

U6D5_T_Translations Trig

Monday, May 13, 2019 9:11 AM



U6D5_T_Tr
anslations...

U6D5 MCR 3UI

Translations of Sinusoidal Functions

Vertical Shifts:

$$y = \sin x + c$$

$$y = \cos x + c$$

This is the same as vertical shifts with other functions.

* If $c > 0$, shift the y -values up c - units.

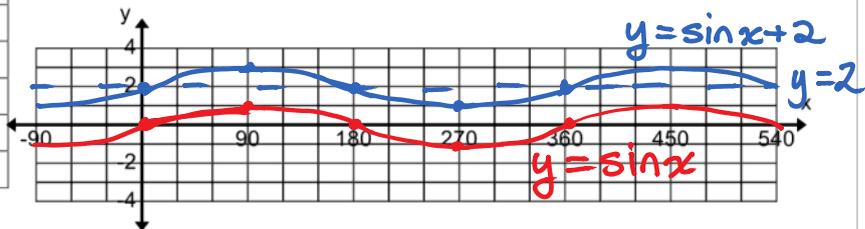
* If $c < 0$, shift the y -values down c - units.

The "sinusoidal axis" is at $y = c$

Example 1: Sketch the graph of $y = \sin x$ and $y = \sin x + 2$ (use the 5 key points)

NOTE: If it does not say how many cycles to sketch then you must fill the grid.

x	$\sin x$	$\sin x + 2$
0°	0	2
90°	1	3
180°	0	2
270°	-1	1
360°	0	2



Amplitude: 1

Period: 360°

Sinusoidal Axis: $y = 2$

Phase Shift: /

Domain: $\{x | x \in \mathbb{R}\}$

Range: $\{y | y \in \mathbb{R}, 1 \leq y \leq 3\}$

Maximum: $c + |a|$
 $= 2 + 1$
 $= 3$

Minimum: $c - |a|$
 $= 2 - 1$
 $= 1$

Horizontal Shifts (also known as **PHASE SHIFTS**)

$$y = \sin(x - d) \longrightarrow$$

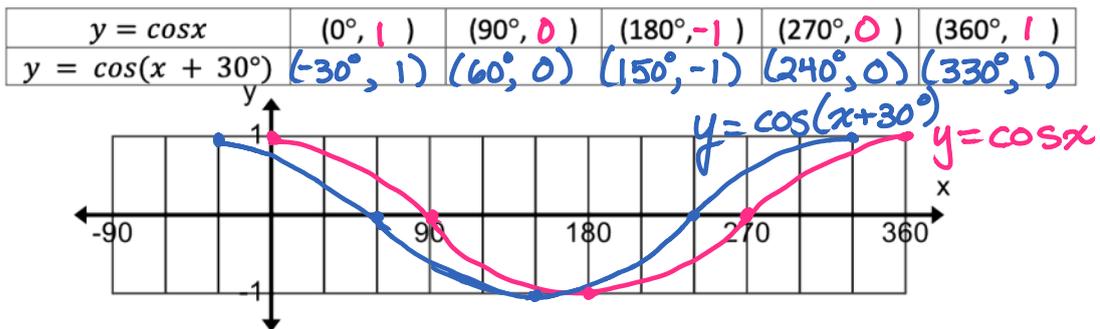
$$y = \cos(x - d) \longrightarrow$$

This is the same as horizontal shifts with other functions.

* If $d < 0$, i.e., the bracket looks like $(x + \text{number})$, shift the graph left d units.

* If $d > 0$, i.e., the bracket looks like $(x - \text{number})$, shift the graph right d units.

Example 2: Sketch **one cycle** of $y = \cos x$ and $y = \cos(x + 30^\circ)$ on the grid below.



Amplitude: 1 Period: 360° Phase Shift: $\text{left } 30^\circ$

Sinusoidal Axis: $y = 0$ Domain (for one cycle): $\{x \mid x \in \mathbb{R}, -30^\circ \leq x \leq 330^\circ\}$

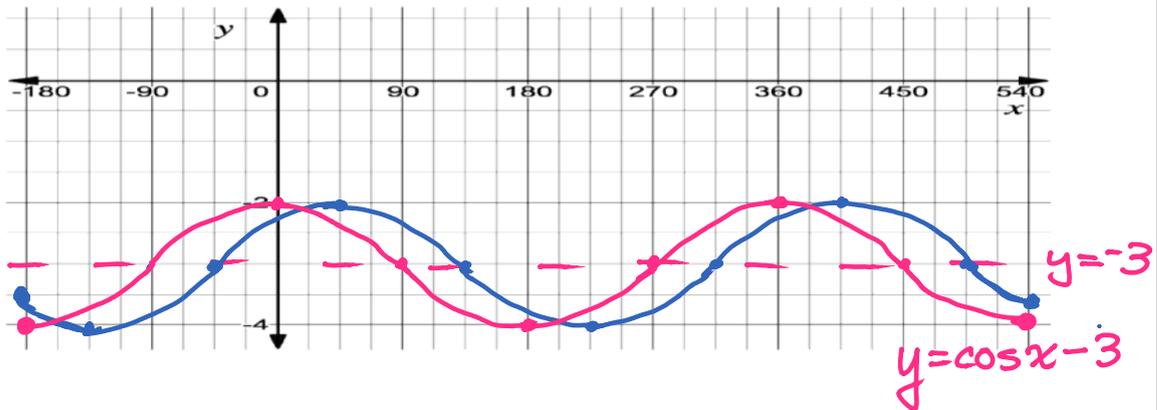
Range: $\{y \mid y \in \mathbb{R}, -1 \leq y \leq 1\}$

Maximum: 1 Minimum: -1

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Example 3: Sketch **two cycles** of $y = \cos x - 3$ and $y = \cos(x - 45^\circ) - 3$ on the grid below.

$y = \cos x - 3$	$(0^\circ, 1)$	$(90^\circ, 0)$	$(180^\circ, -1)$	$(270^\circ, 0)$	$(360^\circ, 1)$
$y = \cos(x - 45^\circ) - 3$	$(45^\circ, 1)$	$(135^\circ, 0)$	$(225^\circ, -1)$	$(315^\circ, 0)$	$(405^\circ, 1)$



Amplitude: 1 Period: 360° Phase Shift: **right 45°**

Sinusoidal Axis: $y = -3$ Domain (for 2 cycles): $\{x \mid x \in \mathbb{R}, -180^\circ \leq x \leq 540^\circ\}$

Range: $\{y \mid y \in \mathbb{R}, -4 \leq y \leq -2\}$

Maximum: $-3 + 1 = -2$ Minimum: $-3 - 1 = -4$

Example 4: If the amplitude is 6, the sinusoidal axis is $y = -3$, period is 600° and the phase shift is 60° to the right, determine the equation of the sine function.

$$a = 6 \quad c = -3 \quad k = \frac{360^\circ}{600^\circ} \quad d = 60^\circ$$

$$k = \frac{3}{5}$$

$$y = 6 \sin \frac{3}{5}(x - 60^\circ) - 3$$

Example 5: Given the equation $y = \frac{1}{5} \sin\left(\frac{3}{2}(x + 120^\circ)\right) + 7$, identify:

Amplitude: $\frac{1}{5}$

Period: $360^\circ \times \frac{2}{3}$
 $= 240^\circ$

Phase Shift:

Left $+120^\circ$

Sinusoidal Axis: $y = 7$

Max value: $7 + \frac{1}{5}$
 $= \frac{36}{5} \text{ @ } 7.2$

Min value: $7 - \frac{1}{5}$
 $= \frac{34}{5} \text{ @ } 6.8$

Domain: $\{x \mid x \in \mathbb{R}\}$

Range: $\{y \mid y \in \mathbb{R}, 6.8 \leq y \leq 7.2\}$