

## 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  $\frac{d}{dx} \left[ \frac{f(x)}{g(x)} \right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$
7. Chain Rule  $\frac{d}{dx} [f(g(x))] = f'(g(x))g'(x)$

## 2 Derivative Rules for Particular Functions

|                         | Basic Rule   | Chain Rule Form  |
|-------------------------|--|--|
| 1. Powers               | $\frac{d}{dx} [x^n] = nx^{n-1}$                      | $\frac{d}{dx} [(f(x))^n] = n(f(x))^{n-1}f'(x)$                     |
| 2. Sine                 | $\frac{d}{dx} [\sin x] = \cos x$                     | $\frac{d}{dx} [\sin (f(x))] = \cos (f(x))f'(x)$                    |
| 3. Cosine               | $\frac{d}{dx} [\cos x] = -\sin x$                    | $\frac{d}{dx} [\cos (f(x))] = -\sin (f(x))f'(x)$                   |
| 4. Tangent              | $\frac{d}{dx} [\tan x] = \sec^2 x$                   | $\frac{d}{dx} [\tan (f(x))] = \sec^2 (f(x))f'(x)$                  |
| 5. Secant               | $\frac{d}{dx} [\sec x] = \sec x \tan x$              | $\frac{d}{dx} [\sec (f(x))] = \sec (f(x)) \tan (f(x))f'(x)$        |
| 6. Cosecant             | $\frac{d}{dx} [\csc x] = -\csc x \cot x$             | $\frac{d}{dx} [\csc (f(x))] = -\csc (f(x)) \cot (f(x))f'(x)$       |
| 7. Cotangent            | $\frac{d}{dx} [\cot x] = -\csc^2 x$                  | $\frac{d}{dx} [\cot (f(x))] = -\csc^2 (f(x))f'(x)$                 |
| 8. Exponential (base e) | $\frac{d}{dx} [e^x] = e^x$                           | $\frac{d}{dx} [e^{f(x)}] = e^{f(x)}f'(x)$                          |
| 9. Exponential (base a) | $\frac{d}{dx} [a^x] = a^x \ln a$                     | $\frac{d}{dx} [a^{f(x)}] = a^{f(x)} \ln a f'(x)$                   |
| 10. Natural Logarithm   | $\frac{d}{dx} [\ln x] = \frac{1}{x}$                 | $\frac{d}{dx} [\ln f(x)] = \frac{1}{f(x)}f'(x)$                    |
| 11. Logarithm (base a)  | $\frac{d}{dx} [\log_a x] = \frac{1}{x \ln a}$        | $\frac{d}{dx} [\log_a f(x)] = \frac{1}{f(x) \ln a} f'(x)$          |
| 12. Inverse sine        | $\frac{d}{dx} [\arcsin x] = \frac{1}{\sqrt{1-x^2}}$  | $\frac{d}{dx} [\arcsin f(x)] = \frac{1}{\sqrt{1-(f(x))^2}} f'(x)$  |
| 13. Inverse cosine      | $\frac{d}{dx} [\arccos x] = \frac{-1}{\sqrt{1-x^2}}$ | $\frac{d}{dx} [\arccos f(x)] = \frac{-1}{\sqrt{1-(f(x))^2}} f'(x)$ |
| 14. Inverse tangent     | $\frac{d}{dx} [\arctan x] = \frac{1}{1+x^2}$         | $\frac{d}{dx} [\arctan f(x)] = \frac{1}{1+(f(x))^2} f'(x)$         |

### 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 ( $n \neq -1$ )   | $x^n$                     | $\frac{x^{n+1}}{n+1} + C$ |
| 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 $e$ )  | $e^x$                     | $e^x + C$                 |
| 10. Exponential (base $a$ ) | $a^x$                     | $\frac{a^x}{\ln a} + C$   |
| 11. Inverse trigonometric   | $\frac{1}{\sqrt{1-x^2}}$  | $\arcsin x + C$           |
| 12. Inverse trigonometric   | $\frac{-1}{\sqrt{1-x^2}}$ | $\arccos x + C$           |
| 13. Inverse trigonometric   | $\frac{1}{1+x^2}$         | $\arctan x + C$           |