1. A window frame has the shape of a rectangle with a semicircle on top. All four sides of the rectangle are part of the frame. The straight portions of the frame (the four sides of the rectangle) cost 8$ per foot, and the curved portion (the semicircle) costs 12$ per foot. The total area of the window must be 20 square feet. Find the dimensions that minimize the cost of the frame.

2. \( f(x) = xe^{-x^2} \)
   (a) Find all \( x \) values at which \( f \) has a local min or max.
   (b) Find all inflection points.
   (c) Find the global min and max over \( 0 \leq x \leq 1 \).

3. Find the following limits exactly,
   \[
   \lim_{x \to \infty} \frac{1 - \cos(ax)}{x^2}, \quad \lim_{x \to 0} \frac{1 - \cos(ax)}{x^2}, \quad \lim_{x \to \infty} \frac{\ln(x)}{\sinh(x)}
   \]

4. Let \( f(x) = 5a^3x^2 - 2x^5 \). Here \( a \) is a parameter; it does not depend on \( x \).
   (a) Find the critical points and determine if they are local min or maxs. Your answer should involve \( a \).
   (b) Find the global max over \( x \geq 0 \).

5. Consider the curve \( x^3 + y^2 \cosh(y - 1) = 2 \)
   (a) Find the equation of the tangent line at the point \((1, 1)\) to the curve.
   (b) Use your answer to (a) to find approximately the value of \( y \) so that \((1.01, y)\) is also on the curve.

6. A function \( f(x) \) has the following properties:
   (i) \( f \) has a local min at \( x = 0 \).
   (ii) \( f \) has inflection points at \( x = 2 \) and \( x = 5 \).
   (iii) \( f \) has a local max at \( x = 3 \)
   (iv) \( f'(7) = 0 \), but \( x = 7 \) is neither a local min or max.
   On the interval \([0, 8]\), \( f \) has no other critical points or inflection points other than those given above. Sketch a possible graph of the derivative \( f'(x) \).