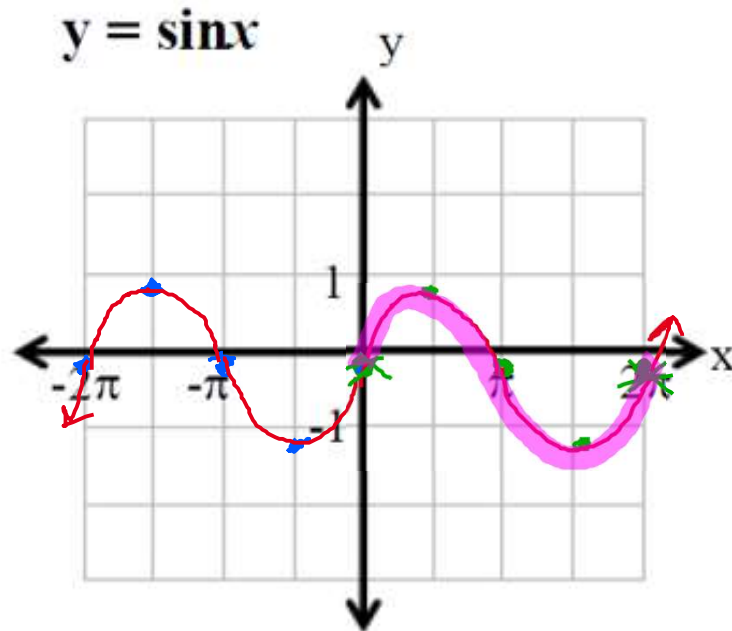
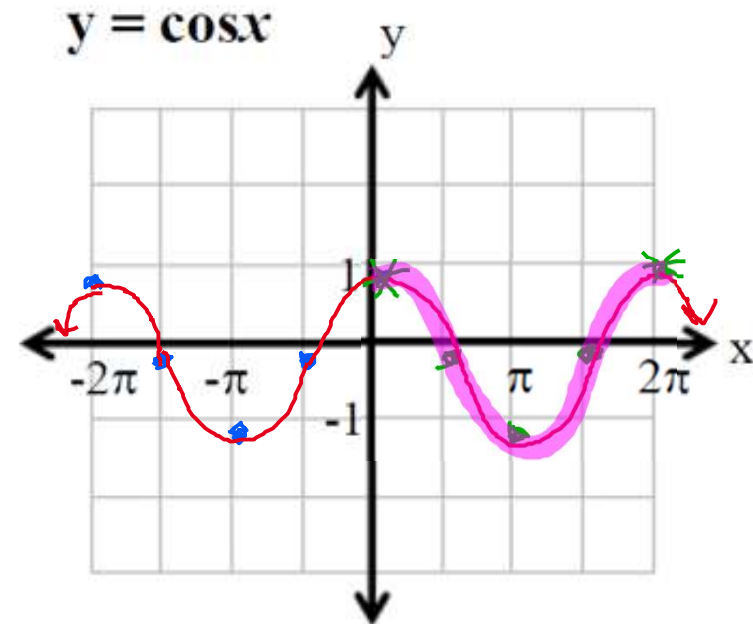


# FROM PREVIOUS NOTES:



“starts” on the axis at  $(0, 0)$

“ends” on the axis at  $(2\pi, 0)$



“begins” at its maximum  $(0, 1)$

“ends” at its maximum  $(2\pi, 1)$

## FROM PREVIOUS NOTES:

graphing form:

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

graphing form:

$$y = A \cos k(x - b) + h$$

Be sure that the equation is in graphing form where **k** (the coefficient of  $x$ ) has been factored out of the parentheses. Then, identify and plot information in the following order:

vertical shift = h → moves entire graph up or down

midline is  $y = h$  → a **horizontal** axis used as a reference line for sine/cosine graphs

amplitude =  $|A|$  → **vertical** stretch/compression that creates maximum and minimum values for sine and cosine

*Note: if  $A < 0$ , then the graph will reflect (flip) across the x-axis*

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*Note: if  $A < 0$ , then the graph will reflect (flip) across the x-axis*

period =  $\frac{2\pi}{k}$ ,  $k > 0$  → the horizontal length of one full cycle  
(**horizontal** stretch/compression)

*Note: if  $k > 1$ , then the period decreases*

*if  $0 < k < 1$ , then period increases*

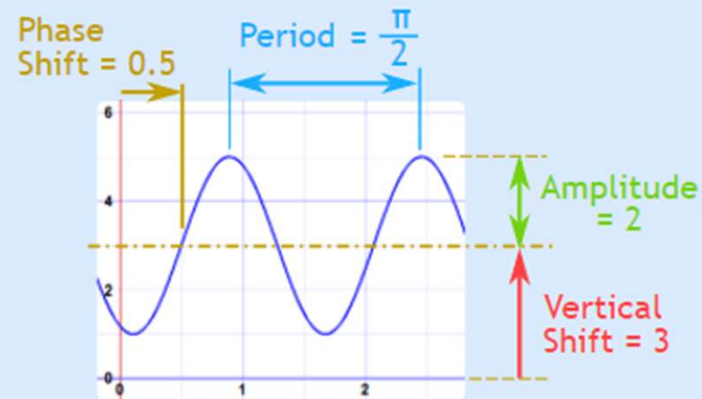
horizontal shift = b → or **PHASE SHIFT**: a horizontal translation (slide) of a trig function

*Note:* frequency is the number of cycles that occur in one horizontal unit →  $\frac{k}{2\pi}$

# See link for 5.3 notes on Rosenow's website:

Example:  $2 \sin(4(x - 0.5)) + 3$

- amplitude  $A = 2$
- period  $2\pi/k = 2\pi/4 = \pi/2$
- phase shift =  $-0.5$  (or  $0.5$  to the right)
- vertical shift  $h = 3$



In words:

- the **2** tells us it will be 2 times taller than usual, so Amplitude = 2
- the usual period is  $2\pi$ , but in our case that is "sped up" (made shorter) by the **4** in  $4x$ , so Period =  $\pi/2$
- and the  $-0.5$  means it will be shifted to the **right** by **0.5**
- lastly the **+3** tells us the center line is  $y = +3$ , so Vertical Shift = 3

## 5-3 Notes/Examples: Graphing sine/cosine

# Key points for “parent” graph

*(prior to amplitude, period, shifts)*

**Sin $\theta$**

$(0, 0)$

$\left(\frac{\pi}{2}, 1\right)$

$(\pi, 0)$

$\left(\frac{3\pi}{2}, -1\right)$

$(2\pi, 0)$

**Compare  
to values  
on the unit  
circle!!**

**Cos $\theta$**

$(0, 1)$

$\left(\frac{\pi}{2}, 0\right)$

$(\pi, -1)$

$\left(\frac{3\pi}{2}, 0\right)$

$(2\pi, 1)$

Sine is based on the y-coordinate for the unit circle.

Sin $\theta$

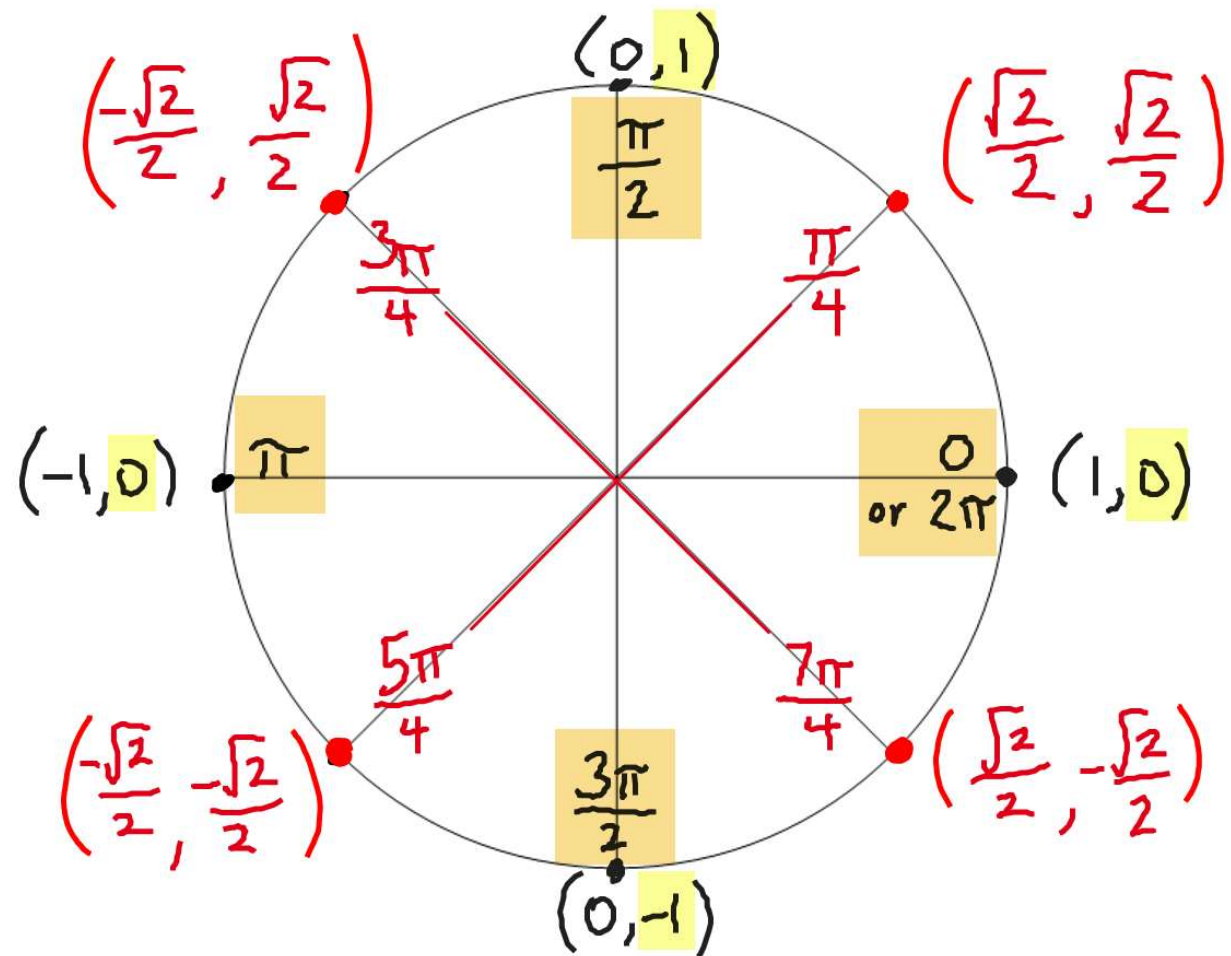
$(0, 0)$

$\left(\frac{\pi}{2}, 1\right)$

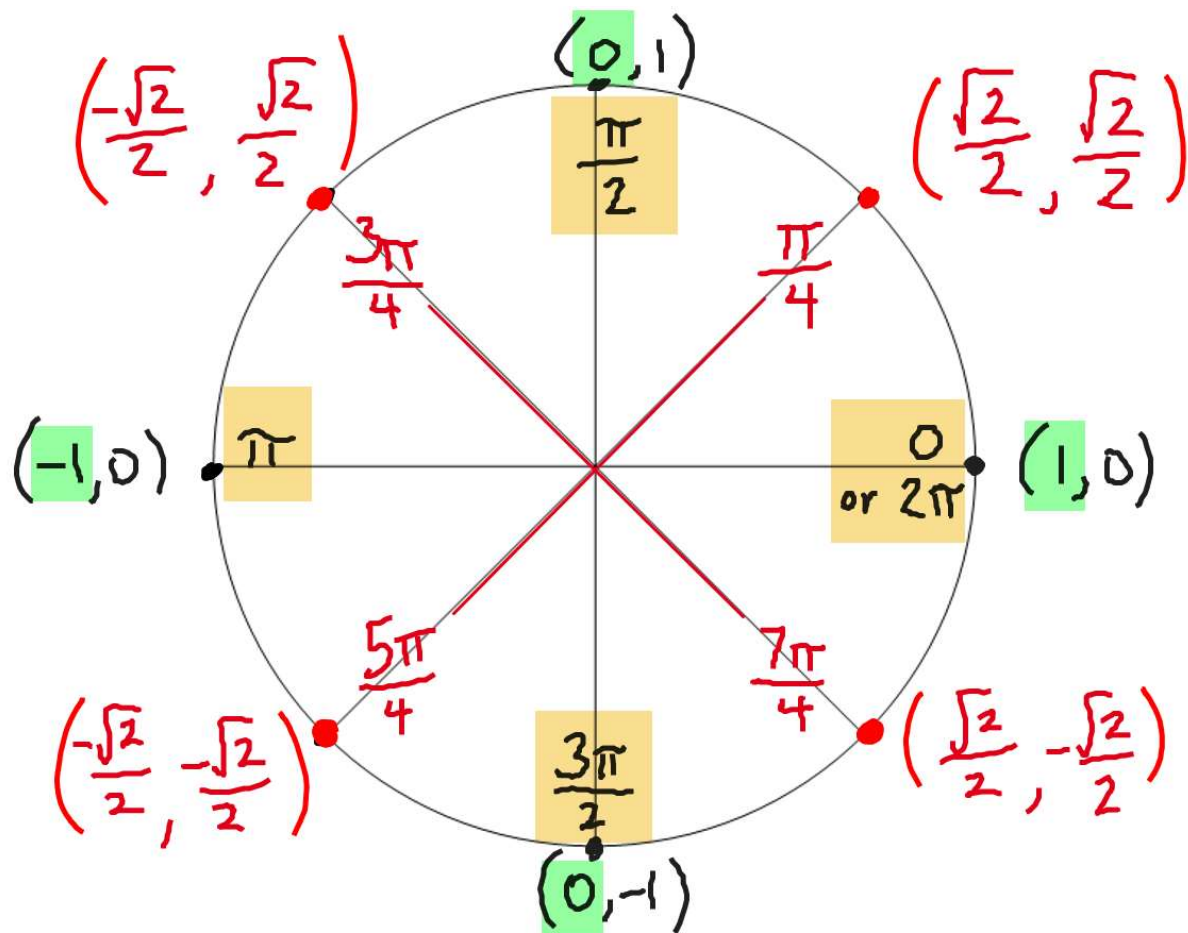
$(\pi, 0)$

$\left(\frac{3\pi}{2}, -1\right)$

$(2\pi, 0)$



**Cosine is based on the x-coordinate for the unit circle.**



**Cos $\theta$**

$(0, 1)$

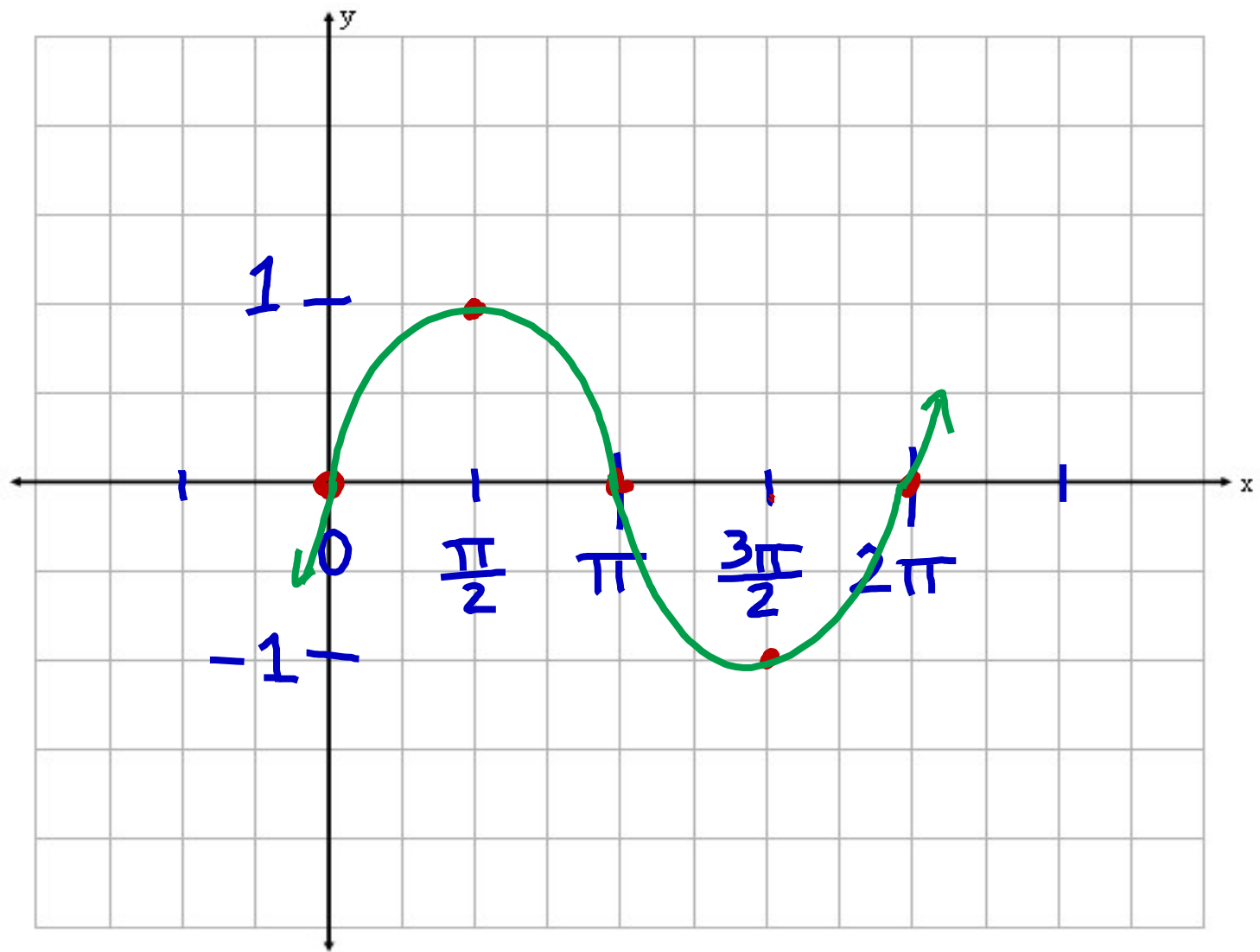
$(\frac{\pi}{2}, 0)$

$(\pi, -1)$

$(\frac{3\pi}{2}, 0)$

$(2\pi, 1)$

$$y = \sin\theta$$





## Notes 5-3: Graphing sine/cosine

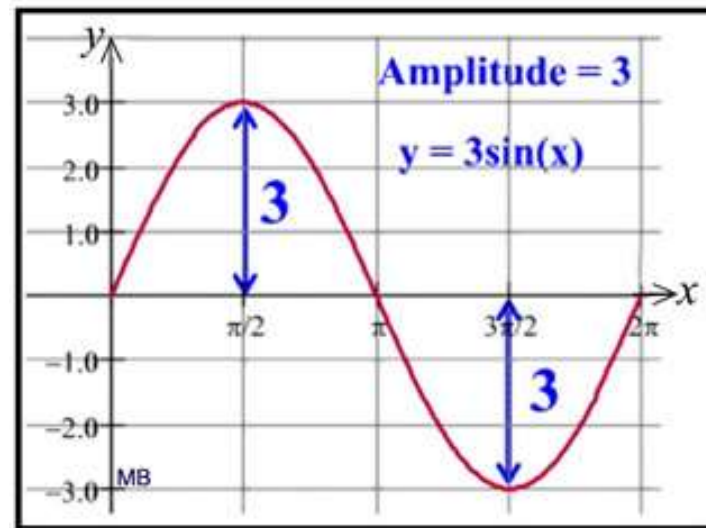
Amplitude is the **vertical** expansion or compression of the graph of a trig function.

examples:  $y = A\sin\theta$        $y = A\cos\theta$   
 $y = -A\sin\theta$        $y = -A\cos\theta$

Amplitude =  $|A|$

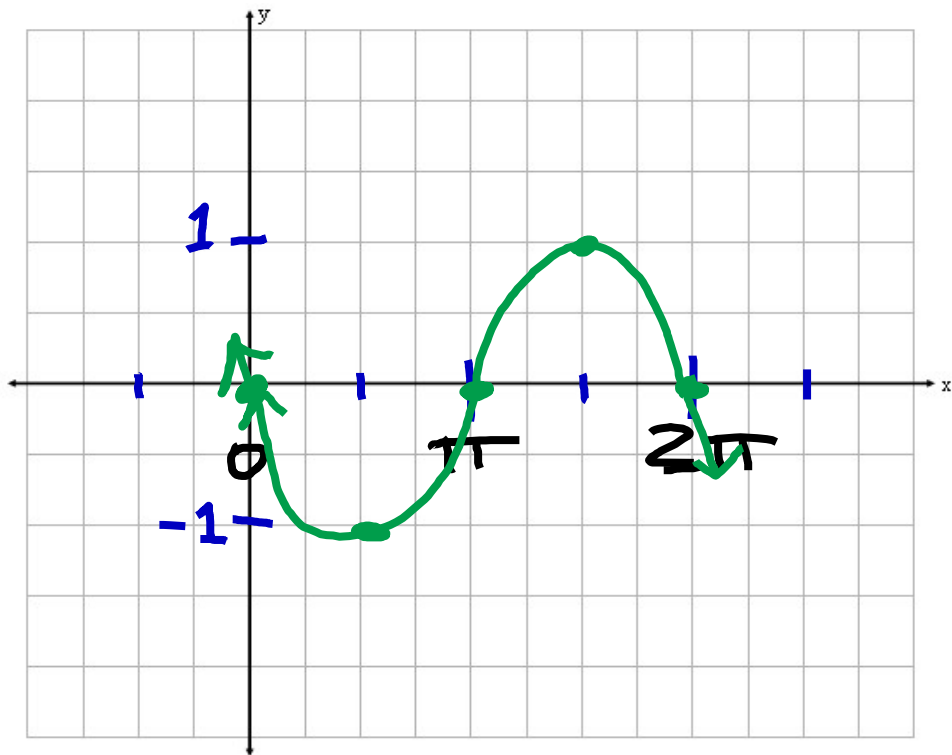
→ maximum located at  $A$

→ minimum located at  $-A$



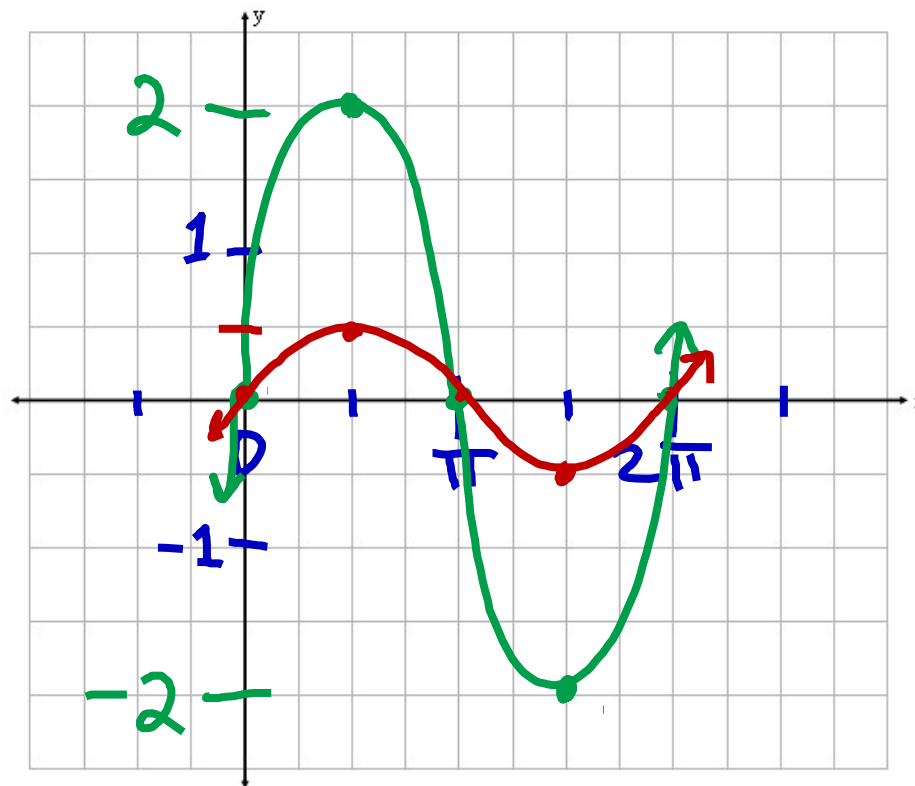
**3 IS THE DISTANCE FROM THE AXIS (MIDLINE)  
TO EACH MAXIMUM AND MINIMUM**

$$y = -\sin\theta$$



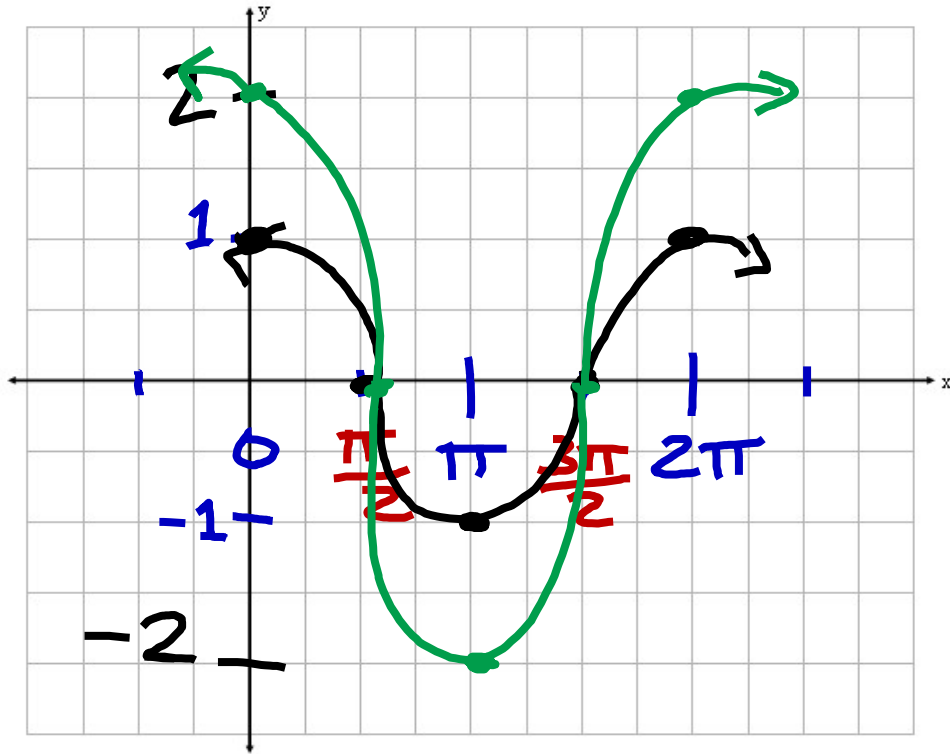
$$y = 2\sin\theta$$

$$y = \frac{1}{2}\sin\theta$$

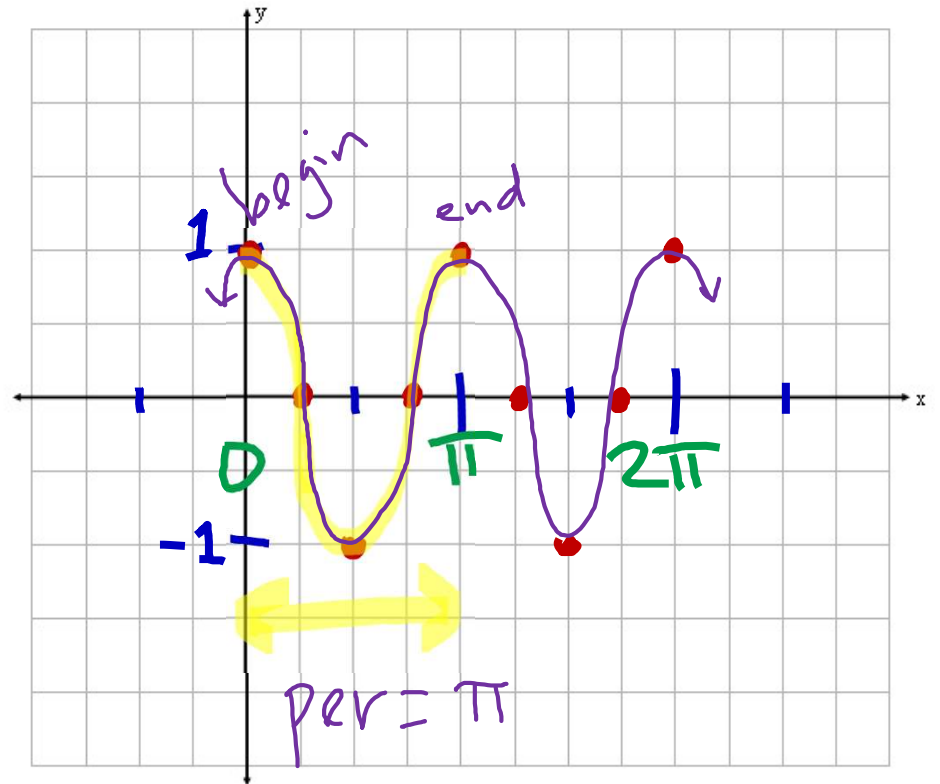


$$y = \cos \theta$$

$$y = 2\cos \theta$$



$$y = \cos 2\theta$$



$$\text{Per} = \frac{2\pi}{k} \rightarrow \frac{2\pi}{2} \rightarrow \boxed{\pi}$$

## Notes 5-3: Graphing sine/cosine

Period: The amount (interval) of time it takes to complete one cycle.

If  $y = \sin kx$  or  $y = \cos kx$ ,

then period =  $\frac{2\pi}{k}$ ,  $k > 0$

**Note:**

$$y = \sin 3x \rightarrow k = 3$$

$$y = \sin \frac{x}{3} \rightarrow k = \frac{1}{3}$$

- \*write given equation
- \*factor k if possible
- \*identify amp, per, vertical/horizontal shift
- \*sketch graph across given interval

## 5-3: #14

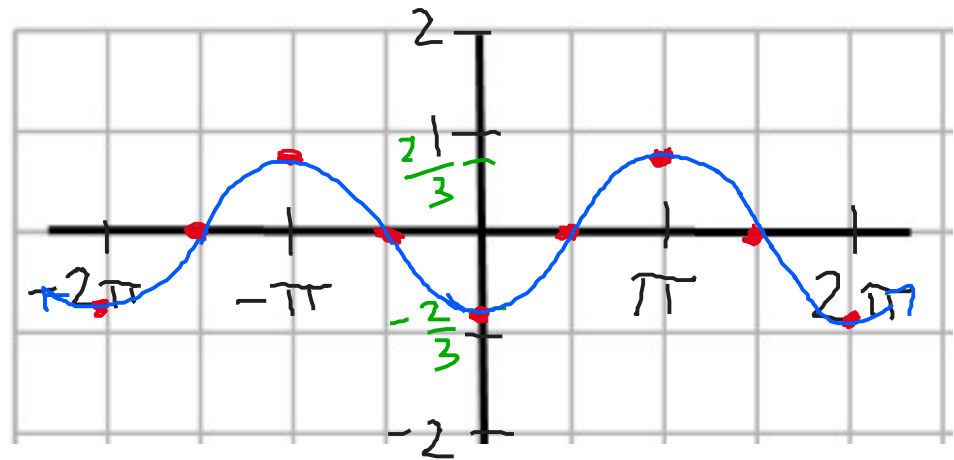
$$g(x) = -\frac{2}{3} \cos x$$

flip  
Amp =  $\boxed{\frac{2}{3}}$

Per =  $\frac{2\pi}{k} = \frac{2\pi}{1} = \boxed{2\pi}$

vertical shift  $\boxed{v.s. = 0}$

horiz shift  $\boxed{h.s. = 0}$



## 5-3: #16

$$g(x) = 4 - 2\sin x$$

$$g(x) = -2\sin(x) + 4$$

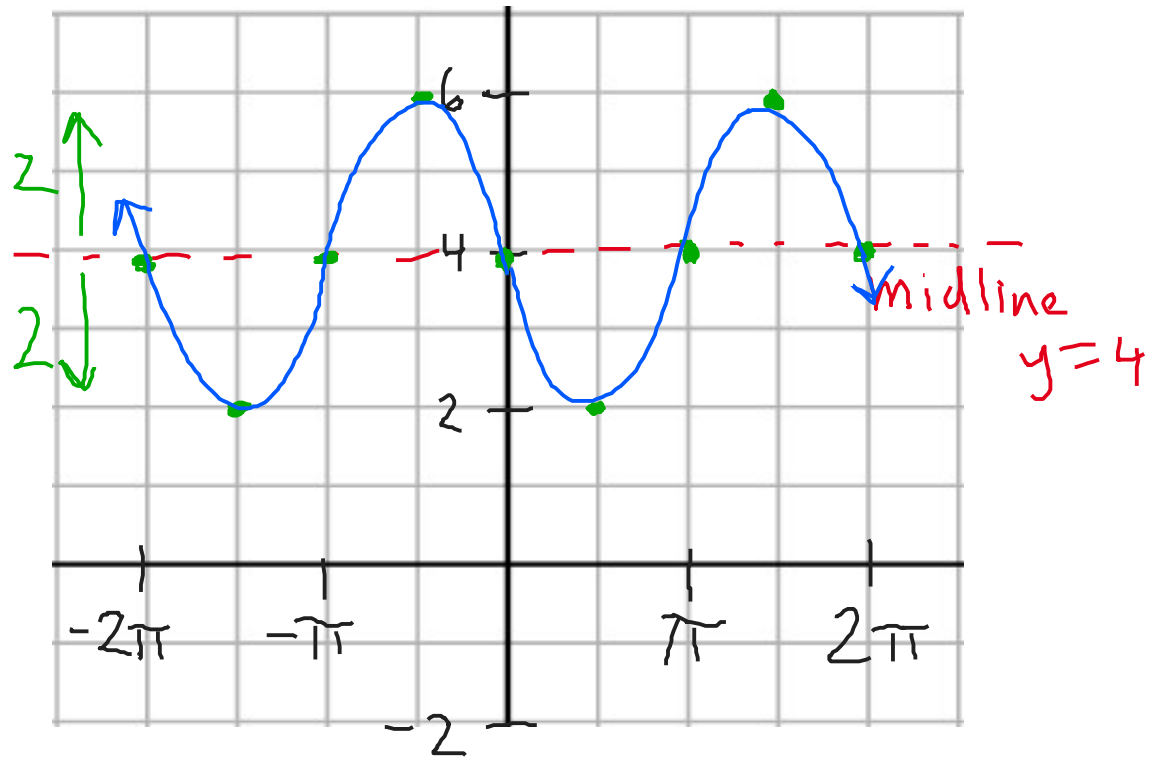
*A* *k=1*  
flip *h*

$$\text{Amp} = 2$$

$$\text{Per} = \frac{2\pi}{1} = 2\pi$$

$$\text{V.S.} = 4$$

$$\text{h.s.} = 0$$



- \*write given equation
- \*factor k if possible
- \*identify amp, per, vertical/horizontal shift
- \*sketch graph across given interval

## 5-3: #39

$$y = 5 \cos \left( 3x - \frac{\pi}{4} \right)$$

$$y = 5 \cos 3 \left( x - \frac{\pi}{12} \right)$$

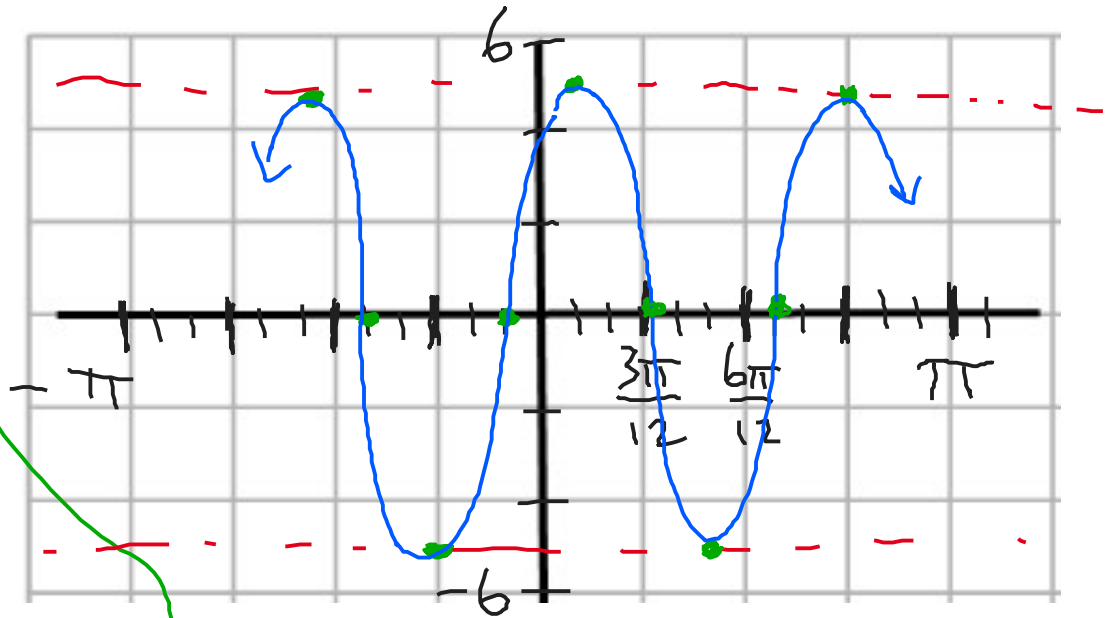
$$\text{Amp} = 5$$

$$\text{Per} = \frac{2\pi}{k} = \frac{2\pi}{3} = \frac{8\pi}{12}$$

$$\text{V.S.} = 0$$

$$\text{h.s.} = \frac{\pi}{12}$$

opposite of  
given value



$$\frac{\pi}{4} \div 3$$

$$= \frac{\pi}{4} \cdot \frac{1}{3} = \frac{\pi}{12}$$

\*write given equation

\*factor k if possible

\*identify amp, per, vertical/horizontal shift

\*sketch graph across given interval