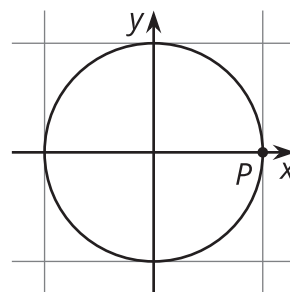


# Introduction to Trigonometric Functions

Let's graph cosine and sine.

## 9.1 An Angle and a Circle

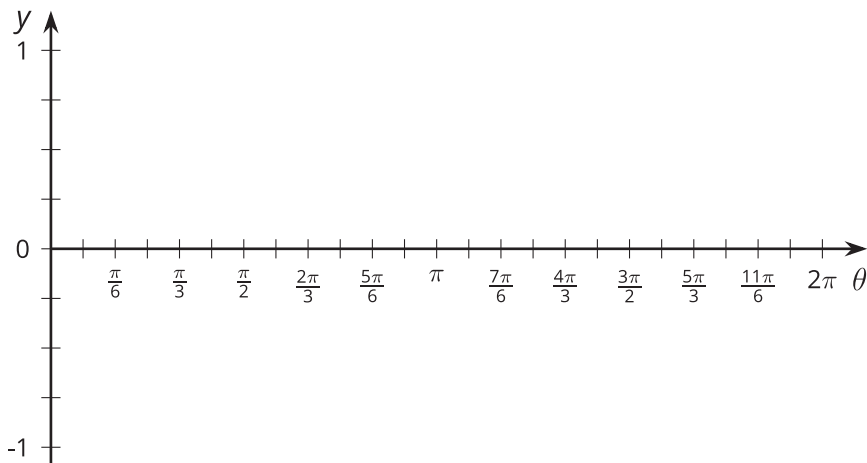
Suppose there is a point  $P$  at  $(1, 0)$  on the unit circle.



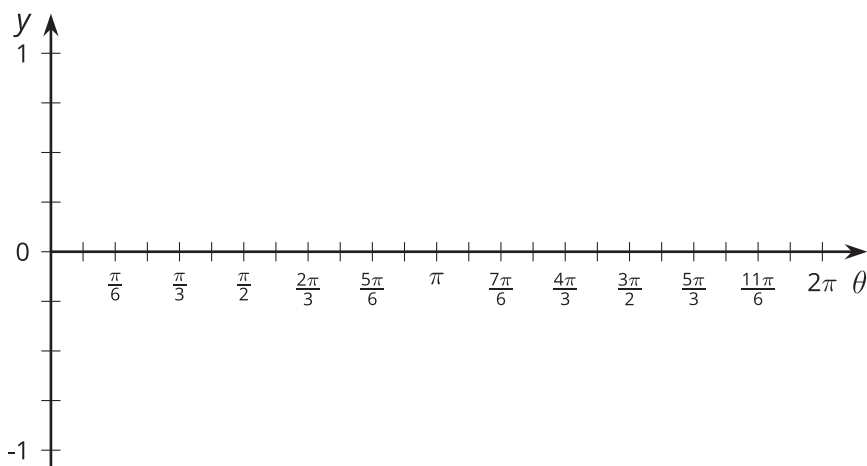
1. Describe how the  $x$ -coordinate of  $P$  changes as it rotates once counterclockwise around the circle.
2. Describe how the  $y$ -coordinate of  $P$  changes as it rotates once counterclockwise around the circle.

## 9.2 Do the Wave

1. For each tick mark on the horizontal axis, plot the value of  $y = \cos(\theta)$ , where  $\theta$  is the measure of an angle in radians. Use the class display of the unit circle, the unit circle from an earlier lesson, or technology to estimate the value of  $\cos(\theta)$ .



2. For each tick mark on the horizontal axis, plot the value of  $y = \sin(\theta)$ . Use the class display of the unit circle, the unit circle from an earlier lesson, or technology to estimate the value of  $\sin(\theta)$ .



3. What do you notice about the two graphs?

4. Explain why any angle measure between 0 and  $2\pi$  gives a point on each graph.
5. Could these graphs represent functions? Explain your reasoning.

## 9.3 Graphs of Cosine and Sine

1. Looking at the graphs of  $y = \cos(\theta)$  and  $y = \sin(\theta)$ , at what values of  $\theta$  do  $\cos(\theta) = \sin(\theta)$ ? To where on the unit circle do these points correspond?
2. For each of these equations, first predict what the graph looks like, and then check your prediction using technology.
  - a.  $y = \cos(\theta) + \sin(\theta)$
  - b.  $y = \cos^2(\theta)$
  - c.  $y = \sin^2(\theta)$
  - d.  $y = \cos^2(\theta) + \sin^2(\theta)$

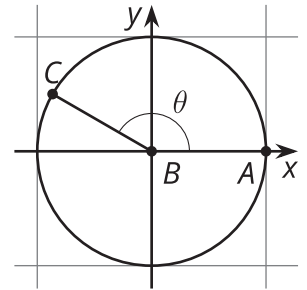


## Are you ready for more?

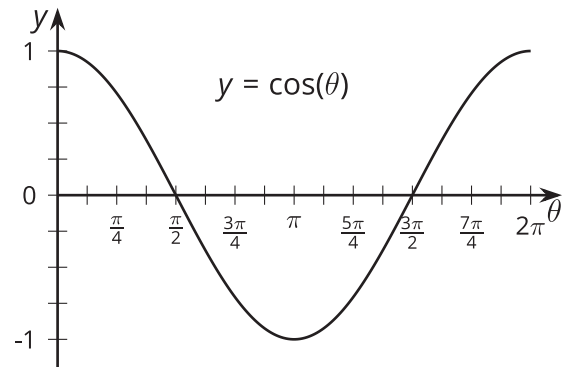
For the equation given, predict what the graph looks like, and then check your prediction using technology:  $y = \theta + \cos(\theta)$ .

## Lesson 9 Summary

Using the unit circle, we can make sense of  $\cos(\theta)$  and  $\sin(\theta)$  for any angle measure  $\theta$  between 0 and  $2\pi$  radians. For an angle  $\theta$ , starting at the positive  $x$ -axis, there is a point,  $C$ , where the terminal ray of the angle intersects the unit circle. The coordinates of that point are  $(\cos(\theta), \sin(\theta))$ .

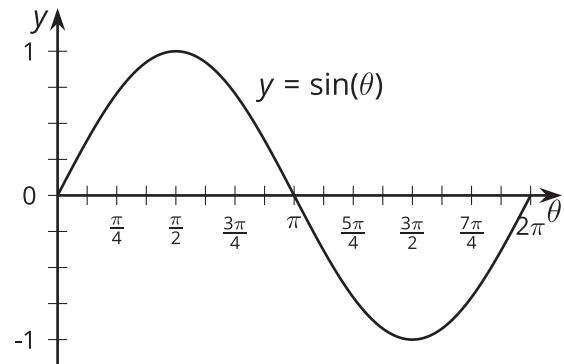


But what if we wanted to think about just the horizontal position of point  $C$  as  $\theta$  goes from 0 to  $2\pi$ ? The horizontal location is defined by the  $x$ -coordinate, which is  $\cos(\theta)$ . If we graph  $y = \cos(\theta)$ , we get:



This graph is 1 when  $\theta$  is 0 because the  $x$ -coordinate of the point at 0 radians on the unit circle is  $(1, 0)$ . The graph then decreases to -1 (the smallest  $x$ -value on the unit circle) before increasing back to 1.

We can do the same for the  $y$ -coordinate of a point on the unit circle by graphing  $y = \sin(\theta)$ :



This graph is 0 when  $\theta$  is 0, increases to 1 (the greatest  $y$ -value on the unit circle), then decreases to -1 before returning to 0.