

Math 131 - Quiz 5

September 25, 2025

Name key

Score _____

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

1. (2 points) State two ways in which a function can fail to be differentiable at a point.

A FUNCTION IS NOT DIFFERENTIABLE AT ANY POINT AT WHICH

- ① THE FUNCTION IS DISCONTINUOUS,
- ② THE GRAPH HAS A SHARP POINT,
- ③ THE GRAPH HAS A VERTICAL TANGENT LINE.

2. (4 points) Let $f(x) = x^2 + x$. Use the limit definition of the derivative to determine $f'(x)$.

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

3. (4 points) Use differentiation rules to determine each derivative. Do not simplify.

(a) $\frac{d}{dx} (2x^2 \cos x) = \boxed{4x \cos x - 2x^2 \sin x}$

$$\frac{d}{dx} 2x^2 = 4x$$

$$\frac{d}{dx} \cos x = -\sin x$$

(b) $\frac{d}{dx} \left(\sqrt{x} + \frac{1}{x^2} + 1 \right) = \frac{d}{dx} (x^{1/2} + x^{-2} + 1)$

$$= \frac{1}{2} x^{-1/2} - 2x^{-3} + 0$$

$$= \boxed{\frac{1}{2\sqrt{x}} - \frac{2}{x^3}}$$