Graphing Sine and Cosine Horizontal Translation

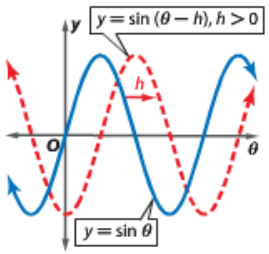
$y = a\sin(bx + c) + d$ $y = a\cos(bx + c) + d$

1 Horizontal Translations Recall that a *translation* occurs when a figure is moved from one location to another on the coordinate plane without changing its orientation. A horizontal translation of a periodic function is called a **phase shift**.

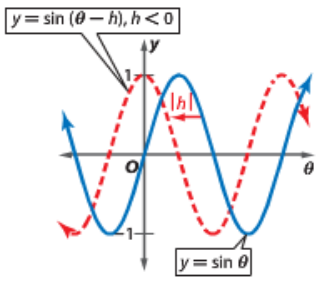
KeyConcept Phase Shift

Words The phase shift of the functions $y = a \sin b(\theta - h)$, $y = a \cos b(\theta - h)$, and $y = a \tan b(\theta - h)$ is h, where $b > 0$.

Models



If $h > 0$, the shift is h units to the right.



If $h < 0$, the shift is $|h|$ units to the left.

Examples

$y = \cos(\theta - 90°)$ The phase shift is 90° to the right.

$y = \tan(\theta + 30°)$ The phase shift is 30° to the left.

Find the phase shi for the following equaons:

$$y = 3\sin(2\theta + \pi)$$

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

$$y = \cos(2\theta + \frac{\pi}{3})$$

$$y = 3\sin(2\theta + \pi)$$

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

$$y = \cos(2\theta + \frac{\pi}{3})$$