

## Calculus Practice: Chain Rule 6b

Differentiate each function with respect to  $x$ .

1)  $y = 3^{2x^3}$

2)  $y = \log_5 x^4$

3)  $f(x) = 5^{2x^4}$

4)  $f(x) = \log_3 3x^3$

5)  $y = \log_3 \log_4 3x^4$

6)  $f(x) = \log_4 (2 + 3^{5x^4})$

$$7) f(x) = \log_4 \log_5 3x^2$$

$$8) f(x) = \log_2 (4^{4x^2} + 2)$$

$$9) f(x) = (2x^4 + 5)\log_2 2x^3$$

$$10) y = \frac{3x^5 + 1}{\log_4 4x^2}$$

## Calculus Practice: Chain Rule 6b

Differentiate each function with respect to  $x$ .

1)  $y = 3^{2x^3}$

$$\begin{aligned}\frac{dy}{dx} &= 3^{2x^3} \ln 3 \cdot 6x^2 \\ &= 2x^2 \cdot 3^{2x^3+1} \ln 3\end{aligned}$$

2)  $y = \log_5 x^4$

$$\begin{aligned}\frac{dy}{dx} &= \frac{1}{x^4 \ln 5} \cdot 4x^3 \\ &= \frac{4}{x \ln 5}\end{aligned}$$

3)  $f(x) = 5^{2x^4}$

$$f'(x) = 5^{2x^4} \ln 5 \cdot 8x^3$$

4)  $f(x) = \log_3 3x^3$

$$\begin{aligned}f'(x) &= \frac{1}{3x^3 \ln 3} \cdot 9x^2 \\ &= \frac{3}{x \ln 3}\end{aligned}$$

5)  $y = \log_3 \log_4 3x^4$

$$\begin{aligned}\frac{dy}{dx} &= \frac{1}{\log_4 3x^4 \cdot \ln 3} \cdot \frac{1}{3x^4 \ln 4} \cdot 12x^3 \\ &= \frac{4}{x \log_4 3x^4 \cdot \ln 3 \cdot \ln 4}\end{aligned}$$

6)  $f(x) = \log_4 (2 + 3^{5x^4})$

$$\begin{aligned}f'(x) &= \frac{1}{(2 + 3^{5x^4}) \ln 4} \cdot 3^{5x^4} \ln 3 \cdot 20x^3 \\ &= \frac{20x^3 \cdot 3^{5x^4} \ln 3}{(2 + 3^{5x^4}) \ln 4}\end{aligned}$$

$$7) f(x) = \log_4 \log_5 3x^2$$

$$\begin{aligned} f'(x) &= \frac{1}{\log_5 3x^2 \cdot \ln 4} \cdot \frac{1}{3x^2 \ln 5} \cdot 6x \\ &= \frac{2}{x \log_5 3x^2 \cdot \ln 4 \cdot \ln 5} \end{aligned}$$

$$8) f(x) = \log_2 (4^{4x^2} + 2)$$

$$\begin{aligned} f'(x) &= \frac{1}{(4^{4x^2} + 2) \ln 2} \cdot 4^{4x^2} \ln 4 \cdot 8x \\ &= \frac{2x \cdot 4^{4x^2+1} \ln 4}{(4^{4x^2} + 2) \ln 2} \end{aligned}$$

$$9) f(x) = (2x^4 + 5) \log_2 2x^3$$

$$\begin{aligned} f'(x) &= (2x^4 + 5) \cdot \frac{1}{2x^3 \ln 2} \cdot 6x^2 + \log_2 2x^3 \cdot 8x^3 \\ &= \frac{8x^4 \log_2 2x^3 \cdot \ln 2 + 6x^4 + 15}{x \ln 2} \end{aligned}$$

$$10) y = \frac{3x^5 + 1}{\log_4 4x^2}$$

$$\begin{aligned} \frac{dy}{dx} &= \frac{\log_4 4x^2 \cdot 15x^4 - (3x^5 + 1) \cdot \frac{1}{4x^2 \ln 4} \cdot 8x}{(\log_4 4x^2)^2} \\ &= \frac{15x^5 \log_4 4x^2 \cdot \ln 4 - 6x^5 - 2}{x \ln 4 \cdot (\log_4 4x^2)^2} \end{aligned}$$