✓ **Note** || If $y = (f(x))^n$

$$\frac{dy}{dx} = n(f(x))^{n-1} \cdot \frac{d}{dx} f(x)$$ ||

Q. If $y = (2x+3)^5$, find dy/dx.

$$y = (2x+3)^5$$

$$\frac{dy}{dx} = 5(2x+3)^{5-1} \cdot \frac{d}{dx}(2x+3)$$

$$\frac{dy}{dx} = 5(2x+3)^4\left(2\cdot\frac{d}{dx}(x) + \frac{d}{dx}(3)\right).$$

$$= 5(2x+3)^4(2\times 1+0)$$

$$= 5(2x+3)^4 \times 2.$$

$$= 10(2x+3)^4$$

Q. If $y = \sin^2 x$, find dy/dx

$$y = \sin^2 x = (\sin x)^2.$$

$$\frac{dy}{dx} = 2\cdot(\sin x)^{2-1}\cdot\frac{d}{dx}(\sin x)$$

$$= 2(\sin x)\cdot\cos x.$$

$$= 2\sin x\cos x.$$

Q. If $y = \tan^5 x$, find dy/dx

$$y = \tan^5 x = (\tan x)^5$$

$$\frac{dy}{dx} = 5(\tan x)^{5-1}\cdot\frac{d}{dx}(\tan x)$$

$$= 5(\tan x)^4\cdot\sec^2 x.$$

$$= 5\tan^4 x\sec^2 x$$

Q. If $y = \sqrt{2x-3}$, find dy/dx

$y = \sqrt{2x-3} = (2x-3)^{1/2}$.

$\frac{dy}{dx} = \frac{1}{2}(2x-3)^{1/2-1} \cdot \frac{d}{dx}(2x-3)$

$= \frac{1}{2}(2x-3)^{-1/2} \cdot \left(2 \cdot \frac{d}{dx}(x) - 0\right)$

$= \frac{1}{2}(2x-3)^{-1/2} \cdot 2$.

$= \frac{1}{(2x-3)^{1/2}} = \frac{1}{\sqrt{2x-3}}$

Q. If $y = \frac{1}{x^2+x+1}$, find dy/dx

$y = \frac{1}{x^2+x+1} = (x^2+x+1)^{-1}$

$\frac{dy}{dx} = -1(x^2+x+1)^{-1-1} \cdot \frac{d}{dx}(x^2+x+1)$

$= -(x^2+x+1)^{-2} \cdot \left(\frac{d}{dx}x^2 + \frac{d}{dx}x + 0\right)$

$= -(x^2+x+1)^{-2}(2x+1)$

$= -\frac{(2x+1)}{(x^2+x+1)^2}$

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Q. Result

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

2. $\frac{d}{dx}(\sin f(x)) = \cos f(x)\cdot\frac{d}{dx}f(x)$.

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

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

5. $\frac{d}{dx}(\log f(x)) = \frac{1}{f(x)}\frac{d}{dx}f(x)$.

6. $\frac{d}{dx}(e^{f(x)}) = e^{f(x)}\cdot\frac{d}{dx}f(x)$.

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

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

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

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

1. $\frac{d}{dx}(\sin 2x)$

$$\frac{d}{dx}(\sin 2x) = \cos 2x \cdot \frac{d}{dx}(2x)$$
$$= \cos 2x \times 2\frac{d}{dx}(x)$$
$$= \cos 2x \times 2 \times 1$$
$$= \underline{2\cos 2x}$$

2. $$\frac{d}{dx}(\tan 3x) = \sec^2 3x \cdot \frac{d}{dx}(3x)$$
$$= \sec^2 3x \cdot 3\frac{d}{dx}(x)$$
$$= \sec^2 3x \cdot 3 \times 1$$
$$= \underline{3\sec^2 3x}$$

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

$$= -\operatorname{cosec}(x^2)\cot(x^2) \cdot 2x$$
$$= -2x\operatorname{cosec}(x^2)\cot(x^2)$$

4. $$\frac{d}{dx}(\cot(x^4)) = -\operatorname{cosec}^2(x^4) \cdot \frac{d}{dx}(x^4)$$

$$= -\operatorname{cosec}^2(x^4) \cdot 4x^3$$
$$= \underline{-4x^3\operatorname{cosec}^2(x^4)}$$

5. $$\frac{d}{dx}[\log(\log x)] = \frac{1}{\log x} \cdot \frac{d}{dx}(\log x)$$

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$$= \frac{1}{\log x} \cdot \frac{1}{x} = \frac{1}{x \log x}$$

6. $\frac{d}{dx}(e^{3x}) = e^{3x} \cdot \cancel{\frac{d}{dx}(e^{3x})} \frac{d}{dx}(3x)$

$$= e^{3x} \cdot 3 \cdot \frac{d}{dx}(x)$$

$$= e^{3x} \cdot 3 \times 1 = 3e^{3x}$$

7. $\frac{d}{dx}(\cos(x^2)) = -\sin(x^2) \cdot \frac{d}{dx}(x^2)$

$$= -\sin(x^2) \cdot 2x$$

$$= -2x \sin(x^2)$$

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

$$= \frac{1}{\sqrt{1-x^4}} \cdot 2x = \frac{2x}{\sqrt{1-x^4}}$$

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

$$= \frac{1}{1+4x^2} \cdot 2 \cdot \frac{d}{dx}(x)$$

$$= \frac{1}{1+4x^2} \cdot 2 \times 1 = \frac{2}{1+4x^2}$$