

Math 131 - Quiz 5

September 24, 2025

Name key

Score _____

Show all work to receive credit. Supply explanations where necessary.

1. (6 points) Let $f(x) = 3x^2 - x$. Use the limit definition of the derivative to determine $f'(x)$.

$$\begin{aligned} f'(x) &= \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h} = \lim_{h \rightarrow 0} \frac{[3(x+h)^2 - (x+h)] - [3x^2 - x]}{h} \\ &= \lim_{h \rightarrow 0} \frac{3x^2 + 6xh + 3h^2 - x - h - 3x^2 + x}{h} = \lim_{h \rightarrow 0} \frac{6xh + 3h^2 - h}{h} \\ &= \lim_{h \rightarrow 0} \frac{h(6x + 3h - 1)}{h} = 6x + 3(0) - 1 = \boxed{6x - 1} \end{aligned}$$

2. (2 points) Use your result from above to find an equation of the line tangent to the graph of $f(x) = 3x^2 - x$ at the point where $x = 2$.

$$\text{Slope} = m = f'(2) = 11$$

$$\text{Point: } x = 2$$

$$y = f(2) = 12 - 2 = 10$$

$$y - 10 = 11(x - 2)$$

or

$$y = 10 + 11(x - 2)$$

or

$$y = 11x - 12$$

3. (2 points) Explain why this function is not differentiable at $x = 1$.

$$f(x) = \begin{cases} 3x + 5, & x \leq 1 \\ x^2 + 1, & x > 1 \end{cases}$$

$$\lim_{x \rightarrow 1^-} f(x) = \lim_{x \rightarrow 1^-} (3x + 5) = 8$$

$$\lim_{x \rightarrow 1^+} f(x) = \lim_{x \rightarrow 1^+} (x^2 + 1) = 2$$

f has a jump

Discont. at $x = 1$.