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Differentiation Rules

General Formulas

1. $\frac{d}{dx}(c) = 0$
2. $\frac{d}{dx}[cf(x)] = cf'(x)$
3. $\frac{d}{dx}[f(x) + g(x)] = f'(x) + g'(x)$
4. $\frac{d}{dx}[f(x) - g(x)] = f'(x) - g'(x)$
5. $\frac{d}{dx}[f(x)g(x)] = f(x)g'(x) + g(x)f'(x)$ (Product Rule)
6. $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$ (Quotient Rule)
7. $\frac{d}{dx}f(g(x)) = f'(g(x))g'(x)$ (Chain Rule)
8. $\frac{d}{dx}(x^n) = nx^{n-1}$ (Power Rule)

Exponential and Logarithmic Functions

9. $\frac{d}{dx}(e^x) = e^x$
10. $\frac{d}{dx}(b^x) = b^x \ln b$
11. $\frac{d}{dx} \ln |x| = \frac{1}{x}$
12. $\frac{d}{dx}(\log_b x) = \frac{1}{x \ln b}$

Trigonometric Functions

$$13. \frac{d}{dx}(\sin x) = \cos x$$

$$14. \frac{d}{dx}(\cos x) = -\sin x$$

$$15. \frac{d}{dx}(\tan x) = \sec^2 x$$

$$16. \frac{d}{dx}(\csc x) = -\csc x \cot x$$

$$17. \frac{d}{dx}(\sec x) = \sec x \tan x$$

$$18. \frac{d}{dx}(\cot x) = -\csc^2 x$$

Inverse Trigonometric Functions

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

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

$$21. \frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2}$$

$$22. \frac{d}{dx}(\csc^{-1} x) = -\frac{1}{x\sqrt{x^2-1}}$$

$$23. \frac{d}{dx}(\sec^{-1} x) = \frac{1}{x\sqrt{x^2-1}}$$

$$24. \frac{d}{dx}(\cot^{-1} x) = -\frac{1}{1+x^2}$$

Hyperbolic Functions

$$25. \frac{d}{dx}(\sinh x) = \cosh x$$

$$26. \frac{d}{dx}(\cosh x) = \sinh x$$

$$27. \frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x$$

$$28. \frac{d}{dx}(\operatorname{csch} x) = -\operatorname{csch} x \coth x$$

$$29. \frac{d}{dx}(\operatorname{sech} x) = -\operatorname{sech} x \tanh x$$

$$30. \frac{d}{dx}(\coth x) = -\operatorname{csch}^2 x$$

Inverse Hyperbolic Functions

$$31. \frac{d}{dx}(\sinh^{-1} x) = \frac{1}{\sqrt{1+x^2}}$$

$$32. \frac{d}{dx}(\cosh^{-1} x) = \frac{1}{\sqrt{x^2-1}}$$

$$33. \frac{d}{dx}(\tanh^{-1} x) = \frac{1}{1-x^2}$$

$$34. \frac{d}{dx}(\operatorname{csch}^{-1} x) = -\frac{1}{|x|\sqrt{x^2+1}}$$

$$35. \frac{d}{dx}(\operatorname{sech}^{-1} x) = -\frac{1}{x\sqrt{1-x^2}}$$

$$36. \frac{d}{dx}(\coth^{-1} x) = \frac{1}{1-x^2}$$

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