Basic Derivatives

$$\frac{d}{dx}e^{f(x)} = f'(x)e^{f(x)}$$
$$\frac{d}{dx}\sin f(x) = \cos f(x) \cdot f'(x)$$
$$\frac{d}{dx}\cos f(x) = -\sin f(x) \cdot f'(x)$$
$$\frac{d}{dx}\tan f(x) = \sec^2 f(x) \cdot f'(x)$$
$$\frac{d}{dx}\cot f(x) = -\csc^2 f(x) \cdot f'(x)$$
$$\frac{d}{dx}\sec f(x) = \sec f(x) \tan f(x) \cdot f'(x)$$
$$\frac{d}{dx}\csc f(x) = -\csc f(x) \cot f(x) \cdot f'(x)$$
$$\frac{d}{dx}\ln f(x) = \frac{f'(x)}{f(x)}$$
$$\frac{d}{dx}\log_a f(x) = \frac{f'(x)}{f(x)\ln a}$$
$$\frac{d}{dx}\left(f(x)\right)^n = n\left(f(x)\right)^{n-1} f'(x)$$
$$\frac{d}{dx}\sqrt{f(x)} = \frac{f'(x)}{2\sqrt{f(x)}}$$
$$\frac{d}{dx}a^x = a^x \ln a$$
$$\frac{d}{dx}b^{g(x)} = b^{g(x)} \ln b \cdot g'(x)$$

Chain Rule

$$\frac{d}{dx}f(g(x)) = f'(g(x)) \cdot g'(x)$$

Higher-Order Derivatives

$$\frac{d^2}{dx^2}e^x = e^x$$
$$\frac{d^3}{dx^3}\sin x = -\cos x$$
$$\frac{d^4}{dx^4}\cos x = \cos x$$

Inverse Trigonometric

$$\frac{d}{dx}\arcsin f(x) = \frac{f'(x)}{\sqrt{1-\left(f(x)\right)^2}}$$
$$\frac{d}{dx}\arccos f(x) = -\frac{f'(x)}{\sqrt{1-\left(f(x)\right)^2}}$$
$$\frac{d}{dx}\arctan f(x) = \frac{f'(x)}{1+\left(f(x)\right)^2}$$
$$\frac{d}{dx}\operatorname{arccot} f(x) = -\frac{f'(x)}{1+\left(f(x)\right)^2}$$
$$\frac{d}{dx}\operatorname{arcsec} f(x) = \frac{f'(x)}{|f(x)|\sqrt{\left(f(x)\right)^2-1}}$$
$$\frac{d}{dx}\operatorname{arccsc} f(x) = -\frac{f'(x)}{|f(x)|\sqrt{\left(f(x)\right)^2-1}}$$

Hyperbolic Function

$$\frac{d}{dx}\sinh f(x) = \cosh f(x) \cdot f'(x)$$
$$\frac{d}{dx}\cosh f(x) = \sinh f(x) \cdot f'(x)$$
$$\frac{d}{dx}\tanh f(x) = \operatorname{sech}^2 f(x) \cdot f'(x)$$
$$\frac{d}{dx}\coth f(x) = -\operatorname{csch}^2 f(x) \cdot f'(x)$$
$$\frac{d}{dx}\operatorname{sech} f(x) = -\operatorname{sech} f(x) \tanh f(x) \cdot f'(x)$$
$$\frac{d}{dx}\operatorname{csch} f(x) = -\operatorname{csch} f(x) \coth f(x) \cdot f'(x)$$

Product and Quotient

$$\frac{d}{dx}[u \cdot v] = u' \cdot v + u \cdot v'$$
$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{u' \cdot v - u \cdot v'}{v^2}$$

θ	Radians	$\sin(\theta)$	$\cos(\theta)$	$\tan(\theta)$
$0°$	0	0	1	0
$30°$	$\pi/6$	$1/2$	$\sqrt{3}/2$	$\sqrt{3}/3$
$45°$	$\pi/4$	$\sqrt{2}/2$	$\sqrt{2}/2$	1
$60°$	$\pi/3$	$\sqrt{3}/2$	$1/2$	$\sqrt{3}$
$90°$	$\pi/2$	1	0	–
$180°$	π	0	-1	0
$270°$	$3\pi/2$	-1	0	–

Table 1: Important Trigonometric Angles

Trigonometric Identities

Pythagorean

$$\begin{aligned} \sin^2\theta + \cos^2\theta &= 1 \\ \tan^2\theta + 1 &= \sec^2\theta \\ 1 + \cot^2\theta &= \csc^2\theta \end{aligned}$$

Reciprocal

$$\begin{aligned} \csc x &= \frac{1}{\sin x} \\ \sec x &= \frac{1}{\cos x} \\ \cot x &= \frac{1}{\tan x} \end{aligned}$$

Even and Odd

$$\begin{aligned} \sin(-x) &= -\sin x \\ \cos(-x) &= \cos x \\ \tan(-x) &= -\tan x \end{aligned}$$

Product to Sum

$$\begin{aligned} \sin x \sin y &= \frac{1}{2}[\cos(x-y) - \cos(x+y)] \\ \cos x \cos y &= \frac{1}{2}[\cos(x-y) + \cos(x+y)] \\ \sin x \cos y &= \frac{1}{2}[\sin(x+y) + \sin(x-y)] \\ \cos x \sin y &= \frac{1}{2}[\sin(x+y) - \sin(x-y)] \end{aligned}$$

Sum to Product

$$\begin{aligned} \sin x + \sin y &= 2\sin\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right) \\ \sin x - \sin y &= 2\cos\left(\frac{x+y}{2}\right)\sin\left(\frac{x-y}{2}\right) \\ \cos x + \cos y &= 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right) \\ \cos x - \cos y &= -2\sin\left(\frac{x+y}{2}\right)\sin\left(\frac{x-y}{2}\right) \end{aligned}$$

Double Angle