Bright Career Academy Narowal

Derivatives & Integration Formulas **Compiled By: Muzzammil Subhan M.Phil. (Math)**

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

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

• $\frac{dx}{dx} = 1$ • $\frac{dc}{dx} = 0$, where "c" is constant.

Product Rule • $\frac{d}{dx}(f.g) = \frac{df}{dx}.g + f.\frac{dg}{dx}$

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

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

Trigonometric Functions

• $\frac{d}{dx}\sin f = \cos f.\frac{df}{dx}$

• $\frac{d}{dx}\cos f = -\sin f.\frac{df}{dx}$

• $\frac{d}{dx}\tan f = \sec^2 f.\frac{df}{dx}$

• $\frac{d}{dx}\cot f = -\csc^2 f.\frac{df}{dx}$

• $\frac{d}{dx}\sec f = \sec f.\tan f.\frac{df}{dx}$

• $\frac{d}{dx}\csc f = -\csc f.\cot f.\frac{df}{dx}$

Hyperbolic Functions

• $\frac{d}{dx}\sinh f = \cosh f.\frac{df}{dx}$

• $\frac{d}{dx}\cosh f = \sinh f.\frac{df}{dx}$

• $\frac{d}{dx}\tanh f = \operatorname{sech}^2 f.\frac{df}{dx}$

• $\frac{d}{dx}\coth f = -\operatorname{csch}^2 f.\frac{df}{dx}$

• $\frac{d}{dx}\operatorname{sech} f = -\operatorname{sech} f.\tanh f.\frac{df}{dx}$

• $\frac{d}{dx}\operatorname{csch} f = -\operatorname{csch} f.\coth f.\frac{df}{dx}$

Inverse Trigonometric Functions

• $\frac{d}{dx}\sin^{-1} f = \frac{1}{\sqrt{1-f^2}}.\frac{df}{dx}$

• $\frac{d}{dx}\cos^{-1} f = \frac{-1}{\sqrt{1-f^2}}.\frac{df}{dx}$

• $\frac{d}{dx}\tan^{-1} f = \frac{1}{1+f^2}.\frac{df}{dx}$

• $\frac{d}{dx}\cot^{-1} f = \frac{-1}{1+f^2}.\frac{df}{dx}$

• $\frac{d}{dx}\sec^{-1} f = \frac{1}{|f|\sqrt{f^2-1}}.\frac{df}{dx}$

• $\frac{d}{dx}\csc^{-1} f = \frac{-1}{|f|\sqrt{f^2-1}}.\frac{df}{dx}$

Inverse Hyperbolic Functions

• $\frac{d}{dx}\sinh^{-1} f = \frac{1}{\sqrt{1+f^2}}.\frac{df}{dx}$

• $\frac{d}{dx}\cosh^{-1} f = \frac{1}{\sqrt{f^2-1}}.\frac{df}{dx}$

• $\frac{d}{dx}\tanh^{-1} f = \frac{1}{1-f^2}.\frac{df}{dx}$

• $\frac{d}{dx}\coth^{-1} f = \frac{1}{1-f^2}.\frac{df}{dx}$

• $\frac{d}{dx}\operatorname{sech}^{-1} f = \frac{-1}{f\sqrt{1-f^2}}.\frac{df}{dx}$

• $\frac{d}{dx}\operatorname{csch}^{-1} f = \frac{-1}{f\sqrt{1+f^2}}.\frac{df}{dx}$

Exponential & Logarithmic Functions

• $\frac{d}{dx}e^f = e^f.\frac{df}{dx}$ • $\frac{d}{dx}a^f = a^f.\ln a.\frac{df}{dx}$ • $\frac{d}{dx}\ln f = \frac{1}{f}.\frac{df}{dx}$ • $\frac{d}{dx}\log_a f = \frac{1}{f.\ln a}.\frac{df}{dx}$

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Power Rule of Integration

• $\int f^n.f'\,dx = \frac{f^{n+1}}{n+1}$, where $n \neq -1$

• $\int x^n\,dx = \frac{x^{n+1}}{n+1}$ • $\int \frac{f'}{f}\,dx = \ln|f|$

* $\int \frac{dx}{a^2-x^2} = \frac{1}{2a}\ln\left|\frac{a+x}{a-x}\right|$ • $\int 1\,dx = x$

* $\int \frac{dx}{x^2-a^2} = \frac{1}{2a}\ln\left|\frac{x-a}{x+a}\right|$ • $\int e^{\lambda x}\,dx = \frac{e^{\lambda x}}{\lambda}$

• $\int \frac{dx}{a^2+x^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)$ * $\int a^{\lambda x}\,dx = \frac{a^{\lambda x}}{\lambda \ln a}$

• $\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1}\left(\frac{x}{a}\right)$

* $\int \frac{dx}{\sqrt{x^2 \pm a^2}} = \ln\left(x+\sqrt{x^2 \pm a^2}\right)$

* $\int \sqrt{a^2-x^2}\,dx = \frac{x}{2}\sqrt{a^2-x^2} + \frac{a^2}{2}\sin^{-1}\left(\frac{x}{a}\right)$

* $\int \sqrt{x^2-a^2}\,dx = \frac{x}{2}\sqrt{x^2-a^2} - \frac{a^2}{2}\cosh^{-1}\left(\frac{x}{a}\right)$

* $\int \sqrt{x^2+a^2}\,dx = \frac{x}{2}\sqrt{x^2+a^2} + \frac{a^2}{2}\sinh^{-1}\left(\frac{x}{a}\right)$

Trigonometric Functions

• $\int \sin ax\,dx = \frac{-\cos ax}{a}$

• $\int \cos ax\,dx = \frac{\sin ax}{a}$

* $\int \tan ax\,dx = \frac{\ln|\sec ax|}{a}$

* $\int \cot ax\,dx = \frac{\ln|\sin ax|}{a}$

• $\int \sec ax\,dx = \frac{\ln|\sec ax + \tan ax|}{a}$

• $\int \csc ax\,dx = \frac{\ln|\csc ax - \cot ax|}{a}$

• $\int \sec^2 ax\,dx = \frac{\tan ax}{a}$

• $\int \csc^2 ax\,dx = \frac{-\cot ax}{a}$

• $\int \sec ax.\tan ax\,dx = \frac{\sec ax}{a}$

* $\int \csc ax.\cot ax\,dx = \frac{-\csc ax}{a}$

* $df(x) = f'(x)dx$

• $f(x+\delta x) \approx f(x) + f'(x)dx$

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

(i) $\int_a^b f(x)\,dx = F(b) - F(a)$

(ii) $\int_a^b f(x)\,dx = -\int_b^a f(x)\,dx$

(iii) $\int_a^c f(x)\,dx = \int_a^b f(x)\,dx + \int_b^c f(x)\,dx$

Where $a < b < c$

Property (i) is Called

"Fundamental Theorem Of Calculus"

<<< 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 $f = f(x)$.