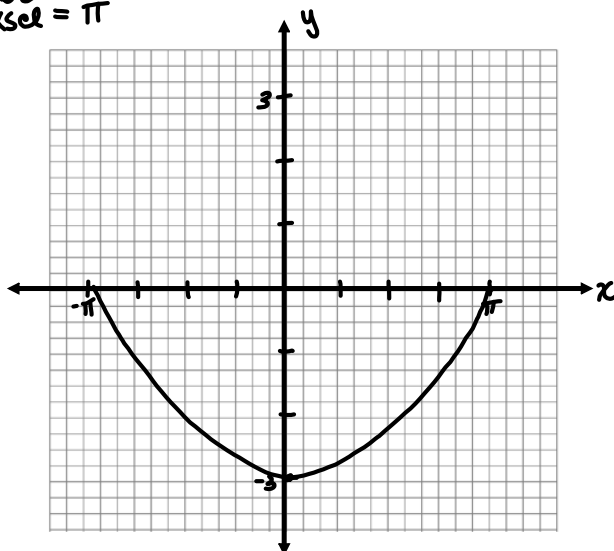


### HOMEWORK 8.4

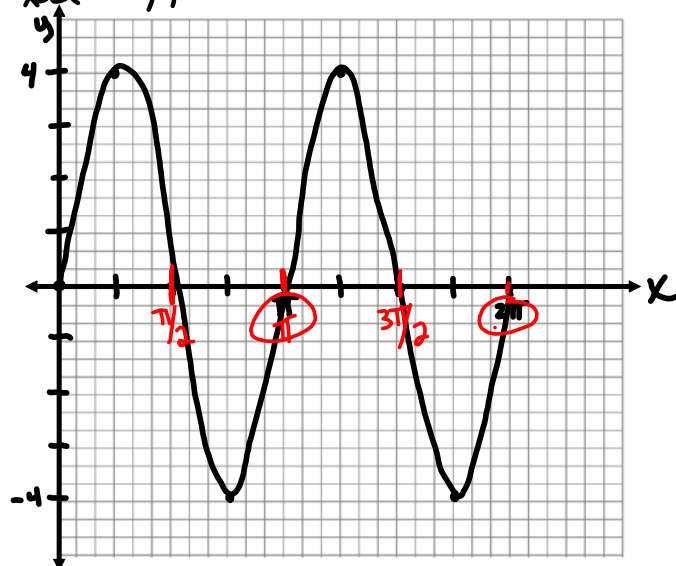
1. Graph  $f(x) = -3 \cos\left(\frac{1}{2}x\right)$  for  $-\pi \leq x \leq \pi$ . Show all work as done in class.

$$\begin{aligned}\text{amp} &= 3 \\ \text{Range} &= [-3, 3] \\ \text{freq} &= \frac{1}{2} \\ \text{Per} &= 4\pi \\ \text{xsel} &= \pi\end{aligned}$$



2. Graph  $f(x) = 4 \sin(2x)$  for  $0 \leq x \leq 2\pi$ . Show all work as done in class.

Amp = 4  
Range =  $[-4, 4]$   
Freq = 2  
Per =  $\pi$   
Xsel =  $\pi/4$



Day 5: Phase Shift & Vertical Shift

A phase shift is a horizontal translation.

$f(x) = \sin(x + h)$  is a phase shift (or horizontal translation) that moves  $f(x) = \sin(x)$  left  $h$  units.

$f(x) = \sin(x - h)$  is a phase shift (or horizontal translation) that moves  $f(x) = \sin(x)$  Right  $h$  units.

A vertical shift is a vertical translation.

$f(x) = \sin(x) + k$  is a vertical shift (or vertical translation) that moves  $f(x) = \sin(x)$  up  $k$  units.

$f(x) = \sin(x) - k$  is a vertical shift (or vertical translation) that moves  $f(x) = \sin(x)$  down  $k$  units.

$f(x) = k$  is also called the midline

Sinusoidal functions can all be written in the form:

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

**Remember:**

$$|A| = \text{amplitude} \quad \frac{|\omega|}{2\pi} = \text{frequency} \quad \frac{2\pi}{|\omega|} = \text{period}$$
$$h = \text{phase shift} \quad k = \text{vert. shift (midline)}$$

To graph a phase shift or a vertical shift, we will:

1. Graph the appropriate parent function  $f(x) = \sin(x)$  or  $f(x) = \cos(x)$
2. Determine the translation and direction.
3. Move key points on the graph (zeros, max, min, etc.) according to this translation.

1. Graph  $f(x) = \cos(x)$  down 1 in the interval  $0 \leq x \leq 2\pi$ . Identify the vertical shift.

amp = 1

freq = 1 cycle in  $2\pi$  (or  $\frac{1}{2\pi}$ )

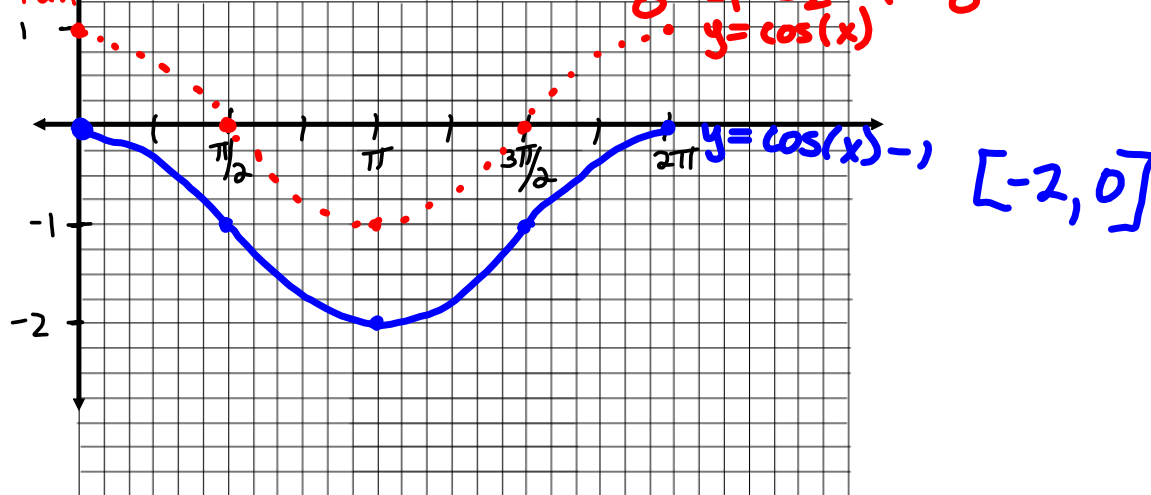
Per =  $2\pi$

$x_{\text{int}} = \frac{2\pi}{4} = \frac{\pi}{2}$

Pattern = 1, 0, -1, 0, 1

x	0	$\frac{\pi}{2}$	$\pi$	$\frac{3\pi}{2}$	$2\pi$
y	1	0	-1	0	1
	-1	-1	-1	-1	-1
	0	-1	-2	-1	0

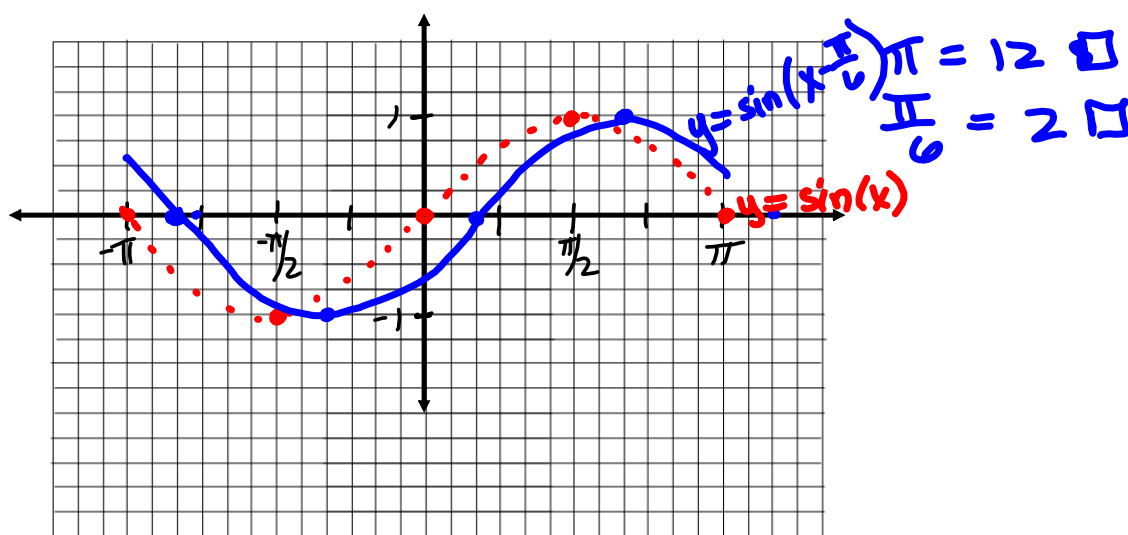
$y = \cos(x)$



2. Graph  $f(x) = \sin(x - \frac{\pi}{6})$  in the interval  $-\pi \leq x \leq \pi$ . Identify the phase shift.

Per =  $2\pi$   
 0, 1, 0, -1, 0  
 $x_{\text{int}} = \frac{2\pi}{4} = \frac{\pi}{2}$

x	0	$\frac{\pi}{2}$	$\pi$	$\frac{3\pi}{2}$	$2\pi$
y	0	1	0	-1	0



3. Describe the graph for  $f(x) = 5 + 2\sin(x + 3)$ .  $\omega = 1$

Amplitude: 2

Period:  $\frac{2\pi}{\omega} = \frac{2\pi}{1} = 2\pi$

Phase Shift: left 3

Vertical Shift: up 5

Minimum: ~~5~~  $-2 + 5 = 3$

Maximum:  $2 + 5 = 7$

4. Describe the graph for  $f(x) = 30 \cos \frac{\pi}{2}(x - 15) - 75$ .  $\omega$

Amplitude: 30

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

Phase Shift:

At 15

Vertical Shift: Down 75

Minimum:  $-30 - 75 = -105$

Maximum:  $30 - 75 = -45$



