LESSON MAKER PRO

Model the Motion

Build sine and cosine models from a few key facts.

HIGH SCHOOL · A2S.GM.B.35

A2S.GM.B.35 "Choose trigonometric functions (sine and cosine) to model periodic phenomena with specified amplitude, frequency, and midline."

NAME _____ DATE _____

CHOOSE A STARTING POINT

In y = A cos(2pi f t) + M or y = A sin(2pi f t) + M, |A| is the amplitude, f is the frequency in cycles per time unit, and M is the midline. Use cosine when the motion starts at a high or low point. Use sine when it starts at the midline.

WORKED EXAMPLE

A wave has a frequency of 1/8 cycle per second. The table shows its highest and lowest values. Write a model that starts at the high point.

WAVE VALUES

Time (s)	Value
0	8
4	2

1. Amplitude = (8 - 2)/2 = 3; midline = (8 + 2)/2 = 5.
2. 2pi f = 2pi(1/8) = pi/4.
3. The wave starts high, so use positive cosine.

Answer: y = 3cos(pi t/4) + 5

PRACTICE 4 problems

1 Write a model with amplitude 2, frequency 1/6 cycle per second, and midline 1. It starts at a high point.

ANSWER _____

2 Write a model with amplitude 4, frequency 1/10 cycle per second, and midline 7. It starts at the midline, rising.

ANSWER _____

3 Write a model with amplitude 5, frequency 1/4 cycle per second, and midline 0. It starts at a low point.

ANSWER _____

4 Write a model with amplitude 6, frequency 1/12 cycle per second, and midline 9. It starts at the midline, falling.

ANSWER _____

APPLY IT Show your work

1 A gaming keyboard's brightness pulses between 22% and 38% at 1/2 cycle per second. It is brightest at t = 0. Model its brightness B(t), with t in seconds.

WORK SPACE

ANSWER _____

2 A Ferris wheel seat moves between 3 m and 27 m above the ground at 1/20 cycle per second. At t = 0, it is at the midline, rising. Model its height h(t), with t in seconds.

WORK SPACE

ANSWER _____

CHALLENGE One step up

A signal has amplitude 7, frequency 1/16 cycle per second, and midline 11. At t = 0, it crosses the midline going down. Write a model and find the first time it reaches a maximum after t = 0.

WORK SPACE AND ANSWER

ANSWER KEY

Model the Motion

HIGH SCHOOL · A2S.GM.B.35

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Write a model with amplitude 2, frequency 1/6 cycle per second, and midline 1. It starts at a high point.	**y = 2cos(pi t/3) + 1**
2	Write a model with amplitude 4, frequency 1/10 cycle per second, and midline 7. It starts at the midline, rising.	**y = 4sin(pi t/5) + 7**
3	Write a model with amplitude 5, frequency 1/4 cycle per second, and midline 0. It starts at a low point.	**y = -5cos(pi t/2)**
4	Write a model with amplitude 6, frequency 1/12 cycle per second, and midline 9. It starts at the midline, falling.	**y = -6sin(pi t/6) + 9**

PART 2 · APPLY IT

1. **B(t) = 8cos(pi t) + 30** The amplitude is (38 - 22)/2 = 8, and the midline is 30. The light starts brightest, so use positive cosine with 2pi f = pi.
2. **h(t) = 12sin(pi t/10) + 15** The amplitude is 12, and the midline is 15. It starts at the midline rising, so use positive sine with 2pi f = pi/10.

CHALLENGE

y = -7sin(pi t/8) + 11; first maximum at t = 12 seconds

Accept equivalent sine or cosine models with phase shifts if they match the stated starting point and direction.