This taxing but fun fifty-minute test covers sections 3.5 through 3.11 of *Calculus* (5ed) by James Stewart. Clearly indicate your answers. Unless otherwise indicated, all parts of problems are four points each.

1. The figure shows the graphs of f, f', and f''. Identify each curve. (2 points each)

   (a) = __, (b) = __, (c) = ___

2. Find the (first) derivative of the following

   a) sinh ln x  
   b) x ln x – x

   c) tanh⁻¹ √x  
   d) ln 5√x

   e) log₃(5x)  
   f) ln sinh x
3. Find the (first) derivative of the \( y = x^x \). (Hint: Logarithmic differentiation?)

(6 points)

4. Find the first and second derivative of the following functions. (6 points each)

   a) \( x \cosh x \)

   b) \( e^{x^2} \)

5. Find the linearization of the function \( y = \cosh(x) \) at \( a = 0 \).
6. **Using differentials** (or a linearization) approximate $(3.00001)^4$. Show your work! (6 points)

7. Use implicit differentiation to find $\frac{dy}{dx}$.
   a) $x^4 + y^4 = a^4$
   b) $x^2 + xy + y^2 = 3$

8. For either part a) or part b) of the previous problem, find $\frac{d^2y}{dx^2}$. (6 points)
9. Find \( \frac{d^{103}}{dx^{103}} f(x) \) for \( f(x) = \cos(2x) \) (6 points)

10. If \( y = x^3 + 2x \) and \( dx/dt = 5 \), find \( dy/dt \) when \( x = 2 \). (6 points)

11. An ice cube (literally a cube) is melting (losing volume) at a rate of 24 mm\(^3\)/sec. How fast is the length of a side decreasing when the side is 3 mm? (8 points)