



Basic Differentiation Rules

Note that we use the following intervals for the definitions of $\csc^{-1} x, \sec^{-1} x$:

$$y = \csc^{-1} x, |x| \geq 1 \Leftrightarrow \csc y = x \text{ and } y \in (0, \pi/2] \cup (\pi, 3\pi/2], \quad y = \sec^{-1} x, |x| \geq 1 \Leftrightarrow \sec y = x \text{ and } y \in [0, \pi/2) \cup [\pi, 3\pi/2)$$

Constant and Power Functions

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

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

Exponentials Function

$$3. \frac{d}{dx}(a^{f(x)}) = f'(x)a^{f(x)} \ln a$$

$$4. \frac{d}{dx}(e^{f(x)}) = f'(x)e^{f(x)}$$

Logarithmic Functions

$$5. \frac{d}{dx}(\ln(f(x))) = \frac{f'(x)}{f(x)}$$

$$6. \frac{d}{dx}(\log_a(f(x))) = \frac{f'(x)}{f(x) \ln a}$$

Product Rule

$$7. \frac{d}{dx}(f(x)g(x)) = f(x)g'(x) + f'(x)g(x)$$

Quotient Rule

$$8. \frac{d}{dx} \left(\frac{f(x)}{g(x)} \right) = \frac{g(x)f'(x) - g'(x)f(x)}{[g(x)]^2}$$

Trigonometric Functions

$$9. \frac{d}{dx}(\sin(f(x))) = f'(x) \cos(f(x))$$

$$10. \frac{d}{dx}(\cos(f(x))) = -f'(x) \sin(f(x))$$

$$11. \frac{d}{dx}(\sec(f(x))) = f'(x) \sec(f(x)) \tan(f(x))$$

$$12. \frac{d}{dx}(\csc(f(x))) = -f'(x) \csc(f(x)) \cot(f(x))$$

$$13. \frac{d}{dx}(\tan(f(x))) = f'(x) \sec^2(f(x))$$

$$14. \frac{d}{dx}(\cot(f(x))) = -f'(x) \csc(f(x))$$

Trigonometric Inverse Functions

$$15. \frac{d}{dx}(\sin^{-1}(f(x))) = \frac{f'(x)}{\sqrt{1 - [f(x)]^2}}$$

$$16. \frac{d}{dx}(\cos^{-1}(f(x))) = \frac{-f'(x)}{\sqrt{1 - [f(x)]^2}}$$

$$17. \frac{d}{dx}(\tan^{-1}(f(x))) = \frac{f'(x)}{1 + [f(x)]^2}$$

$$18. \frac{d}{dx}(\cot^{-1}(f(x))) = \frac{-f'(x)}{1 + [f(x)]^2}$$

$$19. \frac{d}{dx}(\sec^{-1}(f(x))) = \frac{f'(x)}{f(x)\sqrt{[f(x)]^2 - 1}}$$

$$20. \frac{d}{dx}(\csc^{-1}(f(x))) = \frac{-f'(x)}{f(x)\sqrt{[f(x)]^2 - 1}}$$

Hyperbolic Functions

$$21. \frac{d}{dx}(\sinh(f(x))) = f'(x) \cosh(f(x))$$

$$22. \frac{d}{dx}(\cosh(f(x))) = f'(x) \sinh(f(x))$$

$$23. \frac{d}{dx}(\tanh(f(x))) = f'(x) \operatorname{sech}^2(f(x))$$

$$24. \frac{d}{dx}(\cot(f(x))) = -f'(x) \operatorname{csch}^2(f(x))$$

$$25. \frac{d}{dx}(\operatorname{sech}(f(x))) = -f'(x) \operatorname{sech}(f(x)) \tanh(f(x))$$

$$26. \frac{d}{dx}(\operatorname{csch}(f(x))) = -f'(x) \operatorname{csch}(f(x)) \coth(f(x))$$

Hyperbolic Inverse Functions

$$27. \frac{d}{dx}(\sinh^{-1}(f(x))) = \frac{f'(x)}{\sqrt{1 + [f(x)]^2}}$$

$$28. \frac{d}{dx}(\cosh^{-1}(f(x))) = \frac{f'(x)}{\sqrt{[f(x)]^2 - 1}}$$

$$29. \frac{d}{dx}(\tanh^{-1}(f(x))) = \frac{f'(x)}{1 - [f(x)]^2}$$

$$30. \frac{d}{dx}(\coth^{-1}(f(x))) = \frac{f'(x)}{1 - [f(x)]^2}$$

$$31. \frac{d}{dx}(\operatorname{sech}^{-1}(f(x))) = \frac{-f'(x)}{f(x)\sqrt{1 - [f(x)]^2}}$$

$$32. \frac{d}{dx}(\operatorname{csch}^{-1}(f(x))) = \frac{-f'(x)}{|f(x)|\sqrt{[f(x)]^2 + 1}}$$



Basic Integration Rules

Constant Function

$$1. \int a \, dx = ax + C$$

Power Function for $n \neq -1$

$$2. \int (f(x))^n f'(x) \, dx = \frac{(f(x))^{n+1}}{n+1} + C$$

Power Function for $n = -1$

$$3. \int \frac{f'(x)}{f(x)} \, dx = \ln |f(x)| + C$$

Exponentials Functions

$$3. \int a^{f(x)} f'(x) \, dx = \frac{1}{\ln a} a^{f(x)} + C$$

$$4. \int e^{f(x)} f'(x) \, dx = e^{f(x)} + C$$

Trigonometric Functions

$$5. \int \sin(f(x)) f'(x) \, dx = -\cos(f(x)) + C$$

$$6. \int \cos(f(x)) f'(x) \, dx = \sin(f(x)) + C$$

$$7. \int \sec^2(f(x)) f'(x) \, dx = \tan(f(x)) + C$$

$$8. \int \csc^2(f(x)) f'(x) \, dx = -\cot(f(x)) + C$$

$$9. \int \cot(f(x)) f'(x) \, dx = \ln |\sin(f(x))| + C$$

$$10. \int \tan(f(x)) f'(x) \, dx = \ln |\sec(f(x))| + C$$

$$11. \int \sec(f(x)) \tan(f(x)) f'(x) \, dx = \sec(f(x)) + C$$

$$12. \int \csc(f(x)) f'(x) \, dx = \ln |\csc(f(x)) - \cot(f(x))| + C$$

$$13. \int \sec(f(x)) f'(x) \, dx = \ln |\sec(f(x)) + \tan(f(x))| + C$$

$$14. \int \csc(f(x)) \cot(f(x)) f'(x) \, dx = -\csc(f(x)) + C$$

Hyperbolic Functions

$$15. \int \sinh(f(x)) f'(x) \, dx = \cosh(f(x)) + C$$

$$16. \int \cosh(f(x)) f'(x) \, dx = \sinh(f(x)) + C$$

$$17. \int \operatorname{sech}^2(f(x)) f'(x) \, dx = \tanh(f(x)) + C$$

$$18. \int \operatorname{csch}(f(x)) \coth(f(x)) f'(x) \, dx = -\operatorname{csch}(f(x)) + C$$

$$19. \int \operatorname{csch}^2(f(x)) f'(x) \, dx = -\coth(f(x)) + C$$

$$20. \int \operatorname{sech}(f(x)) \tanh(f(x)) f'(x) \, dx = -\operatorname{sech}(f(x)) + C$$

Algebraic Functions

$$21. \int \frac{f'(x)}{\sqrt{a^2 - [f(x)]^2}} \, dx = \sin^{-1} \left(\frac{f(x)}{a} \right) + C$$

$$22. \int \frac{f'(x)}{a^2 + [f(x)]^2} \, dx = \frac{1}{a} \tan^{-1} \left(\frac{f(x)}{a} \right) + C$$

$$23. \int \frac{f'(x)}{f(x) \sqrt{[f(x)]^2 - a^2}} \, dx = \frac{1}{a} \sec^{-1} \left(\frac{f(x)}{a} \right) + C$$

$$24. \int \frac{f'(x)}{\sqrt{a^2 + [f(x)]^2}} \, dx = \ln \left(f(x) + \sqrt{a^2 + [f(x)]^2} \right) + C$$

$$25. \int \frac{f'(x)}{\sqrt{[f(x)]^2 - a^2}} \, dx = \ln \left(f(x) + \sqrt{[f(x)]^2 - a^2} \right) + C$$

$$26. \int \frac{f'(x)}{f(x) \sqrt{a^2 - [f(x)]^2}} \, dx = \frac{-1}{a} \ln \left| \frac{a + \sqrt{a^2 - [f(x)]^2}}{f(x)} \right| + C$$

$$27. \int \frac{f'(x)}{f(x) \sqrt{a^2 + [f(x)]^2}} \, dx = \frac{-1}{a} \ln \left| \frac{a + \sqrt{a^2 + [f(x)]^2}}{f(x)} \right| + C$$

$$28. \int \frac{f'(x)}{a^2 - [f(x)]^2} \, dx = \frac{1}{2a} \ln \left| \frac{a + f(x)}{a - f(x)} \right| + C$$