

**Math 144**  
**Activity #4**  
**Connecting the unit circle to the graphs of the trig functions**

**Graphing the sine function**

We are going to begin this activity with graphing the sine function ( $y = \sin x$ ). To graph the sine function, we are going to use a table of values. We are going to use values on the unit circle. It will be helpful to have your unit circle in front of you. Before beginning, discuss the unit circle. What do the ordered pairs represent, where are the angle measures located, where do sine and cosine appear in the unit circle?

Now, using the unit circle, list the ordered pairs  $(\theta, \sin \theta)$ . Using  $\theta$  as your  $x$  value and  $\sin \theta$  as your  $y$  value, we are going to plot this on a coordinate grid below. What will be the window of your graph? Explain. If you do not understand what the window of your graph is, you need to discuss this in your group.

Next, we need to label our grid. Remember, we are graphing  $y = \sin \theta$ , therefore your  $x$ -values represent \_\_\_\_\_ labeled in \_\_\_\_\_ and your  $y$ -values represent \_\_\_\_\_ labeled in \_\_\_\_\_.

Start by labeling your  $x$ -axis on your coordinate grid.  
 What are the largest values that  $x$  can be?

What are the smallest values that  $x$  can be?

What is a good largest and smallest value to graph? Explain.

Remember that each tic mark needs to be of equal length. For example, the first box can't be 5 and the second box 6. They need to be 1, 2, 3 etc or 5, 10, 15. Also, think about what would be easiest to graph? Should you use integers? Decimals? Numbers in terms of  $\pi$ ? Label the tic marks on the  $x$ -axis.

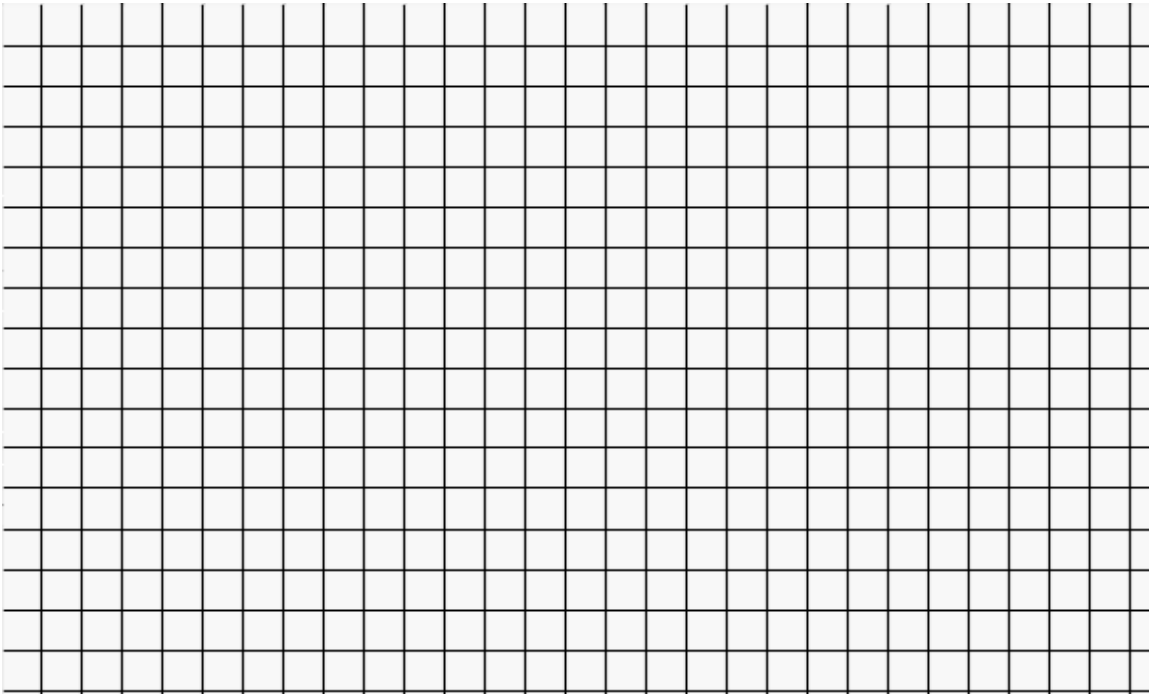
Next, label your  $y$ -axis. Use your unit circle to determine the largest  $y$ -value that you will encounter. What is the largest value that  $\sin \theta$  reaches? Explain. (You might also use your calculator to justify this.)

What will be smallest value that  $\sin \theta$  reaches? Explain. (You might also use your calculator to justify this.)

Remember that each tic mark has to be equally spaced when labeling your  $y$ -axis also.

What are your labels at each tic mark? How far apart are the tic marks? Why did you choose these values?

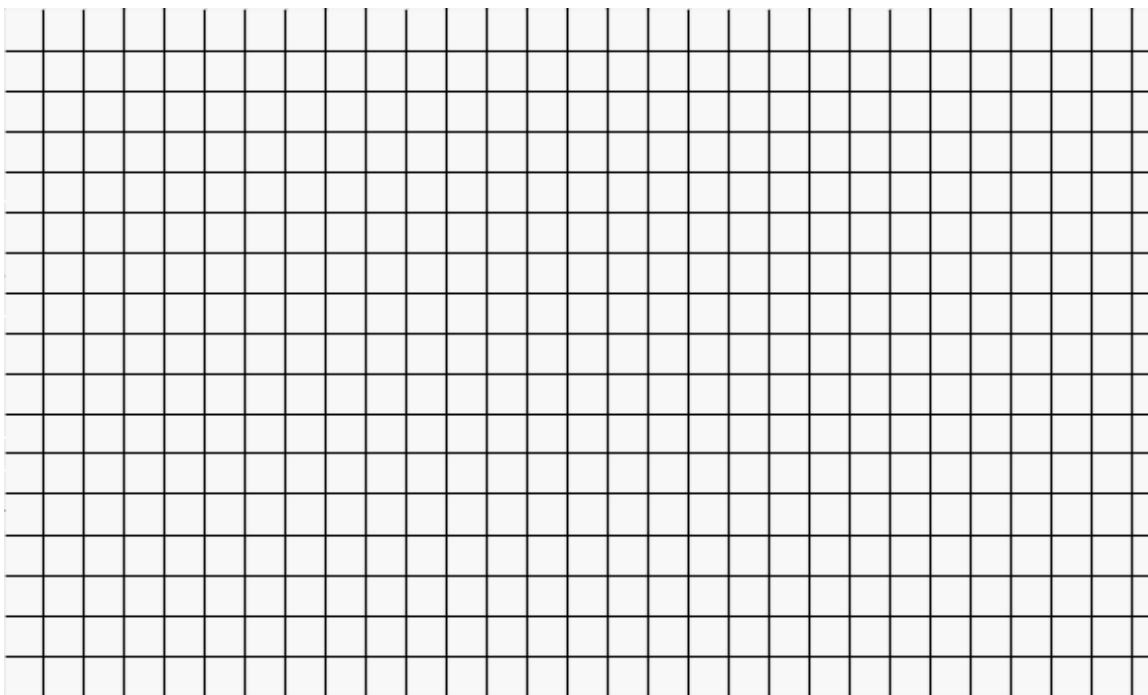
Now begin by plotting known points on your graph. For example, on the unit circle the first angle measure you are given is  $x = 0$  radians and  $y = \sin 0$  or  $y = 0$ . So your first ordered pair is  $(0,0)$ . Plot all labeled points from 0 radians to  $2\pi$  radians.



What happens if you go past  $2\pi$  radians for your  $x$ -values?

Now graph  $y = \sin x$  in your calculator.

1. First, enter the function under  $y = \sin x$ .
2. Set the MODE to radian.
3. Set the window. What should your  $x$ -values be? (Think about what your smallest  $x$ -value should be, think about what your largest  $x$ -value should be.) What should your  $y$ -values be? (Think about what your smallest  $y$ -value should be, think about what your largest  $y$ -value should be.) Make sure to justify your conjectures. Also remember that your  $x$ -values are your domain and your  $y$ -values are your range.
4. Graph your function and adjust your window if necessary. Label your window on your graph.



Does your sketched graph look like your calculator graph? Why or why not? Explain this and discuss within your group why the graphs look alike or why they don't look alike.

### **Graphing the Cosine function**

Now, using the unit circle, list the ordered pairs  $(\theta, \cos \theta)$ . Using theta as your x value and  $\cos \theta$  as your y value, you will be plotting this on a coordinate grid below. What will be the window of your graph? Explain.

First, we need to label our grid. Remember, we are graphing  $y = \cos \theta$ , therefore your x-values represent \_\_\_\_\_ labeled in \_\_\_\_\_ and your y-values represent \_\_\_\_\_ labeled in \_\_\_\_\_.

Start by labeling your x-axis on your coordinate grid.  
What are the largest values that x can be?

What are the smallest values that x can be?

What is a good largest and smallest value to graph? Explain.

And again, remember that each tic mark needs to be of equal length. For example, the first tic mark can't be 5 and the second tic mark be 6. They need to be 1, 2, 3 etc or 5, 10, 15. Also, think about what would be easiest to graph? Should you use integers? Decimals? Numbers in terms of  $\pi$ ?

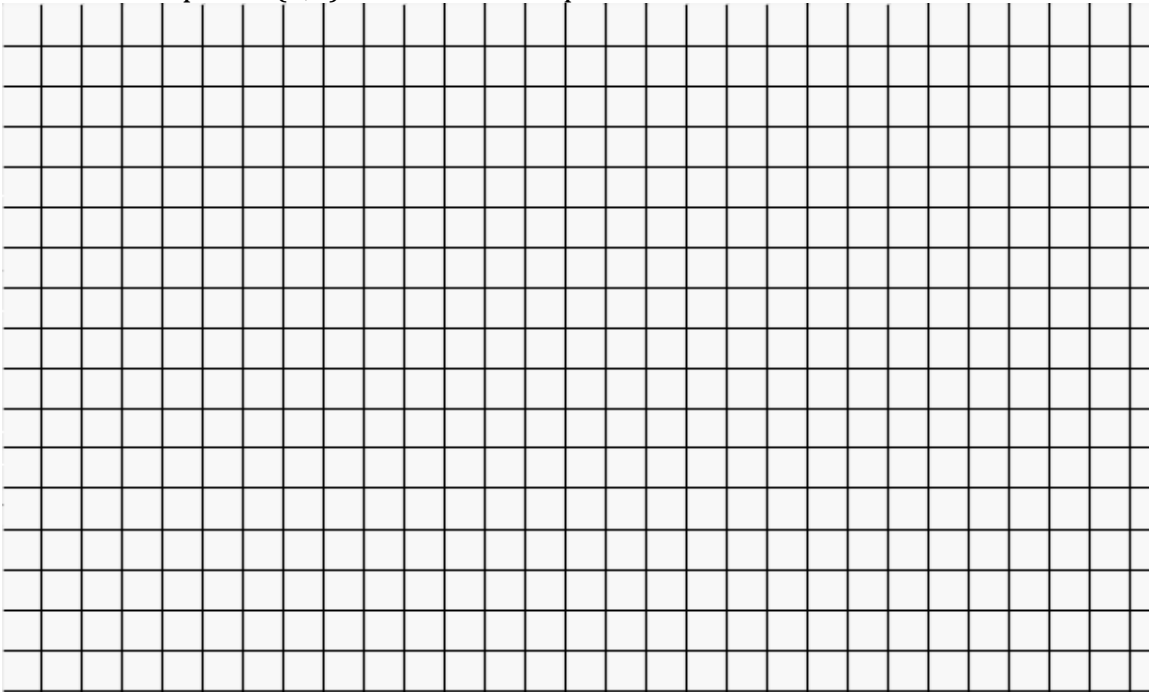
Next, label your y-axis. Use your unit circle to determine the largest y -value that you will encounter. What is the largest value that  $\cos \theta$  reaches? Explain. (You might also use your calculator to justify this.)

What will be smallest value that  $\cos \theta$  reaches? Explain. (You might also use your calculator to justify this.)

Remember that each tic mark has to be equally spaced when labeling your y-axis also.

What are your labels in each tic mark? How far apart are the tic marks? Why?

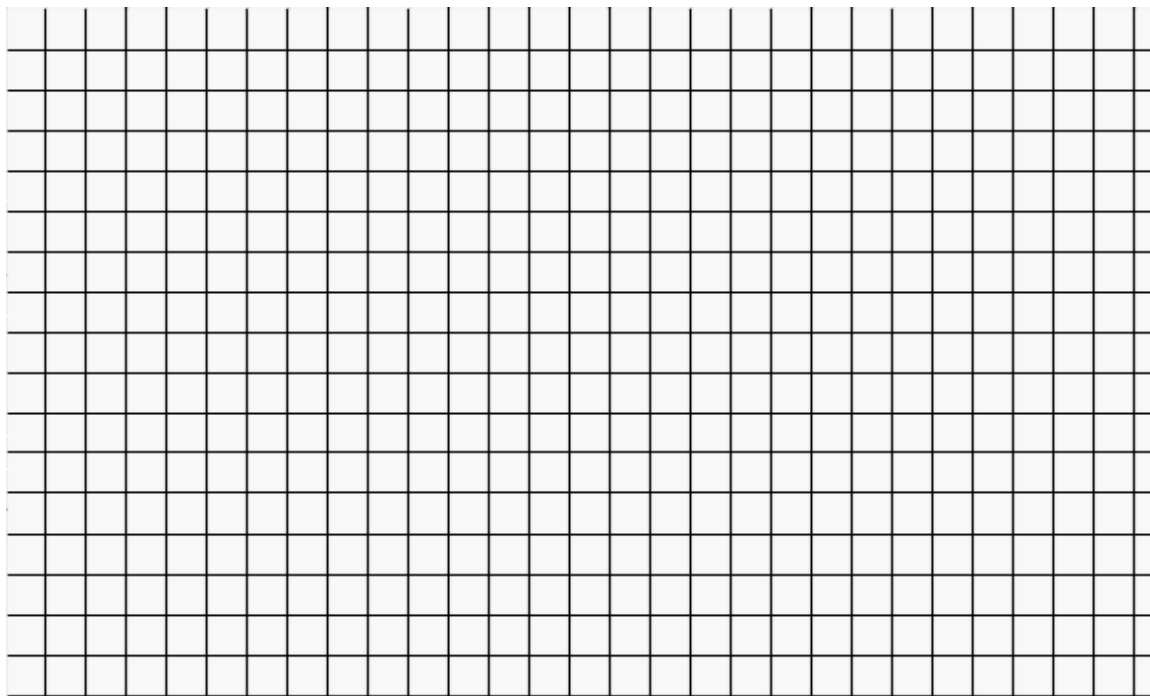
Now begin by plotting known points on your graph. For example, on the unit circle the first angle measure you are given is  $x = 0$  radians and  $y = \cos 0$  or  $y = 1$ . So your first ordered pair is  $(0,1)$ . Plot all labeled points from 0 radians to  $2\pi$  radians.



Now graph  $y = \cos x$  in your calculator.

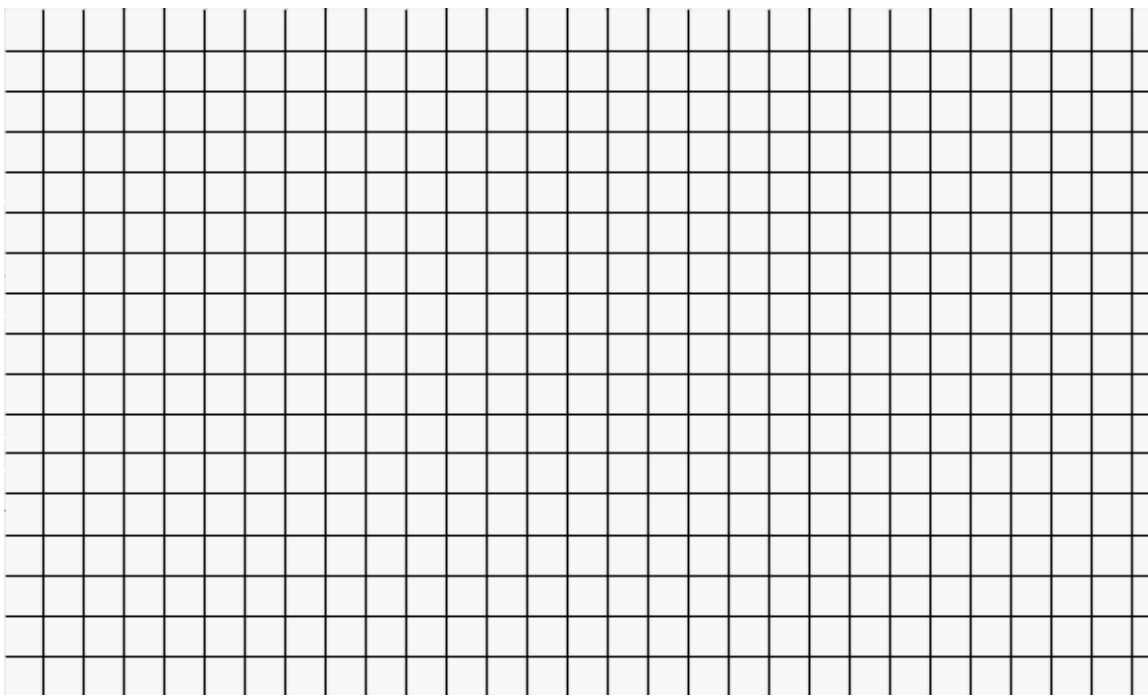
1. First, enter the function under  $y = \cos x$ .
2. Set the MODE to radians.
3. Set the window. What should your x-values be? (Think about what your smallest x-value should be, think about what your largest x-value should be.) What should your y-values be? (Think about what your smallest y-value should be, think about what your largest y-value should be.) Make sure to justify your conjectures. Also remember that your x-values are your domain and your y-values are your range.

4. Graph your function and adjust your window if necessary. Label your window on your graph.



Does the sketch of your graph look like the calculator graph? Why or why not? Remedy any discrepancies.

Look at the graphs of the sine and cosine functions. What are the similarities? What are the differences? Talk about domains, ranges, maximum values, minimum values and transformations.

**Further questions:**

1. Graph  $y = 3\sin x$  in your calculator. Predict what the 3 does to the graph of  $y = \sin x$ . How can you check your prediction with your calculator? Now check your prediction.
2. Graph  $y = -\sin x$  in your calculator. Predict what the “-“ does to the graph of  $y = \sin x$ ?
3. Look at the graph of  $y = \sin x$ , discuss the rate of change on the graph.