Basic Derivatives

$$\frac{d}{dx}e^{f(x)} = \qquad f'(x)e^{f(x)}$$

$$\frac{d}{dx}\sin f(x) = \qquad \cos f(x) \cdot f'(x)$$

$$\frac{d}{dx}\cos f(x) = \qquad -\sin f(x) \cdot f'(x)$$

$$\frac{d}{dx}\tan f(x) = \qquad \sec^2 f(x) \cdot f'(x)$$

$$\frac{d}{dx}\cot f(x) = \qquad -\csc^2 f(x) \cdot f'(x)$$

$$\frac{d}{dx}\sec f(x) = \qquad \sec f(x)\tan f(x) \cdot f'(x)$$

$$\frac{d}{dx}\csc f(x) = \qquad -\csc f(x)\cot f(x) \cdot f'(x)$$

$$\frac{d}{dx}\ln f(x) = \qquad \frac{f'(x)}{f(x)}$$

$$\frac{d}{dx}\log_a f(x) = \qquad \frac{f'(x)}{f(x)\ln a}$$

$$\frac{d}{dx}(f(x))^n = \qquad n\,(f(x))^{n-1}\,f'(x)$$

$$\frac{d}{dx}\sqrt{f(x)} = \qquad \frac{f'(x)}{2\sqrt{f(x)}}$$

$$\frac{d}{dx}a^x = \qquad a^x \ln a$$

$$\frac{d}{dx}b^{g(x)} = \qquad b^{g(x)} \ln b \cdot g'(x)$$

Chain Rule

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

Higher-Order Derivatives

$$\frac{d^2}{dx^2}e^x = \qquad e^x$$

$$\frac{d^3}{dx^3}\sin x = \qquad -\cos x$$

$$\frac{d^4}{dx^4}\cos x = \qquad \cos x$$

Inverse Trigonometric

$$\frac{d}{dx}\arcsin f(x) = \qquad \frac{f'(x)}{\sqrt{1 - (f(x))^2}}$$

$$\frac{d}{dx}\arccos f(x) = \qquad -\frac{f'(x)}{\sqrt{1 - (f(x))^2}}$$

$$\frac{d}{dx}\arctan f(x) = \qquad \frac{f'(x)}{1 + (f(x))^2}$$

$$\frac{d}{dx}\text{arccot}\, f(x) = \qquad -\frac{f'(x)}{1 + (f(x))^2}$$

$$\frac{d}{dx}\text{arcsec}\, f(x) = \qquad \frac{f'(x)}{|f(x)|\sqrt{(f(x))^2 - 1}}$$

$$\frac{d}{dx}\text{arccsc}\, f(x) = \qquad -\frac{f'(x)}{|f(x)|\sqrt{(f(x))^2 - 1}}$$

Hyperbolic Function

$$\frac{d}{dx}\sinh f(x) = \qquad \cosh f(x) \cdot f'(x)$$

$$\frac{d}{dx}\cosh f(x) = \qquad \sinh f(x) \cdot f'(x)$$

$$\frac{d}{dx}\tanh f(x) = \qquad \text{sech}^2 f(x) \cdot f'(x)$$

$$\frac{d}{dx}\coth f(x) = \qquad -\text{csch}^2 f(x) \cdot f'(x)$$

$$\frac{d}{dx}\text{sech}\, f(x) = \qquad -\text{sech}\, f(x)\tanh f(x) \cdot f'(x)$$

$$\frac{d}{dx}\text{csch}\, f(x) = \qquad -\text{csch}\, f(x)\coth f(x) \cdot f'(x)$$

Product and Quotient

$$\frac{d}{dx}[u \cdot v] = \qquad u' \cdot v + u \cdot v'$$

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

Integration

Trigonometric Integrals

$$\int \sin x \, dx = -\cos x + C$$

$$\int \cos x \, dx = \sin x + C$$

$$\int \sin^2 x = \frac{1}{2}(x - \sin x \cos x) + C$$

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

$$\int \tan x \, dx = -\ln|\cos x| + C$$

$$\int \cot x \, dx = \ln|\sin x| + C$$

$$\int \sec x \, dx = \ln|\sec x + \tan x| + C$$

$$\int \csc x \, dx = -\ln|\csc x + \cot x| + C$$

$$\int \sec^2 x \, dx = \tan x + C$$

$$\int \csc^2 x \, dx = -\cot x + C$$

$$\int \sec x \tan x \, dx = \sec x + C$$

$$\int \csc x \cot x \, dx = -\csc x + C$$

Inverse Trigonometric Integrals

$$\int \frac{1}{\sqrt{a^2 - x^2}} \, dx = \arcsin\left(\frac{x}{a}\right) + C$$

$$\int \frac{1}{a^2 + x^2} \, dx = \frac{1}{a}\arctan\left(\frac{x}{a}\right) + C$$

$$\int \frac{1}{x\sqrt{x^2 - a^2}} \, dx = \frac{1}{a}\operatorname{arcsec}\left(\frac{x}{a}\right) + C$$

Regular Integrals and e

$$\int x^n \, dx = \frac{1}{n+1}x^{n+1} + C$$

$$\int \frac{1}{x} \, dx = \ln|x| + C$$

$$\int e^x \, dx = e^x + C$$

$$\int e^{ax} \, dx = \frac{1}{a}e^{ax} + C$$

$$\int e^{f(x)} f'(x) \, dx = e^{f(x)} + C$$

Reduction Formulas for Sine and Cosine

$$\int \sin^n x \, dx = -\frac{1}{n}\sin^{n-1} x \cos x + \frac{n-1}{n}\int \sin^{n-2} x \, dx$$

$$\int \cos^n x \, dx = \frac{1}{n}\cos^{n-1} x \sin x + \frac{n-1}{n}\int \cos^{n-2} x \, dx$$

Common Definite Integrals

Exponetials

$$\int_0^b e^x \, dx = e^b - 1$$

$$\int_0^b e^{-x} \, dx = 1 - e^{-b}$$

$$\int_0^\infty e^{-x} \, dx = 1$$

$$\int_0^\infty x^n e^{-x} \, dx = n!$$

Sines and Cosines

n	$\int_0^{\pi/2} \sin^n x \, dx$	$\int_0^{\pi/2} \cos^n x \, dx$	$\int_0^\pi \sin^n x \, dx$	$\int_0^\pi \cos^n x \, dx$	$\int_0^{2\pi} \sin^n x \, dx$	$\int_0^{2\pi} \cos^n x \, dx$
1	1	1	2	0	0	0
2	$\pi/4$	$\pi/4$	$\pi/2$	$\pi/2$	π	π
3	$2/3$	$2/3$	$4/3$	0	0	0
4	$3\pi/16$	$3\pi/16$	$3\pi/8$	$3\pi/8$	$3\pi/4$	$3\pi/4$
5	$8/15$	$8/15$	$16/15$	0	0	0
6	$5\pi/32$	$5\pi/32$	$5\pi/16$	$5\pi/16$	$5\pi/8$	$5\pi/8$

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

$$\sin^2\theta + \cos^2\theta = 1$$
$$\tan^2\theta + 1 = \sec^2\theta$$
$$1 + \cot^2\theta = \csc^2\theta$$

Even and Odd

$$\sin(-x) = -\sin x$$
$$\cos(-x) = \cos x$$
$$\tan(-x) = -\tan x$$

Product to Sum

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

Sum to Product

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

Half Angle

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

Double Angle

$$\sin 2x = 2\sin x \cos x$$
$$\cos 2x = \cos^2 x - \sin^2 x$$
$$2\cos^2 x - 1$$
$$1 - 2\sin^2 x$$
$$\tan 2x = \frac{2\tan x}{1 - \tan^2 x}$$