

# Trig Identities — Reference Sheet

Every identity you need for Algebra 2 and Precalculus, on one page

## RECIPROCAL

Algebra 2

$$\begin{aligned}\csc \theta &= 1 / \sin \theta \\ \sec \theta &= 1 / \cos \theta \\ \cot \theta &= 1 / \tan \theta\end{aligned}$$

## QUOTIENT

Algebra 2

$$\begin{aligned}\tan \theta &= \sin \theta / \cos \theta \\ \cot \theta &= \cos \theta / \sin \theta\end{aligned}$$

## PYTHAGOREAN

Algebra 2

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

Divide the first by  $\cos^2 \theta$  or  $\sin^2 \theta$  to get the other two — only the first is worth memorising.

## EVEN-ODD

Algebra 2

$$\begin{aligned}\sin(-\theta) &= -\sin \theta \\ \cos(-\theta) &= \cos \theta \\ \tan(-\theta) &= -\tan \theta \\ \csc(-\theta) &= -\csc \theta \\ \sec(-\theta) &= \sec \theta \\ \cot(-\theta) &= -\cot \theta\end{aligned}$$

Only cosine and secant are even; the other four flip sign.

## COFUNCTION

Precalculus

$$\begin{aligned}\sin(\pi/2 - \theta) &= \cos \theta \\ \cos(\pi/2 - \theta) &= \sin \theta \\ \tan(\pi/2 - \theta) &= \cot \theta\end{aligned}$$

## SUM & DIFFERENCE

Precalculus

$$\begin{aligned}\sin(A \pm B) &= \sin A \cos B \pm \cos A \sin B \\ \cos(A \pm B) &= \cos A \cos B \mp \sin A \sin B \\ \tan(A \pm B) &= (\tan A \pm \tan B) / (1 \mp \tan A \tan B)\end{aligned}$$

$\mp$  is the opposite of whichever  $\pm$  you take on the left.

## DOUBLE ANGLE

Precalculus

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

## POWER REDUCING

Precalculus

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

Use these to turn a squared function into a first-power one.

## HALF ANGLE

Precalculus

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

Take the  $\pm$  sign from the quadrant of  $\theta/2$ , not of  $\theta$ . Tangent needs no  $\pm$ .

### How to verify an identity

1. Work on one side only — the messier side. Never move terms across the equals sign.
2. Rewrite everything in sin and cos, then simplify.
3. Look for a Pythagorean identity, a common denominator, or a difference of squares.
4. An identity holds only where both sides are defined — note any excluded values.

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