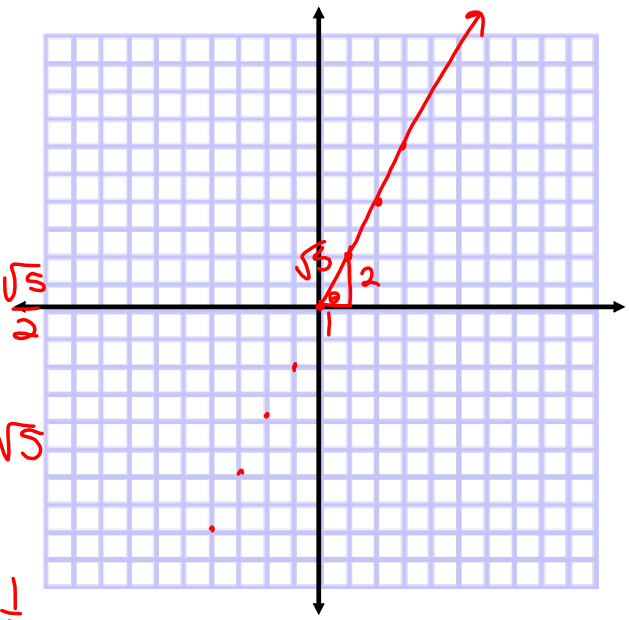
35) $2x - y = 0$

$y = 2x$

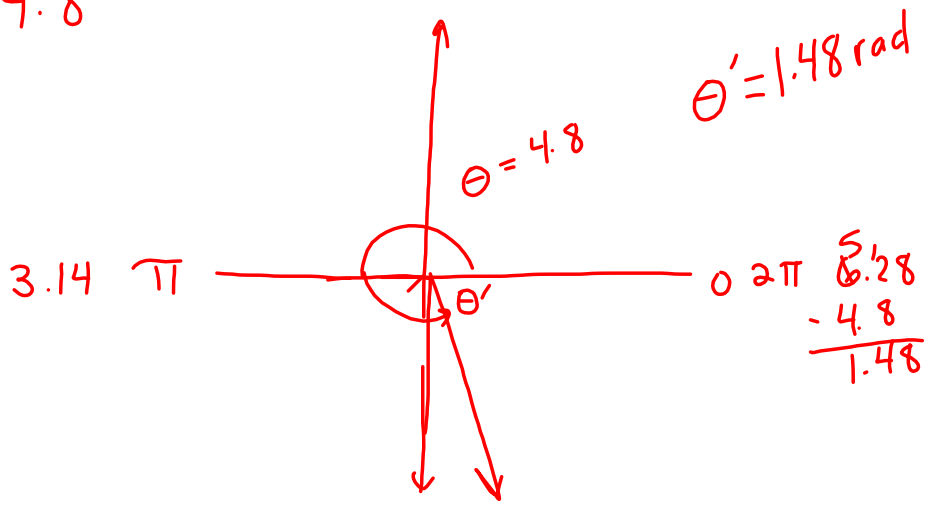


$\sin\theta = \frac{2}{\sqrt{5}} = \frac{2\sqrt{5}}{5}$ $\csc\theta = \frac{\sqrt{5}}{2}$

$\cos\theta = \frac{1}{\sqrt{5}} = \frac{\sqrt{5}}{5}$ $\sec\theta = \sqrt{5}$

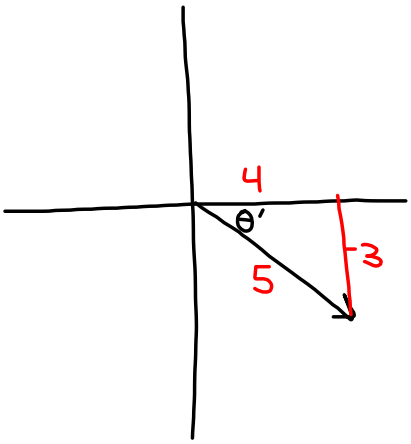
$\tan\theta = \frac{2}{1} = 2$ $\cot\theta = \frac{1}{2}$

53) $\theta = 4.8$



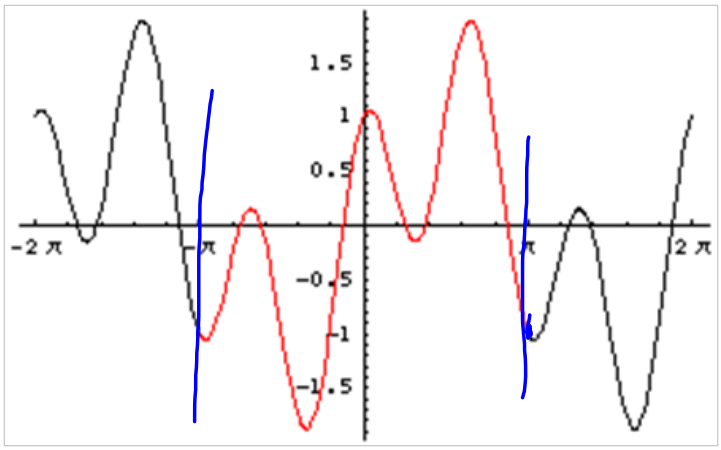
$$\begin{array}{r} 6.28 \\ -\ 4.8 \\ \hline 1.48 \end{array}$$

69) $\sin\theta = -\frac{3}{5}$ opp/hyp IV $\cos\theta = \frac{4}{5}$



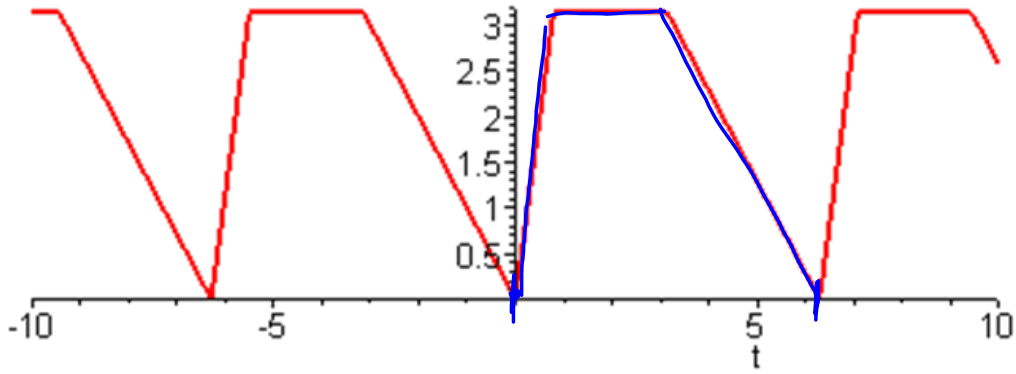
Section 4.5 A Graphing sine

1.



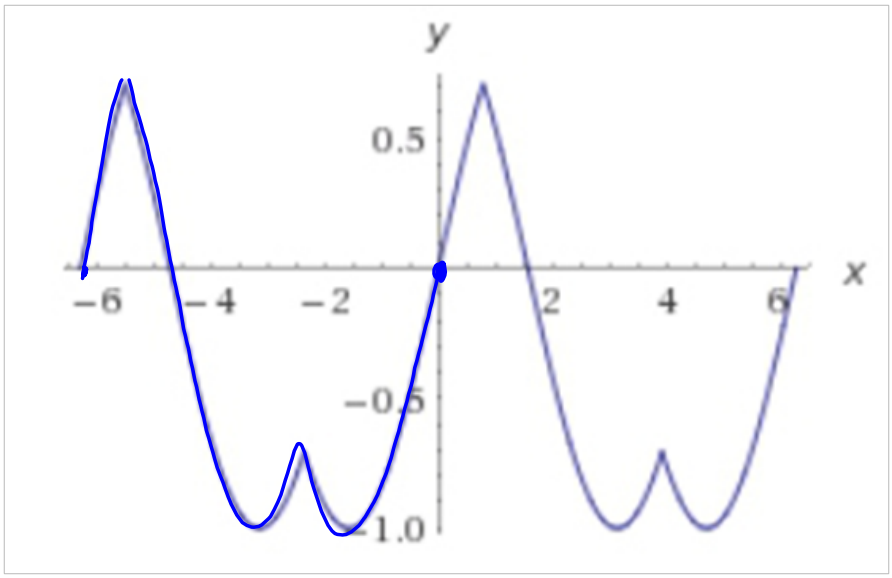
Period = 2π

2.



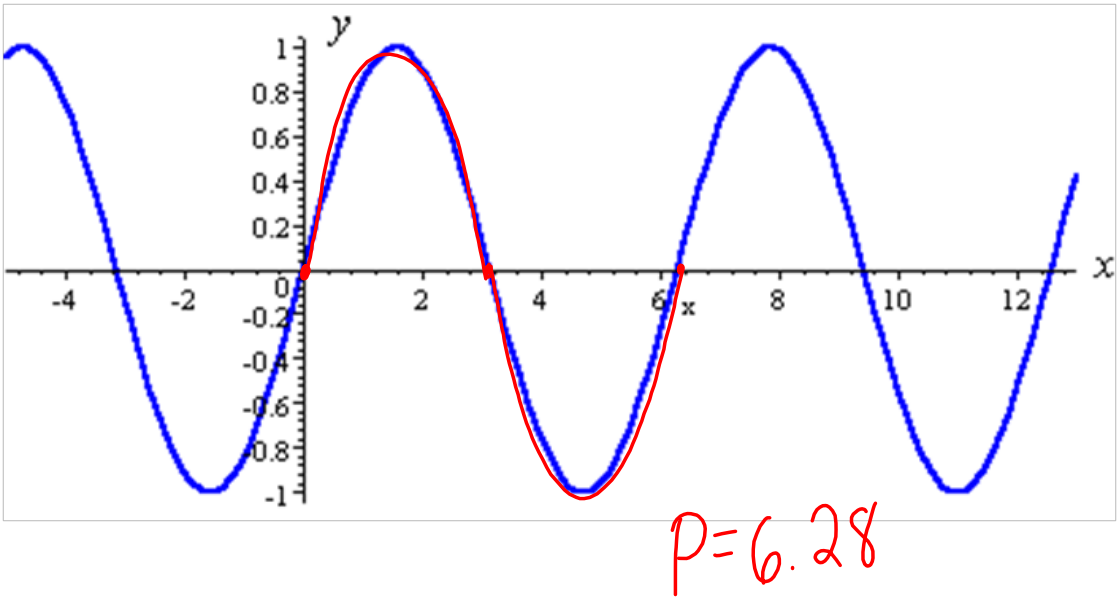
$P = 6.28$

3.



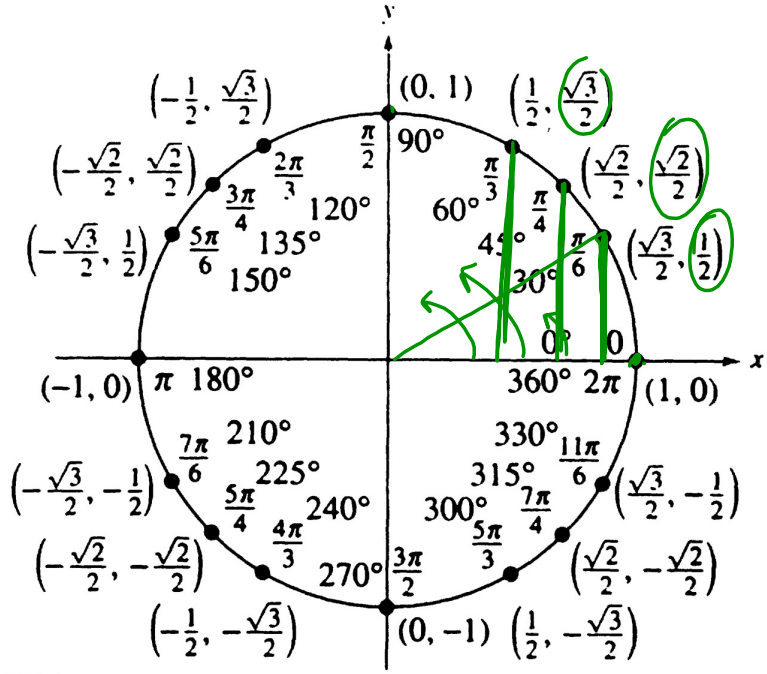
$P = 6.28$

4.

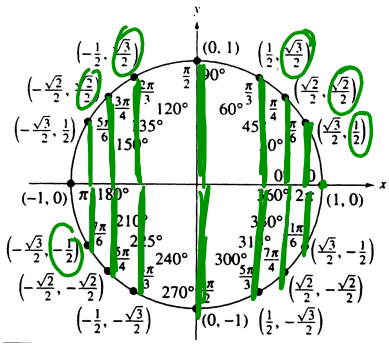


http://demonstrations.wolfram.com/IllustratingSineWithTheUnitCircle/

http://demonstrations.wolfram.com/SineCosineTangentAndTheUnitCircle/

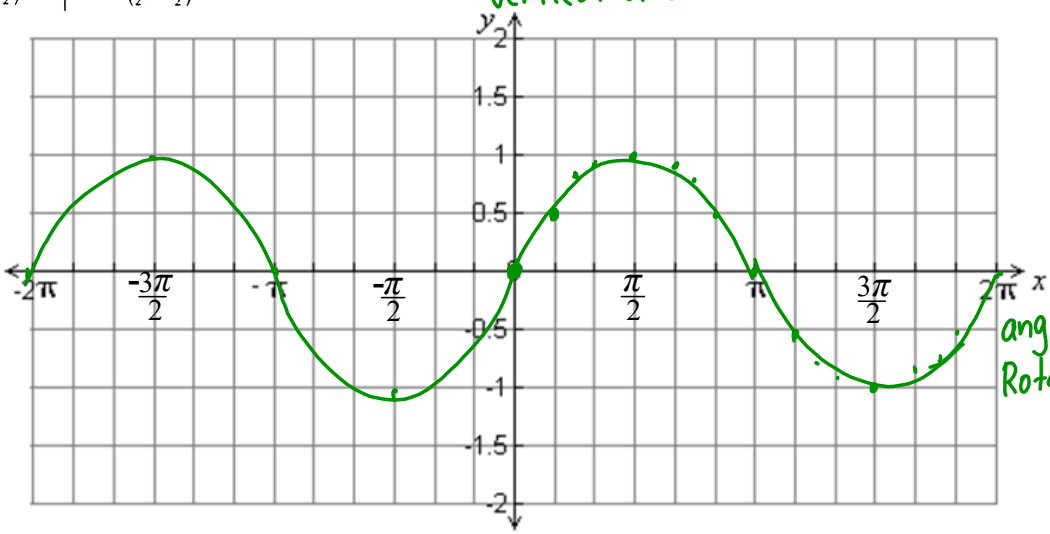


Angle Rotatio
Vertical distar



$y = \sin\theta$

vertical distance



angle Rotation

Study the graph to answer the following questions:

What is the period? 2π

What is the domain? $\mathbb{R}$

What is the range? $[-1, 1]$

What is the y-intercept? $(0,0)$

Where do the x-intercepts occur? $\ldots -2\pi, -\pi, 0, \pi, 2\pi \ldots$

$(n\pi, 0)$ n is an integer

What are the maximum values and where do they occur?

Max @ 1 $\quad -\frac{3\pi}{2}, \frac{\pi}{2}, \frac{5\pi}{2}$ $\quad +2\pi$ $\quad \frac{\pi}{2} + 2\pi n$ n is an integer

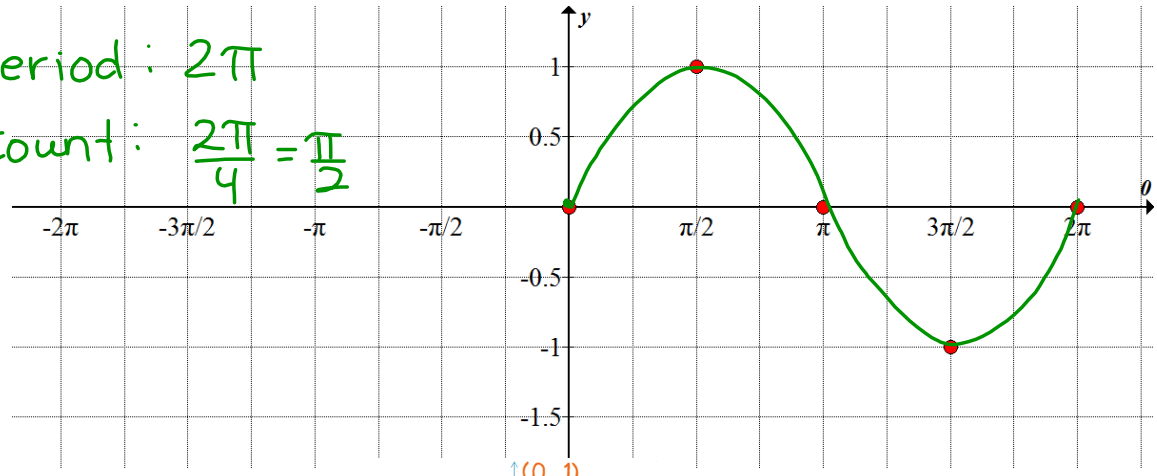
What are the minimum values and where do they occur?

Min @ -1 $\quad -\frac{\pi}{2}, \frac{3\pi}{2}, \ldots$ $\quad -\frac{\pi}{2} + 2\pi n$ n is an integer

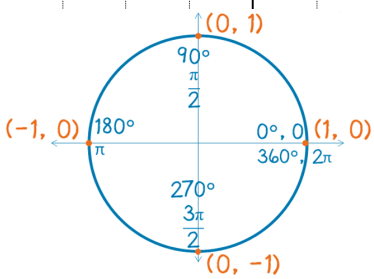
Use this five point pattern to help you sketch the sinusoid accurately!

Period: 2π

count: $\frac{2\pi}{4} = \frac{\pi}{2}$



Find your period and then find your count.



The five points come from the intercepts of the unit circle!

<u>Notation Note</u>: I've been using $f(\theta) = \sin\theta$ to avoid confusion with various x-values, but you will more commonly see:

$$f(x) = \sin x$$

$$f(t) = \sin t$$

$$f(x) = \sin(x)$$

$$f(t) = \sin(t)$$

It's all the same folks!
Just be sure to label your axis accordingly!

Make a conjecture!

Using your hitherto awesome graphing skills, make a quick guess about the effect the number 2 will have on the graph of each sinusoid.

a. $f(x) = 2\sin x$ https://www.desmos.com/calculator/rcv1racftd

vertical stretch by 2

b. $f(x) = \sin x + 2$ https://www.desmos.com/calculator/rgpocrfjq

up 2

c. $f(x) = \sin(x - 2)$ How does h change the graph?

Right 2

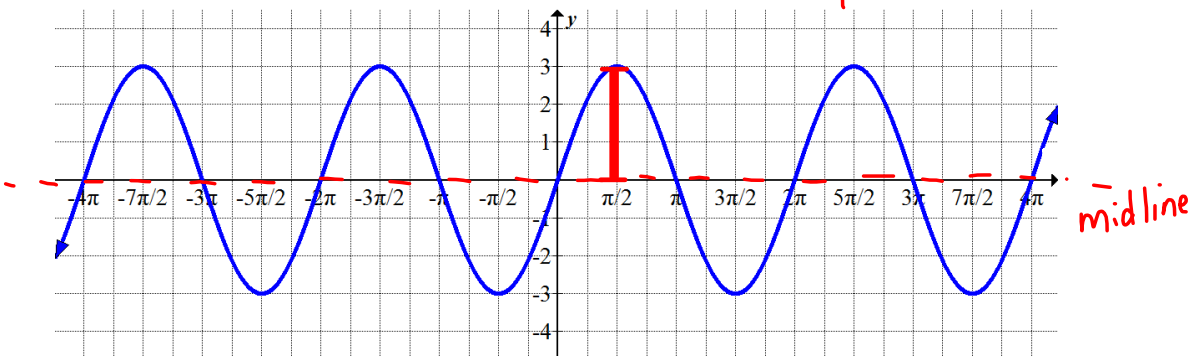
d. $f(x) = \sin(2x)$ How does b change the sinusoid?

horizontal shrink by ½

The <u>Amplitude</u> of the function is |a|.

$$f(x) = 3\sin x$$

amp = 3



$y = a\sin b(\theta - h) + k$ or $y = a\sin(b\theta - h) + k$

left/Right = h

left/right $\frac{h}{b}$

|a| : amplitude

period = $\frac{2\pi}{|b|}$

$\frac{1}{P} \Rightarrow$ Frequency

h : the horizontal phase shift

(solve the parentheses for θ)

k : vertical translation

Find the period, amplitude, phase shift and vertical translation.

1. $y = -\boxed{3}\sin x$

reflect in x-axis
amp: 3
period: 2π

2. $y = 5\sin\theta + 4$

amp: 5
up: 4
period: 2π

3. $y = \frac{3}{4}\sin(\theta - \pi/2) + 2$

amp: $3/4$
right $\pi/2$
up
period: 2π

4. $y = 4\sin(x + \pi/6)$

amp: 4
left $\pi/6$
p: 2π

5. $y = -2\sin\boxed{4(\theta} - \pi)$

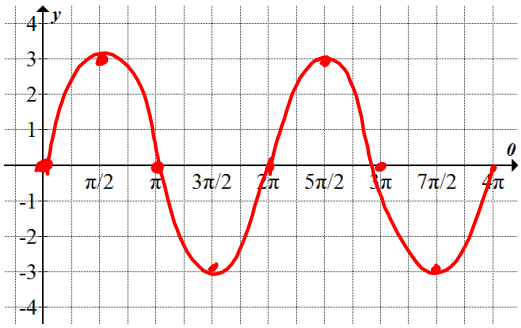
Amp: 2
reflect in x-axis
b=4
Period: $\frac{2\pi}{4} = \frac{\pi}{2}$
right: π

6. $y = -2\sin\boxed{(4\theta} - \pi)$

Amp: 2
reflect in x-axis
p: $\frac{2\pi}{4} = \frac{\pi}{2}$
right: $\frac{\pi}{4}$

Let's try it! Sketch the function (2 periods please).

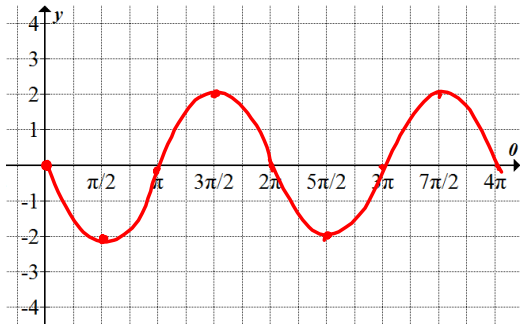
$$f(x) = 3\sin x$$



amplitude: 3
period: 2π
count: $\pi/2$
domain: $\mathbb{R}$
range: $[-3, 3]$

$$f(x) = -2\sin x$$

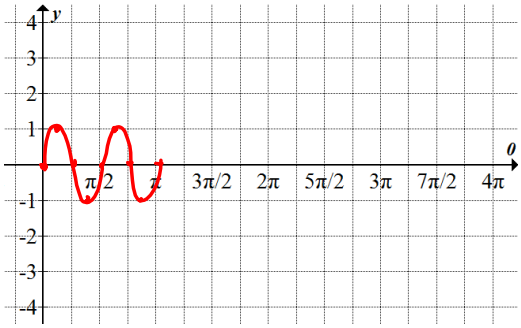
reflect



amplitude: 2
period: 2π
count: $\pi/2$
domain: $\mathbb{R}$
range: $[-2, 2]$

Sketch the function (Number of periods as appropriate).

$$f(x) = \sin 4x$$



Period: $\frac{2\pi}{b} = \frac{2\pi}{4} = \frac{\pi}{2}$

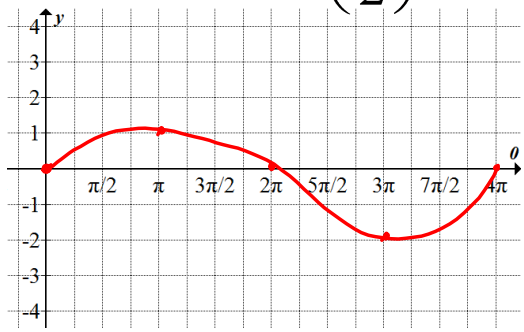
count: $\frac{\pi}{8}$

amplitude: 1

domain: $\mathbb{R}$

range: $[-1, 1]$

$$f(x) = \sin\left(\frac{x}{2}\right)$$



Period: $\frac{2\pi}{\frac{1}{2}} = 2\pi \cdot \frac{2}{1} = 4\pi$

count: $\frac{4\pi}{4} = \pi$

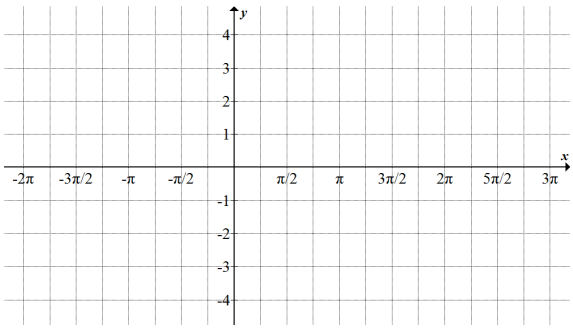
amplitude: 1

domain: $\mathbb{R}$

range: $[-1, 1]$

Can you put it all together?

$$f(x) = \frac{1}{2}\sin 2x$$



amplitude:

period:

count:

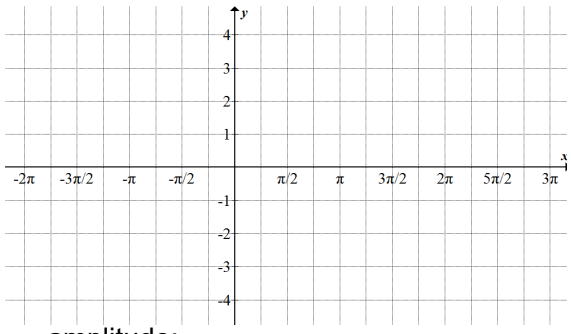
phase shift (L/R):

vertical shift:

domain:

range:

$$g(x) = 2\sin\left(x - \frac{3\pi}{4}\right)$$



amplitude:

period:

count:

phase shift (L/R):

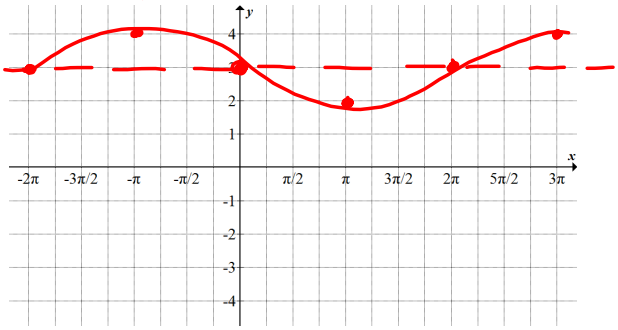
vertical shift:

domain:

range:

$$h(x) = -\sin\left(\frac{1}{2}x\right) + 3$$

reflect



amplitude: 1

period: $\frac{2\pi}{1/2} = 4\pi$

count: π

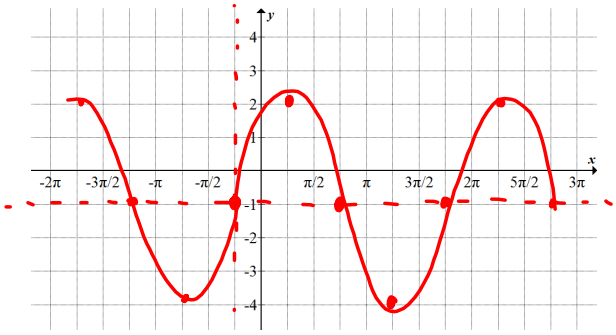
phase shift (L/R): None

vertical shift: up 3

domain: $\mathbb{R}$

range: $[2, 4]$

$$j(x) = 3\sin\left(x + \frac{\pi}{4}\right) - 1$$



amplitude: 3

period: $\frac{2\pi}{b} = 2\pi$

count: $\pi/2$

phase shift (L/R): Left $\pi/4$

vertical shift: down 1

domain:

range: