

Monday, December 10, 2018  
5:23 PM

# KEY

Precalc

4.5C: Sin & Cos curves w/ phase shifts

Obj: to graph sine & cosine curves w/ horizontal (phase) shifts

Hwk: 4.5C #45, 47, 53, 54, 55; graph 1 period. ID amplitude, period, scale, cycle, shifts, range, key pts for each

4.5-4.6 Quiz Weds 12/19

Do Now:

a. Graph  $y = -2\cos\frac{\pi x}{6} + 1$   
\* Reflect over x-axis

$$a = -2 \quad b = \frac{\pi}{6} \quad c = 0 \quad d = 1$$

Line of oscillation:  $y = 1$

Find:  $\frac{2\pi}{\frac{\pi}{6}} = 2\pi \cdot \frac{6}{\pi} = 12$

Period: 12

Amplitude: 2

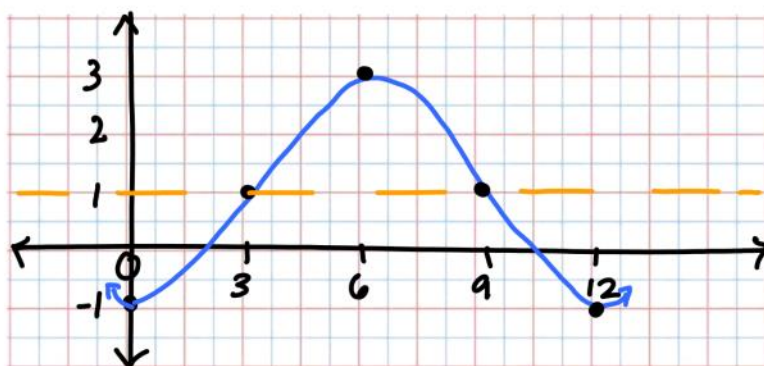
Range:  $[-1, 3]$

Scale:  $\frac{12}{4} = 3$

Cycle:  $[0, 12]$

$\frac{2\pi}{\frac{\pi}{6}}$

period  $\div 4$



Key pts:  $(0, -1), (3, 1), (6, 3), (9, 1), (12, -1)$

Recap:

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

- opens up/down
- vertical stretch or shrink

- Horizontal stretch/shrink

- Per =  $\frac{2\pi}{b}$

- vertical shift

- horizontal shift
- aka phase shift

Today we are studying the **horizontal shift (phase shift)**

How does  $y = \sin x$  compare to  $y = \sin\left(x + \frac{\pi}{2}\right)$ ?

Goes from  
(0, 0) to  $(2\pi, 0)$

Shift everything left  $\frac{\pi}{2}$   
Goes from  $(-\frac{\pi}{2}, 0)$  to  $(\frac{3\pi}{2}, 0)$

To find the beginning and end of 1 complete cycle/period:

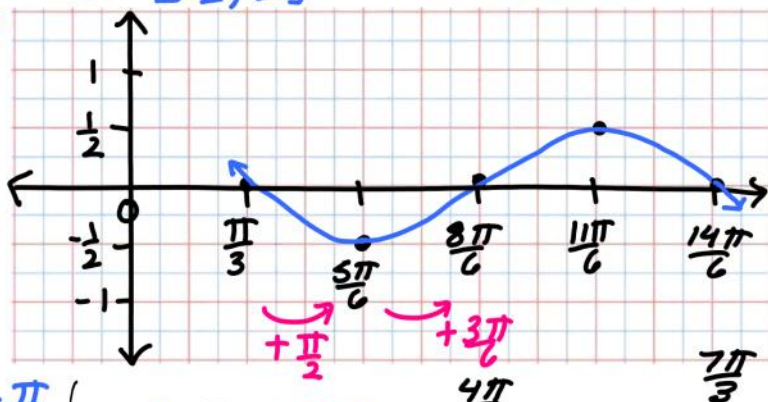
Set  $bx - c = 0$  and  $bx - c = 2\pi$  and solve.

Ex. 1) Graph:  $y = -\frac{1}{2}\sin\left(x - \frac{\pi}{3}\right)$   $a = -\frac{1}{2}$   $b = 1$   $c = \frac{\pi}{3}$   $d = 0$   
\* Reflect over x-axis

$\frac{2\pi}{b}$  Period:  $2\pi$  scale:  $\frac{2\pi}{4} = \frac{\pi}{2}$  period  $\div$  Amp:  $\frac{1}{2}$   
V-Shift: none Range:  $[-\frac{1}{2}, \frac{1}{2}]$  Phase Shift: Right  $\frac{\pi}{3}$   
Cycle:  $[\frac{\pi}{3}, \frac{7\pi}{3}]$

\* See work below

5 key pts:  $(\frac{\pi}{3}, 0)$ ,  
 $(\frac{2\pi}{3}, -\frac{1}{2})$ ,  $(\frac{4\pi}{3}, 0)$ ,  
 $(\frac{5\pi}{3}, \frac{1}{2})$ ,  $(\frac{7\pi}{3}, 0)$



\*  $bx - c = 0$   $x - \frac{\pi}{3} = 0$   $x = \frac{\pi}{3}$

$bx - c = 2\pi$   $x - \frac{\pi}{3} = 2\pi$

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

$x = 6\pi + \frac{\pi}{3}$

$x = 7\pi$

$\frac{2}{2} \frac{\pi}{3} + \frac{\pi}{2} \frac{3}{3}$

$\frac{2\pi}{6} + \frac{3\pi}{6}$

$$a=2 \quad b=1 \quad c=-\frac{\pi}{4}$$

Ex. 2) Graph:  $y=2\cos\left(x+\frac{\pi}{4}\right)$

$\frac{2\pi}{b}$  Period:  $2\pi$       scale:  $\frac{2\pi}{4} = \frac{\pi}{2}$       Amp: 2  
 V-Shift: none      Range:  $[-2, 2]$       Phase Shift:  $\frac{\pi}{4}$  left

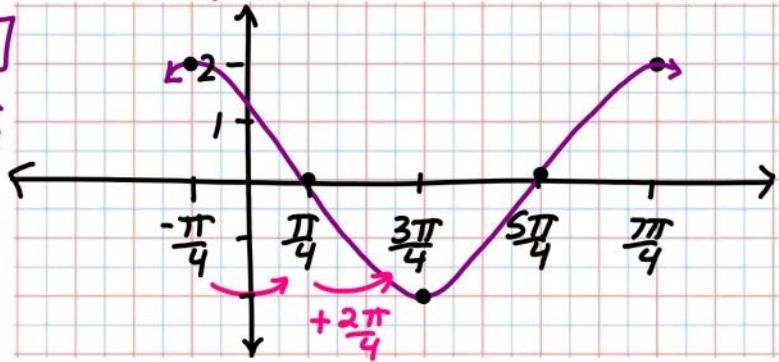
\* Cycle:  $[-\frac{\pi}{4}, \frac{7\pi}{4}]$

\*  $bX-c=0 \quad x+\frac{\pi}{4}=0 \quad x=-\frac{\pi}{4}$

5 key pts:  $(-\frac{\pi}{4}, 2)$ ,  
 $(\frac{\pi}{4}, 0)$ ,  $(\frac{3\pi}{4}, -2)$ ,  
 $(\frac{5\pi}{4}, 0)$ ,  $(\frac{7\pi}{4}, 2)$

\*  $bX-c=2\pi \quad x+\frac{\pi}{4}=2\pi$

$$x = 2\pi - \frac{\pi}{4} = \frac{8\pi}{4} - \frac{\pi}{4} = \frac{7\pi}{4}$$



$$-\frac{\pi}{4} + \frac{\pi}{2} = \frac{\pi}{4}$$

$$-\frac{\pi}{4} + \frac{2\pi}{4} = \frac{\pi}{4}$$

Get into assigned groups. Finish packet

If time:

$$(2\pi(x+2)) \quad a=\frac{1}{2} \quad b=2\pi \quad c=-4\pi \quad d=-1$$

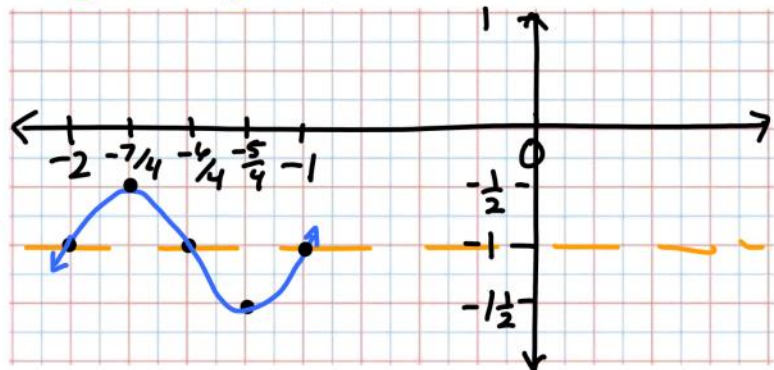
Ex. 3) Graph:  $y=\frac{1}{2}\sin(2\pi x+4\pi)-1$  Line of oscillation:  $y=-1$

$\frac{2\pi}{b}$  Period:  $\frac{2\pi}{2\pi} = 1$       scale:  $\frac{2\pi}{4} = \frac{1}{2}$       Amp:  $\frac{1}{2}$   
 V-Shift: down 1      Range:  $[-\frac{3}{2}, -\frac{1}{2}]$       Phase Shift: Shift 2 left

\* Cycle:  $[-2, -1]$

\*  $bX-c=0 \quad 2\pi x+4\pi=0$   
 $\frac{2\pi x}{2\pi} = \frac{-4\pi}{2\pi} \quad x=-2$

5 key pts:  $(-2, -1)$ ,  
 $(-\frac{7}{4}, -\frac{1}{2})$ ,  $(-\frac{3}{2}, -1)$ ,  
 $(-\frac{5}{4}, -\frac{3}{2})$ ,  $(-1, -1)$



\*  $bX-c=2\pi$   
 $2\pi x+4\pi=2\pi$   
 $2\pi x=-2\pi$   
 $x=-1$

$$\frac{1}{4} \cdot -2 + \frac{1}{4}$$

$$-\frac{2}{4} + \frac{1}{4}$$



Ex. 4) Graph:  $y = -3\cos\left(\frac{x}{4} - \frac{\pi}{2}\right)$

Period:

scale:

Amp:

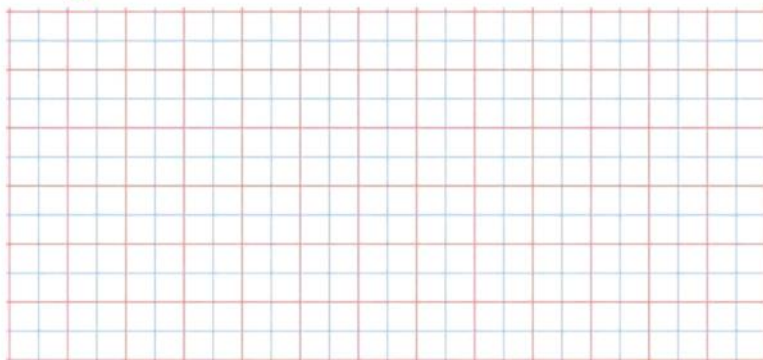
V-Shift:

Range:

Phase Shift:

Cycle:

5 key pts: ( , ),  
 ( , ), ( , ),  
 ( , ), ( , )



Putting it all together:

Ex. 5) Graph:  $y = -2 - 3\sin\left(\frac{x}{2} + \frac{\pi}{6}\right)$

Period:

scale:

Amp:

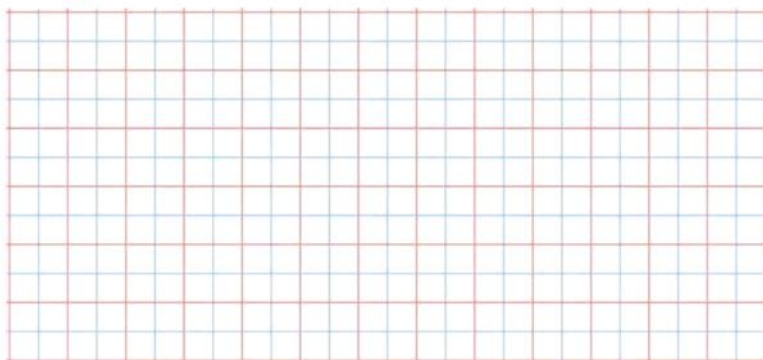
V-Shift:

Range:

Phase Shift:

Cycle:

5 key pts: ( , ),  
 ( , ), ( , ),  
 ( , ), ( , )



If time - How do you determine the range and phase shift of a transformed function?