rad	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{3\pi}{4}$	$\frac{5\pi}{6}$	π	$\frac{7\pi}{6}$	$\frac{5\pi}{4}$	$\frac{4\pi}{3}$	$\frac{3\pi}{2}$	$\frac{5\pi}{3}$	$\frac{7\pi}{4}$	$\frac{11\pi}{6}$	2π
deg	0	30	45	60	90	120	135	150	180	210	225	240	270	300	315	330	360
sin	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	$\frac{-1}{2}$	$\frac{-\sqrt{2}}{2}$	$\frac{-\sqrt{3}}{2}$	-1	$\frac{-\sqrt{3}}{2}$	$\frac{-\sqrt{2}}{2}$	$\frac{-1}{2}$	0
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	$\frac{-1}{2}$	$\frac{-\sqrt{2}}{2}$	$\frac{-\sqrt{3}}{2}$	-1	$\frac{-\sqrt{3}}{2}$	$\frac{-\sqrt{2}}{2}$	$\frac{-1}{2}$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
tan	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	und	$-\sqrt{3}$	-1	$\frac{-\sqrt{3}}{3}$	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	und	$-\sqrt{3}$	-1	$\frac{-\sqrt{3}}{3}$	0

Pythagorean Identities

$$SIN^2\alpha + COS^2\alpha = 1$$
$$1 + TAN^2\alpha = SEC^2\alpha$$
$$1 + COT^2\alpha = CSC^2\alpha$$

Sum & Difference

$$SIN(\alpha \pm \beta) = SIN\alpha COS\beta \pm COS\alpha SIN\beta$$
$$COS(\alpha \pm \beta) = COS\alpha COS\beta \mp SIN\alpha SIN\beta$$
$$TAN(\alpha \pm \beta) = \frac{TAN\alpha \pm TAN\beta}{1 \mp TAN\alpha TAN\beta}$$

Double-Angles

$$SIN(2\alpha) = 2SIN\alpha COS\alpha$$
$$COS(2\alpha) = COS^2\alpha - SIN^2\alpha$$
$$COS(2\alpha) = 2COS^2\alpha - 1$$
$$COS(2\alpha) = 1 - 2SIN^2\alpha$$
$$TAN(2\alpha) = \frac{2TAN\alpha}{1 - TAN^2\alpha}$$

Half-Angles

$$SIN\left(\frac{\alpha}{2}\right) = \pm\sqrt{\frac{1 - COS\alpha}{2}}$$
$$COS\left(\frac{\alpha}{2}\right) = \pm\sqrt{\frac{1 + COS\alpha}{2}}$$
$$TAN\left(\frac{\alpha}{2}\right) = \frac{1 - COS\alpha}{SIN\alpha} = \frac{SIN\alpha}{1 + COS\alpha}$$

Product-To-Sum

$$SIN\alpha SIN\beta = \frac{1}{2}\left[COS(\alpha - \beta) - COS(\alpha + \beta)\right]$$
$$COS\alpha COS\beta = \frac{1}{2}\left[COS(\alpha - \beta) + COS(\alpha + \beta)\right]$$
$$SIN\alpha COS\beta = \frac{1}{2}\left[SIN(\alpha + \beta) + SIN(\alpha - \beta)\right]$$
$$COS\alpha SIN\beta = \frac{1}{2}\left[SIN(\alpha + \beta) - SIN(\alpha - \beta)\right]$$

Sum-to-Product

$$SINx + SINy = 2SIN\left(\frac{x+y}{2}\right)COS\left(\frac{x-y}{2}\right)$$
$$SINx - SINy = 2COS\left(\frac{x+y}{2}\right)SIN\left(\frac{x-y}{2}\right)$$
$$COSx + COSy = 2COS\left(\frac{x+y}{2}\right)COS\left(\frac{x-y}{2}\right)$$
$$COSx - COSy = -2SIN\left(\frac{x+y}{2}\right)SIN\left(\frac{x-y}{2}\right)$$

Power-Reducing

$$SIN^2x = \frac{1 - COS(2x)}{2}$$
$$COS^2x = \frac{1 + COS(2x)}{2}$$
$$TAN^2x = \frac{1 - COS(2x)}{1 + COS(2x)}$$

Law of Sines

$$\frac{a}{SINA} = \frac{b}{SINB} = \frac{c}{SINC}$$

Law of Cosines

$$a^2 = b^2 + c^2 - 2bcCOSA$$
$$COSA = \frac{b^2 + c^2 - a^2}{2bc}$$
$$b^2 = a^2 + c^2 - 2acCOSB$$
$$COSB = \frac{a^2 + c^2 - b^2}{2ac}$$
$$c^2 = a^2 + b^2 - 2abCOSC$$
$$COSC = \frac{a^2 + b^2 - c^2}{2ab}$$

Special limits

$$\lim_{x \to 0}\left(\frac{\sin x}{x}\right) = 1$$
$$\lim_{x \to 0}\left(\frac{1 - \cos x}{x}\right) = 0$$

Heron's Area Formula

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

where $s = \frac{a+b+c}{2}$

Area of Oblique Triangles

$$Area = \frac{1}{2}bcSINA$$
$$Area = \frac{1}{2}abSINC$$
$$Area = \frac{1}{2}acSINB$$

Line Formulas

$y - y_1 = m(x - x_1)$ point-slope

$m = \frac{y_2 - y_1}{x_2 - x_1}$ $m = TAN\theta$

dist. from (x_1, y_1) to $Ax + By = C$ is given by $d = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}$

Conic Sections

$$(x - h)^2 = 4p(y - k)$$
$$\frac{(x-h)^2}{a^2} \pm \frac{(y-k)^2}{b^2} = 1$$

asymptotes: $y = \pm(x - h) + k$

Sequences & Series

$$a_n = a_1 + (n-1)d$$
$$a_a = a_1 r^{n-1} \qquad S_\infty = \frac{a_1}{1-r}$$
$$S_n = \frac{a_1 - a_n r}{1-r} = \frac{a_1 - a_1 r^n}{1-r}$$
$$S_n = \frac{n}{2}(a_1 + a_n) = \frac{n}{2}\left[2a_1 + (n-1)d\right]$$

Differentiation Rules

$\frac{d}{dx}[c] = 0$ $\quad \frac{d}{dx}[x] = 1$

$\frac{d}{dx}[cu] = cu'$

$\frac{d}{dx}[u \pm v] = u' \pm v'$

$\frac{d}{dx}[fgh] = f'gh + fg'h + fgh'$

$\frac{d}{dx}[uv] = uv' + vu'$

$\frac{d}{dx}\left[\frac{u}{v}\right] = \frac{vu' - uv'}{v^2}$

$\frac{d}{dx}[u^n] = nu^{n-1}u'$

$\frac{d}{dx}[|u|] = \frac{u}{|u|}(u'),$

$\frac{d}{dx}[\ln u] = \frac{u'}{u}$

$\frac{d}{dx}[e^u] = e^u u'$

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

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

$\frac{d}{dx}[\tan u] = (\sec^2 u)u'$

$\frac{d}{dx}[\cot u] = -(\csc^2 u)u'$

$\frac{d}{dx}[\sec u] = (\sec u \tan u)u'$

$\frac{d}{dx}[\csc u] = -(\csc u \cot u)u'$

$\frac{d}{dx}[\arcsin u] = \frac{u'}{\sqrt{1-u^2}}$

$\frac{d}{dx}[\arccos u] = \frac{-u^2}{\sqrt{1-u^2}}$

$\frac{d}{dx}[\arctan u] = \frac{u'}{1+u^2}$

$\frac{d}{dx}[arc\cot u] = \frac{-u'}{1+u^2}$

$\frac{d}{dx}[arc\sec u] = \frac{u'}{|u|\sqrt{u^2-1}}$

$\frac{d}{dx}[arc\csc u] = \frac{-u'}{|u|\sqrt{u^2-1}}$

Trig Graphing

$y = a\sin(bx + c) + d$

amplitude: $|u|$

period: $2\pi/|b|$

phase sht: $-c/b$

vertical anslation: d

Integration Formulas

$\int du = u + C$

$\int kf(u)\,du = k\int f(u)\,du$

$\int [f(u) \pm g(u)]\,du = \int f(u)\,du \pm \int g(u)\,du$

$\int u^n\,du = \frac{u^{n+1}}{n+1} + C, \quad n \neq -1$

$\int \frac{du}{u} = \ln|u| + C$

$\int \frac{du}{u\ln u} = \ln|\ln u| + C$

$\int \ln u\,du = u\ln u - u + C$

$\int a^u\,du = \frac{a^u}{\ln a} + C$

$\int e^u\,du = e^u + C$

$\int ue^u\,du = e^u(u-1) + C$

$\int \sin u\,du = -\cos u + C$

$\int u\sin u\,du = \sin u - u\cos u + C$

$\int \sin^2 u\,du = \frac{1}{2}u - \frac{1}{4}\sin(2u) + C$

$\int \cos u\,du = \sin u + C$

$\int ucou\,du = \cos u + u\sin u + C$

$\int \cos^2 u\,du = \frac{1}{2}u + \frac{1}{4}\sin(2u) + C$

$\int \tan u\,du = -\ln|\cos u| + C$

$\int \tan^2 u\,du = \tan u - u + C$

$\int \cot u\,du = \ln|\sin u| + C$

$\int \cot^2 u\,du = -\cot u - u + C$

$\int \sec u\,du = \ln|\sec u + \tan u| + C$

$\int \csc u\,du = -\ln|\csc u + \cot u| + C$

$\int \sec^2 u\,du = \tan u + C$

$\int \csc^2 u\,du = -\cot u + C$

$\int \sec u\tan u\,du = \sec u + C$

$\int \csc u\cot u\,du = -\csc u + C$

$\int \frac{du}{\sqrt{a^2-u^2}} = \arcsin\frac{u}{a} + C$

$\int \frac{du}{a^2+u^2} = \frac{1}{a}\arctan\frac{u}{a} + C$

$\int \frac{du}{u\sqrt{u^2-a^2}} = \frac{1}{a}arc\sec\frac{|u|}{a} + C$

Complex Numbers

$a + bi = (r\cos\vartheta) + (r\sin\vartheta)i$

If $z = a + bi$,

then $|z| = |a + bi| = \sqrt{a^2 + b^2}$

If $z_1 = r_1(\cos\vartheta_1 + i\sin\vartheta_1)$

and $z_2 = r_2(\cos\vartheta_2 + i\sin\vartheta_2)$

then

$z_1z_2 = r_1r_2[\cos(\vartheta_1 + \vartheta_2) + i\sin(\vartheta_1 + \vartheta_2)]$

and

$\frac{z_1}{z_2} = \frac{r_1}{r_2}[\cos(\vartheta_1 - \vartheta_2) + i\sin(\vartheta_1 - \vartheta_2)]$

Log Properties

$\lim_{n\to\infty}\left(1 + \frac{1}{n}\right)^n = e \approx 2.71828$

$\log_a a = 1 \qquad \log_a 1 = 0$

$\log_a(a^x) = x \qquad a^{\log_a x} = x$

$\log_a x = \frac{\log_b x}{\log_b a}$

$\log_a(uv) = \log_a u + \log_a v$

$\log_a\left(\frac{u}{v}\right) = \log_a u - \log_a v$

$\log_a(u^n) = n\log_a u$

Vectors

dot product: $u \bullet v = u_1v_1 + u_2v_2$

If $v = \langle v_1, v_2\rangle$, then $\|v\| = \sqrt{v_1^2 + v_2^2}$

$\cos\vartheta = \frac{u \bullet v}{\|u\| \cdot \|v\|}$

$\|u\| \cdot \|v\|\cos\vartheta = u \bullet v$

$v = \|v\|\langle\cos\vartheta, \sin\vartheta\rangle$

$= \|v\|(\cos\vartheta)i + \|v\|(\sin\vartheta)j$

,where $i = \langle 1,0\rangle$ and $j = \langle 0,1\rangle$.

De Moivre's Theorem

If $z = r(\cos\vartheta = i\sin\vartheta)$ is complex and **n** is a natural number, then $z^n = r^n(\cos n\vartheta = i\sin n\vartheta)$.

Complex number $z = r(\cos\vartheta = i\sin\vartheta)$ has exactly **n** roots given by:

$\sqrt[n]{r}\left(\cos\left(\frac{\vartheta + 2\pi k}{n}\right) + i\sin\left(\frac{\vartheta + 2\pi k}{n}\right)\right)$,w

here **k=0, 1, 2, … , n-1.**