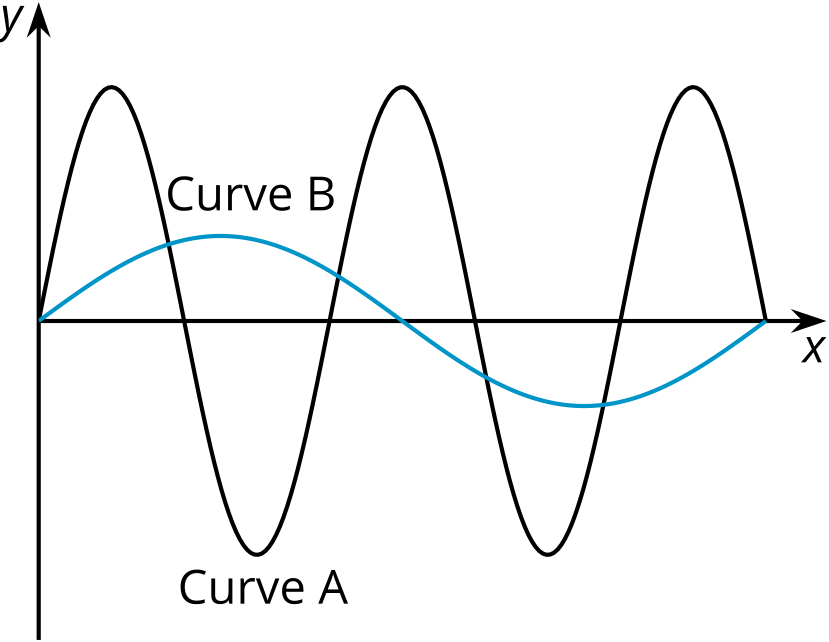
## Lesson 15: Features of Trigonometric Graphs (Part 1)

* Let’s compare graphs and equations of trigonometric functions.

### 15.1: Notice and Wonder: Musical Notes

Here are pictures of sound waves for two different musical notes:



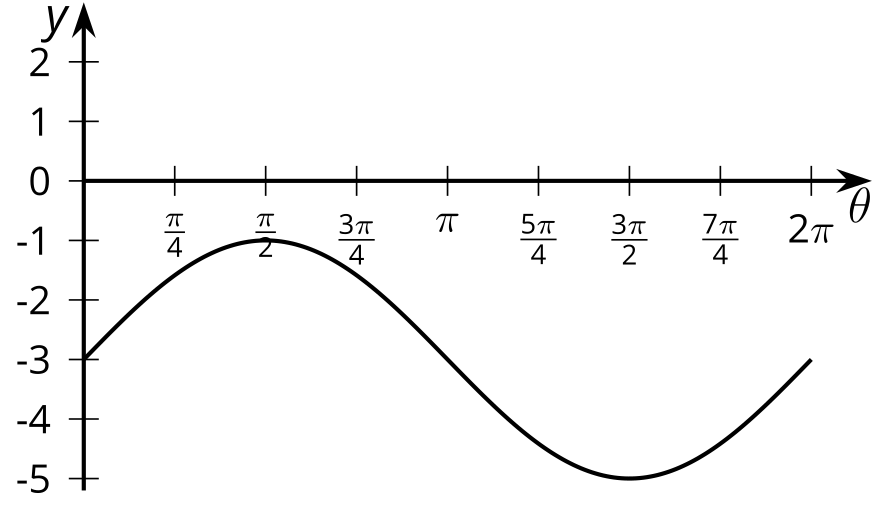
What do you notice? What do you wonder?

### 15.2: Equations and Graphs

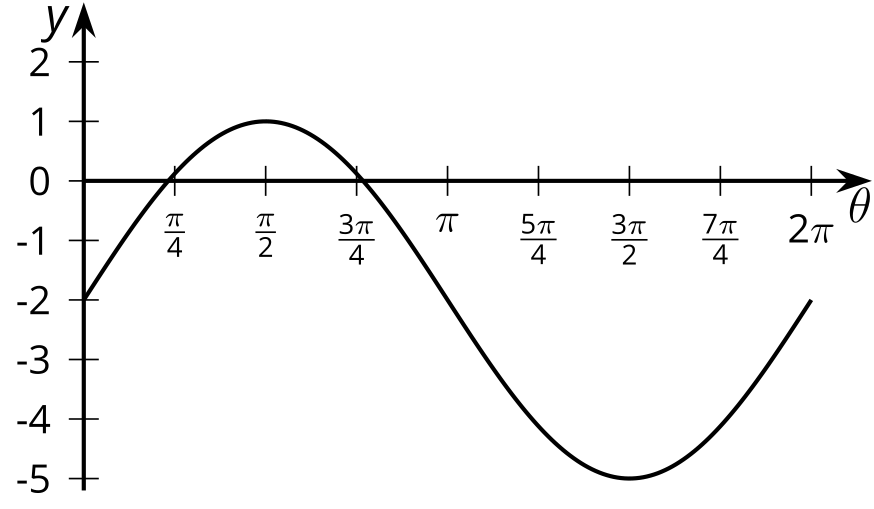
Match each equation with its graph. More than 1 equation can match the same graph.

Equations:

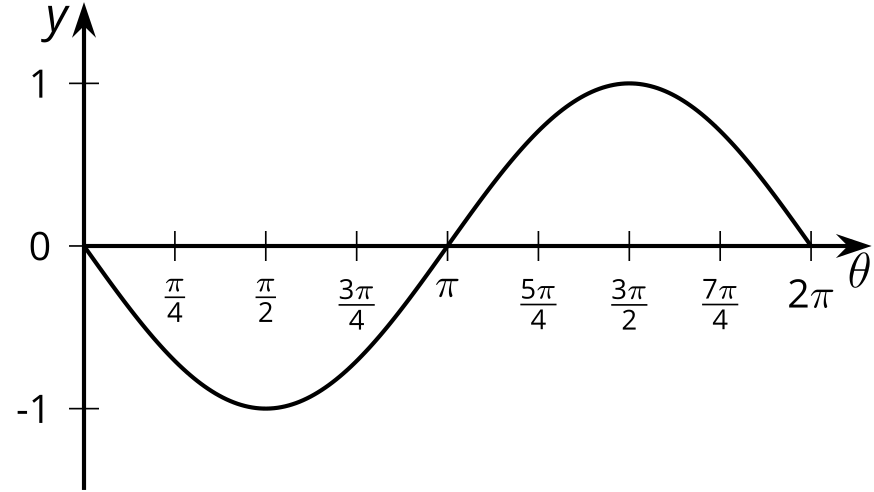
A



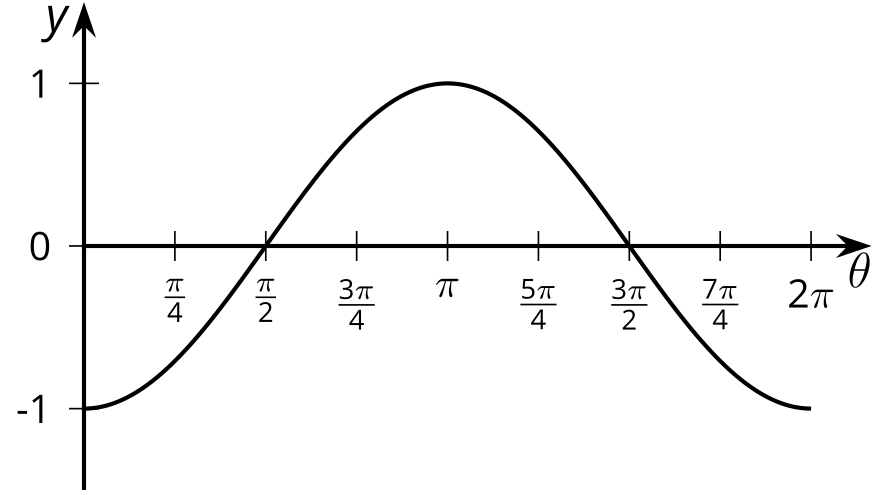
B



C

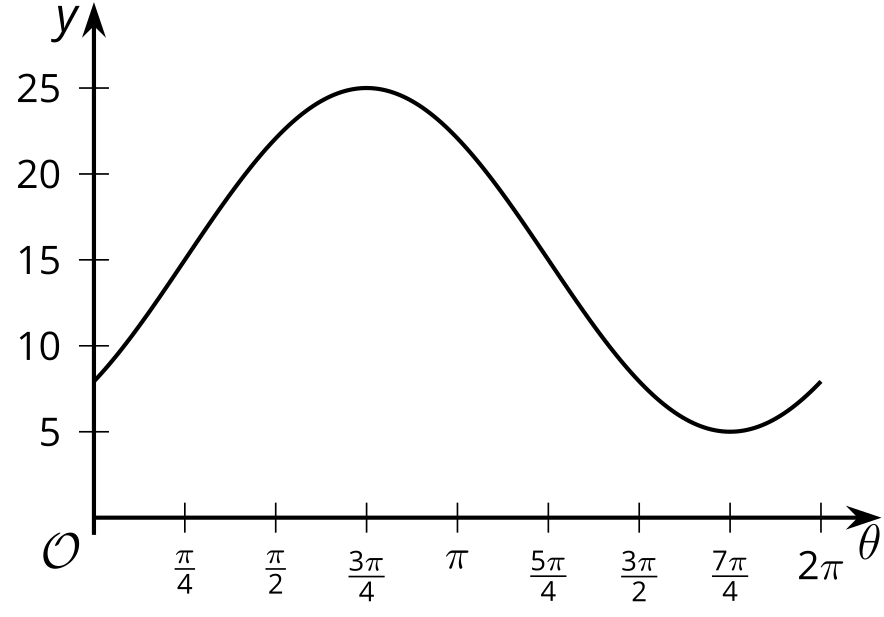


D



#### Are you ready for more?

1. Find an equation for this graph using the sine function.
2. Find another equation for the same graph using a cosine function.

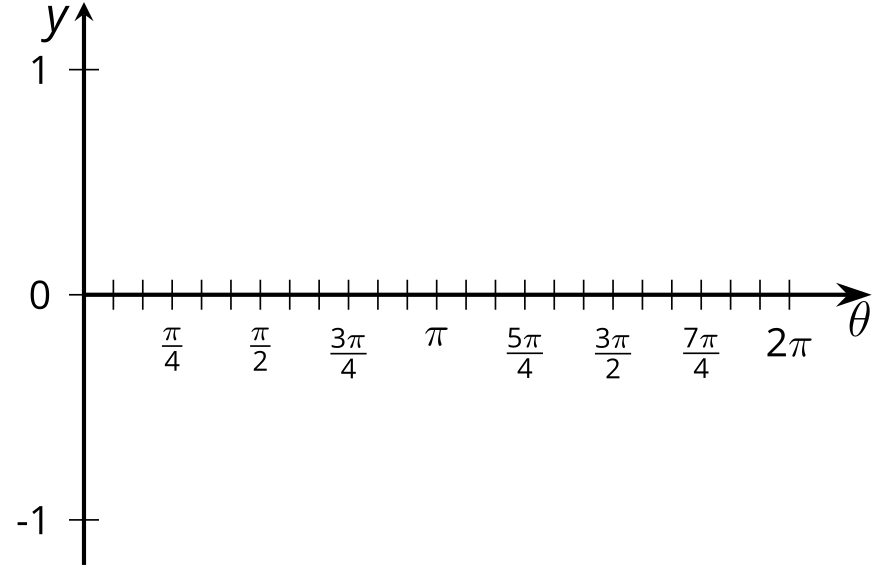


### 15.3: Double the Sine

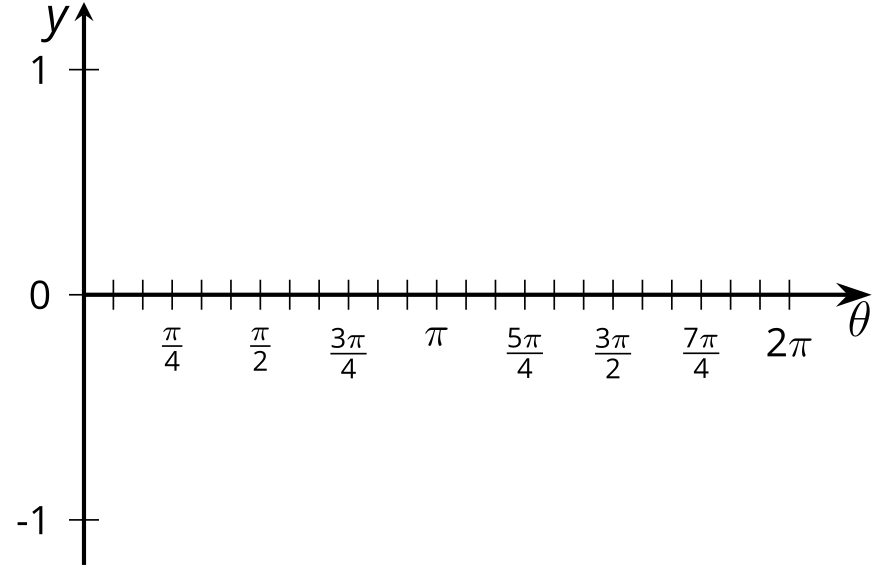
1. Complete the table of values for the expression

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | * 0 |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |

1. Plot the values and sketch a graph of the equation . How does the graph of compare to the graph of ?

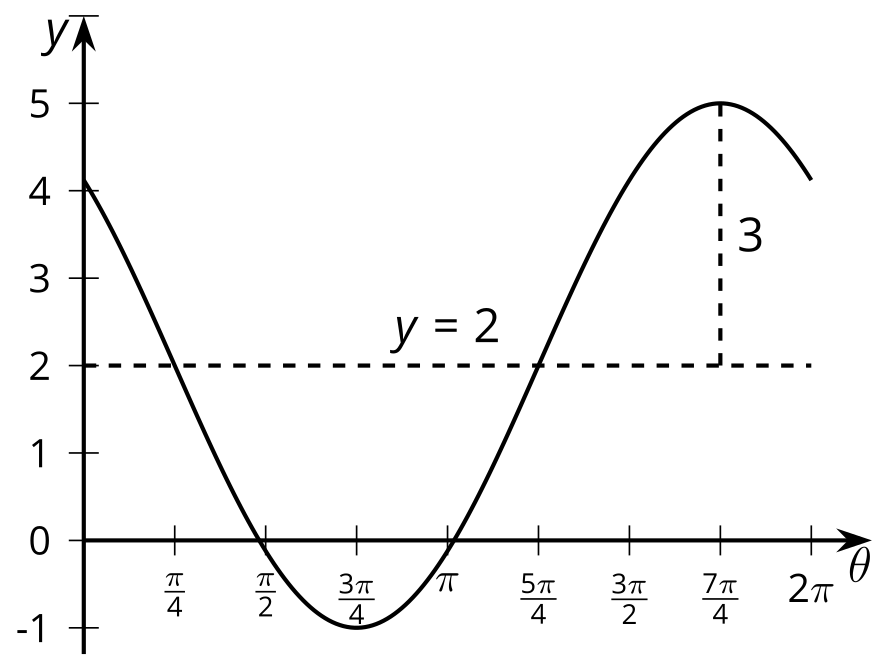
* 

1. Predict what the graph of will look like and make a sketch. Explain your reasoning.

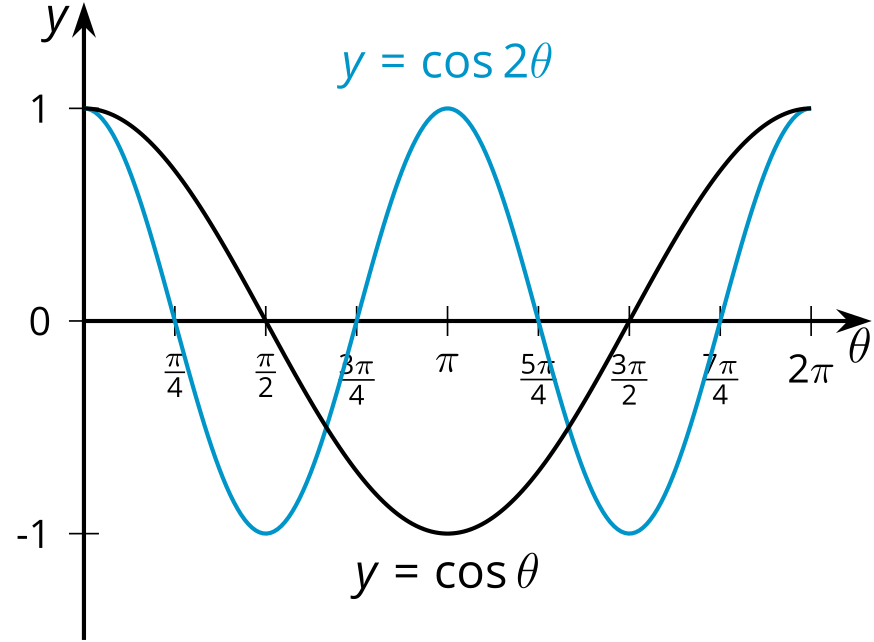
* 

### Lesson 15 Summary

We can find the amplitude and midline of a trigonometric function using the graph or from an equation. For example, let’s look at the function given by the equation . We can see that the midline of this function is 2 because of the vertical translation up by 2. This means the horizontal line goes through the middle of the graph. The amplitude of the function is 3. This means the maximum value it takes is 5, 3 more than the midline value, and the minimum value it takes is -1, 3 less than the midline value. The horizontal translation is to the left, so instead of having, for example, a minimum at , the minimum is at . Here is what the graph looks like:



Another type of transformation is one that affects the period and that is when a horizontal scale factor is used. For example, let's look at the equation where the variable is multiplied by a number. Here, 2 is the scale factor affecting . When , we have so the graph of this cosine equation starts at , just like the graph of . When , we have so the graph of goes through two full periods in the same horizontal span it takes to complete one full period, as shown in their graphs.



Notice that the graph of has the same general shape as the graph of (same midline and amplitude) but the waves are compressed together. And what if we wanted to give the graph of cosine a stretched appearance? Then we could use a horizontal scale factor between 0 and 1. For example, the graph of has a period of .



© CC BY 2019 by Illustrative Mathematics®