1. Random stuff. Short answer.

a) Write down the formal definition of the limit statement \( \lim_{{x \to 1^+}} \frac{2x+3}{x-1} = \infty \).

b) Write down the formal definition of the limit statement \( \lim_{{x \to \infty}} \frac{2x+3}{x-1} = 2 \).

c) \( f(x) = 5 - (x - 2)^2 \) satisfies the hypothesis of the Extreme Value Theorem on \([0, 3]\) because it is continuous on that closed interval. Find \( x \)-values \( M \) and \( m \) in \([0, 3]\) that satisfy the conclusion of the Extreme Value Theorem.

d) \( f(x) = 5 - (x - 2)^2 \) satisfies the hypothesis of the Intermediate Value Theorem on \([0, 3]\) because it is continuous on that closed interval. Find an \( x \)-value \( c \) that satisfies the conclusion of the Intermediate Value Theorem for intermediate value \( K = 1 \).
2. Calculate! Show your work clearly and put boxes around final answers.

a) Find \( \lim_{x \to 2} \frac{1}{2 - x} \). Show your work and be as specific as possible about your answer.

b) Describe the roots, discontinuities, and horizontal and vertical asymptotes of
\( f(x) = \frac{x + 2}{x^2 + 4x + 4} \), if any. Use limits or values to support each of your answers.

c) Use the \( z \to x \) definition of derivative to show that \( \frac{d}{dx} \left( \frac{2}{x-1} \right) = \frac{-2}{(x-1)^2} \).
3. Sketch clear, well-labeled graphs of functions that have the following properties.

a) A function $f(x)$ with $\lim_{x \to 2^-} f(x) = 2$, $\lim_{x \to 2^+} f(x) = -1$, $f(2) = 2$, $\lim_{x \to -\infty} f(x) = \infty$, and $\lim_{x \to \infty} f(x) = 3$.

b) A function $f(x)$ with $f'(-2) = 0$, $f'(0) = 2$, and $f'(3) = -2$.

c) A function $f(x)$ whose DERIVATIVE looks like the one shown below right.

Survey for 2 bonus points: How do you think you did? What is a question or topic that could have been on this exam, but wasn’t?