LESSON MAKER PRO

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 2pi/|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 = 2pi/(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

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.

WORK SPACE AND ANSWER

ANSWER KEY

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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

1. **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 = 2pi/24 = pi/12, and rising from the midline uses positive sine.
2. **d = 6 cos(60pi t)** The amplitude is 6 and the midline is 0. Thirty cycles per second gives a period of 1/30 second, so B = 2pi/(1/30) = 60pi; 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.