

AB: Practice Free Response. No Calculator. Show all work below line.

1. Let $f(x) = \begin{cases} x^2, & x \leq 1 \\ 2x, & x > 1 \end{cases}$

- a. Use the alternate form definition to find the left-hand derivative of f at $x = 1$ if it exists.
 - b. Use the alternate form definition to find the right-hand derivative of f at $x = 1$ if it exists.
 - c. Is $f(x)$ differentiable at $x = 1$? Explain.
 - d. Determine if $f(x)$ is continuous at $x = 1$. Give conclusion based on the 3-step definition.
 - e. Sketch a graph of $f(x)$. Be sure to label it.
 - f. On the same set of axes, sketch a graph of $f'(x)$. Use a different line quality, and be sure to label it.
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2. For $f(x) = \frac{3}{x+1}$

a. Find $f'(x)$ using the formal difference quotient definition of the derivative.

b. If $f'(1) = -\frac{3}{4}$, Write the equation of the tangent line to $f(x)$ at $x = 1$.

c. Write the equation of the normal line to $f(x)$ at $x = 1$.

d. Evaluate $\lim_{x \rightarrow \infty} f'(x)$. What does this result say about the end behavior of $f(x)$?

e. Sketch $f(x)$.