## 1 General Derivative Rules

- 1. Constant Rule  $\frac{d}{dx}[c] = 0$
- 2. Constant Multiple Rule  $\frac{d}{dx} [cf(x)] = cf'(x)$
- 3. Sum Rule  $\frac{d}{dx}[f(x) + g(x)] = f'(x) + g'(x)$
- 4. Difference Rule  $\frac{d}{dx} [f(x) g(x)] = f'(x) g'(x)$
- 5. Product Rule  $\frac{d}{dx}[f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$
- 6. Quotient Rule  $\frac{d}{dx} \left[ \frac{f(x)}{g(x)} \right] = \frac{g(x)f'(x) f(x)g'(x)}{\left[ g(x) \right]^2}$
- 7. Chain Rule  $\frac{d}{dx} [f(g(x))] = f'(g(x))g'(x)$

## 2 Derivative Rules for Particular Functions

**Basic Rule** 

 $\frac{d}{dx}[\ln x] = \frac{1}{x}$ 

11. Logarithm (base a)  $\frac{d}{dx} [\log_a x] = \frac{1}{x \ln a}$ 

10. Natural Logarithm

1. Powers	$\frac{d}{dx}\left[x^n\right] = nx^{n-1}$	$\frac{d}{dx}\left[\left(f(x)\right)^n\right] = n(f(x))^{n-1}f'(x)$
2. Sine	$\frac{d}{dx}\left[\sin x\right] = \cos x$	$\frac{d}{dx}\left[\sin\left(f(x)\right)\right] = \cos\left(f(x)\right)f'(x)$
3. Cosine	$\frac{d}{dx}\left[\cos x\right] = -\sin x$	$\frac{d}{dx}\left[\cos\left(f(x)\right)\right] = -\sin\left(f(x)\right)f'(x)$
4. Tangent	$\frac{d}{dx}\left[\tan x\right] = \sec^2 x$	$\frac{d}{dx}\left[\tan\left(f(x)\right)\right] = \sec^2\left(f(x)\right)f'(x)$
5. Secant	$\frac{d}{dx}\left[\sec x\right] = \sec x \tan x$	$\frac{d}{dx}\left[\sec\left(f(x)\right)\right] = \sec\left(f(x)\right)\tan\left(f(x)\right)f'(x)$
6. Cosecant	$\frac{d}{dx}\left[\csc x\right] = -\csc x \cot x$	$\frac{d}{dx}\left[\csc\left(f(x)\right)\right] = -\csc\left(f(x)\right)\cot\left(f(x)\right)f'(x)$
7. Cotangent	$\frac{d}{dx}\left[\cot x\right] = -\csc^2 x$	$\frac{d}{dx}\left[\cot\left(f(x)\right)\right] = -\csc^2\left(f(x)\right)f'(x)$
8. Exponential (base $e$ )	$\frac{d}{dx}\left[e^{x}\right]=e^{x}$	$\frac{d}{dx}\left[e^{(f(x))}\right] = e^{(f(x))}f'(x)$
9. Exponential (base <i>a</i> )	$\frac{d}{dx}\left[a^{x}\right]=a^{x}\ln a$	$\frac{d}{dx}\left[a^{(f(x))}\right] = a^{(f(x))}\ln af'(x)$

Chain Rule Form

 $\frac{d}{dx}\left[\ln f(x)\right] = \frac{1}{f(x)}f'(x)$ 

 $\frac{d}{dx}\left[\log_a f(x)\right] = \frac{1}{f(x)\ln a}f'(x)$ 

## 3 General Antiderivative Rules

Let F(x) be any antiderivative of f(x). That is, F'(x) = f(x). The most general antiderivative of f(x) is then F(x) + C.

	Original Function	General Antiderivative
1. Constant Rule	c (a constant)	cx + C
2. Constant Multiple Rule	cf(x)	cF(x) + C
3. Sum Rule	f(x) + g(x)	F(x)+G(x)+C
4. Difference Rule	f(x) - g(x)	F(x) - G(x) + C

## 4 Antiderivative Rules for Particular Functions

	Original Function	General Antiderivative
1. Powers $(n \neq -1)$	x <sup>n</sup>	$\frac{x^{n+1}}{n+1}+C$
2. Powers $(n=-1)$	$\frac{1}{x}$	$\ln  x  + C$
3. Sine	$\sin x$	$-\cos x + C$
4. Cosine	cos x	$\sin x + C$
5. Secant squared	$sec^2 x$	tan x + C
6. Secant times tangent	sec x tan x	$\sec x + C$
7. Cosecant times cotangent	$\csc x \cot x$	$-\csc x + C$
8. Cosecant squared	$\csc^2 x$	$-\cot x + C$
9. Exponential (base e)	e <sup>x</sup>	$e^x + C$
10. Exponential (base a)	a <sup>x</sup>	$\frac{a^x}{\ln a} + C$