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. $\frac{d}{dx} [f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$ (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. $\frac{d}{dx} a^x = a^x \ln a$
11. $\frac{d}{dx} \ln |x| = \frac{1}{x}$
12. $\frac{d}{dx} \log_a x = \frac{1}{x \ln a}$

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

Integration Formulas

Basic Formulas

1. $\int x^n\,dx = \frac{x^{n+1}}{n+1} + C \qquad (n \neq -1)$
2. $\int \frac{1}{x}\,dx = \ln|x| + C$
3. $\int \frac{1}{x^2+a^2}\,dx = \frac{1}{a}\tan^{-1}\frac{x}{a} + C$
4. $\int \frac{1}{x^2-a^2}\,dx = \frac{1}{2a}\ln\left|\frac{x-a}{x+a}\right| + C$

Trigonometric Functions

5. $\int \sin x\,dx = -\cos x + C$
6. $\int \cos x\,dx = \sin x + C$
7. $\int \sec^2 x\,dx = \tan x + C$
8. $\int \csc^2 x\,dx = -\cot x + C$
9. $\int \sec x \tan x\,dx = \sec x + C$
10. $\int \csc x \cot x\,dx = -\csc x + C$
11. $\int \tan x\,dx = \ln|\sec x| + C$
12. $\int \cot x\,dx = \ln|\sin x| + C$
13. $\int \sec x\,dx = \ln|\sec x + \tan x| + C$
14. $\int \csc x\,dx = \ln|\csc x - \cot x| + C$
15. $\int \sin^2 x\,dx = \frac{1}{2}x - \frac{1}{4}\sin 2x + C$
16. $\int \cos^2 x\,dx = \frac{1}{2}x + \frac{1}{4}\sin 2x + C$
17. $\int \sin^n x\,dx = -\frac{1}{n}\sin^{n-1}x\cos x + \frac{n-1}{n}\int \sin^{n-2}x\,dx$
18. $\int \cos^n x\,dx = \frac{1}{n}\cos^{n-1}x\sin x + \frac{n-1}{n}\int \cos^{n-2}x\,dx$

Exponential and Logarithmic Functions

19. $\int e^x\,dx = e^x + C$
20. $\int a^x\,dx = \frac{a^x}{\ln a} + C$
21. $\int e^{ax}\sin bx\,dx = \frac{e^{ax}(a\sin bx - b\cos bx)}{a^2+b^2} + C$
22. $\int e^{ax}\cos bx\,dx = \frac{e^{ax}(a\cos bx + b\sin bx)}{a^2+b^2} + C$
23. $\int xe^{ax}\,dx = \frac{1}{a^2}(ax-1)e^{ax} + C$
24. $\int x^n e^{ax}\,dx = \frac{1}{a}x^n e^{ax} - \frac{n}{a}\int x^{n-1}e^{ax}\,dx$
25. $\int \ln x\,dx = x\ln x - x + C$
26. $\int x^n \ln x\,dx = \frac{x^{n+1}}{(n+1)^2}[(n+1)\ln x - 1] + C$

Radicals

27. $\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1}\frac{x}{a} + C$
28. $\int \sqrt{a^2-x^2}\,dx = \frac{x}{2}\sqrt{a^2-x^2} + \frac{a^2}{2}\sin^{-1}\frac{x}{a} + C$
29. $\int \frac{dx}{\sqrt{a^2+x^2}} = \ln(x + \sqrt{a^2+x^2}) + C$
30. $\int \sqrt{a^2+x^2}\,dx = \frac{x}{2}\sqrt{a^2+x^2} + \frac{a^2}{2}\ln(x + \sqrt{a^2+x^2}) + C$
31. $\int \frac{dx}{\sqrt{x^2-a^2}} = \ln|x + \sqrt{x^2-a^2}| + C$
32. $\int \sqrt{x^2-a^2}\,dx = \frac{x}{2}\sqrt{x^2-a^2} - \frac{a^2}{2}\ln|x + \sqrt{x^2-a^2}| + C$
33. $\int \frac{dx}{x\sqrt{x^2-a^2}} = \frac{1}{a}\sec^{-1}\frac{x}{a} + C$
34. $\int \frac{dx}{x\sqrt{a^2-x^2}} = -\frac{1}{a}\ln\left|\frac{a+\sqrt{a^2-x^2}}{x}\right| + C$