Bright Career Science Academy, Narowal

Derivatives Formulas & Rules (Edition-4)

Power Rule • $\frac{d}{dx}x^n = n\,x^{n-1}$ • $\frac{d}{dx}[f]^n = n[f]^{n-1}.\frac{df}{dx}$ where $n \in R$

Product Rule • $\frac{d}{dx}[f.g] = \left[\frac{df}{dx}\right].g + f.\left[\frac{dg}{dx}\right]$

• $\frac{d}{dx}(x) = \frac{dx}{dx} = 1$ • $\frac{d}{dx}c.f(x) = c\frac{d}{dx}f(x)$ • $\frac{d}{dx}(c) = \frac{dc}{dx} = 0$ where "c" is constant.

Quotient Rule • $\frac{d}{dx}\left[\frac{f}{g}\right] = \frac{g.\left[\frac{df}{dx}\right] - f.\left[\frac{dg}{dx}\right]}{[g]^2}$

Rule for Square Root • $\frac{d}{dx}\sqrt{f} = \frac{1}{2\sqrt{f}}.\left[\frac{df}{dx}\right]$

Chain Rule • $\frac{dy}{dx} = \frac{dy}{du}\times\frac{du}{dx}$

Derivative of Trigonometric Functions

- $\frac{d}{dx}\sin u = \cos u.\frac{du}{dx}$
- $\frac{d}{dx}\cos u = -\sin u.\frac{du}{dx}$
- $\frac{d}{dx}\tan u = \sec^2 u.\frac{du}{dx}$
- $\frac{d}{dx}\cot u = -\mathrm{cosec}^2 u.\frac{du}{dx}$
- $\frac{d}{dx}\sec u = \sec u.\tan u.\frac{du}{dx}$
- $\frac{d}{dx}\mathrm{cosec}\,u = -\mathrm{cosec}\,u.\cot u.\frac{du}{dx}$

Derivative of Hyperbolic Functions

- $\frac{d}{dx}\sinh u = \cosh u.\frac{du}{dx}$
- $\frac{d}{dx}\cosh u = \sinh u.\frac{du}{dx}$
- $\frac{d}{dx}\tanh u = \mathrm{sech}^2 u.\frac{du}{dx}$
- $\frac{d}{dx}\coth u = -\mathrm{cosech}^2 u.\frac{du}{dx}$
- $\frac{d}{dx}\mathrm{sech}\,u = -\mathrm{sech}\,u.\tanh u.\frac{du}{dx}$
- $\frac{d}{dx}\mathrm{cosech}\,u = -\mathrm{cosech}\,u.\coth u.\frac{du}{dx}$

Derivative of Inverse Trigonometric Functions

- $\frac{d}{dx}\sin^{-1}u = \frac{1}{\sqrt{1-u^2}}.\frac{du}{dx}$
- $\frac{d}{dx}\cos^{-1}u = \frac{-1}{\sqrt{1-u^2}}.\frac{du}{dx}$
- $\frac{d}{dx}\tan^{-1}u = \frac{1}{1+u^2}.\frac{du}{dx}$
- $\frac{d}{dx}\cot^{-1}u = \frac{-1}{1+u^2}.\frac{du}{dx}$
- $\frac{d}{dx}\sec^{-1}u = \frac{1}{|u|\sqrt{u^2-1}}.\frac{du}{dx}$
- $\frac{d}{dx}\mathrm{cosec}^{-1}u = \frac{-1}{|u|\sqrt{u^2-1}}.\frac{du}{dx}$

Derivative of Inverse Hyperbolic Functions

- $\frac{d}{dx}\sinh^{-1}u = \frac{1}{\sqrt{1+u^2}}.\frac{du}{dx}$
- $\frac{d}{dx}\cosh^{-1}u = \frac{1}{\sqrt{u^2-1}}.\frac{du}{dx}$
- $\frac{d}{dx}\tanh^{-1}u = \frac{1}{1-u^2}.\frac{du}{dx}$
- $\frac{d}{dx}\coth^{-1}u = \frac{1}{1-u^2}.\frac{du}{dx}$
- $\frac{d}{dx}\mathrm{sech}^{-1}u = \frac{-1}{u\sqrt{1-u^2}}.\frac{du}{dx}$
- $\frac{d}{dx}\mathrm{cosech}^{-1}u = \frac{-1}{u\sqrt{1+u^2}}.\frac{du}{dx}$

Derivative of Exponential & Logarithmic Functions

- $\frac{d}{dx}e^u = e^u.\frac{du}{dx}$
- $\frac{d}{dx}a^u = a^u.\ln a.\frac{du}{dx}$
- $\frac{d}{dx}\ln u = \frac{1}{u}.\frac{du}{dx}$
- $\frac{d}{dx}\log_a u = \frac{1}{u.\ln a}.\frac{du}{dx}$

Integration Formulas & Rules

Compiled By: Muzzammil Subhan

Power Rule of Integration

- $\int x^n\,dx = \frac{x^{n+1}}{n+1}$ where $n \neq -1$
- $\int f^n.f'\,dx = \frac{f^{n+1}}{n+1}$ where $n \neq -1$
- $\int \frac{f'}{f}\,dx = \ln|f|$
- $\int 1\,dx = x$
- * $\int a\,f(x)\,dx = a\int f(x)\,dx$

Integration of Trigonometric Functions

- $\int \sin f\,dx = \frac{-\cos f}{f'}$
- $\int \cos f\,dx = \frac{\sin f}{f'}$
- * $\int \tan f\,dx = \frac{\ln|\sec f|}{f'} = \frac{-\ln|\cos f|}{f'}$
- * $\int \cot f\,dx = \frac{\ln|\sin f|}{f'}$
- $\int \sec f\,dx = \frac{\ln|\sec f + \tan f|}{f'}$
- $\int \mathrm{cosec}\,f\,dx = \frac{\ln|\mathrm{cosec}\,f - \cot f|}{f'}$
- $\int \sec^2 f\,dx = \frac{\tan f}{f'}$
- $\int \mathrm{cosec}^2 f\,dx = \frac{-\cot f}{f'}$
- $\int \sec f.\tan f\,dx = \frac{\sec f}{f'}$
- $\int \mathrm{cosec}\,f.\cot f\,dx = \frac{-\mathrm{cosec}\,f}{f'}$

Integration of Exponential & Algebraic Functions

- $\int e^f\,dx = \frac{e^f}{f'}$
- * $\int a^f\,dx = \frac{a^f}{f'\ln a}$
- $\int \frac{dx}{a^2+x^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)$
- * $\int \frac{dx}{a^2-x^2} = \frac{1}{2a}\ln\left|\frac{a+x}{a-x}\right|$
- * $\int \frac{dx}{x^2-a^2} = \frac{1}{2a}\ln\left|\frac{x-a}{x+a}\right|$
- $\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1}\left(\frac{x}{a}\right)$
- * $\int \frac{dx}{\sqrt{x^2-a^2}} = \ln\left(x+\sqrt{x^2-a^2}\right)$
- * $\int \frac{dx}{\sqrt{x^2+a^2}} = \ln\left(x+\sqrt{x^2+a^2}\right)$
- * $\int \sqrt{a^2-x^2}\,dx = \frac{x}{2}\sqrt{a^2-x^2} + \frac{a^2}{2}\sin^{-1}\left(\frac{x}{a}\right)$
- * $\int \sqrt{x^2-a^2}\,dx = \frac{x}{2}\sqrt{x^2-a^2} - \frac{a^2}{2}\cosh^{-1}\left(\frac{x}{a}\right)$
- * $\int \sqrt{x^2+a^2}\,dx = \frac{x}{2}\sqrt{x^2+a^2} + \frac{a^2}{2}\sinh^{-1}\left(\frac{x}{a}\right)$

<<<Important Notes >>>

>> **Add Integration Constant "c" with Every Indefinite Integration Formula.**

>>Where $f = f(x)$ is any function of x. and $f' = f'(x)$ is derivative of $f = f(x)$.

Integration By Parts & " I LATE " Rule

- $\int f.g\,dx = f.\int g\,dx - \int\left(\int g\,dx.\frac{df}{dx}\right)dx$
- $\int e^{ax}\left[a.f(x) + f'(x)\right]dx = e^{ax}.f(x)$

Properties of Definite Integral

Property-1 • $\int_a^b f(x)\,dx = F(b) - F(a)$

Property-1 is Called "Fundamental Theorem Of Calculus"

Property-2 • $\int_a^b f(x)\,dx = -\int_b^a f(x)\,dx$

Property-3 • $\int_a^c f(x)\,dx = \int_a^b f(x)\,dx + \int_b^c f(x)\,dx$

Where $a < b < c$

Algebraic Formulas

- $(a \pm b)^2 = a^2 + b^2 \pm 2ab$
- $a^2 - b^2 = (a+b)(a-b)$
- $a^3 \pm b^3 = (a \pm b)(a^2 + b^2 \mp ab)$
- $(a \pm b)^3 = a^3 \pm b^3 \pm 3ab(a \pm b)$
- $(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

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