

DIFFERENTIATION RULES

GENERAL FORMULAS

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

EXPONENTIAL AND LOGARITHMIC FUNCTIONS

- $\frac{d}{dx}(e^x) = e^x$
- $\frac{d}{dx}(a^x) = a^x \ln a$
- $\frac{d}{dx} \ln |x| = \frac{1}{x}$
- $\frac{d}{dx}(\log_a x) = \frac{1}{x \ln a}$

TRIGONOMETRIC FUNCTIONS

- $\frac{d}{dx}(\sin x) = \cos x$
- $\frac{d}{dx}(\cos x) = -\sin x$
- $\frac{d}{dx}(\tan x) = \sec^2 x$
- $\frac{d}{dx}(\csc x) = -\csc x \cot x$
- $\frac{d}{dx}(\sec x) = \sec x \tan x$
- $\frac{d}{dx}(\cot x) = -\csc^2 x$

INVERSE TRIGONOMETRIC FUNCTIONS

- $\frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$
- $\frac{d}{dx}(\cos^{-1} x) = -\frac{1}{\sqrt{1-x^2}}$
- $\frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2}$
- $\frac{d}{dx}(\csc^{-1} x) = -\frac{1}{x\sqrt{x^2-1}}$
- $\frac{d}{dx}(\sec^{-1} x) = \frac{1}{x\sqrt{x^2-1}}$
- $\frac{d}{dx}(\cot^{-1} x) = -\frac{1}{1+x^2}$

HYPERBOLIC FUNCTIONS

- $\frac{d}{dx}(\sinh x) = \cosh x$
- $\frac{d}{dx}(\cosh x) = \sinh x$
- $\frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x$
- $\frac{d}{dx}(\operatorname{csch} x) = -\operatorname{csch} x \coth x$
- $\frac{d}{dx}(\operatorname{sech} x) = -\operatorname{sech} x \tanh x$
- $\frac{d}{dx}(\operatorname{coth} x) = -\operatorname{csch}^2 x$

INVERSE HYPERBOLIC FUNCTIONS

- $\frac{d}{dx}(\sinh^{-1} x) = \frac{1}{\sqrt{1+x^2}}$
- $\frac{d}{dx}(\cosh^{-1} x) = \frac{1}{\sqrt{x^2-1}}$
- $\frac{d}{dx}(\tanh^{-1} x) = \frac{1}{1-x^2}$
- $\frac{d}{dx}(\operatorname{csch}^{-1} x) = -\frac{1}{|x|\sqrt{x^2+1}}$
- $\frac{d}{dx}(\operatorname{sech}^{-1} x) = -\frac{1}{x\sqrt{1-x^2}}$
- $\frac{d}{dx}(\operatorname{coth}^{-1} x) = \frac{1}{1-x^2}$