MAT 136, Prof. Swift
Differentiation Shortcuts

Rules:

$\frac{d}{dx}\left[c \cdot f(x)\right] = c \cdot f'(x)$ The Constant Multiple Rule (c is any constant).

$\frac{d}{dx}\left[f(x) \pm g(x)\right] = f'(x) \pm g'(x)$ The Sum and Difference Rules.

$\frac{d}{dx}\left[f(x) \cdot g(x)\right] = f'(x) \cdot g(x) + f(x) \cdot g'(x)$ The Product Rule.

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

$\frac{d}{dx}\left[f(g(x))\right] = f'(g(x)) \cdot g'(x)$ The all-important Chain Rule.

$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$ The all-important Chain Rule in Leibnitz notation.

Facts:

$\frac{d}{dx}\left[m \cdot x + b\right] = m$ for any constants m and b. This implies $\frac{d}{dx} c = 0$.

$\frac{d}{dx} x^n = n \cdot x^{n-1}$ for any constant n (positive, negative, integer, fraction, or irrational).

$\frac{d}{dx} e^x = e^x$ and more generally $\frac{d}{dx} a^x = \ln(a) \cdot a^x$ for any positive constant a.

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

$\frac{d}{dx} \ln(x) = \frac{1}{x}$ with domain $x > 0$ $\frac{d}{dx} \ln|x| = \frac{1}{x}$ with domain $x \neq 0$

$\frac{d}{dx} \arcsin(x) = \frac{1}{\sqrt{1-x^2}}$ $\frac{d}{dx} \arctan(x) = \frac{1}{1+x^2}$

Trigonometric Identities:

$\sin^2(x) + \cos^2(x) = 1$ $\tan(x) = \frac{\sin(x)}{\cos(x)}$

$\csc(x) = \frac{1}{\sin(x)}$ $\sec(x) = \frac{1}{\cos(x)}$ $\cot(x) = \frac{1}{\tan(x)} = \frac{\cos(x)}{\sin(x)}$

All there is to know about Logarithms:

$\ln(a) = b \Leftrightarrow e^b = a$, so $\ln(1) = 0$ (since $e^0 = 1$), and $\ln(e) = 1$ (since $e^1 = e$), etc.

$e^{\ln(x)} = x$ for all $x > 0$ $\ln(e^x) = x$ for all x $\log_a(x) = \ln(x)/\ln(a)$ $a^x = e^{\ln(a)\cdot x}$

$\ln(ab) = \ln(a) + \ln(b)$ $\ln(a/b) = \ln(a) - \ln(b)$ $\ln(a^b) = b\ln(a)$