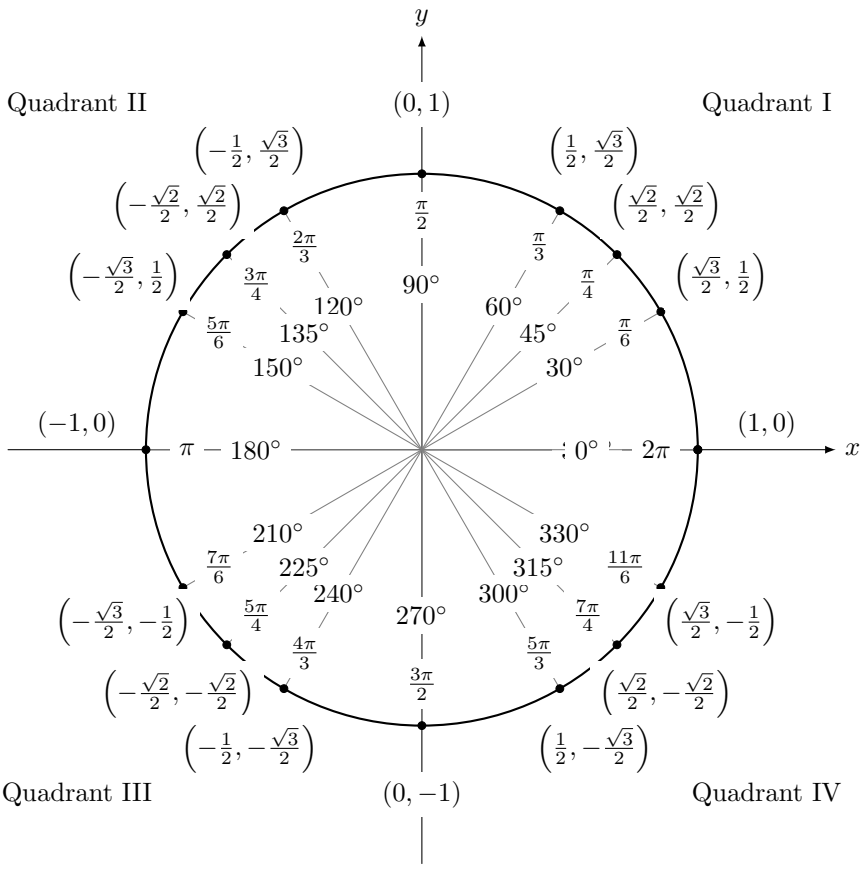
MATH 41: Trigonometry and Analytic Geometry
Section 7, 105 Wartik Lab
MTWF 4:40 - 5:30 PM



Graphing Trig Functions

So far we've been plotting $\cos(\theta)$ and $\sin(\theta)$ on the unit circle by using the identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and comparing it to $x^2 + y^2 = 1$ (the unit circle). The graph we used was the one pictured above.

Today, we do something different. Instead of thinking of trigonometric functions as ones that *send angles to ratios*—which is how they were initially developed—we are going to make them a little more *abstract*.

We will treat trig functions as those that take in x and spit out y.

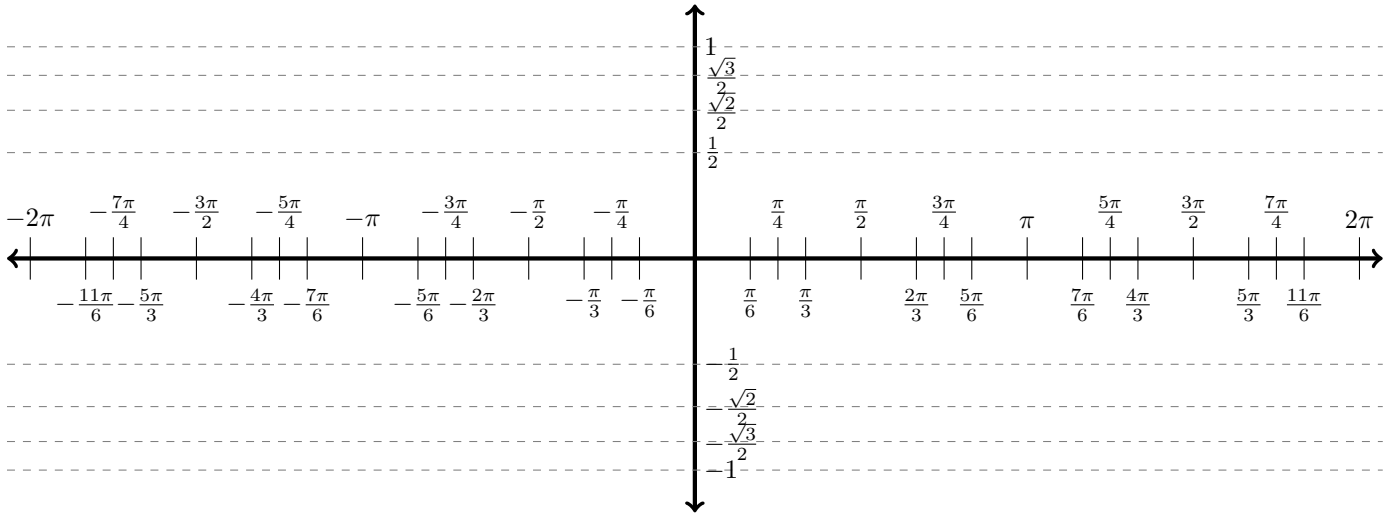
Here are the important differences to know:

- We will now think of the x axis as angels <u>in radians</u>.
- Functions will repeat (because of co-terminal angles). So you'll quickly see a pattern with *all* trig functions.

0.1 Graph Sine

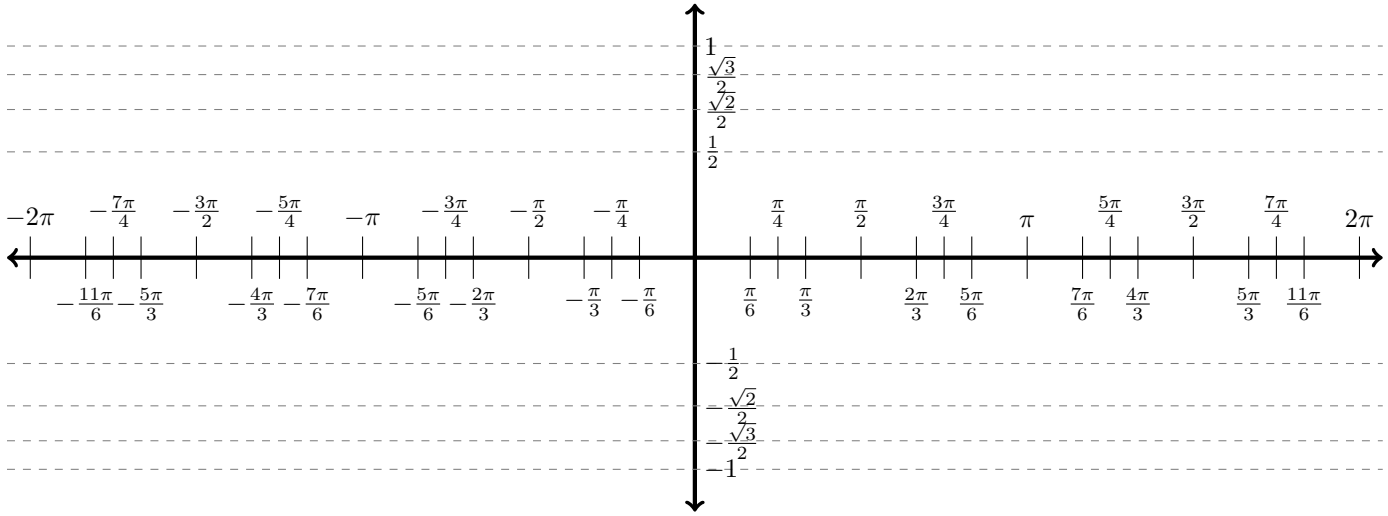
Use the unit circle to graph the function of sine where the x-axis are angles and the y-axis is $\sin(x)$.

Note: Labels on the x-axis alternate between being above and below the tick marks so there is enough room to read them.



0.2 Graph Cosine

Now, do the same procedure for $y = \cos(x)$



Answer the following questions:

1. What does it mean if a function in odd or even in an algebraic sense?

2. What does it mean if a function is odd or even in a graphical sense?

3. Is sine odd, even, or neither? Why?

4. Is cosine odd, even, or neither? Why?

5. What is the domain of sine?

6. What is the range of sine?

7. Are the domain and ranges of sine and cosine different?

To answer the remaining questions correctly, think about how the functions repeat.

8. What are <u>all</u> the x-intercepts of $\sin(x)$?

9. What is the y-intercept of $\sin(x)$?

10. What are <u>all</u> the x-intercepts of $\cos(x)$?

11. What is the y-intercept of $\cos(x)$?

12. What are <u>all</u> the (local) minimum(s) of $\sin(x)$?

13. What is <u>all</u> the (local) maximum(s) of $\sin(x)$?

14. What are <u>all</u> the (local) minimum(s) of $\cos(x)$?

15. What is <u>all</u> the (local) maximums(s) of $\cos(x)$?

16. The **amplitude** of a trig function is the height of the waves in the function. What is the amplitude of $\sin(x)$ and $\cos(x)$? How are they related to the range?

17. The **period** tells you the smallest interval of x-values you have to traverse before seeing a repeat in the pattern. What is the period of $\sin(x)$? What is the period for $\cos(x)$? How do they compare?

0.3 Amplitude, Period, and Transforming Trig Graphs

In this more abstract form, trig functions are **very** important in the fields of physics and biology. They are used to model repeating processes like

- sound and ocean waves,
- planetary orbits,
- springs and dampeners,
- earth quakes,
- seasons, and
- animal populations (like those that only breed during the spring).

Perhaps the two most talked about concepts in science classes are **amplitudes** and **periods**. Amplitudes correspond to how dramatic the repeating process is, like

- how large a wave is,
- how much distances change between two orbiting bodies,
- how wide a spring flexes,
- the amount tectonic plates vibrate,
- the extreme temperatures between summer and winter, and
- how animal populations shrink (during the winter) and grow (during the summer).

Because these are important concepts in science, we need to spend some time understanding how graph transformations effect the amplitude and the and the period of $\sin(x)$ and $\cos(x)$.

Time allowing, let us consider

1. $y = 4\cos(x)$
2. $y = 4\cos(x - \pi/4)$
3. $y = \sin(2x)$
4. $y = \sin(2x + \pi/2)$
5. $y = 4\cos(2x + \pi/2)$

- For each function, what is the amplitude and the period?
- What kinds of transformations influence the amplitude?
- What kinds of transformations influence the period?