

## Differentiation - Logs and Exponentials

**Differentiate each function with respect to  $x$ .**

1)  $y = 4^{4x^4}$

2)  $y = 4^{-5x^3}$

3)  $y = \log_3 3x^2$

4)  $y = \log_2 4x^2$

5)  $y = \log_3 (3x^5 + 5)^5$

6)  $y = \log_5 (-5x^3 - 2)^3$

7)  $y = (4^{x^3} + 2)^3$

8)  $y = 3^{(x^4 + 1)^3}$

9)  $y = 3^{\cos 3x^4}$

10)  $y = \log_5 \tan 4x^4$

## Differentiation - Logs and Exponentials

Differentiate each function with respect to  $x$ .

1)  $y = 4^{4x^4}$

$$\begin{aligned}\frac{dy}{dx} &= 4^{4x^4} \ln 4 \cdot 16x^3 \\ &= x^3 \cdot 4^{4x^4+2} \ln 4\end{aligned}$$

2)  $y = 4^{-5x^3}$

$$\begin{aligned}\frac{dy}{dx} &= 4^{-5x^3} \ln 4 \cdot -15x^2 \\ &= -\frac{15x^2 \ln 4}{4^{5x^3}}\end{aligned}$$

3)  $y = \log_3 3x^2$

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

4)  $y = \log_2 4x^2$

$$\begin{aligned}\frac{dy}{dx} &= \frac{1}{4x^2 \ln 2} \cdot 8x \\ &= \frac{2}{x \ln 2}\end{aligned}$$

5)  $y = \log_3 (3x^5 + 5)^5$

$$\begin{aligned}\frac{dy}{dx} &= \frac{1}{(3x^5 + 5)^5 \ln 3} \cdot 5(3x^5 + 5)^4 \cdot 15x^4 \\ &= \frac{75x^4}{\ln 3 \cdot (3x^5 + 5)}\end{aligned}$$

6)  $y = \log_5 (-5x^3 - 2)^3$

$$\begin{aligned}\frac{dy}{dx} &= \frac{1}{(-5x^3 - 2)^3 \ln 5} \cdot 3(-5x^3 - 2)^2 \cdot -15x^2 \\ &= -\frac{45x^2}{\ln 5 \cdot (-5x^3 - 2)}\end{aligned}$$

7)  $y = (4^{x^3} + 2)^3$

$$\begin{aligned}\frac{dy}{dx} &= 3(4^{x^3} + 2)^2 \cdot 4^{x^3} \ln 4 \cdot 3x^2 \\ &= 9x^2(4^{x^3} + 2)^2 \cdot 4^{x^3} \ln 4\end{aligned}$$

8)  $y = 3^{(x^4+1)^3}$

$$\begin{aligned}\frac{dy}{dx} &= 3^{(x^4+1)^3} \ln 3 \cdot 3(x^4+1)^2 \cdot 4x^3 \\ &= 4x^3 \cdot 3^{(x^4+1)^3+1} \cdot (x^4+1)^2 \ln 3\end{aligned}$$

9)  $y = 3^{\cos 3x^4}$

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

10)  $y = \log_5 \tan 4x^4$

$$\begin{aligned}\frac{dy}{dx} &= \frac{1}{\tan 4x^4 \cdot \ln 5} \cdot \sec^2 4x^4 \cdot 16x^3 \\ &= \frac{16x^3 \cdot \sec^2 4x^4}{\tan 4x^4 \cdot \ln 5}\end{aligned}$$