

Cycle Code

Build sinusoidal models from repeating patterns.

HIGH SCHOOL • HSF-TF.B

CCSS.Math.Content.HSF-TF.B "Model periodic phenomena with trigonometric functions"

NAME _____

DATE _____

MODEL A CYCLE

Use $y = D + A \sin(B(x - C))$ or $y = D + A \cos(B(x - C))$ to model a repeating pattern. The amplitude is $|A|$, the midline is $y = D$, and the period is $2\pi/|B|$.

WORKED EXAMPLE

For $y = 9 - 5 \cos((\pi/4)(x - 1))$, find the amplitude, period, midline, and maximum value.

1. Identify $D = 9$ and $A = -5$.
2. Amplitude $= |-5| = 5$.
3. $B = \pi/4$, so period $= 2\pi/(\pi/4) = 8$.
4. Maximum $= 9 + 5 = 14$.

**Answer: Amplitude: 5; period: 8;
midline: $y = 9$; maximum: 14**

PRACTICE 6 problems

- 1** For $y = -6 \sin((\pi/3)x) + 2$, state the amplitude, period, and midline.

ANSWER _____

- 2** For $y = 7 \cos((\pi/10)(x + 3)) - 6$, state the amplitude, period, and midline.

ANSWER _____

- 3** A sinusoid has a maximum of 20, a minimum of 6, and a period of 12. It starts at its midline and rises when $x = 0$. Write a sine model.

ANSWER _____

- 4** A periodic signal has a maximum value of 22 and a minimum value of 2. Find its amplitude and midline.

ANSWER _____

- 5** A cosine graph has a maximum of 24, a minimum of 12, and a period of 20. It begins at a maximum when $x = 0$. Write a model.

ANSWER _____

- 6** For $y = 16 + 7 \sin((\pi/12)x)$, find y when $x = 6$.

ANSWER _____

APPLY IT Show your work

- 1** At a theme park, the height h of a rider above the ground ranges from 10 feet to 30 feet. One full ride cycle takes 24 seconds. At $t = 0$, the rider is at the midline and moving upward. Write a sine model for h in terms of time t .

WORK SPACE

ANSWER _____

- 2** A music speaker cone has displacement d , in millimeters, that ranges from -6 to 6. It completes 30 cycles each second and is at its greatest positive displacement when $t = 0$. Write a cosine model for d in terms of time t .

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A sinusoidal function has a minimum value of -7 when $x = 6$ and its next maximum value of 27 when $x = 12$. Write a cosine model. Explain how the distance between these points determines the period.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	For $y = -6 \sin((\pi/3)x) + 2$, state the amplitude, period, and midline.	Amplitude: 6; period: 6; midline: $y = 2$
2	For $y = 7 \cos((\pi/10)(x + 3)) - 6$, state the amplitude, period, and midline.	Amplitude: 7; period: 20; midline: $y = -6$
3	A sinusoid has a maximum of 20, a minimum of 6, and a period of 12. It starts at its midline and rises when $x = 0$. Write a sine model.	$y = 13 + 7 \sin((\pi/6)x)$
4	A periodic signal has a maximum value of 22 and a minimum value of 2. Find its amplitude and midline.	Amplitude: 10; midline: $y = 12$
5	A cosine graph has a maximum of 24, a minimum of 12, and a period of 20. It begins at a maximum when $x = 0$. Write a model.	$y = 18 + 6 \cos((\pi/10)x)$
6	For $y = 16 + 7 \sin((\pi/12)x)$, find y when $x = 6$.	23

PART 2 • APPLY IT

- $h = 20 + 10 \sin((\pi/12)t)$** The midline is $(30 + 10)/2 = 20$ and the amplitude is $(30 - 10)/2 = 10$. A period of 24 gives $B = 2\pi/24 = \pi/12$, and rising from the midline uses positive sine.
- $d = 6 \cos(60\pi t)$** The amplitude is 6 and the midline is 0. Thirty cycles per second gives a period of $1/30$ second, so $B = 2\pi/(1/30) = 60\pi$; cosine starts at a maximum.

CHALLENGE

$y = 10 - 17 \cos((\pi/6)(x - 6))$. The distance from the minimum to the next maximum is 6, which is half a period, so the period is 12 and $B = \pi/6$.

Accept equivalent sine or cosine models that have the stated amplitude, midline, period, and starting behavior. Equivalent phase shifts and algebraically equivalent forms are correct.