1. (15 pts.) Find the exact intervals on which \( f(x) = x^4 - x^3 - 3x^2 \) is increasing and on which \( f \) is decreasing. You do not need to draw a graph of \( f \).

2. (15 pts.) Suppose that \( g(x) = \cos 2x - x^2 \), restricted to the domain \( 0 \leq x \leq \pi \). Find the exact intervals on which \( g \) is concave up and on which \( g \) is concave down. You do not need to draw a graph of \( g \).

3. (15 pts.) Find \( \lim_{x \to 0^+} \frac{\ln(e^x - 1)}{\ln x} \)

4. (15 pts.) Use differential approximation to estimate \((995)^{1/3}\).

5. (15 pts.) If \( f(4) = 5 \) and \( f'(x) = 0.5 \) on \([0, 4]\), find \( f(0) \).

6. (15 pts.) A water tank with a square end and unspecified width is shown at right. The total surface area (four sides and bottom) is 12 ft\(^2\). What is the maximum possible volume of the tank? **NOTE:** For full credit you must include a graph of the quantity you are maximizing and show work that justifies your graph.

7. (10 pts.) In the graph at right the curve is

\[
f(x) = \sin(\pi x) - x^2 - 0.25
\]

and the line is tangent to \( f \) at \( x = -1.5 \). Find the area of the triangle formed by the tangent line and the axes.