

1. Basic Derivative formulae

$$\begin{aligned}(x^n)' &= nx^{n-1} & (e^x)' &= e^x \\ (a^x)' &= a^x \ln a & (\ln x)' &= \frac{1}{x} \\ (\log_a x)' &= \frac{1}{x \ln a} \\ (\sin x)' &= \cos x & (\cos x)' &= -\sin x \\ (\tan x)' &= \sec^2 x & (\cot x)' &= -\operatorname{csc}^2 x \\ (\sec x)' &= \sec x \tan x & (\csc x)' &= -\operatorname{csc} x \cot x \\ (\sin^{-1} x)' &= \frac{1}{\sqrt{1-x^2}} & (\cos^{-1} x)' &= \frac{-1}{\sqrt{1-x^2}} \\ (\tan^{-1} x)' &= \frac{1}{1+x^2} & (\cot^{-1} x)' &= \frac{-1}{1+x^2} \\ (\sec^{-1} x)' &= \frac{1}{x\sqrt{x^2-1}} & (\csc^{-1} x)' &= \frac{-1}{x\sqrt{x^2-1}}\end{aligned}$$

2. Differentiation Rules

Sum rule: $(f + g)' = f' + g'$ where $f = f(x)$, $g = g(x)$

Product rule: $(f \cdot g)' = f'g + g'f$

Quotient rule: $\left(\frac{f}{g}\right)' = \frac{f'g - g'f}{g^2}$

Chain rule: $[f(g)]' = f'(g) \cdot g'$ or $\frac{dy}{dx} = \left(\frac{dy}{du}\right) \cdot \left(\frac{du}{dx}\right)$

Implicit differentiation:

If $y = y(x)$ is given implicitly, find derivative to the entire equation with respect to x . Then solve for y' .

3. Identities of Trigonometric Functions

$$\begin{aligned}\tan x &= \frac{\sin x}{\cos x} & \cot x &= \frac{\cos x}{\sin x} \\ \sec x &= \frac{1}{\cos x} & \csc x &= \frac{1}{\sin x} \\ \sin^2 x + \cos^2 x &= 1 & 1 + \tan^2 x &= \sec^2 x & 1 + \cot^2 x &= \operatorname{csc}^2 x\end{aligned}$$

4. Laws of Exponential Functions and Logarithms Functions

$$\begin{aligned}a^x \cdot a^y &= e^{x+y} & \log_a(xy) &= \log_a(x) + \log_a(y) \\ \frac{a^x}{a^y} &= a^{x-y} & \log_a\left(\frac{x}{y}\right) &= \log_a(x) - \log_a(y) \\ (a^x)^y &= a^{xy} & \log_a(x^n) &= n \log_a(x) \\ a^{\log_a(x)} &= x & \ln x &= \log_e x \\ a^0 &= 1 & \log_a a &= 1, \log_a 1 = 0\end{aligned}$$