1. For some \( f(x) \), \( f'(x) = x^2 + 2x - 8 \). Find where \( f(x) \) is increasing and where it is decreasing.

2. For some \( f(x) \), \( f'(x) = x^2 + 2x - 8 \). Find where \( f(x) \) is concave up and and where it is concave down.

3. For some \( f(x) \), \( f'(x) = -10x^2 + 60x - 50 \). Find the \( x \) coordinates of all first order critical points and use the first derivative test to determine what kind of critical point at each \( x \).

4. For some \( f(x) \), \( f'(x) = -10x^2 + 60x - 50 \). Find the \( x \) coordinates of all first order critical points and use the second derivative test to determine what kind of critical point at each \( x \).

5. Given \( f(x) = (x^2 + 7x + 1) \cdot \sqrt{5x^2 + x} \) find \( \frac{df}{dx} \) at \( x = 1 \).

6. Find the slope of the tangent line to the graph of \( 3xy^2 + 4y = 10 \) at the point \((2,1)\).

7. Find \( \frac{df}{dx} \) by using the limit definition of the derivative. \( f(x) = x^2 \)

8. Find the following limits:
   
   \( \lim_{x \to \infty} \frac{x-3}{2x^2 + 2x + 3} \)
   
   \( \lim_{x \to 3} \frac{9-x^2}{3-x} \)

   Find \( \frac{df}{dx} \) for the following functions, Please Do Not Simplify answers:

9. \( f(x) = (x^3 + x + 1)/(x^3 + 1) \)

10. \( f(x) = (x^3 + x + 1) \cdot (x^3 + 1) \)

11. \( f(x) = (x^2 + x)^{1/3} \)

12. \( f(x) = \ln(x^2 + x) \)

13. \( f(x) = e^{x^2 + x} \)

14. Use implicit differentiation to find \( \frac{dy}{dx} \) when \( y^2 + x = x^2 + x^3 y^4 \)

15. Use the chain rule to find \( \frac{dy}{dx} \) if \( y = u^3 - 3u^2 + 1 \) and \( u = x^2 + 2 \)

16. Given \( f(x) = e^{2x} + \ln(3x) + \sqrt{4x + 1} \) find the differential of \( f(x) \).

17. For \( f(x) = x^3 - 9x^2 \) find the locations of any inflection points. Use \( f''(x) \) to show that the points you found actually are inflection points.

18. \( f(x) = (x - 1)^3 + 1 \) Find the location of any critical points and use the first derivative test to determine what kind of critical point.

19. \( f(x) = \frac{x}{(x+1)^7} \) Use the second derivative test to determine what kind of critical point it has.
20. For \( f(x) = x^4 - 6x^2 + 10 \), use \( f'' \) determine where the graph of \( f(x) \) is concave up and where it is concave down.

21. For some \( f(x), f'(x) = \frac{(2x-x^2)}{(x-3)} \) use \( f' \) determine where the graph of \( f(x) \) is increasing, and where it is decreasing.

22. Write the general form of the Power Rule, Exponential Rule and Log Rule for differentiation.

23. \( f(x) \) is a function with first derivative \( f'(x) = (x - 1)(x - 2)(x - 3)(x - 4)/x \). \( f(x) \) obviously has a critical number at \( x = 2 \). Use the first derivative test to determine what kind of critical point is at \( x = 2 \).

24. The function in the previous problem has a critical number \( x_c = 2 \) and a second derivative \( f''(x) = \frac{3x^4 - 20x^3 + 35x^2 - 24}{x^2} \). Use the second derivative test to determine what kind of critical point is at \( x_c = 2 \).

25. Given the cost to produce one unit is \$1.00 and the demand relation is given by \( p = 10 - .1q \). Find the following and Box Your Answers:
   - profit function \( P(q) \)
   - marginal profit \( MP = \frac{dP}{dq} \)
   - find the production level that maximizes the profit by setting the slope of the profit function to zero and solving for \( q_{\text{max}} \).
   - find the price that should charged to maximize the profit \( p_{\text{max}} \).
   - find the maximum profit \( P_{\text{max}} \).

26. A store has been selling skateboards at the price of \$46 per board, and at this price, skaters have been buying 66 boards a month. The owner of the store wants to raise the price and estimates that for each \$2 increase in price, 4 fewer boards will be sold each month. Each board costs the store \$24.
   (a) Find the linear demand function that gives \( p \) as a function of \( q \), the quantity sold.
   (b) Find the profit function as a function of \( q \).
   (c) At what price \( p \) should the store sell the boards in order to maximize profit?

27. A company estimates that the cost in dollars of producing \( x \) units of a certain product is \( C(x) = \frac{x^2}{3} + 6x + 1000 \). Find the production level that minimizes average cost. Hint: find average cost, find all critical numbers for average cost, use the first or 2nd derivative test to determine that the CNs correspond to a minimum. Average cost is defined as \( C_{\text{avg}} = \frac{C(x)}{x} \)