

1)

- a. Suppose the concentration $C(t)$, in mg/ml, of a drug in the bloodstream t minutes after an injection is given by $C(t) = 10te^{-0.02t}$. Find the maximum concentration and when it occurs. (6pts)
- b. For selected years from 1978 to 2000, the number of mutual funds N , excluding money market funds, can be modeled by $N = 220.7e^{0.1080t}$ where t is the number of years past 1975. Find and interpret the rate of change of the number of mutual funds in 1995. (6pts)
- c. Find the critical value(s) of $y = 5\ln x - 9x$ and indicate which ones are maxima, minima or HPI. (4 pts.)

2) Find the derivative of the following functions. DO NOT SIMPLIFY.(4 pts. Each)

a. $y = \sqrt{\ln(7x+8)}$

b. $y = \log_3(2-x-x^7)$

c. $y = 3^{6x+1}$

d. $y = 6e^{\sqrt{x^4-4}}$

3)

- a. A company handles an apartment building with 60 units. Experience has shown that, if the rent for each of the units is \$360 per month, all the units will be filled, but 1 unit will become vacant for each \$10 increase in the monthly rate. What rent should be charged to maximize the total revenue from the building if the upper limit on the rent is \$550 per month? (6 pts.)
- b. If the total cost function for a product is $C(x) = 200 + 8x + 0.07x^2$ dollars, determine how many units x should be produced to minimize the average cost per unit? (5pts.)
- c. A small business has weekly average costs (in dollars) of $\bar{C} = \frac{100}{x} + 10 + \frac{x}{10}$, where x is the number of units produced each week. The competitive market price for this business's product is \$54 per unit. If production is limited to 249 units per week, find the level of production that yields maximum profit. (6.pts.)
- d. The millions of worldwide cellular subscribers can be modeled by $C(t) = -0.935t^3 + 28.6t^2 + 2.51t + 40.6$ where t is the number of years past 1993. In what year does the model predict the number of worldwide cellular subscribers will reach a maximum? (5 pts.)

4) 4pts. each

a. Find y' at the given point without first solving for y .

$3x^2 - 10y + 500 = 0$ at $(30, 320)$ and write the equation of the line at that point.

b. Find y' of $x^2 - 9y^4 = 2x^5 + 2y^3 - 8$. using implicit differentiation method.

c. Find y' from $8x + 6y = \sqrt{x^2 + y^2} + 4$. using implicit differentiation method.

d. If $\ln(5x + 9y) = 8y^2$, find dy/dx . (y').

5) 3pts.each

- a. If $u = f(w, x, y, z) = \frac{wx - yz^2}{xy - wz}$, find $f(182, 27, 13, -13)$.
- b. In economics, the most economical quantity Q of goods (TVs, dresses, gallons of paint, etc.) for a store to order is given by Wilson's lot size formula $Q = f(K, M, h) = \sqrt{2KM/h}$, where K is the cost of placing the order, M is the number of items sold per week, and h is the weekly holding cost for each item (the cost of storage space, utilities, taxes, security, etc.). Find $f(350, 120, 3)$.
- c. Suppose an area of land is to be sprayed with two brands of pesticide: x liters of brand 1 and y liters of brand 2. If the number of thousands of insects killed is given by $f(x, y) = 10,000 - 6500e^{-0.01x} - 3500e^{-0.02y}$. How many insects would be killed if 60 liters of brand 1 and 120 liters of brand 2 were used? Round your answer to the nearest integer.
- d. The cost per day to society of an epidemic is $C(x, y) = 11x + 200y$, where C is in dollars, x is the number of people infected on a given day, and y is the number of people who die on a given day. If 5,500 people are infected and 95 people die on a given day, what is the cost to society?

6) 6 pts. Each

- a. If the demand function for q units of a commodity at $\$p$ per unit is given by

$$p^2(2q + 1) = 100,000$$

Find the rate of change of quantity with respect to price when $p = \$50$. Interpret this result.

- b. At what points does the curve $x^2 + 4y^2 - 4 = 0$ have

- i. Horizontal tangents
- ii. Vertical tangents

- c. Suppose that a company can produce 12,000 units when the number of hours of skilled labor y and unskilled labor x satisfy $135 = (x + 3)^{\frac{3}{2}}(y + 2)^{\frac{1}{3}}$. Find the rate of change of skilled-labor hours with respect to unskilled-labor hours when $x = 78$ and $y = 123$. Interpret your results.