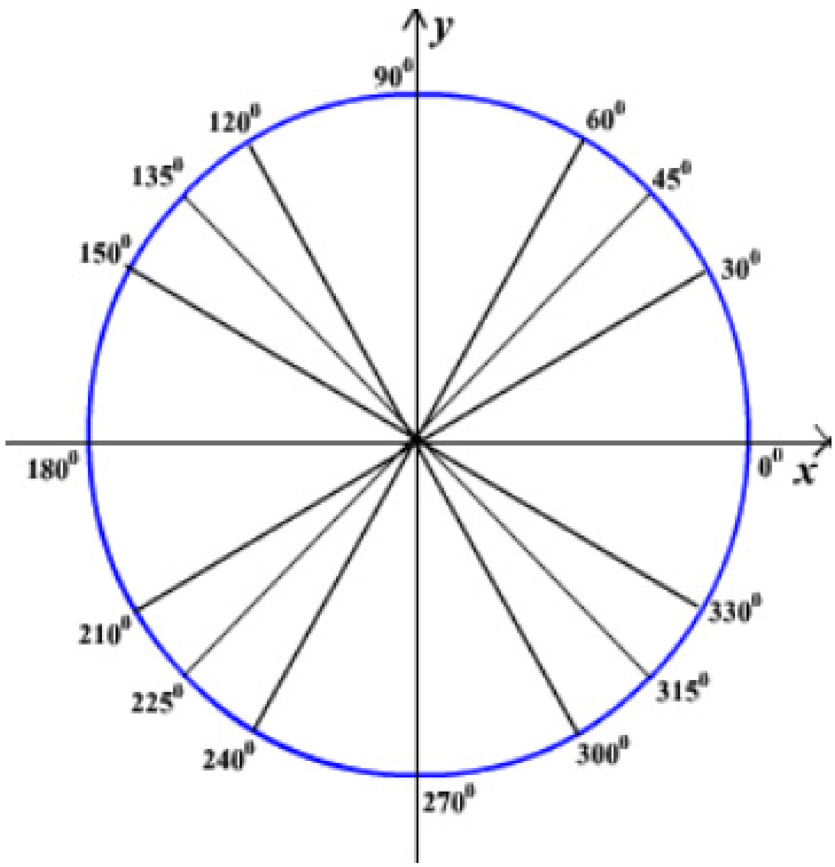
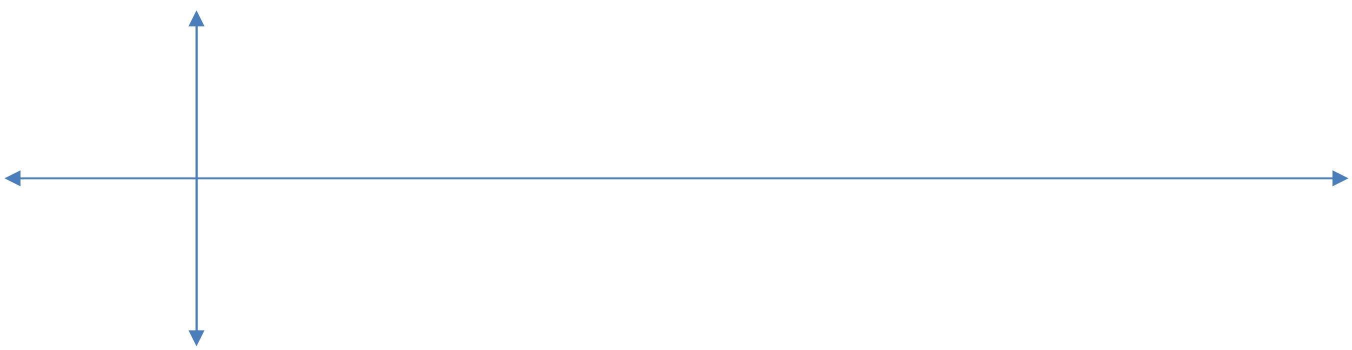

y
90°
120°
60°
135°
45°
150°
30°
180°
0°
x
210°
330°
225°
315°
240°
300°
270°

Graph: $y = \sin x$ over a period of 2π.

$x\ (radians)$	$y\ = \sin x$



Period:

Amplitude:

Graph: $y = \cos x$ over a period of 2π.

$x\ (radians)$	$y\ = \cos x$

Period:

Amplitude:

Vertical and Horizontal Stretch and Compress

$y = a\, sin\, bx$
$y = a\, cos\, bx$

Amplitude:

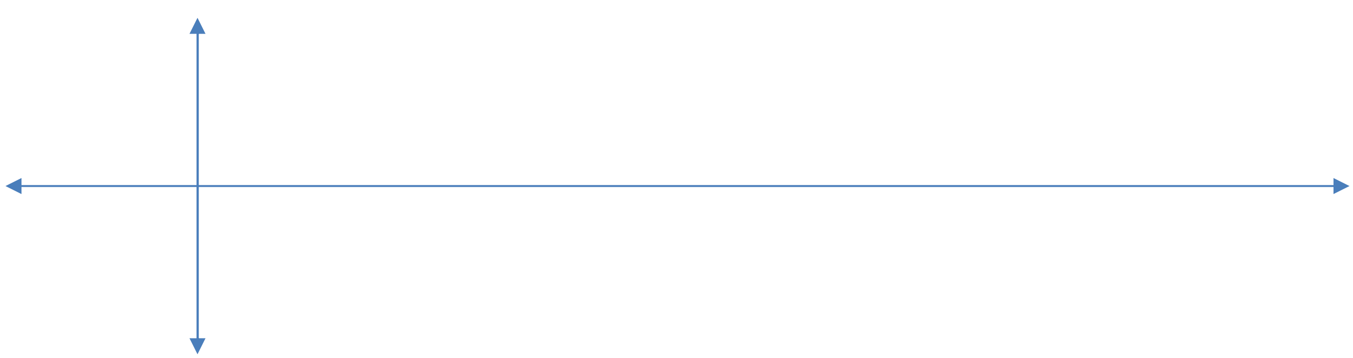
Period:

Graph: $y = 2\sin x$ over one period.

Period:

Amplitude:

$x\ (radians)$	$y = 2\sin x$



Graph: $y = -\frac{1}{2}\sin x$ over one period.

Period:

Amplitude:

Reflection:

$x\ (radians)$	$y = sin\ x$	$y = -\frac{1}{2}\sin x$

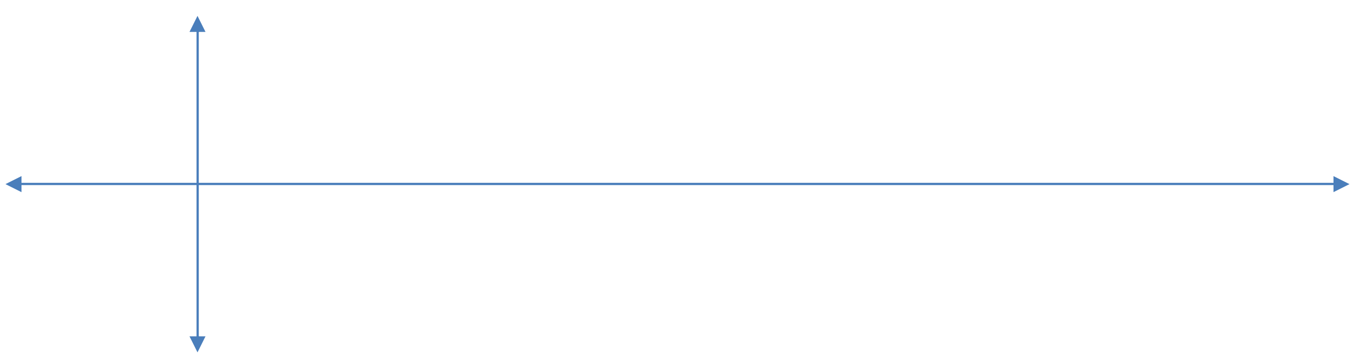
Graph: $y = \cos 2x$ over one period.

Period:

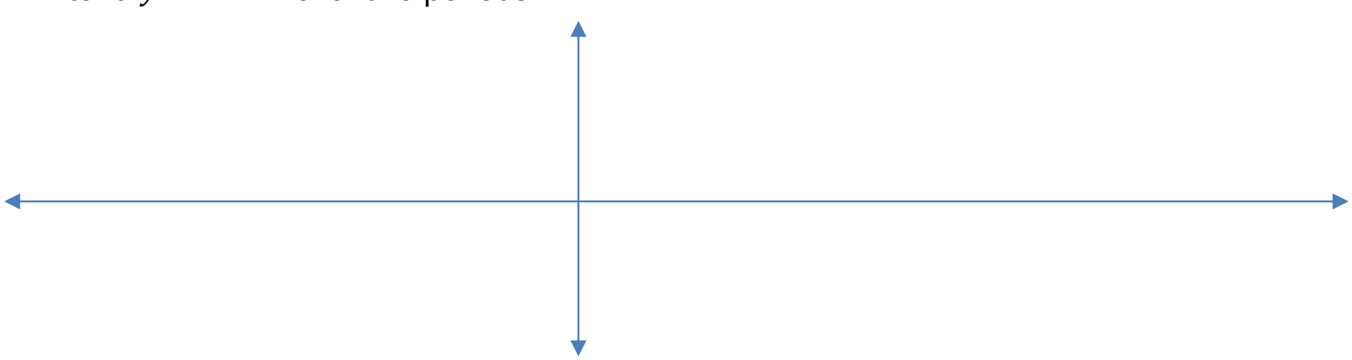
Amplitude:

Reflection:

$x\ (radians) for$ $y = cosx$	$y\ =\ cos\ x$	$x\ (radians) for$ $y\ = \cos 2x$



Extend $y = \cos 2x$ over two periods.



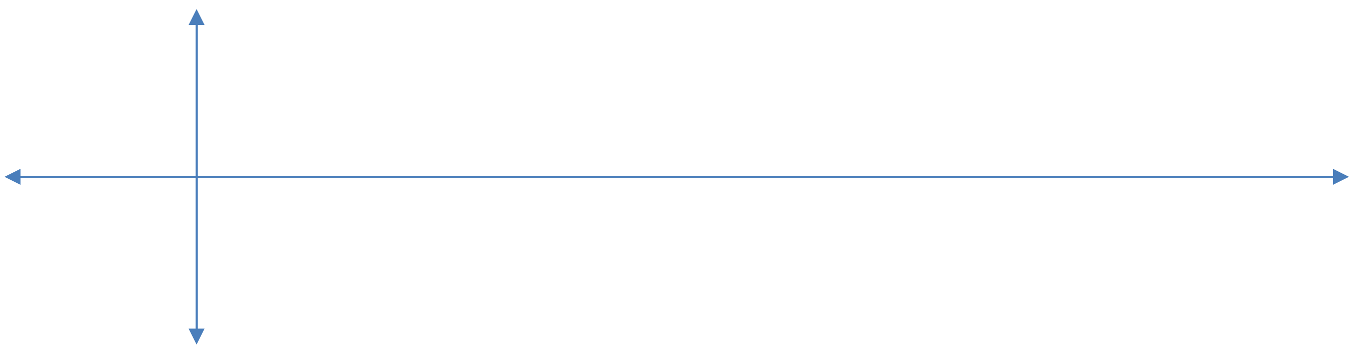
Recall from last class:
Equations are of the form:

$y = a \sin bx$
$y = a \cos bx$

Period:

Amplitude:

Graph of $y = \sin x$. Period: , Amplitude:



Graph of $y = \cos x$. Period: , Amplitude:

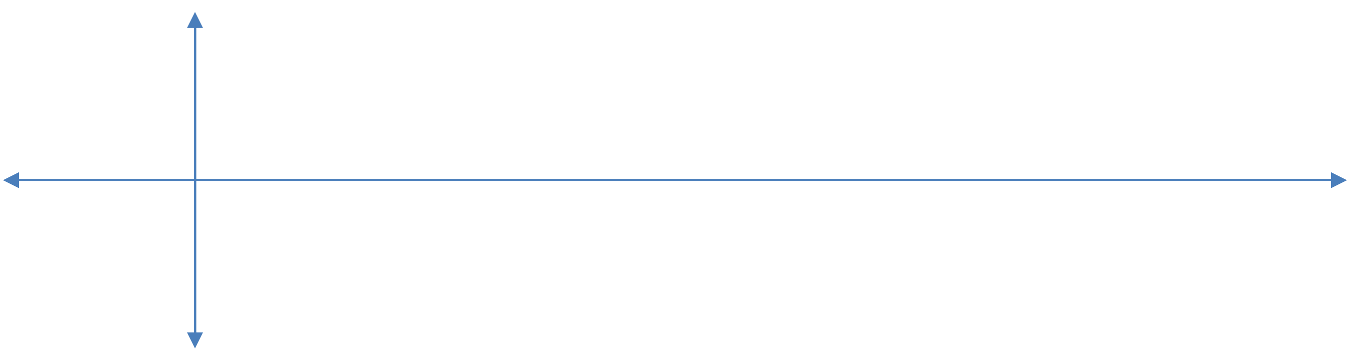
Graph: $y = \cos \frac{1}{2} x$.

Period:

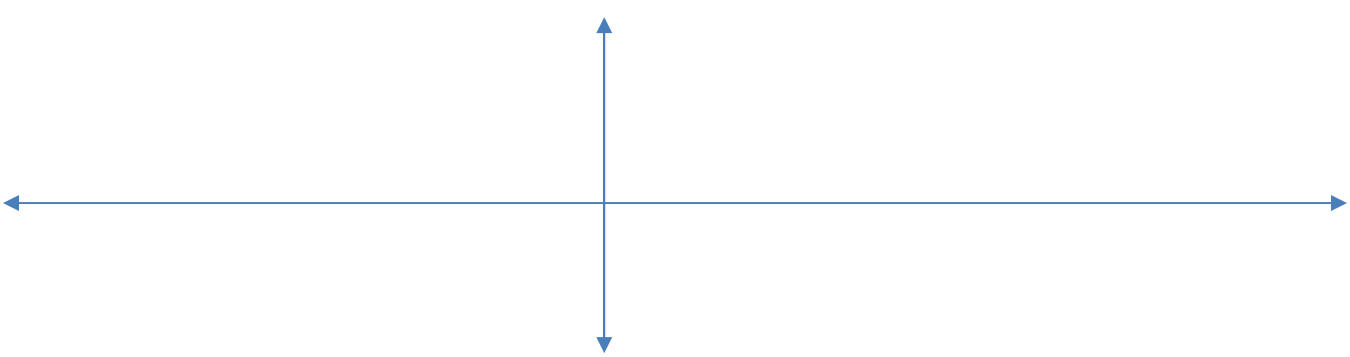
Amplitude:

Reflection:

$x\ (radians)$	$y = \cos \dfrac{1}{2} x$

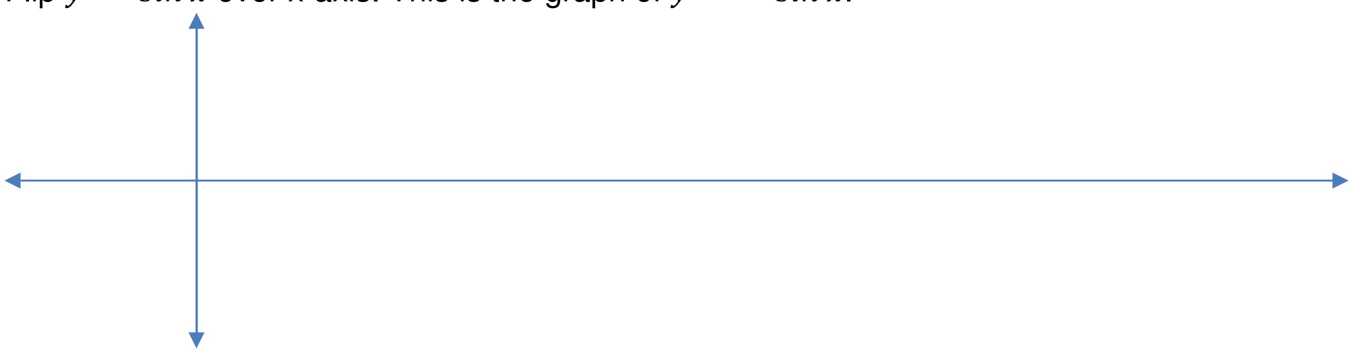


Graph: $y = \cos \frac{1}{2} x$ over two periods.

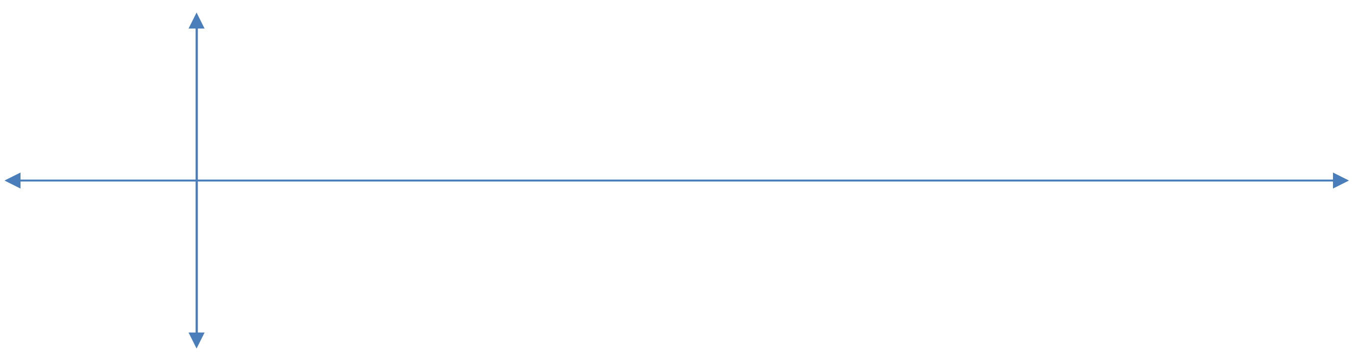


Graph of $y = \sin x$.

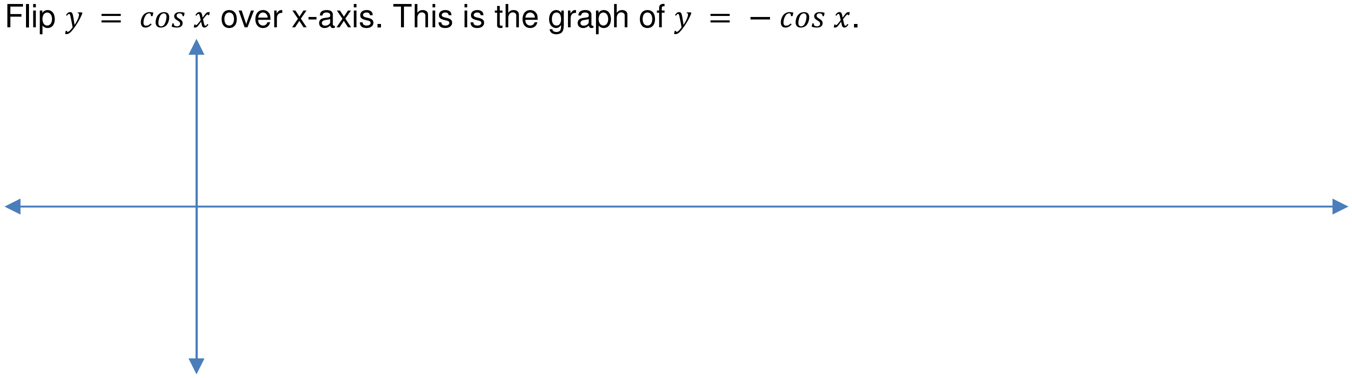
Flip $y = sin\ x$ over x-axis. This is the graph of $y = -sin\ x$.



Graph of $y = \cos x$.



Flip $y = cos\ x$ over x-axis. This is the graph of $y = -cos\ x$.



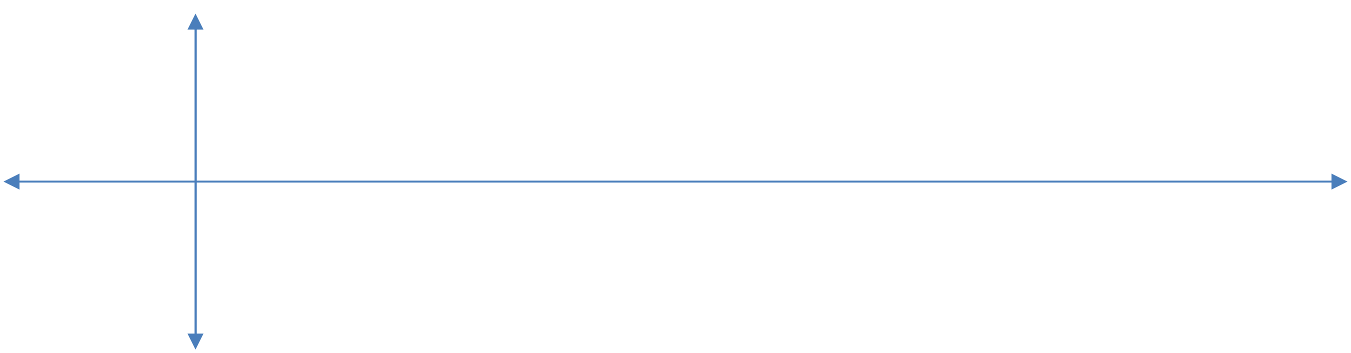
Graph: $y = -3\sin 2x$ over one period.

Period:

Amplitude:

Reflection:

$x\ (radians)$	$y\ =\ sin\ 2x$	$y = -3\sin 2x$



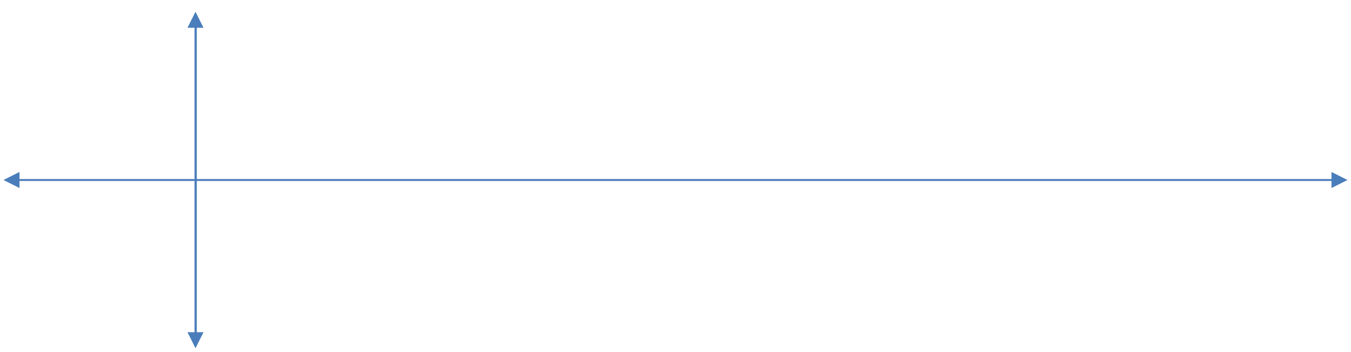
Graph: $y = 5\cos\frac{\pi}{2}x$ over one period.

Period:

Amplitude:

Reflection:

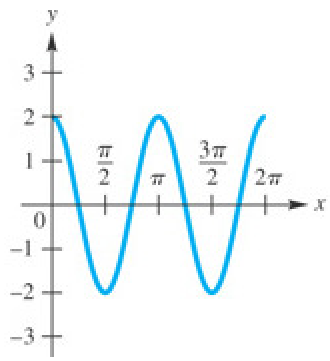
$x\ (radians)$	$y = cos\,\frac{\pi}{2}x$	$y = 5\cos\frac{\pi}{2}x$



Start with graph and find formula.

Determine the formula for the graph given.

41.



Strategies:

1. **Function:** Look at the y-intercept, look at the maximum.

Looks like: cos or sin

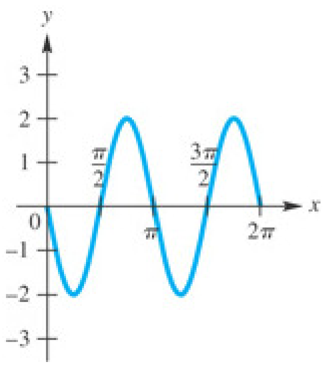
2. **Period:** Where does the graph start to repeat?

Use $\frac{2\pi}{|b|}$ = period, to find *b.*

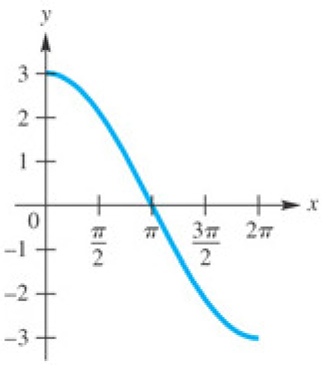
3. **Amplitude:** so a =
4. **Flip**:
5. Fill in appropriate general formula:

$$y = a\cos bx$$
$$y = a\sin bx$$

42.



44.



Recall from last class:
Equations are of the form:

$y = a\,sin\,bx$
$y = a\,cos\,bx$

If we have horizontal or vertical shifts, our general form changes slightly to take them into account:

$y = c + a\,sin\,[b(x - d)]$
$y = c + a\,cos\,[b(x - d)]$

$|a|$ is:

$-a$ means:

$\frac{2\pi}{|b|}$ is:

d is:

c is:

Graph of $y = \sin\left(x + \frac{3\pi}{4}\right)$.

Amplitude:

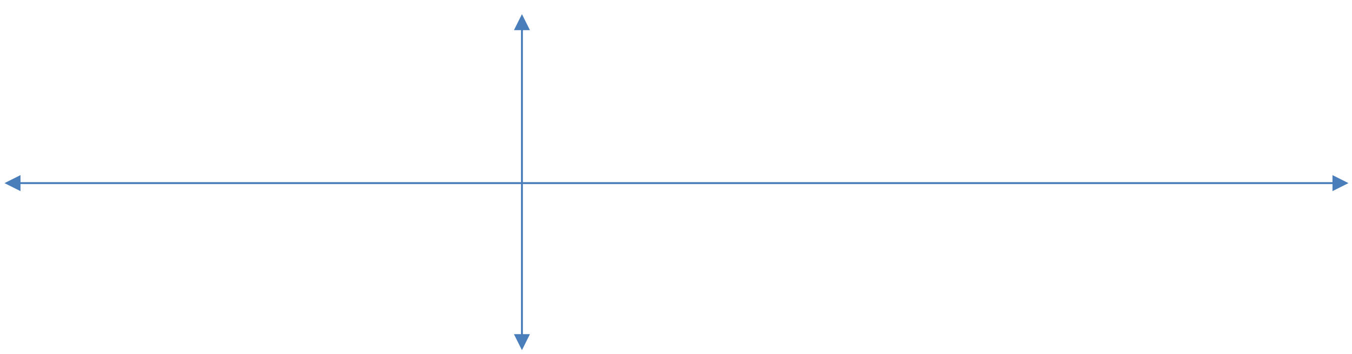
Period:

Reflection:

Translation: (phase shift)

(V)

x	$y = sin\left(x + \frac{3\pi}{4}\right)$



Graph: $y = -2\cos\left(x - \frac{\pi}{3}\right)$.

Amplitude:

Period:

Reflection:

Translation: (phase shift)

(V)

x	$y = cos\left(x - \frac{\pi}{3}\right)$	$y = -2\cos\left(x - \frac{\pi}{3}\right)$

Graph: $y = \frac{3}{2}\cos(2x - \pi)$.

Amplitude:

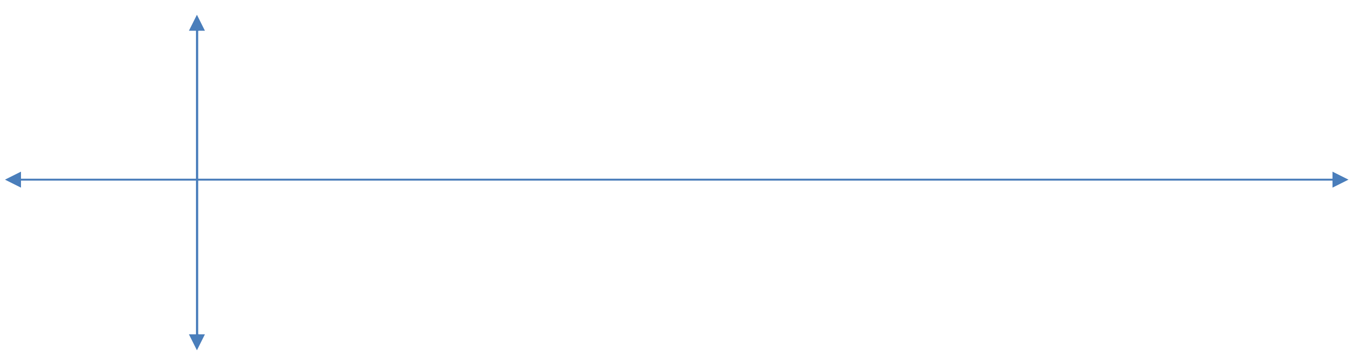
Period:

Reflection:

Translation: (phase shift)

(V)

x	$y = cos\,(2x - \pi)$	$y = \frac{3}{2}\cos(2x - \pi)$



Graph: $y = 4 - \ 2\sin\left(3x - \pi\right)$.

Amplitude:

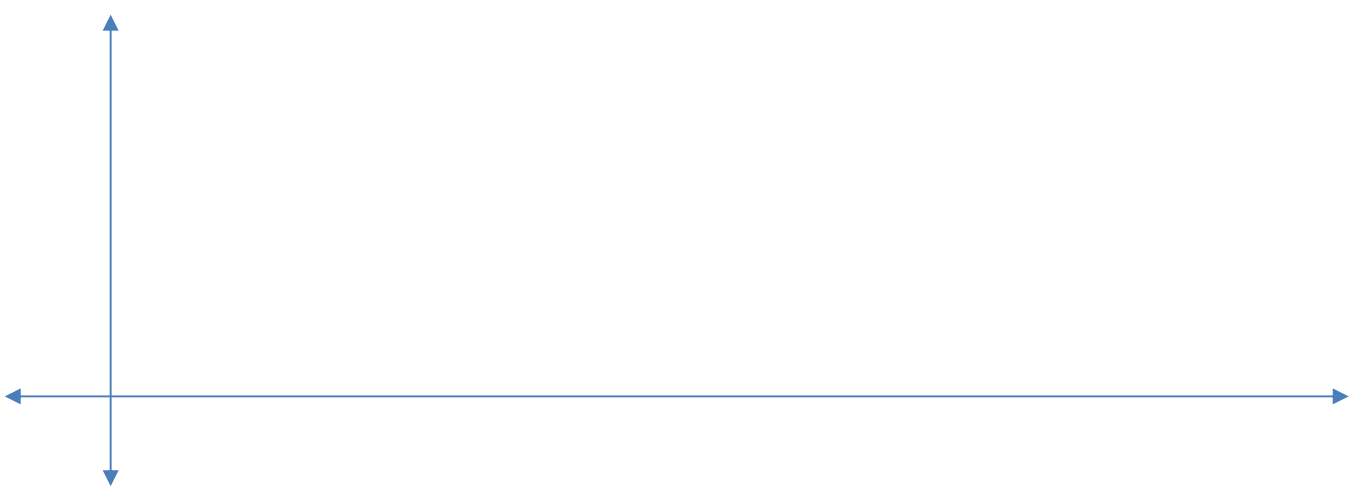
Period:

Reflection:

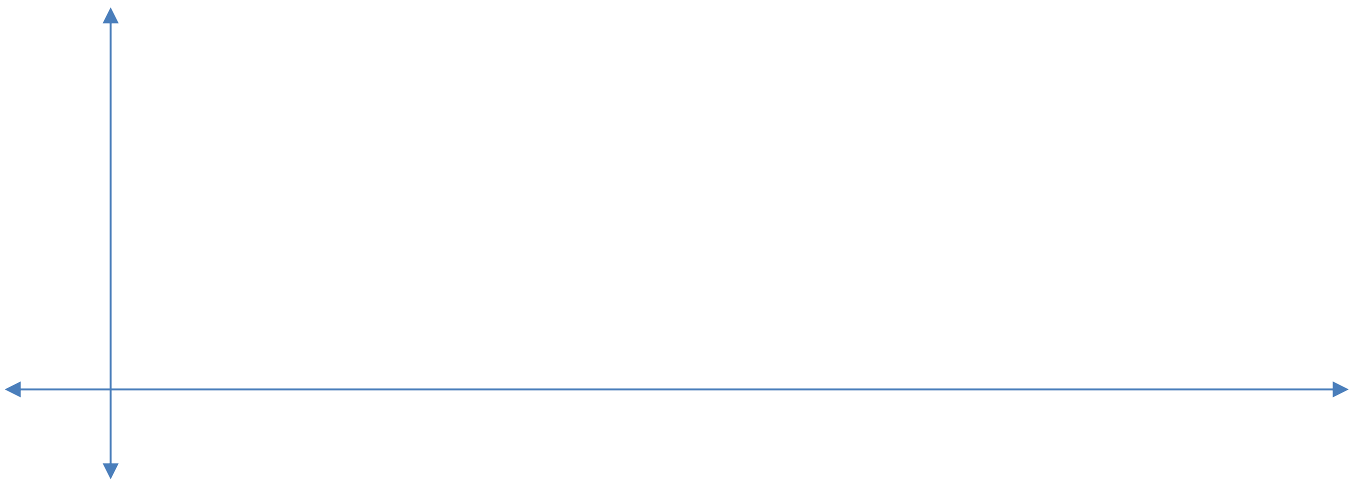
Translation: (H)

(V)

x	$y\ = \sin(3x - \pi)$	$y = 4 - \ 2\sin\left(3x - \pi\right)$



Extend the graph of $y = 4 - 2\sin(3x - \pi)$ to two periods.

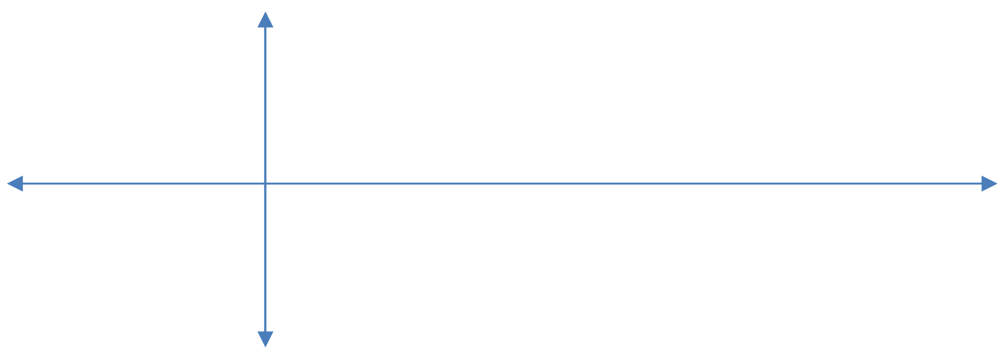


Graphs of tan and cot.

Use the unit circle to find the initial graph. Recall (x, y) is (cos, sin). Recall that $tan\ s\ =\ \frac{y\ coord}{x\ coord}$ for point of intersection of terminal side with the unit circle. Look back at 3.3 for the unit circle with ordered pairs for each standard angle.

$y\ =\ tan\ x$

$radians$	$\frac{y}{x}$
0	
$\frac{\pi}{4}$	
$\frac{\pi}{2}$	



Period of $y\ =\ tan\ x$:

So the equation to find b is:

Differences from sin/cos graphs:

Example: $y = tan\ \frac{1}{3}x$

Vertical scaling (formerly amplitude):

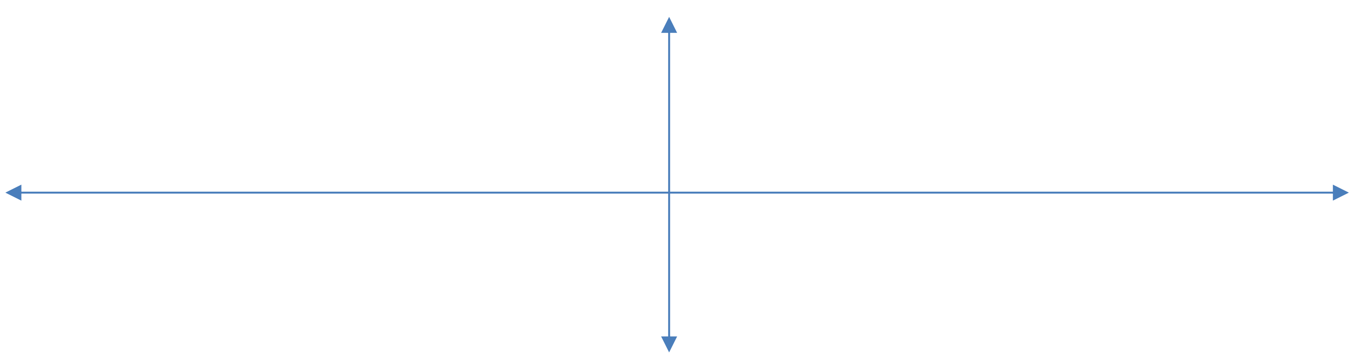
Period:

Reflections:

Phase shift:

Vertical shift:

x	$\tan\left(\frac{1}{3}x\right)$



Example: $y = -\frac{1}{2} tan\ 2x$

Vertical scaling (formerly amplitude):

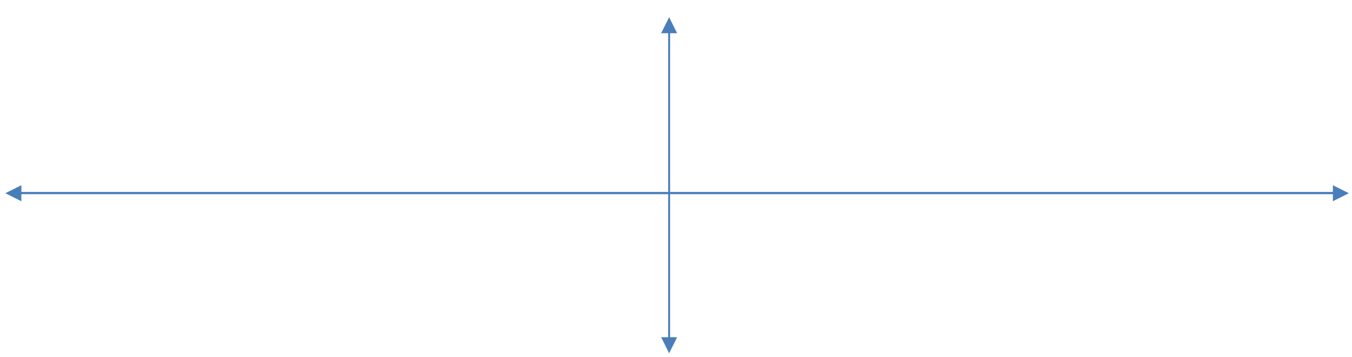
Period:

Reflections:

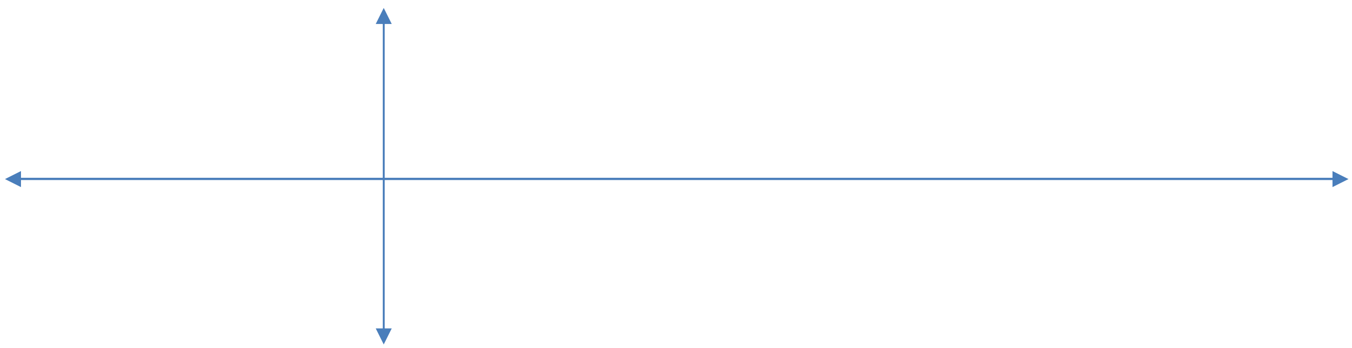
Phase shift:

Vertical shift:

x	$\tan(2x)$	$-\frac{1}{2}\tan(2x)$



Extend the graph of $y = -\frac{1}{2} tan\, 2x$ to two periods.



$y = \cot x$.

Shortcut method: Because ________________________________, where $\tan x = 0$, $\cot x$ will be undefined.

$cot\ x$ is defined as $\frac{(coordinate)}{(coordinate)}$ but also as $\frac{1}{(trig\ function)}$. Which is easier to find?

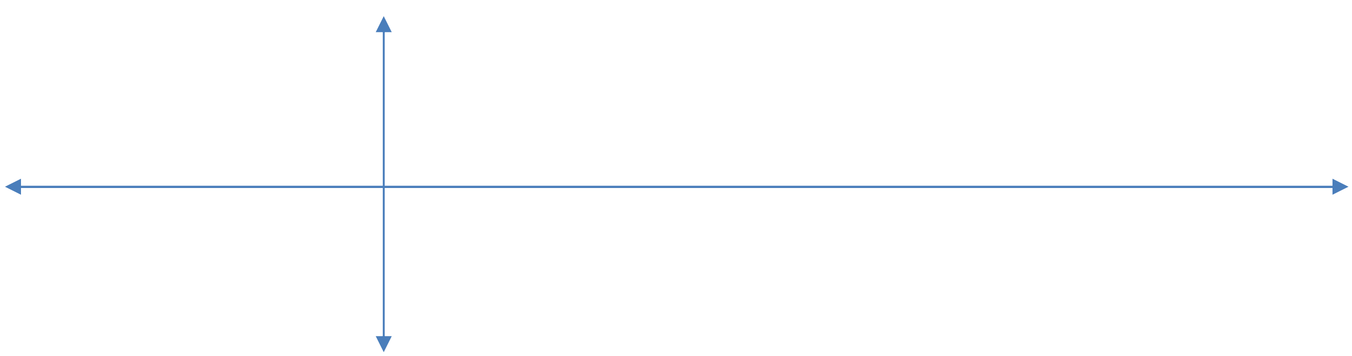
Asymptotes:

Asymptotes of tan graph become:

Period:

Asymptote to Asymptote:

x	$\tan x$	$\cot x$



Word: Don't rely on a graphing calculator – learn to recognize the shapes of each trig graph!

Graph $y = 1 + 3\cot\left(2x + \frac{\pi}{2}\right)$

Vertical scaling:

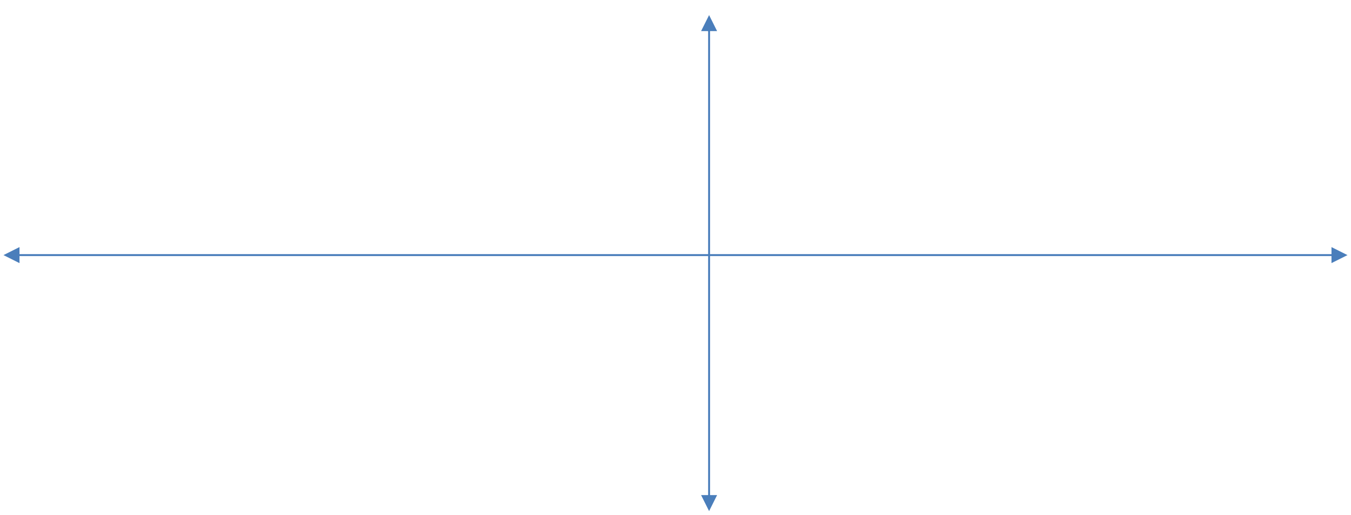
Period:

Reflections:

Phase shift:

Vertical shift:

x	$\cot\left(2x + \frac{\pi}{2}\right)$	$1 + 3\cot\left(2x + \frac{\pi}{2}\right)$



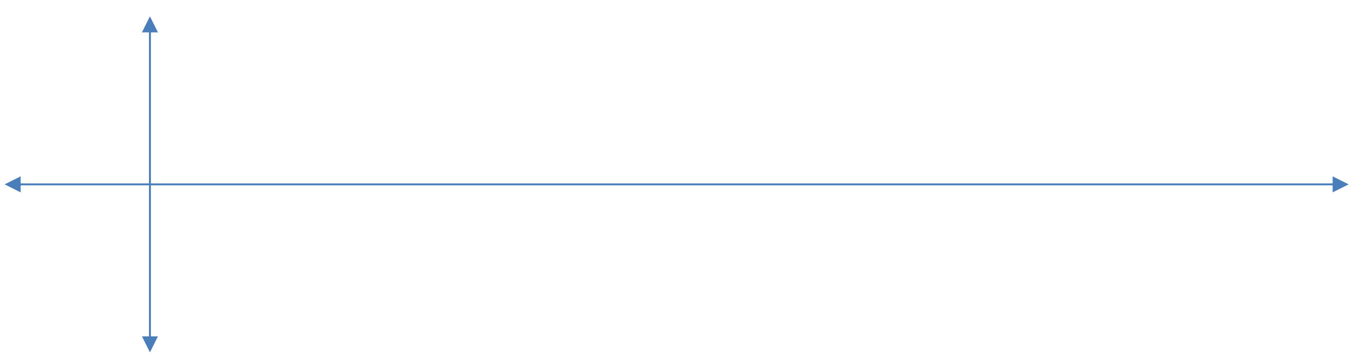
Graphs of sec and csc:

Consider the graph of $y = sin\, x$:

$y =$ ________ $x = \frac{1}{\sin x}$

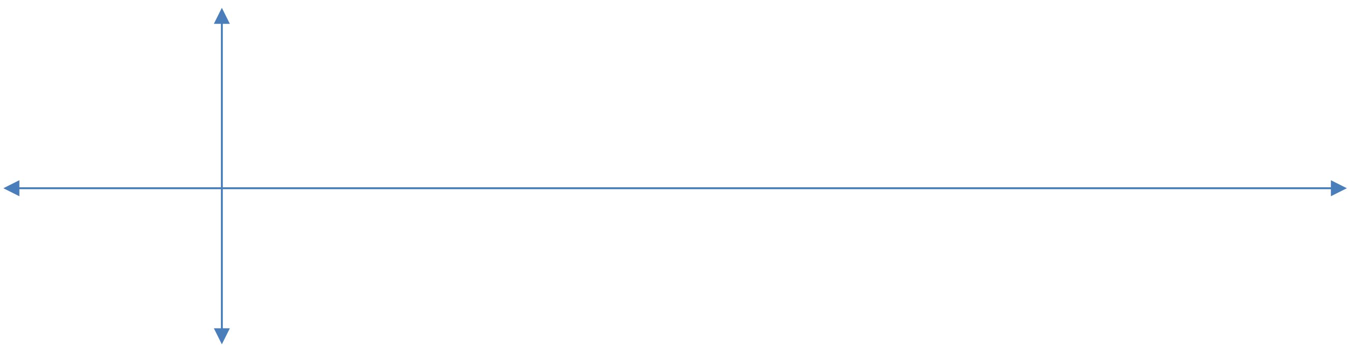
Period:

x	$\sin x$	$\frac{1}{\sin x} =$



Example: $y = 3\csc 2x$

Same as:

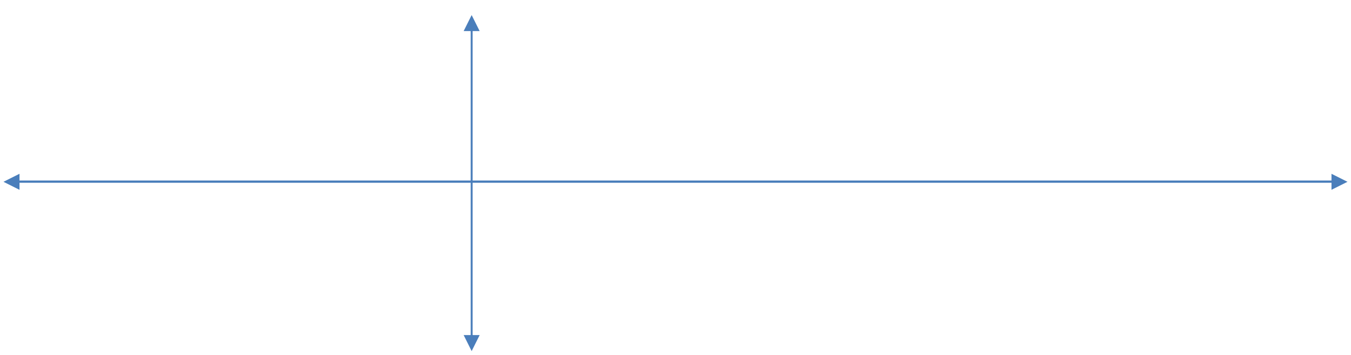


Consider the graph of $y = cos\ x$:

$y =$ ________ $x = \dfrac{1}{\cos x}$

Period:

x	$\cos x$	$\dfrac{1}{\cos x} =$

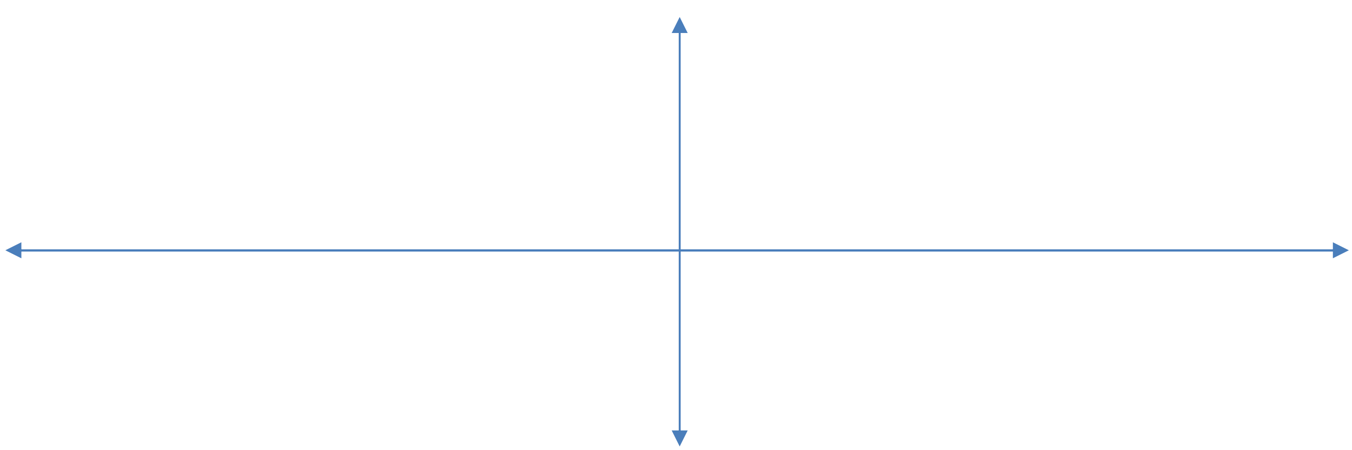


Example: $y = 1 - 3\,sec(2x + \pi)$

Same as:

Amplitude: Period: Reflection: Phase shift: Vertical shift:

x	$\cos(2x + \pi)$	$y = \dfrac{1}{\cos(2x + \pi)}$	$1 - 3(y)$



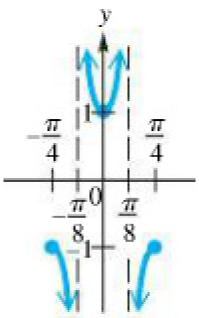
Graphing Summary

One Period's Width	One Period's Domain	Trig Function(s)

Function	Shape of Graph	Function	Shape of Graph
$sin\ x$		$cos\ x$	
$csc\ x$		$sec\ x$	
$tan\ x$		$cot\ x$	

Create the formula from a graph:

You can write these as either csc or sec, just take the shift into account.



Period:

Scaling:

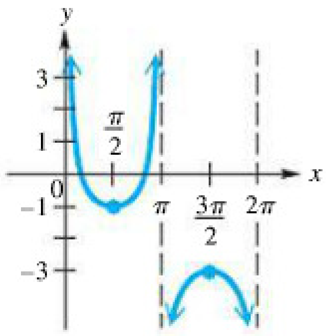
Reflection:

Phase shift:

Vertical shift:

$y = c + a\,fcn\,[b(x - d)]$

21.



Period:

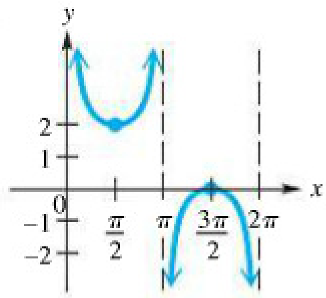
Scaling:

Reflection:

Phase shift:

Vertical shift:

22.



Period:

Scaling:

Reflection:

Phase shift:

Vertical shift: