

Sinusoid Signal

Use key features and exact values to model repeating motion.

HIGH SCHOOL • MA.912.T.3

MA.912.T.3 "Graph and apply trigonometric relations and functions."

NAME _____

DATE _____

GRAPHING A SINUSOID

For $y = a \sin(bx) + d$ or $y = a \cos(bx) + d$, the amplitude is $|a|$, the midline is $y = d$, and the period is $360/|b|$ degrees when x is measured in degrees. To graph one cycle, use the midline, then find five key points spaced one quarter-period apart.

WORKED EXAMPLE

Find the key points for one cycle of $y = 11 \sin(7x) + 13$.

1. The amplitude is $|11| = 11$, and the midline is $y = 13$.
2. The period is $360/7$ degrees, so one quarter-period is $90/7$ degrees.
3. Starting at $x = 0$, use sine values 0, 1, 0, -1, 0.
4. The key points are $(0, 13)$, $(90/7, 24)$, $(180/7, 13)$, $(270/7, 2)$, and $(360/7, 13)$.

Answer: One cycle has key points (0, 13), (90/7, 24), (180/7, 13), (270/7, 2), and (360/7, 13).

PRACTICE 6 problems

- 1** For $y = -6 \sin(x) + 8$, state the amplitude and midline.

ANSWER _____

- 2** Find the period, in degrees, of $y = 9 \cos(5x) - 4$.

ANSWER _____

- 3** State the range of $y = 4 \sin(3x) + 1$.

ANSWER _____

- 4** Find y when $x = 30$ degrees in $y = 8 \cos(x) - 5$.

ANSWER _____

- 5** List five key points for one cycle of $y = 6 \sin(8(x - 15)) + 9$, starting at $x = 15$.

ANSWER _____

- 6** Write a sine equation with amplitude 5, period 72 degrees, midline $y = -4$, and a midline crossing upward at $x = 12$ degrees.

ANSWER _____

APPLY IT Show your work

- 1** An amusement ride seat has height $h = 16 \sin(4x) + 25$ feet, where x is measured in degrees. Find the seat's height when $x = 30$ degrees.

WORK SPACE

ANSWER _____

- 2** A school theater platform follows the model $h = 12 \cos(4x) + 20$, where h is its height in feet and x is measured in degrees. Find the platform's height when $x = 30$ degrees.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A sinusoidal graph has a maximum of 14 and a minimum of -4. Its period is 120 degrees, and it crosses its midline moving upward at $x = 15$ degrees. Write one sine equation for the graph.

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	For $y = -6 \sin(x) + 8$, state the amplitude and midline.	Amplitude: 6; midline: $y = 8$
2	Find the period, in degrees, of $y = 9 \cos(5x) - 4$.	72 degrees
3	State the range of $y = 4 \sin(3x) + 1$.	$[-3, 5]$
4	Find y when $x = 30$ degrees in $y = 8 \cos(x) - 5$.	$4\sqrt{3} - 5$
5	List five key points for one cycle of $y = 6 \sin(8(x - 15)) + 9$, starting at $x = 15$.	$(15, 9), (105/4, 15), (75/2, 9), (195/4, 3), (60, 9)$
6	Write a sine equation with amplitude 5, period 72 degrees, midline $y = -4$, and a midline crossing upward at $x = 12$ degrees.	$y = 5 \sin(5(x - 12)) - 4$

PART 2 · APPLY IT

- 25 + $8\sqrt{3}$ feet** Substitute $x = 30$. Since $\sin(120 \text{ degrees}) = \sqrt{3}/2$, $h = 16(\sqrt{3}/2) + 25 = 25 + 8\sqrt{3}$.
- 14 feet** Substitute $x = 30$. Since $\cos(120 \text{ degrees}) = -1/2$, $h = 12(-1/2) + 20 = 14$.

CHALLENGE

$$y = 9 \sin(3(x - 15)) + 5$$

Accept equivalent equation forms that produce the same graph, including equivalent angle expressions. For key-point answers, accept coordinates written as equivalent fractions or decimals.