

Differentiation

$$\frac{d}{dx} f(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$\text{or } \frac{d}{dx} f(x) = \lim_{h \rightarrow 0} \frac{f(x-h) - f(x)}{-h}$$

Derivatives of some standard functions

1. $\frac{d}{dx} x^n = n x^{n-1}$

2. $\frac{d}{dx} e^x = e^x$

3. $\frac{d}{dx} a^x = a^x \log_e a, a > 0$

4. $\frac{d}{dx} \log_e x = \frac{1}{x}$

5. $\frac{d}{dx} \log_a x = \frac{1}{x \log_e a}, a > 0, a \neq 1$

6. $\frac{d}{dx} \sin x = \cos x$

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

8. $\frac{d}{dx} \tan x = \sec^2 x$

9. $\frac{d}{dx} \cot x = -\operatorname{cosec}^2 x$

10. $\frac{d}{dx} \sec x = \sec x * \tan x$

11. $\frac{d}{dx} \operatorname{cosec} x = -\operatorname{cosec} x * \cot x$

12. $\frac{d}{dx} \sin^{-1} x = \frac{1}{\sqrt{1-x^2}}$

13. $\frac{d}{dx} \cos^{-1} x = -\frac{1}{\sqrt{1-x^2}}$

14. $\frac{d}{dx} \tan^{-1} x = \frac{1}{1+x^2}$

15. $\frac{d}{dx} \cot^{-1} x = -\frac{1}{1+x^2}$

16. $\frac{d}{dx} \sec^{-1} x = \frac{1}{|x| \sqrt{x^2-1}}$

17. $\frac{d}{dx} \operatorname{cosec}^{-1} x = -\frac{1}{|x| \sqrt{x^2-1}}$

Product Rule- $\frac{d}{dx} u*v = u \frac{d}{dx} v + v \frac{d}{dx} u$

Quotient Rule- $\frac{d}{dx} \frac{u}{v} = \frac{v \frac{d}{dx} u - u \frac{d}{dx} v}{v^2}$

Where u and v are functions of x

Chain Rule

$$\frac{dy}{dx} = \frac{dy}{dt} \cdot \frac{dt}{dz} \cdot \frac{dz}{dx}$$

Log Formulas

1. $\log_a (mn) = \log_a m + \log_a n$

2. $\log_a \left(\frac{m}{n}\right) = \log_a m - \log_a n$

3. $\log_a (m^n) = n(\log_a m)$

4. $\log_x x = 1$

5. $\log_a x = \frac{1}{\log_a a}$

6. $\log_a x = \frac{\log_b x}{\log_b a} = \frac{\log x}{\log a}$

7. $a^{(\log_a x)} = x$

8. $\log_a 1 = 0$

9. $\log_a 0 = -\infty$

10. $\log (1+x) = x - x^2/2 + x^3/3 - x^4/4 \dots \dots \dots \infty (-1 < x \leq 1)$

✓ $e = 2.718 \dots$