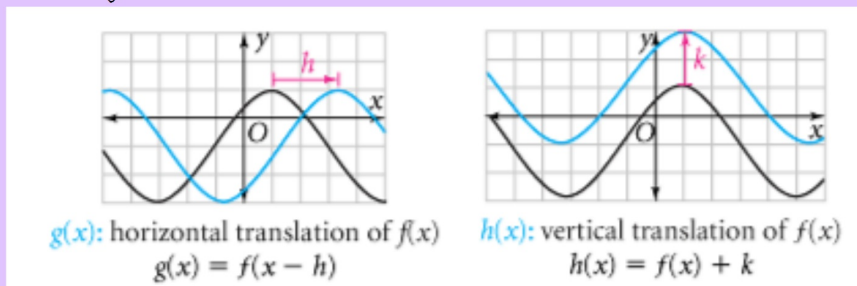
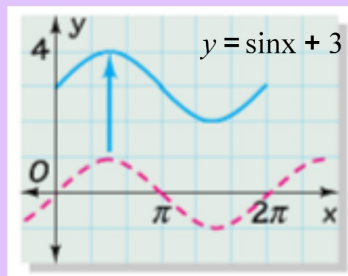


### 13.7 Translating Sine and Cosine Functions

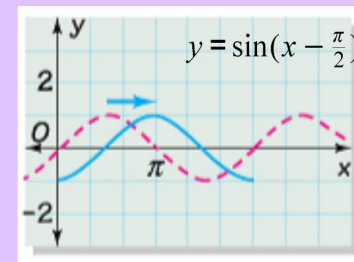
You can translate periodic functions horizontally and vertically using methods you have used for other functions.



You can analyze a translation to determine how it relates to the parent function. Note the parent function  $y = \sin x$  is dashed.



The graph of  $y = \sin x$  is translated 3 units up



The graph of  $y = \sin x$  is translated  $\frac{\pi}{2}$  units right

Phase Shift – A horizontal translation of a periodic function.

Translations of Sine and Cosine Function	
Parent Function	Translated Function
$y = a \sin bx$	$y = a \cos bx$
$y = a \sin L(x - h) + k$	$y = a \cos L(x - h) + k$
<ul style="list-style-type: none"> <li>• <math> a </math> = amplitude of the function</li> <li>• <math>b</math> = number of cycles in the interval from 0 to <math>2\pi</math></li> <li>• <math>\frac{2\pi}{b}</math> = period of the function. (when <math>x</math> is in radians &amp; <math>b &gt; 0</math>)</li> <li>• <math>h</math> = phase shift, or horizontal shift</li> <li>• <math>k</math> = vertical shift.</li> </ul>	

When graphing the sine or cosine functions, a stat sheet needs to be completed. List the six key factors. Then graph the five points for each cycle.

1. Amplitude,
2. Period,
3. Each,
4. Flip,
5. Phase shift,
6. Vertical shift.

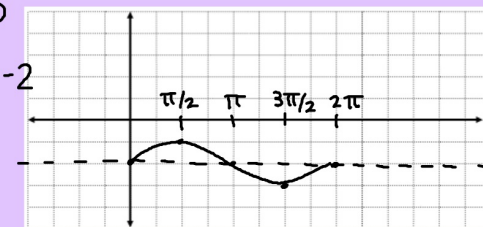
Graph one cycle  $y = \sin\theta - 2$

Amplitude = 1      Phase Shift = 0

Period =  $2\pi$       Vertical Shift = -2

Each =  $2\pi \cdot \frac{1}{4} = \frac{2\pi}{4} = \frac{\pi}{2}$

Flip = no



Graph one cycle  $y = \cos(\theta - \pi)$

Amplitude = 1

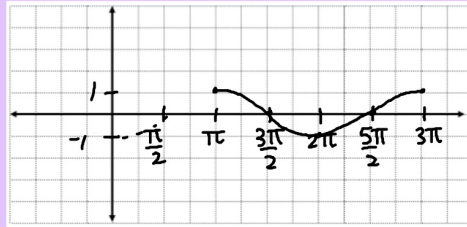
Period =  $2\pi$

Each =  $\frac{\pi}{2}$

Flip = no

Phase Shift =  $\pi$  right

Vertical Shift = 0



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Graph one cycle  $y = \cos(\theta + \pi) - 2$

Amplitude = 1

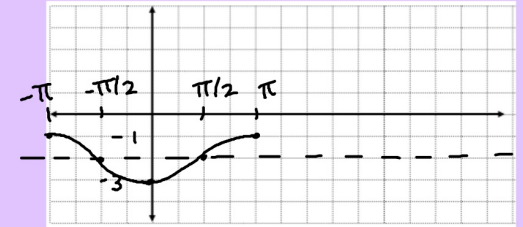
Period =  $2\pi$

Each =  $\pi/2$

Flip = no

Phase Shift =  $-\pi$  left

Vertical Shift = -2 down



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Graph one cycle  $y = \sin(\theta + \frac{\pi}{2}) + 1$

Amplitude = 1

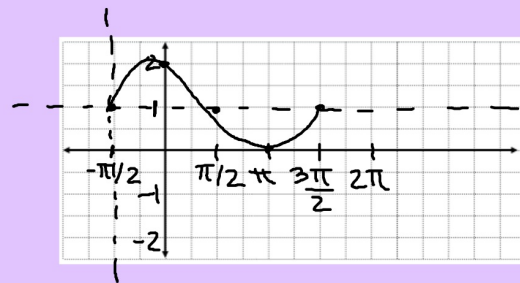
Period =  $2\pi$

Each =  $\pi/2$

Flip = no

Phase Shift =  $\pi/2$  left

Vertical Shift = 1 up



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Graph one cycle  $y = \cos 3(\theta - \frac{\pi}{2}) - \frac{1}{2}$

Amplitude = 1

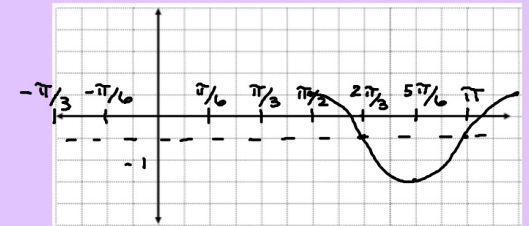
Period =  $2\pi/3$

Each =  $\pi/6$   $\frac{2\pi}{3} \cdot \frac{1}{4} = \frac{2\pi}{12}$

Flip = no

Phase Shift =  $\rightarrow \pi/2$

Vertical Shift =  $\downarrow 1/2$



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Graph one cycle  $y = -3\sin 2(\theta - \frac{\pi}{3}) - \frac{3}{2}$

Amplitude = 3

Period =  $\frac{2\pi}{2} = \pi$

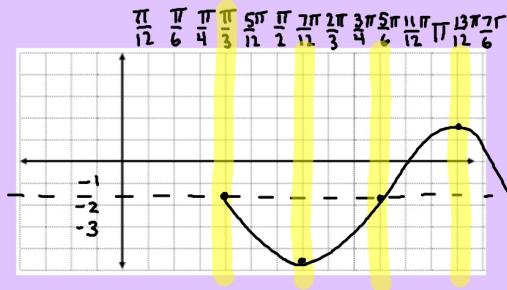
Each =  $\frac{\pi}{4}$

Flip = yes

Phase Shift =  $\frac{\pi}{3}$  right

Vertical Shift =  $-\frac{3}{2}$

common denominator  $\frac{\quad}{12}$



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You can write an equation to describe a translation.

Write each equation.

$y = \sin \theta$ ,  $\pi$  units down.

$$y = \sin \theta - \pi$$

$y = 2 \sin \theta$ ,  $\frac{\pi}{4}$  units to the right

$$y = 2 \sin(\theta - \frac{\pi}{4})$$

$y = -2 \cos x$ ,  $\frac{\pi}{2}$  units to the right and 2 units up

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

$y = 3 \cos x$ ,  $\frac{\pi}{4}$  units left and 1 unit down.

$$y = 3 \cos(x + \frac{\pi}{4}) - 1$$

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homework.

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