Differentiation Formulas

General Formulas

1. **Constant Rule:** $\dfrac{d}{dx}[c] = 0$

2. **Power Rule:** $\dfrac{d}{dx}[x^n] = n \cdot x^{n-1}$, $x \in \square$

3. **Scalar Multiple of a Function:** $\dfrac{d}{dx}[c \cdot f(x)] = c \cdot f'(x)$

4. **Sum and Difference of Functions:** $\dfrac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x)$

5. **Product Rule:** $\dfrac{d}{dx}[f(x) \cdot g(x)] = f'(x) \cdot g(x) + g'(x) \cdot f(x)$

6. **Quotient Rule:** $\dfrac{d}{dx}\left[\dfrac{f(x)}{g(x)}\right] = \dfrac{f'(x) \cdot g(x) - g'(x) \cdot f(x)}{[g(x)]^2}$

7. **Chain Rule:** $\dfrac{d}{dx}[f(g(x))] = f'(g(x)) \cdot g'(x)$

Exponential and Logarithmic Derivatives

8. $\dfrac{d}{dx}[e^x] = e^x$

9. $\dfrac{d}{dx}[b^x] = b^x \cdot \ln(b)$

10. $\dfrac{d}{dx}[\ln|x|] = \dfrac{1}{x}$

11. $\dfrac{d}{dx}[\log_b(x)] = \dfrac{1}{x \ln(b)}$

Trigonometric Derivatives

12. $\dfrac{d}{dx}[\sin x] = \cos x$

13. $\dfrac{d}{dx}[\cos x] = -\sin x$

14. $\dfrac{d}{dx}[\tan x] = \sec^2 x$

15. $\dfrac{d}{dx}[\csc x] = -\csc x \cot x$

16. $\dfrac{d}{dx}[\sec x] = \sec x \tan x$

17. $\dfrac{d}{dx}[\cot x] = -\csc^2 x$

Inverse Trigonometric Derivatives

18. $\dfrac{d}{dx}\left[\sin^{-1}x\right] = \dfrac{1}{\sqrt{1-x^2}}$

19. $\dfrac{d}{dx}\left[\cos^{-1}x\right] = -\dfrac{1}{\sqrt{1-x^2}}$

20. $\dfrac{d}{dx}\left[\tan^{-1}x\right] = \dfrac{1}{1+x^2}$

21. $\dfrac{d}{dx}\left[\csc^{-1}x\right] = -\dfrac{1}{x\sqrt{x^2-1}}$

22. $\dfrac{d}{dx}\left[\sec^{-1}x\right] = \dfrac{1}{x\sqrt{x^2-1}}$

23. $\dfrac{d}{dx}\left[\cot^{-1}x\right] = -\dfrac{1}{1+x^2}$

Hyperbolic Derivatives

24. $\dfrac{d}{dx}\left[\sinh x\right] = \cosh x$

25. $\dfrac{d}{dx}\left[\cosh x\right] = \sinh x$

26. $\dfrac{d}{dx}\left[\tanh x\right] = \operatorname{sech}^2 x$

27. $\dfrac{d}{dx}\left[\operatorname{csch} x\right] = -\operatorname{csch} x \coth x$

28. $\dfrac{d}{dx}\left[\operatorname{sech} x\right] = -\operatorname{sech} x \tanh x$

29. $\dfrac{d}{dx}\left[\coth x\right] = -\operatorname{csch}^2 x$

Inverse Hyperbolic Derivatives

30. $\dfrac{d}{dx}\left[\sinh^{-1}x\right] = \dfrac{1}{\sqrt{1+x^2}}$, $x \in \mathbb{R}$

31. $\dfrac{d}{dx}\left[\cosh^{-1}x\right] = \dfrac{1}{\sqrt{x^2-1}}$, $x \in (1,\infty)$

32. $\dfrac{d}{dx}\left[\tanh^{-1}x\right] = \dfrac{1}{1-x^2}$, $x \in (-1,1)$

33. $\dfrac{d}{dx}\left[\operatorname{csch}^{-1}x\right] = -\dfrac{1}{|x|\sqrt{x^2+1}}$, $x \in (-\infty,0)\cup(0,\infty)$

34. $\dfrac{d}{dx}\left[\operatorname{sech}^{-1}x\right] = -\dfrac{1}{x\sqrt{1-x^2}}$, $x \in (0,1)$

35. $\dfrac{d}{dx}\left[\coth^{-1}x\right] = \dfrac{1}{1-x^2}$, $x \in (-\infty,-1)\cup(1,\infty)$