1. What are the dimensions in inches of the largest rectangle which can be inscribed inside the ellipse \( \frac{x^2}{8} + \frac{y^2}{9} = 1 \)?

2. The surface area of a sphere is changing at a rate of 25 square millimeters per second. At what rate is the volume of the sphere changing when the radius is 10 millimeters? (Hint: The surface area and volume of a sphere are given by the formulas \( SA = 4\pi r^2 \) and \( V = \frac{4}{3}\pi r^3 \).)

3. The diameter of a tree was 12 inches. During the following year the circumference increased 1 inch. About how much did the tree’s cross sectional area increase?

4. It took 10 seconds for a mercury thermometer to rise from 0°F to 100°F in boiling water. Show that somewhere along the way the mercury was rising at the rate of 10°F/sec.

5. A rocket lifts off the surface of the earth with a constant acceleration of 25 m/sec². How fast will the rocket be going after 10 seconds?

6. Find the intervals where the function \( f(x) = 3x^2 - 8x^3 \) is increasing.

7. Identify the critical values of \( f(x) = \frac{x}{4 + x^2} \) as either local maxima, local minima or neither using the first derivative test.

8. Find \( \lim_{x \to 0} \frac{x - \sin x}{x^2} \).

9. Find the antiderivative \( F(x) \) of \( f(x) = x\sqrt{x^2 - 9} \) satisfying \( F(5) = 3 \).

10. Give a rough sketch of \( f \) given that \( f(x) \) is increasing on \( (-\infty, -1) \) and \( (3, 5) \), decreasing on \( (-1, 3) \) and \( (5, \infty) \), concave up on \( (0, 4) \) and concave down on \( (-\infty, 0) \) and \( (4, \infty) \) and \( f(-1) = 2, f(0) = 0, f(3) = -2, f(4) = 1 \) and \( f(5) = 4 \).
11. Find the tangent line to \( f(x) = \tan(2x) + (x + 1) \cos x \) at the point \((0, 1)\).

12. Using the definition of the limit, show that \( \lim_{x \to 2} 7 - 3x = 1 \).

13. For what value of \( a \) will \( f(x) = \begin{cases} x + a, & x > 2; \\ x^2 + 2x - 3, & x \leq 2 \end{cases} \) be continuous.

14. Suppose \( f \) and \( g \) are continuous functions with \( f(4) = 2, \ g(4) = -1, \ f'(4) = \frac{3}{2} \) and \( g'(4) = 7 \). Compute the following:
   
   (a) \( \left( \frac{f}{g} \right)'(4) \)
   
   (b) \( (5f + fg)'(4) \).

15. If \( \lim_{x \to 3^+} f(x) = -1 \) and \( \lim_{x \to -3^+} f(x) = 4 \), could \( f(x) \) be an odd function? Explain your answer.