Math Virtual Learning

Precalculus

Phase Shift Changes to Trig Graphs

April 21, 2020

Precalculus
Lesson: April 21st, 2020

Objective/Learning Target:

Students will be able to determine the phase shift of a trigonometric function. The student will also be able to adjust a graph of a trigonometric function based on any phase shift changes.

Let's Get Started:

What is the phase shift of a trigonometric function?

Watch the video below to see an explanation of the phase shift of a trig function.

Video: How do you determine the phase shifts for sine and cosine graphs

Transformations of Trigonometric Graphs (Phase Shift Changes)

Below you will find the general equation for the sine function. Different textbooks use different variables, but as you can see, both equations are in the same format. For the purposes of this lesson, we will use the top version of the equation and focus on the **c** value AND the **b** value.

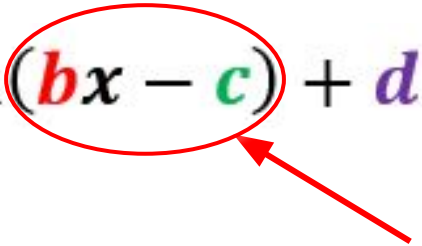
$$y = a\sin(bx - c) + d$$

OR

$$y = A\sin(\omega x - h) + k$$

Phase Shift Changes

$$y = a\sin(bx - c) + d$$



- To determine the phase shift, set the interior of the parenthesis equal to zero and then solve. The solution should either be positive or negative c/b.
- If the solution is positive, then shift the graph to the right by c/b.
- If the solution is negative, then shift the graph to the left by c/b

Phase Shift Changes

Example #1: Determine the phase shift.

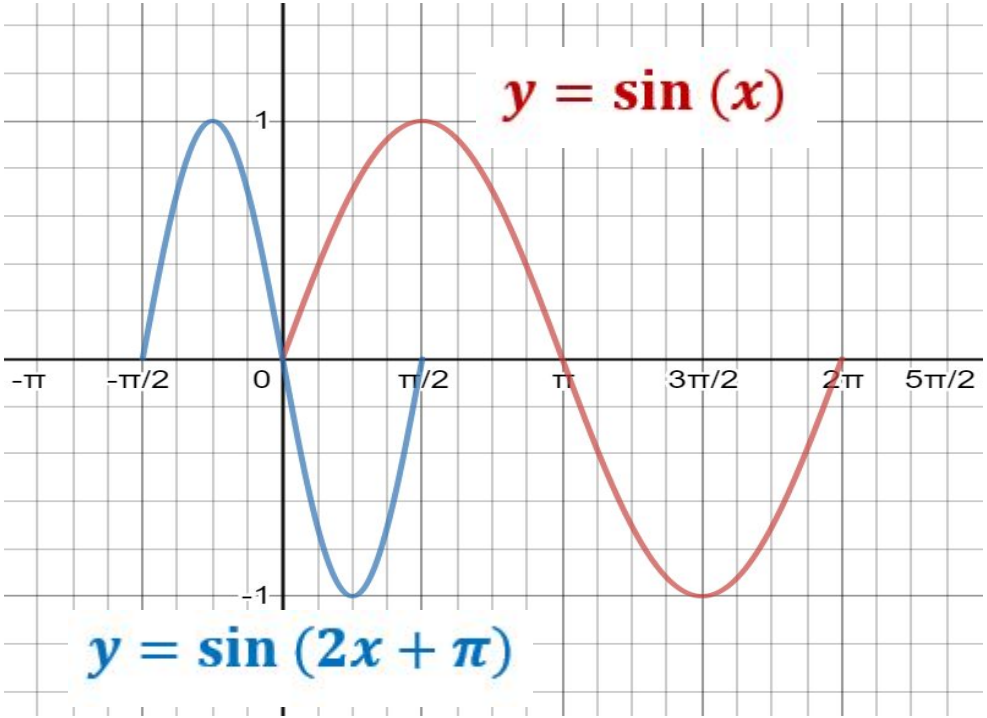
$y = \sin(2x + \pi)$

$2x + \pi = 0$

$2x = -\pi$

$x = -\frac{\pi}{2}$

Phase shift of $\frac{\pi}{2}$ to the left



***** Notice that the blue graph is not only shifted to the left by pi/2, but it has also been compressed horizontally because the period has been changed from 2pi to pi because the b value was 2.**

Example #2: Determine the phase shift.

$$y = \tan(3x - 2\pi)$$

$$3x - 2\pi = 0$$

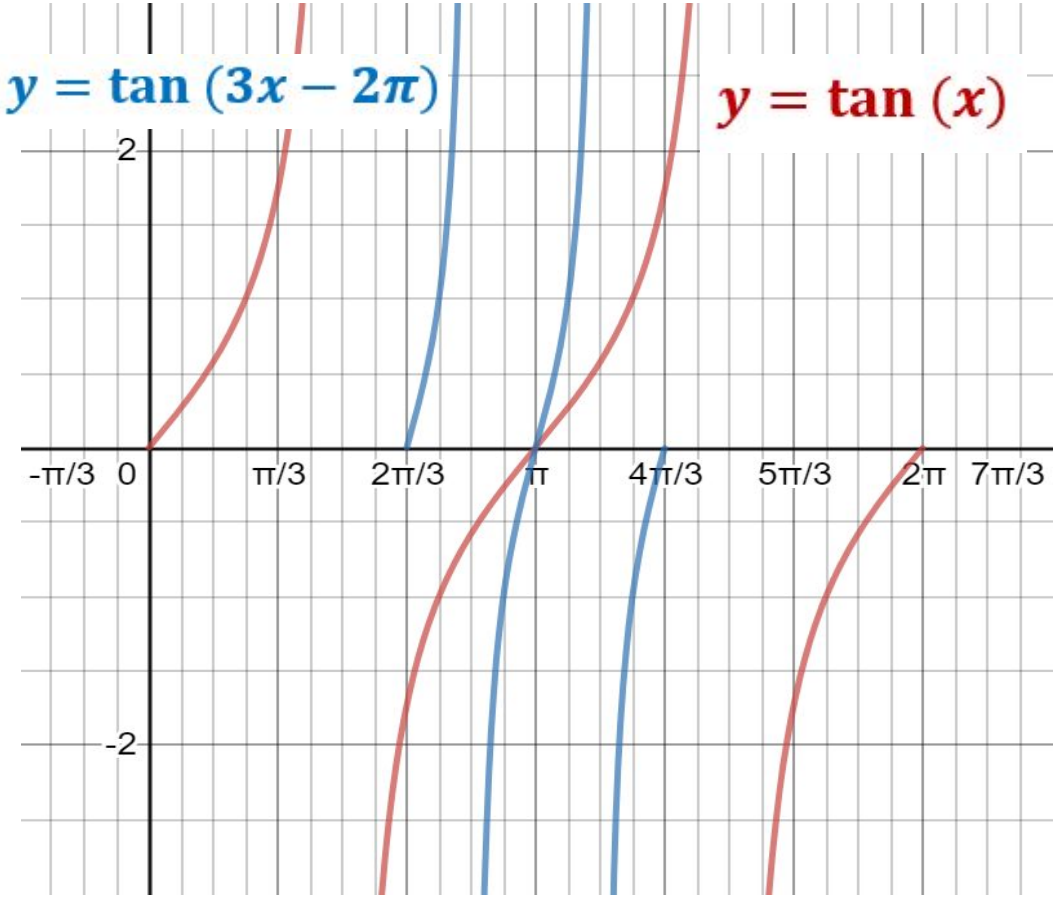
$$3x = 2\pi$$

$$x = \frac{2\pi}{3}$$

Phase shift of $\frac{2\pi}{3}$ to the right

***** Notice that the blue graph is not only shifted to the right by 2pi/3, but it has also been compressed horizontally because the period has been changed from pi to pi/3 because the b value was 3.**

Phase Shift Changes



Example #3: Determine the phase shift.

$$y = \csc(4x - 3\pi)$$

$$4x - 3\pi = 0$$

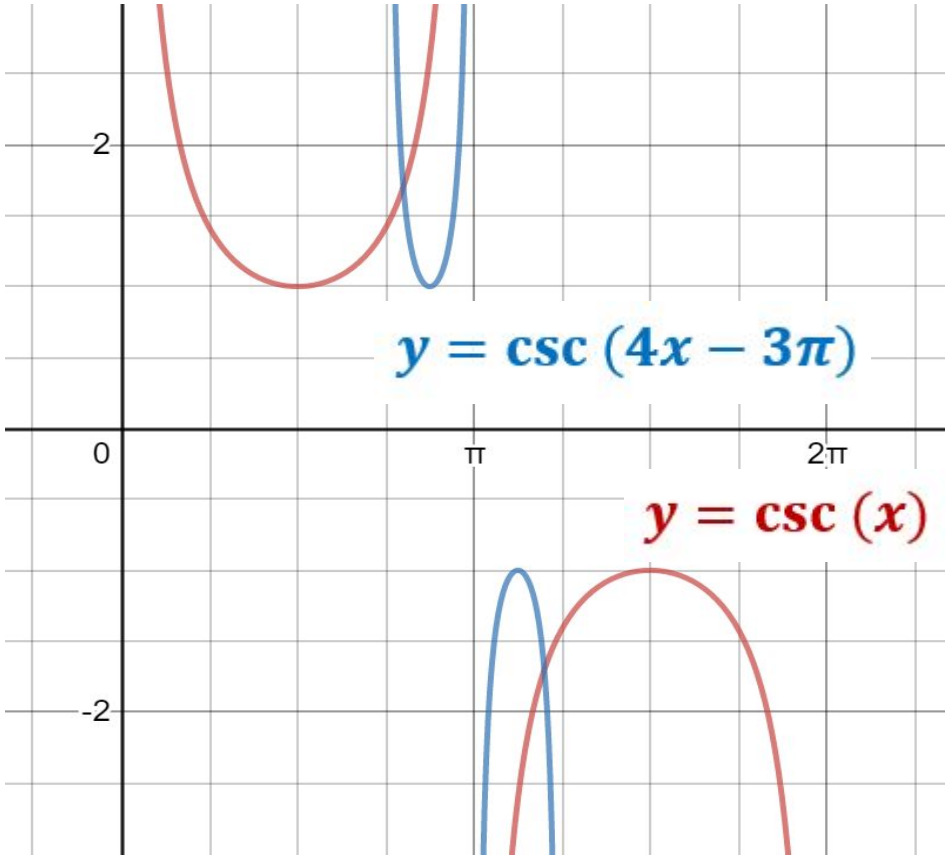
$$4x = 3\pi$$

$$x = \frac{3\pi}{4}$$

Phase shift of $\frac{3\pi}{4}$ to the right

***** Notice that the blue graph is not only shifted to the right by 3pi/4, but it has also been compressed horizontally because the period has been changed from 2pi to pi/2 because the b value was 4.**

Phase Shift Changes



Graphing Period Changes Practice:

On a sheet of paper, determine the phase shift and period of each of the equations below.

1. $y = \sin(x - \pi/3)$

2. $y = \cos(4x + \pi)$

3. $y = \tan(\pi x + 3\pi)$

4. $y = \sec(2x - 2\pi)$

Graphing Period Changes Practice ANSWERS:

On a sheet of paper, determine the phase shift and period of each of the equations below.

1. $y = \sin(x - \pi/3)$

   Period = $2\pi/1 = 2\pi$

   Phase Shift = $\pi/3/1 = \pi/3$

2. $y = \cos(4x + \pi)$

   Period = $2\pi/4 = \pi/2$

   Phase Shift = $-\pi/4$

3. $y = \tan(\pi x + 3\pi)$

   Period = $\pi/\pi = 1$

   Phase Shift = $-3\pi/\pi = -3$

4. $y = \sec(2x - 2\pi)$

   Period = $2\pi/2 = \pi$

   Phase Shift = $2\pi/2 = \pi$

Additional Resources:

Click on the links below to get additional helpful videos as well as additional practice to check your understanding.

Additional Practice

Graphing Trigonometric Functions & Answers to the WS

Helpful Videos

Phase shifts of trigonometric functions

Graphing Trigonometric Functions, Phase Shift, Period, Transformations, Tangent, Cosecant, Cosine

(Watch **24:18 - 32:37** for Phase Shift changes or watch it all for overall help graphing)

Amplitude, period, vertical shift, and phase shift