1. Differentiate the functions. If possible, first use properties of logarithms to simplify the given function.
   a) \( y = \ln(3x^2 + 2x + 1) \)
   b) \( y = x^2 \ln x \)
   c) \( y = x^2 \log_2 x \)
   d) \( y = \frac{x^2}{\ln x} \)

2. A total-cost function is given by \( c = 25 \ln(q + 1) + 12 \). Find the marginal cost when \( q = 6 \).

3. Differentiate the functions:
   a) \( y = x^2 e^{-x} \)
   b) \( y = \frac{e^x - e^{-x}}{e^x + e^{-x}} \)
   c) \( y = 2x^2 \)

4. If \( f(x) = e^xe^{-x} \), find \( f'(1) \)

5. Find \( dy/dx \) by implicit differentiation
   a) \( xy = 4 \)
   b) \( 2x^3 + 3xy + y^3 = 0 \)
   c) \( \ln(xy) + x = 4 \)

6. Find an equation of the tangent line to the curve of \( x^3 + y^2 = 3 \) at the point \((-1, 2)\).

7. Find \( y' \) by using logarithmic differentiation.
   a) \( y = (3x^3 - 1)^2 (2x + 5)^3 \)
   b) \( y = (x + 2)\sqrt{x^2 + 9 + \sqrt{6x + 1}} \)
   c) \( y = \sqrt[6]{\frac{6(x^3 + 1)^2}{x^5 e^{4x}}} \)
   d) \( y = 4e^x x^3 \)
   e) \( y = (\ln x)^e \)

8. Differentiate
   a) \( y = x^x \)
   b) \( y = (x + 1)^{x+1} \)

9. Find \( dy/dx \)
   a) \( \ln(xy^2) = xy \)
   b) \( (\ln y)e^{\ln x} = e^x \)

10. If \( y \) is defined implicitly by \( e^y = (y + 1)e^{-x} \), determine \( dy/dx \) as explicit functions of \( y \) only.

11. Determine when the function is increasing or decreasing, and determine when relative maxima and minima occur. Do not sketch the graph.
   a) \( y = -x^5 - 5x^4 + 200 \)
   b) \( y = \frac{x^2 - 3}{x + 2} \)
   c) \( y = e^x + e^{-x} \)

12. Sketch the graph of a continuous function \( f \) such that \( f(1) = 2, f(3) = 1, f'(1) = f'(3) = 0, f'(x) > 0 \) for \( x < 1 \), \( f'(x) < 0 \) for \( 1 < x < 3 \), and \( f \) has a relative minimum when \( x = 3 \).

13. For a manufacturer’s product, the revenue function is given by \( r = 240q + 57q^2 - q^3 \). Determine the output for maximum revenue.

14. Determine concavity and the \( x \) values for the function \( y = \frac{-5}{2} x^4 - \frac{1}{6} x^3 + \frac{1}{2} x^2 + \frac{1}{3} x - \frac{2}{5} \). Where points of inflection occur. Do not sketch the graph.

15. Determine intervals on which the function \( y = 3x^4 - 4x^3 + 1 \) is increasing, decreasing, concave up, and concave down; relative maxima and minima; inflection points; symmetry; and those intercepts that can be obtained conveniently. Then sketch the curve.

16. Sketch the graph of a continuous function \( f \) such that \( f(4) = 4, f'(4) = 0, f''(x) < 0 \) for \( x < 4 \), and \( f''(x) > 0 \) for \( x > 4 \).

17. Sketch the graph of a continuous function \( f \) such that \( f(1) = 1, f'(1) = 0, f''(x) < 0 \) for all \( x \).

18. Test for relative maxima and minima for the function \( y = x^4 - 2x^2 + 4 \). Use the second derivative test if possible.

19. Find the horizontal and vertical asymptotes for the graphs of the functions. Do not sketch the graphs.
   a) \( y = \frac{4}{x - 6} + 7 \)
   b) \( y = \frac{2}{9} + \frac{3x}{14x^2 + x - 3} \)

20. Determine intervals on which the function is increasing, decreasing, concave up, and concave down; relative maxima and minima; inflection points; symmetry; horizontal and vertical asymptotes; and those intercepts that can be obtained conveniently. Then sketch the curve.
   a) \( y = \frac{1}{x^2 + 1} \)
   b) \( y = \frac{3x}{(x - 2)^2} \)

21. Let \( f(x) = (x^2 + 1)e^{-x} \)
   a) Determine the values of \( x \) at which relative maxima and relative minima, if any, occur. b) Determine the interval(s) on which the graph of \( f \)'s concave down, and find the coordinates of all points of inflection.

22. Indicate intervals on which the function \( y = x^3 - 12x + 20 \) is increasing, decreasing, concave up, or concave down; indicate relative maximum points, relative minimum points, points of inflection; horizontal asymptotes, vertical asymptotes, symmetry, and those intercepts that can be obtained conveniently and sketch the graph.