Differentiation Review

Definition of the derivative:

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

Basic derivatives:

$[x^a]' = ax^{a-1}, \quad a$ any real number

$[a^x]' = a^x \ln a, \quad a > 0$

$[\ln x]' = \dfrac{1}{x}$

$[e^x]' = e^x$ (special case of above)

$[\sin x]' = \cos x$

$[\cos x]' = -\sin x$

$[\tan x]' = \sec^2 x$

$[\cot x]' = -\csc^2 x$

$[\sec x]' = \tan x \sec x$

$[\csc x]' = -\cot x \csc x$

$[\arcsin x]' = \dfrac{1}{\sqrt{1-x^2}}$

$[\arccos x]' = -\dfrac{1}{\sqrt{1-x^2}}$

$[\arctan x]' = \dfrac{1}{1+x^2}$

$[\text{arccot}\, x]' = -\dfrac{1}{1+x^2}$

$[\text{arcsec}\, x]' = \dfrac{1}{x\sqrt{x^2-1}}$

$[\text{arccsc}\, x]' = -\dfrac{1}{x\sqrt{x^2-1}}$

$[\sinh x]' = \cosh x$

$[\cosh x]' = \sinh x$

Differentiation rules:

Linearity: $[f(x) + g(x)]' = f'(x) + g'(x)$

$[cf(x)]' = cf'(x), \quad c$ any constant

Product Rule: $[f(x)g(x)]' = f'(x)g(x) + f(x)g'(x)$

Quotient Rule: $\left[\dfrac{f(x)}{g(x)}\right]' = \dfrac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$

Chain Rule: $[f(g(x))]' = f'(g(x))g'(x)$