Definitions

(OPPosite, ADJacent, HYPotenouse)

$$\sin(\theta) = \frac{\text{opp}}{\text{hyp}} \qquad \csc(\theta) = \frac{\text{hyp}}{\text{opp}}$$

$$\cos(\theta) = \frac{\text{adj}}{\text{hyp}} \qquad \sec(\theta) = \frac{\text{hyp}}{\text{adj}}$$

$$\tan(\theta) = \frac{\text{opp}}{\text{adj}} \qquad \cot(\theta) = \frac{\text{adj}}{\text{opp}}$$

Definitions - (x, y, r)

$$\sin(\theta) = \frac{y}{r} \qquad \csc(\theta) = \frac{r}{y}$$

$$\cos(\theta) = \frac{x}{r} \qquad \sec(\theta) = \frac{r}{x}$$

$$\tan(\theta) = \frac{y}{x} \qquad \cot(\theta) = \frac{x}{y}$$

Changing To Sine And Cosine

$$\tan(\theta) = \frac{\sin(\theta)}{\cos(\theta)} \qquad \sec(\theta) = \frac{1}{\cos(\theta)}$$

$$\cot(\theta) = \frac{\cos(\theta)}{\sin(\theta)} \qquad \csc(\theta) = \frac{1}{\sin(\theta)}$$

Pythagorean Identities

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

Double-Angle Formulas

$$\begin{aligned} \sin(2\theta) &= 2\sin(\theta)\cos(\theta) \\ \cos(2\theta) &= \cos^2(\theta) - \sin^2(\theta) \\ \cos(2\theta) &= 2\cos^2(\theta) - 1 \\ \cos(2\theta) &= 1 - 2\sin^2(\theta) \\ \tan(2\theta) &= \frac{2\tan(\theta)}{1 - \tan^2(\theta)} \end{aligned}$$

Half-Angle Formulas

$$\begin{aligned} \sin\left(\frac{\theta}{2}\right) &= \pm\sqrt{\frac{1 - \cos(\theta)}{2}} \\ \cos\left(\frac{\theta}{2}\right) &= \pm\sqrt{\frac{1 + \cos(\theta)}{2}} \\ \tan\left(\frac{\theta}{2}\right) &= \frac{1 - \cos(\theta)}{\sin(\theta)} \\ \tan\left(\frac{\theta}{2}\right) &= \frac{\sin(\theta)}{1 + \cos(\theta)} \end{aligned}$$

Sum and Difference Formulas

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

Product-to-Sum Formulas

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

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

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

Sum-to-Product Formulas

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

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

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

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

Power Reducing Formulas

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

$$\cos^2(\theta) = \frac{1+\cos(2\theta)}{2}$$

$$\tan^2(\theta) = \frac{1-\cos(2\theta)}{1+\cos(2\theta)}$$

Even and Odd Trig Functions

$\sin(-\theta) = -\sin(\theta)$	sine is ODD
$\csc(-\theta) = -\csc(\theta)$	cosecant is ODD
$\tan(-\theta) = -\tan(\theta)$	tangent is ODD
$\cot(-\theta) = -\cot(\theta)$	cotangent is ODD
$\cos(-\theta) = \cos(\theta)$	cosine is EVEN
$\sec(-\theta) = \sec(\theta)$	secant is EVEN

Cofunction Formulas (in degrees)

$$\sin(\theta) = \cos(90^\circ - \theta)$$
$$\cos(\theta) = \sin(90^\circ - \theta)$$
$$\tan(\theta) = \cot(90^\circ - \theta)$$
$$\cot(\theta) = \tan(90^\circ - \theta)$$
$$\sec(\theta) = \csc(90^\circ - \theta)$$
$$\csc(\theta) = \sec(90^\circ - \theta)$$

Cofunction Formulas (in radians)

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

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

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

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

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

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

Derivative Formulas (Calculus)

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

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

$$\frac{d}{dx}\Big(\tan(x)\Big) = \sec^2(x)$$

$$\frac{d}{dx}\Big(\cot(x)\Big) = -\csc^2(x)$$

$$\frac{d}{dx}\Big(\sec(x)\Big) = \sec(x)\tan(x)$$

$$\frac{d}{dx}\Big(\csc(x)\Big) = -\csc(x)\cot(x)$$