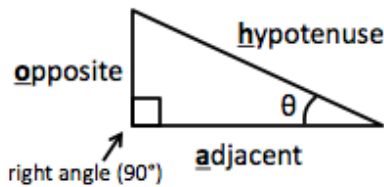


Basic Trigonometric Functions and the Unit Circle

First, let's define our basic trig functions using a right triangle.

In every right triangle you can define the three sides: opposite, adjacent, and hypotenuse.



Hypotenuse – side opposite right angle

Opposite – side opposite angle (\angle) θ

Adjacent – side next to $\angle \theta$

Use **Soh Cah Toa** to remember the basic trig ratios.

Soh: **S**ine = **O**pposite over **H**ypotenuse

Cah: **C**osine = **A**djacent over **H**ypotenuse

Toa: **T**angent = **O**pposite over **A**djacent

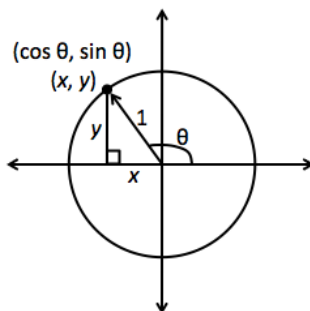
$$\sin \theta = \frac{opp}{hyp} \quad \cos \theta = \frac{adj}{hyp} \quad \tan \theta = \frac{opp}{adj}$$

Cosecant, secant, and cotangent are the reciprocal ratios of sine, cosine, and tangent.

$$\begin{aligned} \csc \theta &= \frac{1}{\sin \theta} = \frac{hyp}{opp} & \sec \theta &= \frac{1}{\cos \theta} = \frac{hyp}{adj} \\ \cot \theta &= \frac{1}{\tan \theta} = \frac{adj}{opp} \end{aligned}$$

The Unit Circle

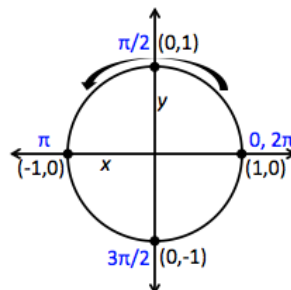
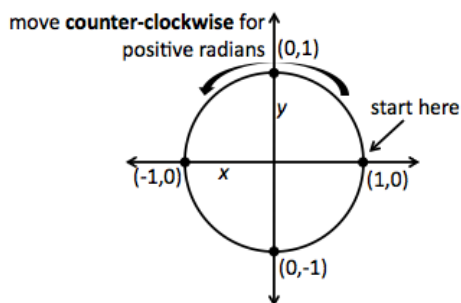
We can also define trig functions using a circle with radius of 1 (unit circle) centered on an xy -plane. This is valuable because **we can define the functions in terms of x and y** .



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

How do we measure angle θ ?

When using the unit circle, we most commonly measure θ in **radians**. Remember, 1 full trip around **the circle equals 2π radians**.

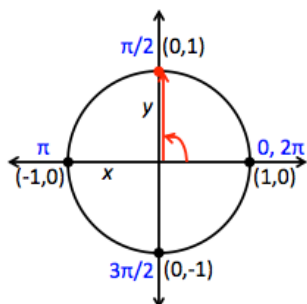


Using the unit circle to solve trig functions.

Example: $\sin \frac{\pi}{2} = ?$

Let's remember from before that $\sin \theta = y$. This means our answer will be the value of the y coordinate at $\pi/2$.

First, draw out the unit circle and draw a line at $\pi/2$.



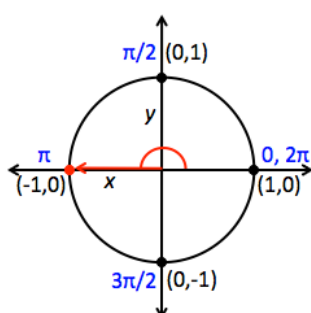
A line drawn at $\pi/2$ intersects the circle at $(0,1)$.

$$\rightarrow \sin \frac{\pi}{2} = 1$$

Example: $\cos \pi = ?$

Here we must remember that $\cos \theta = x$, therefore we must find the value of the x at π .

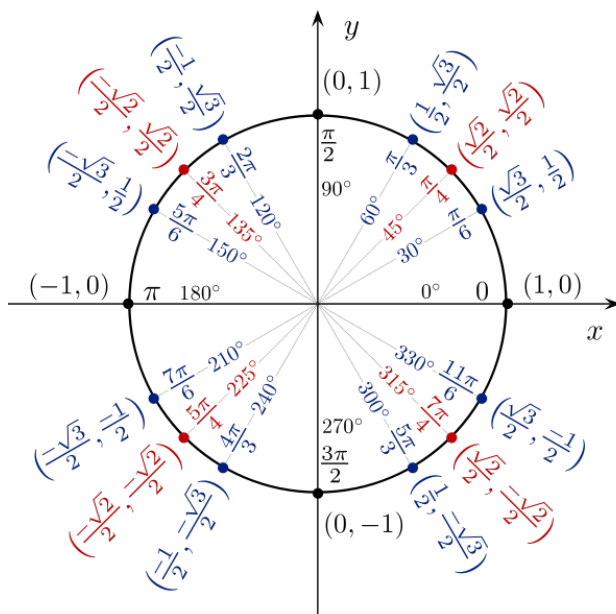
Don't forget to always draw out the unit circle or picture it in your mind!



$(-1, 0)$ is the point on the unit circle where $\theta = \pi$.

$$\rightarrow \cos \pi = -1$$

The **unit circle is a valuable tool** for solving many trig functions **without a calculator**. Here's a unit circle with additional points which you should know. It's important to get familiar with the unit circle to know where different radian values are located. Don't forget, the coordinate points listed on the chart represent **(cos θ , sin θ)**.



Watch this video to learn an excellent way to remember the values on the unit circle!!!

<http://www.youtube.com/watch?v=ao4EJzNWmK8>

http://en.wikipedia.org/wiki/Unit_circle

For more help and practice problems check out these sites!

- <http://www.khanacademy.org/math/trigonometry/basic-trigonometry/unit-circle-tut/v/unit-circle-definition-of-trig-functions-1>
- <http://www.mathsisfun.com/sine-cosine-tangent.html>