

# Trig Functions Cheat Sheet

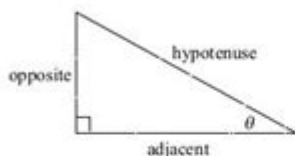
## Trig Cheat Sheet

### Definition of the Trig Functions

#### Right triangle definition

For this definition we assume that

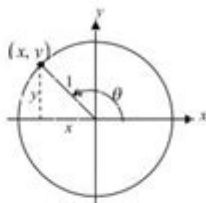
$$0 < \theta < \frac{\pi}{2} \text{ or } 0^\circ < \theta < 90^\circ.$$



$$\begin{aligned} \sin \theta &= \frac{\text{opposite}}{\text{hypotenuse}} & \csc \theta &= \frac{\text{hypotenuse}}{\text{opposite}} \\ \cos \theta &= \frac{\text{adjacent}}{\text{hypotenuse}} & \sec \theta &= \frac{\text{hypotenuse}}{\text{adjacent}} \\ \tan \theta &= \frac{\text{opposite}}{\text{adjacent}} & \cot \theta &= \frac{\text{adjacent}}{\text{opposite}} \end{aligned}$$

#### Unit circle definition

For this definition  $\theta$  is any angle.



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

### Facts and Properties

#### Domain

The domain is all the values of  $\theta$  that can be plugged into the function.

$$\begin{aligned} \sin \theta, \quad \theta &\text{ can be any angle} \\ \cos \theta, \quad \theta &\text{ can be any angle} \\ \tan \theta, \quad \theta &\neq \left(n + \frac{1}{2}\right)\pi, \quad n = 0, \pm 1, \pm 2, \dots \\ \csc \theta, \quad \theta &\neq n\pi, \quad n = 0, \pm 1, \pm 2, \dots \\ \sec \theta, \quad \theta &\neq \left(n + \frac{1}{2}\right)\pi, \quad n = 0, \pm 1, \pm 2, \dots \\ \cot \theta, \quad \theta &\neq n\pi, \quad n = 0, \pm 1, \pm 2, \dots \end{aligned}$$

#### Range

The range is all possible values to get out of the function.

$$\begin{aligned} -1 \leq \sin \theta \leq 1 & \quad \csc \theta \geq 1 \text{ and } \csc \theta \leq -1 \\ -1 \leq \cos \theta \leq 1 & \quad \sec \theta \geq 1 \text{ and } \sec \theta \leq -1 \\ -\infty < \tan \theta < \infty & \quad -\infty < \cot \theta < \infty \end{aligned}$$

#### Period

The period of a function is the number,  $T$ , such that  $f(\theta + T) = f(\theta)$ . So, if  $\omega$  is a fixed number and  $\theta$  is any angle we have the following periods.

$$\begin{aligned} \sin(\omega \theta) &\rightarrow T = \frac{2\pi}{\omega} \\ \cos(\omega \theta) &\rightarrow T = \frac{2\pi}{\omega} \\ \tan(\omega \theta) &\rightarrow T = \frac{\pi}{\omega} \\ \csc(\omega \theta) &\rightarrow T = \frac{2\pi}{\omega} \\ \sec(\omega \theta) &\rightarrow T = \frac{2\pi}{\omega} \\ \cot(\omega \theta) &\rightarrow T = \frac{\pi}{\omega} \end{aligned}$$

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**Trig functions cheat sheet** are essential tools for students, teachers, and professionals who frequently work with trigonometry in mathematics, physics, engineering, and various fields. Trigonometric functions, including sine, cosine, tangent, and their respective reciprocals, play a crucial role in understanding the relationships between angles and sides in triangles. This article serves as a comprehensive cheat sheet, providing valuable insights and formulas, along with tips to enhance your understanding of trig functions.

## Understanding Trigonometric Functions

Trigonometric functions relate angles to ratios of sides in right triangles. The primary functions include:

- Sine (sin)
- Cosine (cos)
- Tangent (tan)
- Cosecant (csc)
- Secant (sec)
- Cotangent (cot)

These functions can be defined using a unit circle or right triangle definitions and have numerous applications in various fields.

## Right Triangle Definitions

In a right triangle, the definitions of the trigonometric functions are based on the sides of the triangle:

- For an angle  $\theta$ :
- Sine ( $\sin \theta$ ) = Opposite side / Hypotenuse
- Cosine ( $\cos \theta$ ) = Adjacent side / Hypotenuse
- Tangent ( $\tan \theta$ ) = Opposite side / Adjacent side

From these definitions, we can derive the reciprocal functions:

- Cosecant ( $\csc \theta$ ) =  $1 / \sin \theta$  = Hypotenuse / Opposite side
- Secant ( $\sec \theta$ ) =  $1 / \cos \theta$  = Hypotenuse / Adjacent side
- Cotangent ( $\cot \theta$ ) =  $1 / \tan \theta$  = Adjacent side / Opposite side

## Unit Circle and Trigonometric Functions

The unit circle provides a powerful way to understand trigonometric functions beyond just right triangles. The unit circle is centered at the origin (0,0) with a radius of 1. The coordinates of points on the circle correspond to the cosine and sine of an angle.

# Key Points on the Unit Circle

Here are some key angles and their corresponding sine and cosine values:

- $0^\circ$  (0 radians):  $(1, 0) \rightarrow \sin(0) = 0, \cos(0) = 1$
- $30^\circ$  ( $\pi/6$  radians):  $(\sqrt{3}/2, 1/2) \rightarrow \sin(30^\circ) = 1/2, \cos(30^\circ) = \sqrt{3}/2$
- $45^\circ$  ( $\pi/4$  radians):  $(\sqrt{2}/2, \sqrt{2}/2) \rightarrow \sin(45^\circ) = \sqrt{2}/2, \cos(45^\circ) = \sqrt{2}/2$
- $60^\circ$  ( $\pi/3$  radians):  $(1/2, \sqrt{3}/2) \rightarrow \sin(60^\circ) = \sqrt{3}/2, \cos(60^\circ) = 1/2$
- $90^\circ$  ( $\pi/2$  radians):  $(0, 1) \rightarrow \sin(90^\circ) = 1, \cos(90^\circ) = 0$
- $120^\circ$  ( $2\pi/3$  radians):  $(-1/2, \sqrt{3}/2) \rightarrow \sin(120^\circ) = \sqrt{3}/2, \cos(120^\circ) = -1/2$
- $135^\circ$  ( $3\pi/4$  radians):  $(-\sqrt{2}/2, \sqrt{2}/2) \rightarrow \sin(135^\circ) = \sqrt{2}/2, \cos(135^\circ) = -\sqrt{2}/2$
- $150^\circ$  ( $5\pi/6$  radians):  $(-\sqrt{3}/2, 1/2) \rightarrow \sin(150^\circ) = 1/2, \cos(150^\circ) = -\sqrt{3}/2$
- $180^\circ$  ( $\pi$  radians):  $(-1, 0) \rightarrow \sin(180^\circ) = 0, \cos(180^\circ) = -1$
- $210^\circ$  ( $7\pi/6$  radians):  $(-\sqrt{3}/2, -1/2) \rightarrow \sin(210^\circ) = -1/2, \cos(210^\circ) = -\sqrt{3}/2$
- $225^\circ$  ( $5\pi/4$  radians):  $(-\sqrt{2}/2, -\sqrt{2}/2) \rightarrow \sin(225^\circ) = -\sqrt{2}/2, \cos(225^\circ) = -\sqrt{2}/2$
- $240^\circ$  ( $4\pi/3$  radians):  $(-1/2, -\sqrt{3}/2) \rightarrow \sin(240^\circ) = -\sqrt{3}/2, \cos(240^\circ) = -1/2$
- $270^\circ$  ( $3\pi/2$  radians):  $(0, -1) \rightarrow \sin(270^\circ) = -1, \cos(270^\circ) = 0$
- $300^\circ$  ( $5\pi/3$  radians):  $(1/2, -\sqrt{3}/2) \rightarrow \sin(300^\circ) = -\sqrt{3}/2, \cos(300^\circ) = 1/2$
- $315^\circ$  ( $7\pi/4$  radians):  $(\sqrt{2}/2, -\sqrt{2}/2) \rightarrow \sin(315^\circ) = -\sqrt{2}/2, \cos(315^\circ) = \sqrt{2}/2$
- $330^\circ$  ( $11\pi/6$  radians):  $(\sqrt{3}/2, -1/2) \rightarrow \sin(330^\circ) = -1/2, \cos(330^\circ) = \sqrt{3}/2$
- $360^\circ$  ( $2\pi$  radians):  $(1, 0) \rightarrow \sin(360^\circ) = 0, \cos(360^\circ) = 1$

# Common Trigonometric Identities

Trigonometric identities are equations involving trigonometric functions that hold true for all values of the variables involved. Here are some of the most commonly used identities:

## Pythagorean Identities

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

## Angle Sum and Difference Identities

- $\sin(a \pm b) = \sin a \cos b \pm \cos a \sin b$
- $\cos(a \pm b) = \cos a \cos b \mp \sin a \sin b$
- $\tan(a \pm b) = \frac{\tan a \pm \tan b}{1 \mp \tan a \tan b}$

## Double Angle Identities

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

## Applications of Trigonometric Functions

Trigonometric functions have a wide range of applications in various fields:

- **Physics:** Used to analyze wave functions, oscillations, and circular motion.
- **Engineering:** Essential in fields like civil, mechanical, and electrical engineering for understanding forces, structures, and waveforms.
- **Computer Graphics:** Used to create realistic animations and models through transformations and rotations.

- **Architecture:** Vital for designing structures and understanding angles and dimensions.
- **Navigation:** Employed in triangulation and determining positions using angles.

## Conclusion

A solid understanding of the **trig functions cheat sheet** can enhance your mathematical skills and applications in various fields. Whether you're preparing for an exam, tackling engineering problems, or working on a physics project, having a quick reference for trigonometric functions, identities, and their applications is invaluable. Keep this cheat sheet handy, and practice regularly to reinforce your understanding of trigonometric functions.

## Frequently Asked Questions

### What are the basic trigonometric functions included in a cheat sheet?

The basic trigonometric functions included are sine (sin), cosine (cos), tangent (tan), cosecant (csc), secant (sec), and cotangent (cot).

### How can a trig functions cheat sheet help in solving problems?

A trig functions cheat sheet provides quick access to key formulas, identities, and values of trigonometric functions, making it easier to solve problems without needing to memorize all the details.

### What are some common trigonometric identities found on a cheat sheet?

Common trigonometric identities include the Pythagorean identities, angle sum and difference identities, double angle identities, and half angle identities.

### Is there a standard format for a trigonometric functions cheat sheet?

Yes, a standard format often includes sections for basic definitions, key values for angles (like  $0^\circ$ ,  $30^\circ$ ,  $45^\circ$ ,  $60^\circ$ ,  $90^\circ$ ), identities, and graphs of the trig functions.

### Where can I find reliable trig functions cheat sheets for study?

Reliable trig functions cheat sheets can be found in math textbooks, educational websites, online forums, or as downloadable PDFs from reputable educational resources.

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