

# Trigonometric Identities

## Basic Identities

$$\sin^2(\theta) + \cos^2(\theta) = 1$$

$$\sec^2(\theta) = 1 + \tan^2(\theta)$$

$$\csc^2(\theta) = 1 + \cot^2(\theta)$$

## Sums and Differences

$$\cos(\alpha + \beta) = \cos(\alpha) \cos(\beta) - \sin(\alpha) \sin(\beta)$$

$$\cos(\alpha - \beta) = \cos(\alpha) \cos(\beta) + \sin(\alpha) \sin(\beta)$$

$$\sin(\alpha + \beta) = \sin(\alpha) \cos(\beta) + \cos(\alpha) \sin(\beta)$$

$$\sin(\alpha - \beta) = \sin(\alpha) \cos(\beta) - \cos(\alpha) \sin(\beta)$$

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

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

$$\tan(\alpha + \beta) = \frac{\tan(\alpha) + \tan(\beta)}{1 - \tan(\alpha) \tan(\beta)}$$

$$\tan(\alpha - \beta) = \frac{\tan(\alpha) - \tan(\beta)}{1 + \tan(\alpha) \tan(\beta)}$$

## Double Angle

$$\sin(2\theta) = 2 \sin(\theta) \cos(\theta)$$

$$\cos(2\theta) = \cos^2(\theta) - \sin^2(\theta)$$

$$\cos(2\theta) = 2 \cos^2(\theta) - 1$$

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

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

## Half Angle

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

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

## Inverse

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

$$\cot^{-1}(\theta) = \frac{\pi}{2} - \tan^{-1}(\theta)$$

$$\csc^{-1}(\theta) = \frac{\pi}{2} - \sec^{-1}(\theta)$$

## Product-Sum

$$\cos(\alpha) \cos(\beta) = \frac{\cos(\alpha - \beta) + \cos(\alpha + \beta)}{2}$$

$$\sin(\alpha) \sin(\beta) = \frac{\cos(\alpha - \beta) - \cos(\alpha + \beta)}{2}$$

$$\sin(\alpha) \cos(\beta) = \frac{\sin(\alpha + \beta) + \sin(\alpha - \beta)}{2}$$

$$\cos(\alpha) \sin(\beta) = \frac{\sin(\alpha + \beta) - \sin(\alpha - \beta)}{2}$$

$$\sin(\alpha - \beta) \sin(\alpha + \beta) = \sin^2(\alpha) - \sin^2(\beta)$$

$$\sin(\alpha) + \sin(\beta) = 2 \sin\left(\frac{\alpha + \beta}{2}\right) \cos\left(\frac{\alpha - \beta}{2}\right)$$

$$\sin(\alpha) - \sin(\beta) = 2 \cos\left(\frac{\alpha + \beta}{2}\right) \sin\left(\frac{\alpha - \beta}{2}\right)$$

$$\cos(\alpha) + \cos(\beta) = 2 \cos\left(\frac{\alpha + \beta}{2}\right) \cos\left(\frac{\alpha - \beta}{2}\right)$$

$$\cos(\alpha) - \cos(\beta) = -2 \sin\left(\frac{\alpha + \beta}{2}\right) \sin\left(\frac{\alpha - \beta}{2}\right)$$

### Law Of Sines

$$\frac{\sin(\alpha)}{a} = \frac{\sin(\beta)}{b} = \frac{\sin(\gamma)}{c}$$

### Law Of Cosines

$$a^2 = b^2 + c^2 - 2bc \cos(\alpha)$$

$$b^2 = a^2 + c^2 - 2ac \cos(\beta)$$

$$c^2 = a^2 + b^2 - 2ab \cos(C)$$