LESSON MAKER PRO

Periodic Pattern Builders

Build sine and cosine models from key features.

HIGH SCHOOL · HSF-TF.B.5

CCSS.Math.Content.HSF-TF.B.5 "Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. *"

NAME _____ DATE _____

MODEL THE CYCLE

Use y = A sin(2pi f x) + D or y = A cos(2pi f x) + D. The amplitude is |A|, D is the midline, and f is the frequency in cycles per unit. If a situation gives a starting position or direction, choose sine or cosine and a sign that fit it.

WORKED EXAMPLE

Write a sine model with amplitude 17, frequency 7/13 cycle per second, and midline y = -11.

1. Start with y = A sin(2pi f x) + D.
2. Substitute A = 17, f = 7/13, and D = -11.
3. Simplify: y = 17sin(14pi x/13) - 11.

Answer: y = 17sin(14pi x/13) - 11

PRACTICE 6 problems

1 Write a sine model with amplitude 4, frequency 1/5 cycle per unit, and midline y = 3.

ANSWER _____

2 Write a cosine model with amplitude 6, frequency 2 cycles per unit, and midline y = -1.

ANSWER _____

3 Write a sine model with amplitude 1/2, frequency 3/4 cycle per unit, and midline y = 8.

ANSWER _____

4 For y = -5cos(pi x/2) + 9, state the amplitude, frequency, and midline.

ANSWER _____

5 Write a cosine model with amplitude 3, frequency 3 cycles per unit, and midline y = -9. The graph begins at a maximum when x = 0.

ANSWER _____

6 For y = -2sin(5pi x/3) + 4, state the amplitude, frequency, and midline.

ANSWER _____

APPLY IT Show your work

1 A music app shows a visualizer bar whose vertical position, p, is measured in pixels. The bar moves 18 pixels above and below its midline of 40 pixels, completes one cycle every 8 seconds, and is at the midline moving upward when t = 0. Write a model for p in terms of t.

WORK SPACE

ANSWER _____

2 A Ferris wheel car has a height, h, in meters. Its midline height is 22 meters, its amplitude is 12 meters, and it completes one rotation every 16 seconds. At t = 0, the car is at its highest point. Write a model for h in terms of t.

WORK SPACE

ANSWER _____

CHALLENGE One step up

A game character's height repeats in a cycle. Its greatest height is 35 units, its least height is 15 units, and it completes 3 cycles every 4 seconds. At t = 0, it is at its midline and moving upward. Write a sine model and explain how you found its amplitude, midline, and frequency.

WORK SPACE AND ANSWER

ANSWER KEY

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Write a sine model with amplitude 4, frequency 1/5 cycle per unit, and midline y = 3.	**y = 4sin(2pi x/5) + 3**
2	Write a cosine model with amplitude 6, frequency 2 cycles per unit, and midline y = -1.	**y = 6cos(4pi x) - 1**
3	Write a sine model with amplitude 1/2, frequency 3/4 cycle per unit, and midline y = 8.	**y = (1/2)sin(3pi x/2) + 8**
4	For y = -5cos(pi x/2) + 9, state the amplitude, frequency, and midline.	**Amplitude: 5; frequency: 1/4 cycle per unit; midline: y = 9**
5	Write a cosine model with amplitude 3, frequency 3 cycles per unit, and midline y = -9. The graph begins at a maximum when x = 0.	**y = 3cos(6pi x) - 9**
6	For y = -2sin(5pi x/3) + 4, state the amplitude, frequency, and midline.	**Amplitude: 2; frequency: 5/6 cycle per unit; midline: y = 4**

PART 2 · APPLY IT

1. **p = 18sin(pi t/4) + 40** The amplitude is 18, the midline is 40, and a period of 8 seconds gives frequency 1/8. Starting at the midline and moving upward matches a positive sine model.
2. **h = 12cos(pi t/8) + 22** The frequency is 1/16 because one cycle takes 16 seconds. A positive cosine model starts at a maximum, so h = 12cos(2pi(1/16)t) + 22.

CHALLENGE

h = 10sin(3pi t/2) + 25. The amplitude is (35 - 15)/2 = 10, the midline is (35 + 15)/2 = 25, and the frequency is 3/4 cycle per second.

Accept equivalent forms that leave the frequency factor unexpanded, such as 4sin(2pi(1/5)x) + 3. For model-writing items, accept equivalent sine or cosine forms with a phase shift when they satisfy all stated conditions.