

# Trigonometric Equations

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## What is a Trigonometric Equation?



The equations having trigonometric functions of unknown angles are known as [trigonometric equations](#).

For example:  $\tan \theta = \frac{1}{\sqrt{3}}$

### Solution of a trigonometric equation

The value of the unknown angle that satisfies the given trigonometric equation is called the [solution](#) of the trigonometric equation.

## General Solutions of Trigonometric Equations

Under this section, we will learn about the [general solutions](#) of the trigonometric equations  $\sin \theta = 0$ ,  $\cos \theta = 0$ ,  $\tan \theta = 0$  and  $\cot \theta = 0$ ,  $\sin \theta = \sin \alpha$ ,  $\cos \theta = \cos \alpha$  and  $\tan \theta = \tan \alpha$  and  $a \cos \theta + b \sin \theta = c$

### General Solution of $\sin \theta = 0$

The general solution of  $\sin \theta = 0$  is  $\theta = n\pi$ ,  $n \in \mathbb{Z}$

### General Solution of $\cos \theta = 0$

The general solution of  $\cos \theta = 0$  is  $\theta = (2n + 1)\frac{\pi}{2}$ ,  $n \in \mathbb{Z}$ .

### General Solution of $\tan \theta = 0$

The general solution of  $\tan \theta = 0$  is  $\theta = n\pi$ ,  $n \in \mathbb{N}$ .

### General Solution of $\cot \theta = 0$

The general solution of  $\cot \theta = 0$  is  $(2n + 1)\frac{\pi}{2}$ ,  $n \in \mathbb{Z}$ .

#### Important Note:

As we have discussed the general solution of 4 trigonometric ratios out of 6.

### General Solution of $\sec \theta = 0$

Since  $\sec \theta \geq 1$ , or  $\sec \theta \leq -1$

Therefore,  $\sec \theta = 0$  does not have any solution.

### General Solution of $\operatorname{cosec} \theta = 0$

Since  $\operatorname{cosec} \theta \geq 1$ , or  $\operatorname{cosec} \theta \leq -1$

Therefore,  $\operatorname{cosec} \theta = 0$  does not have any solution.

### General Solution of $\sin \theta = \sin \phi$

$$\theta = n\pi + (-1)^n \phi, n \in \mathbb{Z}$$

The equation  $\operatorname{cosec} \theta = \operatorname{cosec} \phi$  is equivalent to  $\sin \theta = \sin \phi$ . Thus,  $\operatorname{cosec} \theta = \operatorname{cosec} \phi$  and  $\sin \theta = \sin \phi$  have the same general solution.

### General Solution of $\cos \theta = \cos \phi$

$$\theta = 2n\pi \pm \phi, \text{ where } n \in \mathbb{Z}.$$

The equation  $\sec \theta = \sec \phi$  is equivalent to  $\cos \theta = \cos \phi$ . Thus,  $\sec \theta = \sec \phi$  and  $\cos \theta = \cos \phi$  have the same general solution.

### General Solution of $\tan \theta = \tan \phi$

$$\theta = n\pi + \phi, n \in \mathbb{Z}$$

The equation  $\tan \theta = \tan \phi$  is equivalent to  $\cot \theta = \cot \phi$ . Thus,  $\tan \theta = \tan \phi$  and  $\cot \theta = \cot \phi$  have the same general solution.

## General Solution of $\sin^2 \theta = \sin^2 \phi$

$$\theta = n\pi \pm \phi, n \in \mathbb{Z}.$$

## General Solution of $\cos^2 \theta = \cos^2 \phi$

$$\theta = n\pi \pm \phi, n \in \mathbb{Z}.$$

## General Solution of $\tan^2 \theta = \tan^2 \phi$

$$\theta = n\pi \pm \phi, n \in \mathbb{Z}.$$

## General Solution of $a \cos \theta + b \sin \theta = c$

$a \cos \theta + b \sin \theta = c$ , where  $a, b, c \in \mathbb{R}$  such that  $|c| \leq \sqrt{a^2 + b^2}$

In order to solve this type of equations, we reduce them in the form  $\cos \theta = \cos \phi$  or  $\sin \theta = \sin \phi$ .

Now try it yourself! Should you still need any help, [click here](#) to schedule live online session with e Tutor!

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## Reference Links:

- <http://www.purplemath.com/modules/solvtrig.htm>
- <http://www.wikihow.com/Solve-Trigonometric-Equations>
- [http://en.wikibooks.org/wiki/Trigonometry/Solving\\_Trigonometric\\_Equations](http://en.wikibooks.org/wiki/Trigonometry/Solving_Trigonometric_Equations)

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