

Day 5: Phase Shift & Vertical Shift

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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 (mean of all graphed values)

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→ **Sine and cosine**

Sinusoidal functions can all be written in the form:

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

Remember:

$$|A| = \text{amplitude} \quad \frac{|\omega|}{2\pi} = \text{frequency} \quad \frac{2\pi}{|\omega|} = \text{period}$$

$$h = \begin{array}{c} \text{phase shift} \\ \text{horizontal} \end{array} \quad k = \begin{array}{c} \text{midline} \\ \text{vertical} \end{array}$$

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.

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