Derivative Rules:

If c is a constant, then the derivative of a constant function at any value of x is zero.

$$\frac{d}{dx}[c]=0$$

Power Rule:	**Constant Multiple Rule:**
$\frac{d}{dx}\left[x^n\right]=n\cdot x^{n-1}$	$\frac{d}{dx}\left[c\cdot f(x)\right]=c\cdot\frac{d}{dx}\left[f(x)\right]=c\cdot f'(x)$
Sum/Difference Rule:	**Quotient Rule:**
$\frac{d}{dx}\left[f(x)\pm g(x)\right]=\frac{d}{dx}\left[f(x)\right]\pm\frac{d}{dx}\left[g(x)\right]=f'(x)\pm g'(x)$	$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right]=\frac{f'(x)g(x)-f(x)g'(x)}{\left[g(x)\right]^2}$

Product Rule:

$$\left[f(x)\cdot g(x)\right]'=f'(x)g(x)+f(x)g'(x)$$

Extended Product Rule:

$$\left[f(x)\cdot g(x)\cdot h(x)\right]'=f'(x)\cdot g(x)\cdot h(x)+f(x)\cdot g'(x)\cdot h(x)+f(x)\cdot g(x)\cdot h'(x)$$

$$\vdots$$

Chain Rule:

$$\left[f\left(g(x)\right)\right]'=f'\left(g(x)\right)\cdot g'(x)$$

Extended Chain Rule:

$$\left[f\left(g\left(h(x)\right)\right)\right]'=f'\left(g\left(h(x)\right)\right)\cdot g'\left(h(x)\right)\cdot h'(x)$$

$$\vdots$$

Basic Differentiation Rules:

$\frac{d}{dx}[c\cdot x]=c$	$\frac{d}{dx}\left[x^n\right]=n\cdot x^{n-1}$	$\frac{d}{dx}\left[\lvert x\rvert\right]=\frac{x}{\lvert x\rvert}$
$\frac{d}{dx}\left[\sin(x)\right]=\cos(x)$	$\frac{d}{dx}\left[\sec(x)\right]=\sec(x)\tan(x)$	$\frac{d}{dx}\left[\tan(x)\right]=\sec^2(x)$
$\frac{d}{dx}\left[\cos(x)\right]=-\sin(x)$	$\frac{d}{dx}\left[\csc(x)\right]=-\csc(x)\cot(x)$	$\frac{d}{dx}\left[\cot(x)\right]=-\csc^2(x)$
$\frac{d}{dx}\left[e^x\right]=e^x$	$\left(f^{-1}\right)'(b)=\frac{1}{f'\left(\begin{matrix}\text{whatever makes}\\ f(x)=b\end{matrix}\right)}$	$\frac{d}{dx}\left[\log_a(x)\right]=\frac{1}{\ln(a)}\cdot\frac{1}{x}$
$\frac{d}{dx}\left[\ln(x)\right]=\frac{1}{x}$		$\frac{d}{dx}\left[a^x\right]=\ln(a)\cdot a^x$
$\frac{d}{dx}\left[\arcsin(x)\right]=\frac{1}{\sqrt{1-x^2}}$	$\frac{d}{dx}\left[\arctan(x)\right]=\frac{1}{1+x^2}$	$\frac{d}{dx}\left[\operatorname{arcsec}(x)\right]=\frac{1}{\lvert x\rvert\sqrt{x^2-1}}$
$\frac{d}{dx}\left[\arccos(x)\right]=-\frac{1}{\sqrt{1-x^2}}$	$\frac{d}{dx}\left[\operatorname{arccot}(x)\right]=-\frac{1}{1+x^2}$	$\frac{d}{dx}\left[\operatorname{arccsc}(x)\right]=-\frac{1}{\lvert x\rvert\sqrt{x^2-1}}$

Basic Differentiation Rules with Chain Rule:

$$\frac{d}{dx}[c\cdot x]=c \qquad \frac{d}{dx}\left[u^n\right]=n\cdot u^{n-1}\cdot u' \qquad \frac{d}{dx}\left[|u|\right]=\frac{u}{|u|}\cdot u'$$

$$\frac{d}{dx}\left[\sin(u)\right]=\cos(u)\cdot u' \qquad \frac{d}{dx}\left[\sec(u)\right]=\sec(u)\tan(u)\cdot u' \qquad \frac{d}{dx}\left[\tan(u)\right]=\sec^2(u)\cdot u'$$

$$\frac{d}{dx}\left[\cos(u)\right]=-\sin(u)\cdot u' \qquad \frac{d}{dx}\left[\csc(u)\right]=-\csc(u)\cot(u)\cdot u' \qquad \frac{d}{dx}\left[\cot(u)\right]=-\csc^2(u)\cdot u'$$

$$\frac{d}{dx}\left[e^u\right]=e^u\cdot u' \qquad \left(f^{-1}\right)'(b)=\frac{1}{f'\begin{pmatrix}\text{whatever makes}\\ f(x)=b\end{pmatrix}} \qquad \frac{d}{dx}\left[\log_a(u)\right]=\frac{1}{\ln(a)}\cdot\frac{1}{u}\cdot u'$$

$$\frac{d}{dx}\left[\ln(u)\right]=\frac{1}{u}\cdot u' \qquad \frac{d}{dx}\left[a^u\right]=\ln(a)\cdot a^u\cdot u'$$

$$\frac{d}{dx}\left[\arcsin(u)\right]=\frac{1}{\sqrt{1-u^2}}\cdot u' \qquad \frac{d}{dx}\left[\arctan(u)\right]=\frac{1}{1+u^2}\cdot u' \qquad \frac{d}{dx}\left[\operatorname{arcsec}(u)\right]=\frac{1}{|u|\sqrt{u^2-1}}\cdot u'$$

$$\frac{d}{dx}\left[\arccos(u)\right]=-\frac{1}{\sqrt{1-u^2}}\cdot u' \qquad \frac{d}{dx}\left[\operatorname{arccot}(u)\right]=-\frac{1}{1+u^2}\cdot u' \qquad \frac{d}{dx}\left[\operatorname{arccsc}(u)\right]=-\frac{1}{|u|\sqrt{u^2-1}}\cdot u'$$

Higher order derivatives:

First Derivative	y'	$f'(x)$	$\frac{dy}{dx}$	$\frac{d}{dx}\left[f(x)\right]$
Second Derivative	y''	$f''(x)$	$\frac{d^2y}{dx^2}$	$\frac{d^2}{dx}\left[f(x)\right]$
Third Derivative	y'''	$f'''(x)$	$\frac{d^3y}{dx^3}$	$\frac{d^3}{dx^3}\left[f(x)\right]$
Fourth Derivative	$y^{(4)}$	$f^{(4)}(x)$	$\frac{d^4y}{dx^4}$	$\frac{d^4}{dx^4}\left[f(x)\right]$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
n^{th} Dertivative	$y^{(n)}$	$f^{(n)}(x)$	$\frac{d^ny}{dx^n}$	$\frac{d^n}{dx^n}\left[f(x)\right]$

$$\frac{d^2}{dx^2}\left[f(x)\right]\leftrightarrow\frac{d}{dx}\left[\frac{d}{dx}\left[f(x)\right]\right]$$