Mathematical Tables

Trigonometric

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$
$$\cot\theta = \frac{1}{\tan\theta}$$
$$\sec\theta = \frac{1}{\cos\theta}$$
$$\operatorname{cosec}\theta = \frac{1}{\sin\theta}$$
$$\sin(-\theta) = -\sin\theta$$
$$\cos(-\theta) = \cos\theta$$
$$\sin(A \pm B) = \sin A\cos B \pm \cos A\sin B$$
$$\cos(A \pm B) = \cos A\cos B \mp \sin A\sin B$$
$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A\tan B}$$
$$\cos A + \cos B = 2\cos\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right)$$
$$\cos A - \cos B = -2\sin\left(\frac{A+B}{2}\right)\sin\left(\frac{A-B}{2}\right)$$
$$\cos\left(\theta \pm \frac{\pi}{2}\right) = \mp\sin\theta$$
$$\sin\left(\theta \pm \frac{\pi}{2}\right) = \pm\cos\theta$$
$$\sin\left(90^{\circ} - \theta\right) = \cos\theta$$
$$\cos\left(90^{\circ} - \theta\right) = \sin\theta$$
$$\cos^2\theta = \frac{1}{2}\left[1 + \cos\left(2\theta\right)\right]$$
$$\sin^2\theta = \frac{1}{2}\left[1 - \cos\left(2\theta\right)\right]$$
$$\cos^3\theta = \frac{1}{4}\left[3\cos\theta + \cos\left(3\theta\right)\right]$$
$$\sin^3\theta = \frac{1}{4}\left[3\sin\theta - \sin\left(3\theta\right)\right]$$
$$\sin^2\theta + \cos^2\theta = 1$$
$$1 + \cot^2\theta = \operatorname{cosec}^2\theta$$

$\cos^2\theta - \sin^2\theta = \cos(2\theta)$
$2\sin\theta\cos\theta = \sin(2\theta)$
$a\cos\theta + b\sin\theta = \sqrt{(a^2+b^2)}\cos(\theta+\alpha)$, where $\alpha = \tan^{-1}\left(\frac{-b}{a}\right)$ and $a \geq 0$
$a\cos\theta + b\sin\theta = -\sqrt{(a^2+b^2)}\cos(\theta+\alpha)$, where $\alpha = \tan^{-1}\left(\frac{-b}{a}\right)$ and $a < 0$
$\sin A\sin B = \frac{1}{2}\left[\cos(A-B) - \cos(A+B)\right]$
$\cos A\cos B = \frac{1}{2}\left[\cos(A-B) + \cos(A+B)\right]$
$\sin A\cos B = \frac{1}{2}\left[\sin(A-B) + \sin(A+B)\right]$

Indicies

$x^0 = 1$
$x^p x^q = x^{p+q}$
$\frac{x^p}{x^q} = x^{p-q}$
$(x^p)^q = x^{pq}$

Logs

$\ln x \equiv \log_e x$
$\log(x^p) = p\log x$
$\log_2 x = \frac{\log_{10}(x)}{\log_{10}(2)}$
$\log A + \log B = \log(AB)$
$\log A - \log B = \log\left(\frac{A}{B}\right)$

Complex

$j = \sqrt{-1}$
$e^{\pm j\theta} = \cos\theta \pm j\sin\theta$
$e^{\pm j\frac{\pi}{2}} = \pm j$
$\cos\theta = \frac{1}{2}\left[e^{j\theta} + e^{-j\theta}\right]$
$\sin\theta = \frac{1}{2j}\left[e^{j\theta} - e^{-j\theta}\right]$
$a + jb = re^{j\theta}$, where $r = \sqrt{(a^2+b^2)}$ and $\theta = \tan^{-1}\left(\frac{b}{a}\right)$
$r\left(e^{j\theta}\right)^n = r^n e^{jn\theta}$
$\left(r_1 e^{j\theta_1}\right)\left(r_2 e^{j\theta_2}\right) = r_1 r_2 e^{j(\theta_1+\theta_2)}$

Exponential

$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$

Logarithmic

$\log_e (1 + x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \cdots$ where $(|x| < 1)$

Binomial

$(1 + x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \cdots$ where $|nx| < 1$

Taylor

$f(x) = f(a) + (x - a) \frac{df(x)}{dx}\Big|_{x=a} + (x - a)^2 \frac{1}{2!}\frac{d^2 f(x)}{d^2 x}\Big|_{x=a} + \cdots + (x - a)^n \frac{1}{n!}\frac{d^n f(x)}{d^n x}\Big|_{x=a}$

Derivatives and Integrals

$\frac{d(au)}{dx} = a\frac{d(u)}{dx}$

$\frac{d(u+v)}{dx} = \frac{d(u)}{dx} + \frac{d(v)}{dx}$

$\frac{d(uv)}{dx} = u\frac{d(v)}{dx} + v\frac{d(u)}{dx}$

$\frac{d(x^n)}{dx} = nx^{n-1}$

$\frac{d(e^u)}{dx} = e^u \frac{d(u)}{dx}$

$\frac{d(e^{ax})}{dx} = ae^{ax}$

$\frac{d(\sin u)}{dx} = \cos u \frac{d(u)}{dx}$

$\frac{d(\cos u)}{dx} = -\sin u \frac{d(u)}{dx}$

$\frac{d(\sin ax)}{dx} = a\cos(ax)$

$\frac{d(\cos ax)}{dx} = -a\sin(ax)$

$$\frac{d(\tan\theta)}{dx} = \sec^2\theta$$
$$\frac{d(\cot\theta)}{dx} = -\operatorname{cosec}^2\theta$$
$$\frac{d(\sec\theta)}{dx} = \tan\theta\sec\theta$$
$$\frac{d(\operatorname{cosec}\theta)}{dx} = -\cot\theta\operatorname{cosec}\theta$$
$$\frac{d(\ln ax)}{dx} = \frac{d(\ln x)}{dx} = \frac{1}{x}$$

Indefinite Integrals

$$\int au\ dx = a\int u\ dx$$
$$\int (u+v)\ dx = \int u\ dx + \int v\ dx$$
$$\int x^p\ dx = \frac{x^{p+1}}{p+1} \quad (p \neq -1)$$
$$\int \frac{1}{x}\ dx = \ln|x|$$
$$\int u\ dv = uv - \int v\ du$$
$$\int u\ \frac{dv}{dx}dx = uv - \int v\ \frac{du}{dx}dx$$
$$\int \sin(ax) = \frac{-1}{a}\cos(ax)$$
$$\int \cos(ax) = \frac{1}{a}\sin(ax)$$
$$\int \sin^2(ax) = \frac{x}{2} - \frac{\sin(2ax)}{4a}$$
$$\int \cos^2(ax) = \frac{x}{2} + \frac{\sin(2ax)}{4a}$$
$$\int x\sin(ax) = \frac{\sin(ax)-ax\cos(ax)}{a^2}$$
$$\int x\cos(ax) = \frac{\cos(ax)+ax\sin(ax)}{a^2}$$
$$\int x^2\sin(ax) = \frac{2ax\sin(ax)+2\cos(ax)-(ax)^2\cos(ax)}{a^3}$$
$$\int x^2\cos(ax) = \frac{2ax\cos(ax)-2\sin(ax)+(ax)^2\sin(ax)}{a^3}$$
$$\int e^{ax}dx = \frac{e^{ax}}{a}$$

$$\int xe^{ax}dx = \frac{e^{ax}}{a^2}(ax-1)$$

$$\int x^n e^{ax}dx = \frac{x^n e^{ax}}{a} - \frac{n}{a}\int x^{n-1}e^{ax}dx$$

$$\int xe^{ax^2}dx = \frac{1}{2a}e^{ax^2}$$

$$\int e^{ax}\sin(bx)\,dx = \frac{e^{ax}}{a^2+b^2}\left[a\sin(bx) - b\cos(bx)\right]$$

$$\int e^{ax}\cos(bx)\,dx = \frac{e^{ax}}{a^2+b^2}\left[a\cos(bx) + b\sin(bx)\right]$$

$$\int \frac{1}{(a^2+b^2x^2)}dx = \frac{1}{ab}\tan^{-1}\left(\frac{bx}{a}\right)$$

$$\int \frac{x^2}{(a^2+b^2x^2)}dx = \frac{x}{b^2} - \frac{a}{b^3}\tan^{-1}\left(\frac{bx}{a}\right)$$

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

Definite Integrals

$$\int_0^\infty \frac{x\sin(ax)}{b^2+x^2}dx = \frac{\pi}{2}e^{(-ab)} \quad \text{where } a>0 \text{ and } b>0$$

$$\int_0^\infty \frac{\cos(ax)}{b^2+x^2}dx = \frac{\pi}{2b}e^{(-ab)} \quad \text{where } a>0 \text{ and } b>0$$

$$\int_0^\infty \operatorname{sinc} dx = \int_0^\infty \operatorname{sinc}^2 dx = \frac{1}{2}$$

$$\int_0^\infty e^{-ax^2}dx = \frac{1}{2}\sqrt{\frac{\pi}{a}} \text{ for } a>0$$

$$\int_0^\infty x^2 e^{-ax^2}dx = \frac{1}{4a}\sqrt{\frac{\pi}{a}} \text{ for } a>0$$

$$\int_0^\infty x^n e^{-ax}dx = \frac{n!}{a^{n+1}}$$