1. (3 points each) Using the function graphed below, identify each limit or state clearly why it does not exist.

(a) \( \lim_{x \to 2^-} f(x) \)

(b) \( \lim_{x \to 2^+} f(x) \)

(c) \( \lim_{x \to 2} f(x) \)

(d) \( \lim_{x \to 0^-} f(x) \)
2. (6 points each) Evaluate the following limits using the properties of limits.

(a) \( \lim_{x \to -1} \frac{x^2 - 1}{x^2 + 2x + 1} \)

(b) \( \lim_{x \to 0} \frac{\frac{1}{2+x} - \frac{1}{2}}{x} \)

(c) \( \lim_{x \to 0} \frac{(x + 3)^2 - 9}{x} \)
3. (12 points) Find all the discontinuities of the following function. For each discontinuity found, name the type of discontinuity (removable, jump, infinite).

\[ f(x) = \frac{\sqrt{x^2 - 4x + 4}}{x^2 - x - 2} \]
4. (12 points) Give a mathematically valid reason why the function \( f(x) = x^4 - 3x^3 - 2 \) must equal 0 between \( x = 3 \) and \( x = 4 \).

5. (8 points each) Using the limit definition of the derivative (no short cut formulas allowed) find the derivatives of the functions below.

(a) \( f(x) = x^2 - x + 2 \)

(b) \( f(x) = 3\sqrt{x} \)
6. (12 points) Find the equation of the tangent line to the graph of \( f(x) = x^2 - 2x - 1 \) at \( x = 0 \).
7. (3 points each) Match the graph of the function shown in the column on the left with the graph of its derivative shown in the column on the right.

I ________  II ________  III ________  IV ________

I

II

III

IV

A

B

C

D