4}{3}\pi R^3$)

7. An ice block used for refrigeration is modeled as a cube of side s. The block currently has volume 125,000 cm^3 and is melting at the rate of 1,000 cm^3 per hour.
   (a) What is the current length s of each side of the cube? At what rate is s currently changing with respect to time t ?
   (b) What is the current rate of change of the surface area A of the block with respect to time?
   Note: A cube of side s has volume $V = s^3$ and surface area $A = 6s^2$.

Solutions
1. horizontal tangents at (1, -0.27) and (1, -3.73); no vertical tangents, since the original function does not have a point with a y-coordinate of -2.
2. The cost of producing 1500 units is \$120,000 and at that level of production, the total cost is increasing at the rate of \$1687.50 per week.
3a. approx. 0.55 ft/min 3b. approx. 28,652 ft^3 (which is about 214,332 gallons) 4. The fish population is decreasing by 70 fish per year.
5. The supply is increasing at the rate of 0.206 thousand units per week, or 206 units per week. 6. 20 mm/min 7a. 50 cm;-2/15 cm/hr 7b. -8/5 cm^2/hr