

# Trigonometry Function Identities

## Quotient Identities

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$
$$\cot\theta = \frac{\cos\theta}{\sin\theta}$$

## Reciprocal Identities

$$\sin\theta = \frac{1}{\csc\theta} \quad \csc\theta = \frac{1}{\sin\theta}$$
$$\cos\theta = \frac{1}{\sec\theta} \quad \sec\theta = \frac{1}{\cos\theta}$$
$$\tan\theta = \frac{1}{\cot\theta} \quad \cot\theta = \frac{1}{\tan\theta}$$

## Pythagorean Identities

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

## Even/Odd Identities

$$\sin(-\theta) = -\sin\theta \quad \cos(-\theta) = \cos\theta$$
$$\tan(-\theta) = -\tan\theta \quad \cot(-\theta) = -\cot\theta$$
$$\csc(-\theta) = -\csc\theta \quad \sec(-\theta) = \sec\theta$$

## Cofunction Identities

$$\sin\left(\frac{\pi}{2} - \theta\right) = \cos\theta \quad \cos\left(\frac{\pi}{2} - \theta\right) = \sin\theta$$
$$\tan\left(\frac{\pi}{2} - \theta\right) = \cot\theta \quad \cot\left(\frac{\pi}{2} - \theta\right) = \tan\theta$$
$$\csc\left(\frac{\pi}{2} - \theta\right) = \sec\theta \quad \sec\left(\frac{\pi}{2} - \theta\right) = \csc\theta$$
$$\frac{\pi}{2} \text{ radians} = 90^\circ$$

## Sum/Difference Identities

$$\sin(\theta \pm \phi) = \sin\theta \cos\phi \pm \cos\theta \sin\phi$$
$$\cos(\theta \pm \phi) = \cos\theta \cos\phi \mp \sin\theta \sin\phi$$
$$\tan(\theta \pm \phi) = \frac{\tan\theta \pm \tan\phi}{1 \mp \tan\theta \tan\phi}$$

## Double Angle Identities

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

## Half Angle Identities

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

## Sum to Product of Two Angles

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

## Product to Sum of Two Angles

$$\sin\theta \sin\phi = \frac{[\cos(\theta - \phi) - \cos(\theta + \phi)]}{2}$$
$$\cos\theta \cos\phi = \frac{[\cos(\theta - \phi) + \cos(\theta + \phi)]}{2}$$
$$\sin\theta \cos\phi = \frac{[\sin(\theta + \phi) + \sin(\theta - \phi)]}{2}$$
$$\cos\theta \sin\phi = \frac{[\sin(\theta + \phi) - \sin(\theta - \phi)]}{2}$$