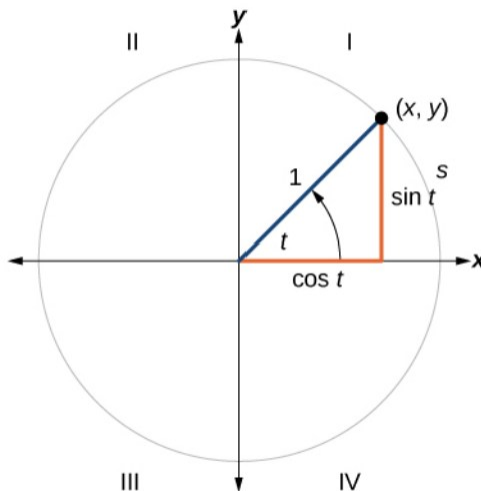


Unit Circle:

Key Points:



- A **unit circle** has a center at $(0,0)$ and radius 1. In a unit circle, the length of the intercepted arc s is equal to the radian measure of the central angle t .
- Let (x, y) be the endpoint of the unit circle of an arc length s . The (x, y) coordinates of this point can be described as functions of the angle t .
- Using the unit circle,

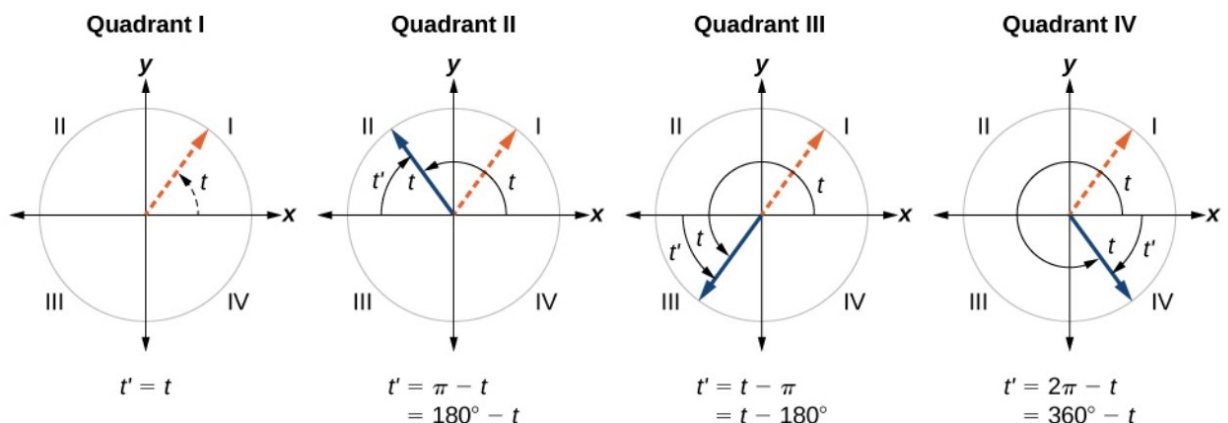
$$\sin t = \frac{\text{Opposite}}{\text{Hypotenuse}} = \frac{y}{1} = y, \cos t = \frac{\text{Adjacent}}{\text{Hypotenuse}} = \frac{x}{1} = x$$

When the sine or cosine is known, we can use the **Pythagorean Identity**

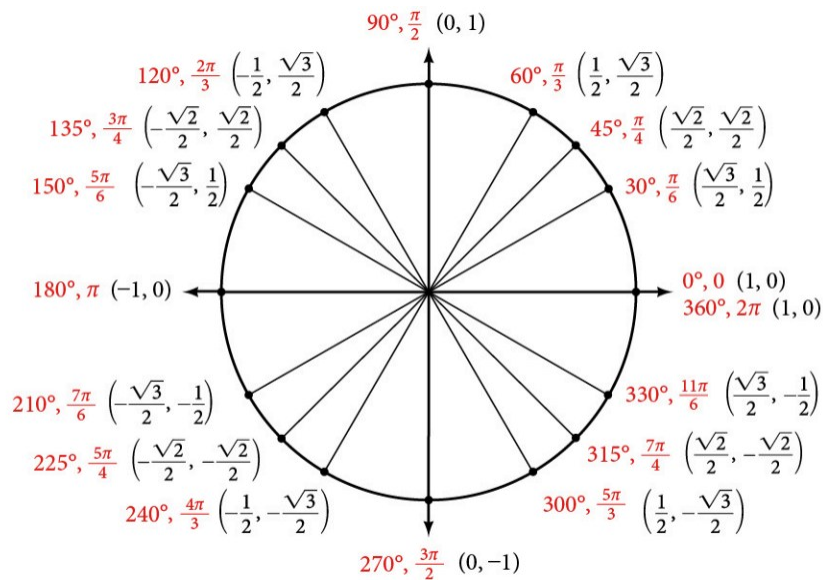
$$\sin^2 t + \cos^2 t = 1$$

to find the other.

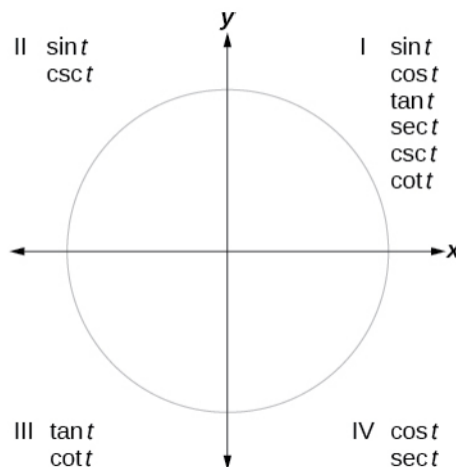
- $\tan t = \frac{y}{x}, x \neq 0, \cot t = \frac{x}{y}, y \neq 0, \csc t = \frac{1}{y}, y \neq 0, \sec t = \frac{1}{x}, x \neq 0$.
- Reference angle t' is an acute angle formed by the terminal side of an angle t and the horizontal axis



- Reference angles can be used to find the sine and cosine of the angle t when t is not an acute angle anymore.
- Reference angles can also be used to find the coordinates of a point on a circle.
- Special angles and coordinates of corresponding points on the unit circle



- The trigonometric functions are each listed in the quadrants in which they are positive.



Unit Circle Videos:

- [Finding Function Values for Sine and Cosine from the Unit Circle: Example 1](#)
- [Calculating Sines and Cosines along an Axis: Example 2](#)
- [Finding a Sine from Cosine or Cosine from Sine of an angle, given its quadrant location: Example 3](#)
- [Finding a Reference Angle: Example 4](#)
- [Using Reference Angles to Find Sine and Cosine: Examples 5-7](#)
- [Finding Trigonometric Functions from a point on the Unit Circle:: Example 8](#)
- [Finding the Trigonometric Function of an Angle: Example 9](#)
- [Using Reference Angles to Find Trigonometric Functions: Example 10](#)

Practice Exercises:

For the following exercises, use the given sign of the sine and cosine functions to find the quadrant in which the terminal point determined by t lies.

1. $\sin(t) < 0$ and $\cos(t) < 0$
2. $\sin(t) > 0$ and $\cos(t) > 0$
3. $\sin(t) > 0$ and $\cos(t) < 0$

For the following exercises, find the exact value of each trigonometric function.

4. $\sin\left(\frac{\pi}{3}\right)$
5. $\cos\left(\frac{\pi}{4}\right)$
6. $\cos\left(\frac{\pi}{3}\right)$
7. $\sin(\pi)$
8. $\cos\left(\frac{\pi}{6}\right)$
9. $\cos(\pi)$

For the following exercises, state the reference angle for the given angle.

10. 240°

11. 135°

12. 100°

13. $\frac{2\pi}{3}$

14. $-\frac{\pi}{8}$

15. $-\frac{11\pi}{3}$

Answers:

1. Quadrant III

2. Quadrant I

3. Quadrant II

4. $\frac{\sqrt{3}}{2}$

5. $\frac{\sqrt{2}}{2}$

6. $\frac{1}{2}$

7. 0

8. $\frac{\sqrt{3}}{2}$

9. -1

10. 60°

11. 45°

12. 70°

13. $\frac{\pi}{3}$

14. $\frac{\pi}{8}$

15. $\frac{\pi}{3}$