

$$\frac{d}{dx} b^x = (\ln b) b^x$$

$$\frac{d}{dx} \log_b x = \frac{1}{(\ln b)x}$$

Differentiate the following functions:

1. $f(x) = \log_2 5x$

$$f'(x) = \frac{1}{(\ln 2)x}$$

2. $f(x) = \log_5(x^2 - x)$

$$f'(x) = \frac{(2x-1)}{(\ln 5)(x^2-x)}$$

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

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

4. $f(x) = x^2 b^x$

$$f'(x) = 2x b^x + x^2 (\ln b) b^x$$

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

$$f'(x) = 2(x^2-3x)(2x-3)2^{-5x} - 5 \ln 2 (x^2-3x)^2 2^{-5x}$$

Derivative using the properties of Logarithm

$$\ln ab = \ln a + \ln b \quad \ln \frac{a}{b} = \ln a - \ln b \quad \ln b^a = a \ln b$$

Logarithmic differentiation:

1. $y = x(\sqrt[4]{1-x^3})$

$$y \left[\frac{1}{x} - \frac{3x^2}{4(1-x^3)} \right]$$

2. $y = \sqrt{\frac{1+x}{1-x}}$

$$\frac{y}{2} \left[\frac{1}{1+x} + \frac{1}{1-x} \right]$$

3. $y = \frac{(x^3+5)^2 \sqrt[3]{4-x^2}}{x^4-x^2+6}$

$$y \left[\frac{9x^2}{2(x^3+5)} - \frac{2x}{3(4-x^2)} - \frac{4x^3-2x}{(x^4-x^2+6)} \right]$$

4. $y = \frac{\sin x \cos x}{\sqrt{x^3-4}}$

$$y \left[\cot x - \tan x - \frac{3x^2}{2(x^3-4)} \right]$$

5. $y = \frac{(4x^2-8x)^3 (5-8x^4+7x)^4}{(x^2+x)^3}$

$$y \left[\frac{3(2x-2)}{x^2-2x} + \frac{4(-12x^3+7)}{5-8x^4+7x} - \frac{3(2x+1)}{(x^2+x)} \right]$$

6. $y = \frac{x-1}{x \tan x}$

$$y \left[\frac{1}{x-1} - \frac{1}{x} - \sec x \csc x \right]$$