DIFFERENTIATION

Differentiation Rules

1. $\frac{d}{dx}(c) = 0$
2. $\frac{d}{dx}x = 1$
3. $\frac{d}{dx}(x^n) = nx^{n-1}$ (Power Rule)
4. $\frac{d}{dx}[cf(x)] = cf'(x)$
5. $\frac{d}{dx}[f(x) + g(x)] = f'(x) + g'(x)$
6. $\frac{d}{dx}[f(x)g(x)] = f(x)g'(x) + g(x)f'(x)$ (Product Rule)
7. $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$ (Quotient Rule)
8. $\frac{d}{dx}f(g(x)) = f'(g(x))g'(x)$ (Chain Rule)
9. $\frac{d}{dx}f(x)^n = nf(x)^{n-1}f'(x)$ (General Power Rule)
10. $\frac{d}{dx}f(kx + b) = kf'(kx + b)$
11. $\frac{d}{dx}g(x) = \frac{1}{f'(g(x))}$ where g is the inverse f^{-1}
12. $\frac{d}{dx}\ln f(x) = \frac{f'(x)}{f(x)}$

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

Exponential and Logarithmic Functions

25. $\frac{d}{dx}(e^x) = e^x$
26. $\frac{d}{dx}(a^x) = (\ln a)a^x$
27. $\frac{d}{dx}\ln|x| = \frac{1}{x}$
28. $\frac{d}{dx}(\log_a x) = \frac{1}{(\ln a)x}$

Hyperbolic Functions

29. $\frac{d}{dx}(\sinh x) = \cosh x$
30. $\frac{d}{dx}(\cosh x) = \sinh x$
31. $\frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x$
32. $\frac{d}{dx}(\operatorname{csch} x) = -\operatorname{csch} x \coth x$
33. $\frac{d}{dx}(\operatorname{sech} x) = -\operatorname{sech} x \tanh x$
34. $\frac{d}{dx}(\coth x) = -\operatorname{csch}^2 x$

Inverse Hyperbolic Functions

35. $\frac{d}{dx}(\sinh^{-1} x) = \frac{1}{\sqrt{1+x^2}}$
36. $\frac{d}{dx}(\cosh^{-1} x) = \frac{1}{\sqrt{x^2-1}}$
37. $\frac{d}{dx}(\tanh^{-1} x) = \frac{1}{1-x^2}$
38. $\frac{d}{dx}(\operatorname{csch}^{-1} x) = -\frac{1}{|x|\sqrt{x^2+1}}$
39. $\frac{d}{dx}(\operatorname{sech}^{-1} x) = -\frac{1}{x\sqrt{1-x^2}}$
40. $\frac{d}{dx}(\coth^{-1} x) = \frac{1}{1-x^2}$