Name: ________________________________

Score: __________

**Directions.** Answer the questions in the space provided. Unless noted otherwise, you must show and explain your work to receive full credit. Put your final answer in a [box] when appropriate.

This is a closed-book, closed-notes test. Calculators, computers, etc., are not used.
1. (30 points) Find the indefinite integrals.

(a) \( \int (4x^5 + x + 2) \, dx = \)

(b) \( \int \sqrt{x} \, dx = \)

(c) \( \int \frac{1}{\sqrt{1 - x^2}} \, dx = \)

(d) \( \int \sec(x) \tan(x) \, dx = \)

(e) \( \int \frac{1}{x} \, dx = \)
2. (10 pts.)

(a) Is the following equation true or false? Explain.
\[ \int x \cos(x) \, dx = x \sin(x) + \cos(x) + C \]

(b) If \( f(x) \) and \( g(x) \) are differentiable functions, then
\[ \int \left( f'(x)g(x) + f(x)g'(x) \right) \, dx = \]
3. (10 pts.) The graph \( y = f'(x) \) of the derivative of a function \( f(x) \) is shown. Answer the questions about \( f(x) \).

(a) State the intervals on which \( f(x) \) increases.

(b) State the intervals on which \( f(x) \) decreases.

(c) List all critical points of \( f(x) \).

(d) At which of its critical points does \( f(x) \) have a local maximum?

(e) At which of its critical points does \( f(x) \) have a local minimum?

(f) State the intervals on which the function \( f(x) \) is concave up.

(g) State the intervals on which the function \( f(x) \) is concave down.

(h) Based on this information, sketch a possible graph of \( f(x) \) on the coordinate axis above.
4. (20 pts.) Find the limits.

(a) \[ \lim_{x \to 0} \frac{x^2}{\ln(\sec(x))} = \]

(b) \[ \lim_{x \to 0^+} x \ln(x) = \]
5 (10 pts.) An open-top box is made from a 12 by 12 inch piece of cardboard by cutting a square from each corner, and folding up. What should \( x \) be to maximize the volume of the box?
6. (10 pts.) A 10-foot ladder is leaning against a wall, as illustrated. Its base slides away from the wall at a rate of 2 feet per second. At what rate is the height $y$ changing when the base is 6 feet from the wall?
7. (10 pts.) Suppose $f(x)$ is a function for which $f'(x) = 2x + \cos(x)$ and $f(\pi) = 0$. Find $f(x)$. 