

# Math 131 - Quiz 9

April 8, 2026

Name key

Score \_\_\_\_\_

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

1. (3 points) Use logarithmic differentiation to find  $dy/dx$  when  $y = x^{x^2}$ .

$$\begin{aligned}\ln y &= x^2 \ln x \\ \frac{1}{y} \frac{dy}{dx} &= 2x \ln x + x^2 \left(\frac{1}{x}\right) \\ &= 2x \ln x + x\end{aligned}$$

$$\frac{dy}{dx} = (2x \ln x + x) x^{x^2}$$

2. (4 points) Determine each derivative.

(a)  $\frac{d}{dx} \log_2(5x^2 + \sin x)$

$$\begin{aligned}\frac{d}{dx} \frac{\ln(5x^2 + \sin x)}{\ln 2} &= \frac{1}{\ln 2} \frac{1}{5x^2 + \sin x} \cdot (10x + \cos x) \\ &= \frac{10x + \cos x}{\ln 2 (5x^2 + \sin x)}\end{aligned}$$

(b)  $\frac{d}{dx} 5^{3x}$

$$= 5^{3x} \cdot \ln 5 \cdot 3$$

3. (3 points) Find the linearization of  $f(x) = \sqrt[3]{x}$  at  $x = 8$ . Then use your linearization to approximate  $\sqrt[3]{8.1}$ .

$$L(x) = f(8) + f'(8)(x-8) = 2 + \frac{1}{12}(x-8)$$

$$f(8) = \sqrt[3]{8} = 2$$

$$f'(x) = \frac{1}{3} x^{-2/3}$$

$$f'(8) = \frac{1}{3(8)^{2/3}} = \frac{1}{3 \cdot 4} = \frac{1}{12}$$

$$\begin{aligned}\sqrt[3]{8.1} &\approx 2 + \frac{1}{12}(0.1) \\ &= 2.008\bar{3}\end{aligned}$$