

Objective: To graph trigonometric functions with horizontal (phase) shifts.

Vocabulary:

Phase Shift: the amount a wave has shifted horizontally from the original wave.

Transformed Equation

$$y = a \sin(bx + c) + k$$

Vertical Shift (midline)

Amplitude
|a|

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

Phase Shift = $\frac{-c}{b}$

Identify each of the key features for the following examples. Then, graph the function.

Example 1: $h(x) = \sin(x - 2\pi) - 1$

Vertical Shift: $y = -1$ ("down 1")

Amplitude: 1

Phase Shift: $\frac{+2\pi}{1} = 2\pi$ ("right 2π ")

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

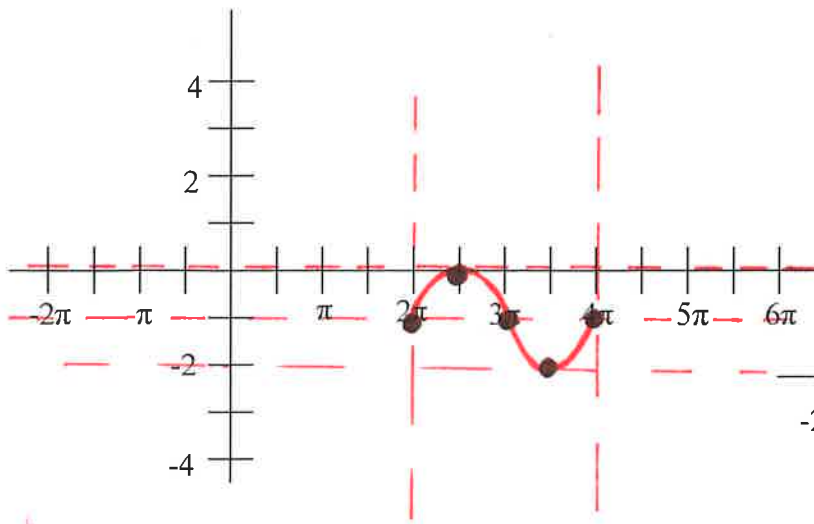
Example 2: $m(x) = \cos(2x - 6\pi) + 3$

Vertical Shift: $y = 3$ ("up 3")

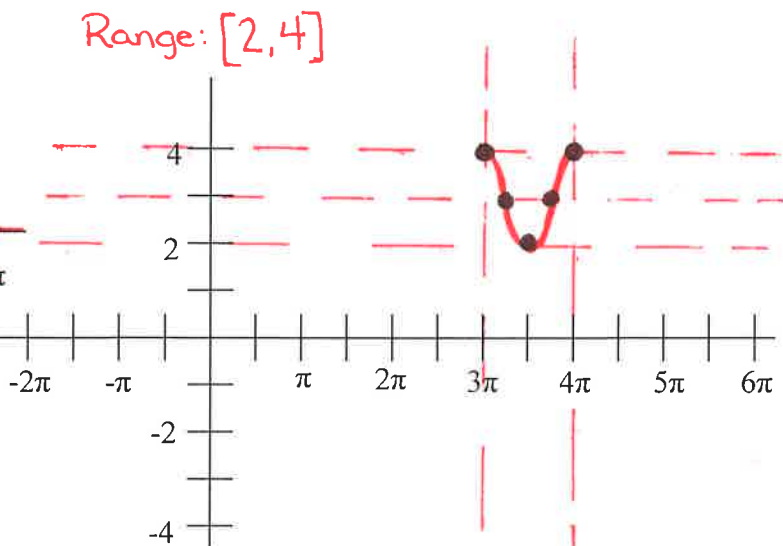
Amplitude: 1

Phase Shift: $\frac{+6\pi}{2} = 3\pi$ ("right 3π ")

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



Range: $[-2, 0]$



Range: $[2, 4]$

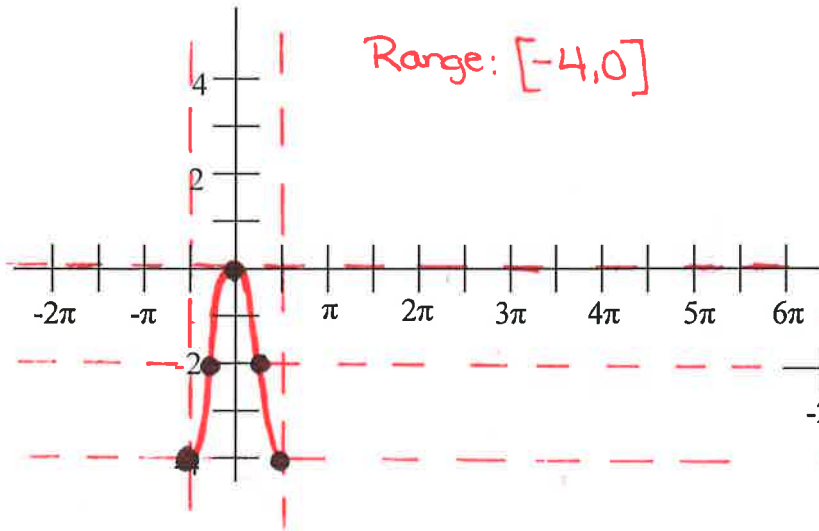
Example 3: $t(x) = -2 \cos(2x + \pi) - 2$

Vertical Shift: $y = -2$ ("down 2")

Amplitude: 2 *reflected*

Phase Shift: $\frac{-\pi}{2}$ ("left $\pi/2$ ")

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



$w(x) = 3 \sin(\frac{1}{2}x - \frac{1}{2}\pi) + 1$

Example 4: $w(x) = 3 \sin(\frac{1}{2}(x - \pi) + 1)$ *distribute first

Vertical Shift: $y = 1$ ("up 1")

Amplitude: 3

Phase Shift: $\frac{+\frac{1}{2}\pi}{\frac{1}{2}} = \pi$ ("right π ")

Period: $\frac{2\pi}{1/2} = 4\pi$

Range: $[-2, 4]$

