

Formulas for Differentiations :-----

$$1. \frac{d}{dx}(c) = 0$$

$$2. \frac{d}{dx}(x^n) = n x^{n-1}$$

$$3. \frac{d}{dx}(\log_e x) = \frac{1}{x}$$

$$4. \frac{d}{dx}(a^x) = a^x \log_e a.$$

$$\text{and} \quad \frac{d}{dx}(a^{mx}) = m a^{mx} \log_e a.$$

$$5. \frac{d}{dx}(e^x) = e^x.$$

$$\text{and} \quad \frac{d}{dx}(e^{mx}) = m e^{mx}.$$

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

$$\text{and} \quad \frac{d}{dx}(\sin mx) = m \cos mx$$

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

$$\text{and} \quad \frac{d}{dx}(\cos mx) = -m \sin mx$$

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

$$\text{and} \quad \frac{d}{dx}(\tan mx) = m \sec^2 mx.$$

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

$$\text{and} \quad \frac{d}{dx}(\cot mx) = -m \operatorname{cosec}^2 mx$$

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

$$\text{and} \quad \frac{d}{dx}(\sec mx) = m \sec mx \tan mx$$

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

$$\text{and} \quad \frac{d}{dx}(\operatorname{cosec} mx) = -m \operatorname{cosec} mx \cot mx$$

$$12. \frac{d}{dx}(u \pm v) = \frac{du}{dx} \pm \frac{dv}{dx}$$

$$13. \frac{d}{dx}(cu) = c \frac{du}{dx}$$

$$14. \frac{d}{dx}(uv) = u \frac{dv}{dx} + v \frac{du}{dx}$$

$$15. \frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\left(\frac{du}{dx}\right) - u\left(\frac{dv}{dx}\right)}{v^2}$$

$$16. \frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$$

$$17. \frac{d}{dx}(\cos^{-1} x) = -\frac{1}{\sqrt{1-x^2}}$$

$$18. \frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2}$$

$$19. \frac{d}{dx}(\cot^{-1} x) = -\frac{1}{1+x^2}$$

$$20. \frac{d}{dx}(\sec^{-1} x) = \frac{1}{x\sqrt{x^2-1}}$$

$$21. \frac{d}{dx}(\operatorname{cosec}^{-1} x) = -\frac{1}{x\sqrt{x^2-1}}$$

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To differentiate from the first principle (from definition) :----

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

Formulas for Limits

$$1. \lim_{x \rightarrow a} \left(\frac{x^n - a^n}{x - a} \right) = n a^{n-1}, \text{ where } a > 0$$

$$2. \lim_{x \rightarrow 0} \left(\frac{e^x - 1}{x} \right) = 1$$

$$3. \lim_{x \rightarrow 0} \left(\frac{a^x - 1}{x} \right) = \log_e a$$

$$4. \lim_{x \rightarrow 0} (1 + x)^{1/x} = e$$

$$5. \lim_{x \rightarrow 0} \frac{\log(1+x)}{x} = 1$$

$$6. \lim_{x \rightarrow \infty} x^n = 0 \text{ where } -1 < x < 1$$

$$7. \lim_{x \rightarrow 0} \sin x = 0$$

$$8. \lim_{x \rightarrow 0} \cos x = 1$$

$$9. \lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$$

$$10. \lim_{x \rightarrow 0} \frac{\tan x}{x} = 1$$

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