1. (32 points) Find the indefinite integrals.

(a) \( \int (x^5 + x + 1) \, dx = \)

(b) \( \int 4e^{3x} \, dx = \)

(c) \( \int \frac{5}{1 + x^2} \, dx = \)

(d) \( \int \left( \frac{1}{x} + \cos(x) \right) \, dx = \)

7. (10 pts.) Suppose \( f(x) \) is a function for which \( f'(x) = \sqrt{x} + 2 \) and \( f(4) = 7 \). Find \( f(x) \).
2. (10 pts.) Suppose you have 160 feet of fencing material to enclose a rectangular region. One side of the rectangle will border a building, so no fencing is required for that side. Find the dimensions $x$ and $y$ that maximize the fenced area.

![Diagram showing a building and a rectangular fenced area with sides marked $x$ and $y$.]

3. (10 pts.) The graph $y = f'(x)$ of the derivative of a function $f(x)$ is shown. Answer the questions about $f(x)$.

![Graph of $y = f'(x)$ with x-axis from -5 to 12 and y-axis from -3 to 3.]

(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 these critical points is there a local maximum?
(e) State the intervals on which the function $f(x)$ is concave up.
4. (20 pts.) Find the limits.

(a) \( \lim_{x \to 0} \frac{1 - \cos x}{x^2} = \)

(b) \( \lim_{x \to 0^+} x^x = \)

5. (8 pts.) Is the following equation true or false?

\[ \int \left( \cos(x) \frac{1}{x} - \sin(x) \ln(x) \right) \, dx = \cos(x) \ln(x) + C \]

Explain.

6. (10 pts.) Water flows into the conical tank (shown below) at a rate of 9 cubic feet per minute. How fast is the water level \( h \) rising when the water is 6 feet deep?

The volume of a cone of height \( h \) and radius \( r \) is

\[ V = \frac{1}{3} \pi r^2 h \]