

14.5 Write Trigonometric Functions and Models

TEKS a.5, a.6, 2A.1.B;
P.3.B

Before

You graphed sine and cosine functions.

Now

You will model data using sine and cosine functions.

Why?

So you can model the number of bicyclists, as in Ex. 26.



Key Vocabulary

- sinusoid

Graphs of sine and cosine functions are called **sinusoids**. One method to write a sine or cosine function that models a sinusoid is to find the values of a , b , h , and k for

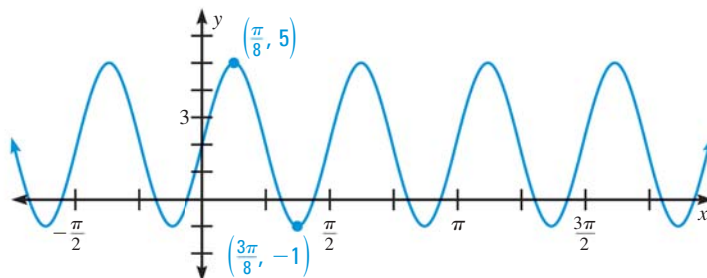
$$y = a \sin b(x - h) + k \quad \text{or} \quad y = a \cos b(x - h) + k$$

where $|a|$ is the amplitude, $\frac{2\pi}{b}$ is the period ($b > 0$), h is the horizontal shift, and k is the vertical shift.



EXAMPLE 1 TAKS REASONING Multi-Step Problem

Write a function for the sinusoid shown below.



Solution

STEP 1 Find the maximum value M and minimum value m . From the graph, $M = 5$ and $m = -1$.

STEP 2 Identify the vertical shift, k . The value of k is the mean of the maximum and minimum values. The vertical shift is $k = \frac{M + m}{2} = \frac{5 + (-1)}{2} = \frac{4}{2} = 2$. So, $k = 2$.

STEP 3 Decide whether the graph should be modeled by a sine or cosine function. Because the graph crosses the midline $y = 2$ on the y -axis, the graph is a sine curve with no horizontal shift. So, $h = 0$.

STEP 4 Find the amplitude and period. The period is $\frac{\pi}{2} = \frac{2\pi}{b}$. So, $b = 4$.

The amplitude is $|a| = \frac{M - m}{2} = \frac{5 - (-1)}{2} = \frac{6}{2} = 3$. The graph is not a reflection, so $a > 0$. Therefore, $a = 3$.

► The function is $y = 3 \sin 4x + 2$.

FIND PERIOD

Because the graph repeats every $\frac{\pi}{2}$ units, the period is $\frac{\pi}{2}$.