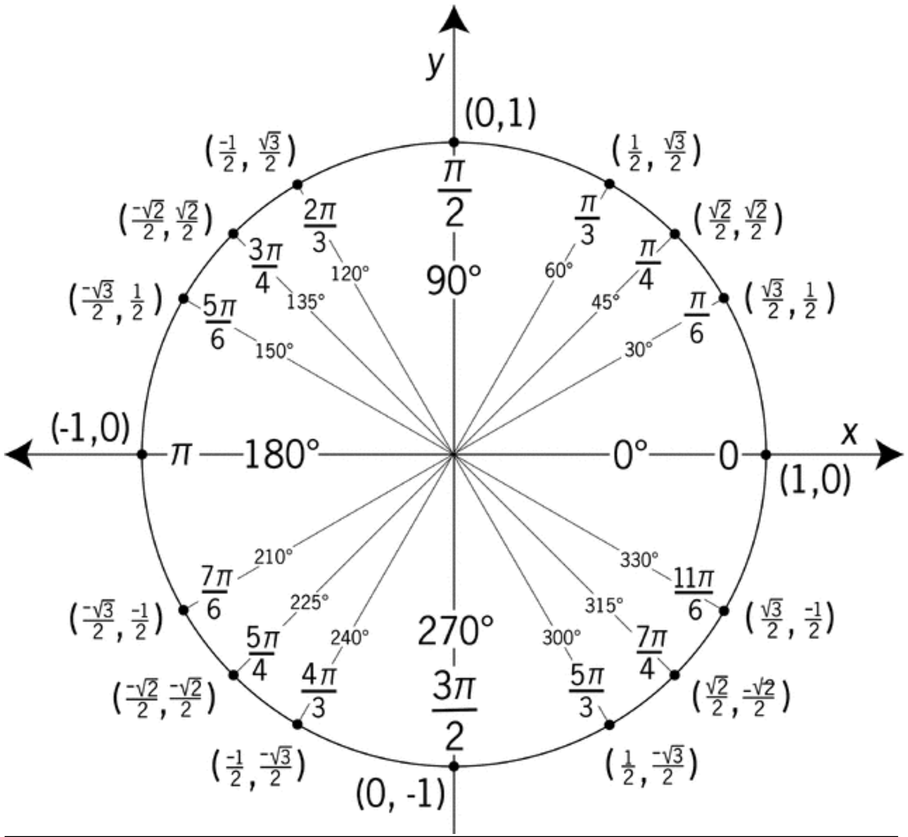
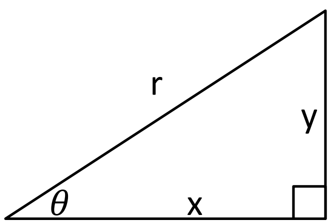
## Unit Circle:

$x^2 + y^2 = 1$




## Right Triangle Definitions:




$\cos(\theta) = \frac{x}{r}$ $\quad \sin(\theta) = \frac{y}{r}$ $\quad \tan(\theta) = \frac{y}{x}$

$\theta = \cos^{-1}\left(\frac{x}{r}\right)$ $\quad \theta = \sin^{-1}\left(\frac{y}{r}\right)$ $\quad \theta = \tan^{-1}\left(\frac{y}{x}\right)$

$\sec(\theta) = \frac{r}{x}$ $\quad \csc(\theta) = \frac{r}{y}$ $\quad \cot(\theta) = \frac{x}{y}$

**Range of Inverses**: arccos: $[0, \pi]$ arcsin: $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ arctan: $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

## Pythagorean Identities:

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

## Even/Odd Identities:

$\sin(-x) = -\sin x$ $\quad \csc(-x) = -\csc x$

$\cos(-x) = \cos x$ $\quad \sec(-x) = \sec x$

$\tan(-x) = -\tan x$ $\quad \cot(-x) = -\cot x$

## Sum/Difference Identities

$$\sin(A+B) = \sin A \cos B + \cos A \sin B$$
$$\sin(A-B) = \sin A \cos B - \cos A \sin B$$
$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$
$$\cos(A-B) = \cos A \cos B + \sin A \sin B$$
$$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$
$$\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

## Periodic Identities:

$\sin(x + 2\pi n) = \sin x$ $\quad \csc(x + 2\pi n) = \csc x$

$\cos(x + 2\pi n) = \cos x$ $\quad \sec(x + 2\pi n) = \sec x$

$\tan(x + \pi n) = \tan x$ $\quad \cot(x + \pi n) = \cot x$

## Cofunction Identities:

$\sin\left(\frac{\pi}{2} - x\right) = \cos x$ $\quad \cos\left(\frac{\pi}{2} - x\right) = \sin x$

$\tan\left(\frac{\pi}{2} - x\right) = \cot x$ $\quad \cot\left(\frac{\pi}{2} - x\right) = \tan x$

$\csc\left(\frac{\pi}{2} - x\right) = \sec x$ $\quad \sec\left(\frac{\pi}{2} - x\right) = \csc x$

## Complex Rectangular to Polar:

$$x + yi = r(\cos\theta + i\sin\theta) = r \text{ cis } \theta$$
$$x = r\cos\theta \quad y = r\sin\theta \quad r^2 = x^2 + y^2$$

## Product/Quotient Theorem:

$$(r \text{ cis } A)(s \text{ cis } B) = rs \text{ cis}(A+B)$$
$$\frac{r \text{ cis } A}{s \text{ cis } B} = \frac{r}{s} \text{ cis}(A-B)$$

## De Moivre's and Nth Root Theorem:

$$[r \text{ cis } \theta]^n = r^n \text{ cis}(n\theta)$$
$$w_k = \sqrt[n]{r} \text{ cis}\left(\frac{\theta + k \cdot 360°}{n}\right)$$

k takes all values between zero and n-1

## Half Angle Identities:

$$\sin\left(\frac{x}{2}\right) = \pm\sqrt{\frac{1-\cos x}{2}}$$
$$\cos\left(\frac{x}{2}\right) = \pm\sqrt{\frac{1+\cos x}{2}}$$
$$\tan\left(\frac{x}{2}\right) = \frac{\sin x}{1+\cos x} = \frac{1-\cos x}{\sin x}$$

## Power Reducing Identities:

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

## Double Angle Identities:

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

## Product/Sum Identities:

$$\sin A \sin B = \frac{1}{2}\cos(A-B) - \frac{1}{2}\cos(A+B)$$
$$\cos A \cos B = \frac{1}{2}\cos(A-B) + \frac{1}{2}\cos(A+B)$$
$$\sin A \cos B = \frac{1}{2}\sin(A+B) + \frac{1}{2}\sin(A-B)$$

$$\sin A + \sin B = 2\sin\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right)$$
$$\sin A - \sin B = 2\cos\left(\frac{A+B}{2}\right)\sin\left(\frac{A-B}{2}\right)$$
$$\cos A + \cos B = 2\cos\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right)$$
$$\cos A - \cos B = -2\sin\left(\frac{A+B}{2}\right)\sin\left(\frac{A-B}{2}\right)$$

## Law of Sines/Cosines:

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$b^2 = a^2 + c^2 - 2ac\cos B$$
$$c^2 = a^2 + b^2 - 2ab\cos C$$