LESSON MAKER PRO

Patterns in Motion

Model repeating changes with trigonometric functions.

HIGH SCHOOL · PC.T.2.1

PC.T.2.1 "Create models for situations involving trigonometry."

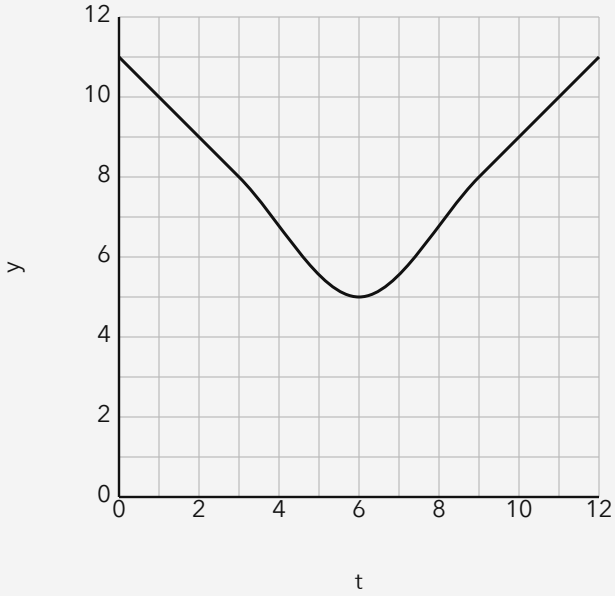
NAME _____ DATE _____

MODEL A REPEATING PATTERN

For a sinusoidal pattern, use $y(t) = D + A\cos(2\pi t/T)$ if it begins high, or $y(t) = D - A\cos(2\pi t/T)$ if it begins low. D is the middle value, A is half the difference between the high and low values, and T is the time between matching peaks. A pattern that begins at the middle value and rises can use $y(t) = D + A\sin(2\pi t/T)$.

WORKED EXAMPLE

Write a cosine model y(t) for the curve.

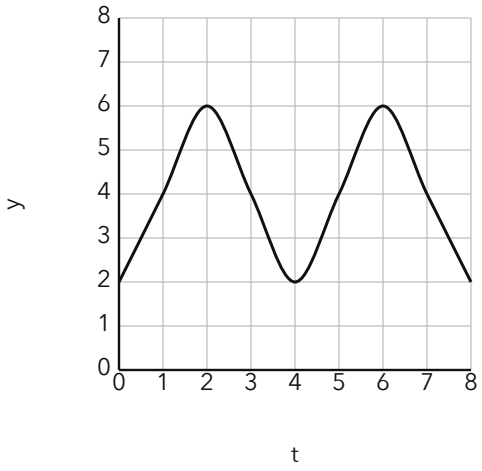


1. Read the high value, 11, and the low value, 5.
2. Find $D = (11 + 5)/2 = 8$ and $A = (11 - 5)/2 = 3$.
3. The peak repeats from $t = 0$ to $t = 12$, so $T = 12$.
4. The curve begins high, so $y(t) = 8 + 3\cos(2\pi t/12)$.

Answer: $y(t) = 8 + 3\cos(\pi t/6)$

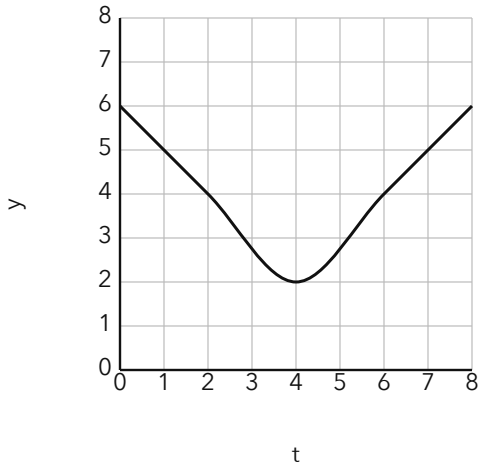
PRACTICE 6 problems

1 Write a cosine model y(t) for the curve.



ANSWER _____

2 Write a cosine model y(t) for the curve.



ANSWER _____

3 A sinusoidal signal starts at a high value of 7, falls to 1, and returns to 7 after 6 seconds. Write a model y(t), where t is in seconds.

ANSWER _____

4 A sinusoidal signal starts at a low value of 1, rises to 9, and returns to 1 after 10 seconds. Write a model y(t), where t is in seconds.

ANSWER _____

5 The table shows readings from a sinusoidal signal. Write a model y(t) for the signal.

SIGNAL READINGS

t	y
0	5
1	3
2	1
3	3
4	5

ANSWER _____

6 A sinusoidal signal starts at 0, reaches a high value of 8, and repeats every 8 seconds. Write a model y(t), then find y(4).

ANSWER _____

APPLY IT Show your work

1 A concert stage light cycles smoothly between brightness settings 20 and 80. It begins at 80 and repeats its cycle every 6 seconds. Write a model B(t) for its brightness, then find B(3).

WORK SPACE

ANSWER _____

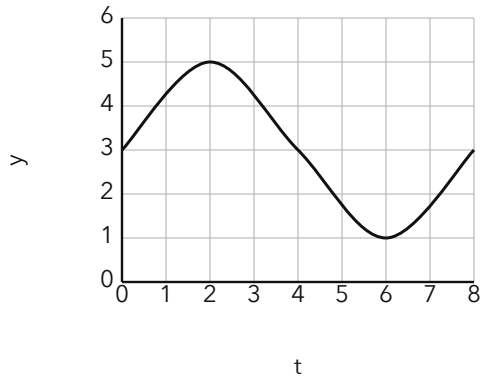
2 On a Ferris wheel, your seat moves between 2 meters and 18 meters above the ground. One turn takes 40 seconds, and you begin at the lowest point. Write a model h(t) for your height in meters, then find h(20).

WORK SPACE

ANSWER _____

CHALLENGE One step up

Write a sine model y(t) for the curve. In one sentence, explain why a sine model without a shift fits its starting point.



WORK SPACE AND ANSWER

Patterns in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Write a cosine model y(t) for the curve.	**y(t) = 4 - 2cos(πt/2)**
2	Write a cosine model y(t) for the curve.	**y(t) = 4 + 2cos(πt/4)**
3	A sinusoidal signal starts at a high value of 7, falls to 1, and returns to 7 after 6 seconds. Write a model y(t), where t is in seconds.	**y(t) = 4 + 3cos(πt/3)**
4	A sinusoidal signal starts at a low value of 1, rises to 9, and returns to 1 after 10 seconds. Write a model y(t), where t is in seconds.	**y(t) = 5 - 4cos(πt/5)**
5	The table shows readings from a sinusoidal signal. Write a model y(t) for the signal.	**y(t) = 3 + 2cos(πt/2)**
6	A sinusoidal signal starts at 0, reaches a high value of 8, and repeats every 8 seconds. Write a model y(t), then find y(4).	**y(t) = 4 - 4cos(πt/4); y(4) = 8**

PART 2 · APPLY IT

1. **B(t) = 50 + 30cos(πt/3); B(3) = 20** The middle setting is 50, the amplitude is 30, and the period is 6 seconds. At 3 seconds, the light reaches its lowest setting.
2. **h(t) = 10 - 8cos(πt/20); h(20) = 18 meters** The middle height is 10 meters, the amplitude is 8 meters, and the period is 40 seconds. After half a turn, the seat is at its highest point.

CHALLENGE

y(t) = 3 + 2sin(πt/4). A sine model without a shift starts at the middle value and rises, as this curve does.

Accept equivalent forms using 2π/T in place of simplified coefficients of t. For the challenge, accept any explanation that identifies the middle-value start and upward motion.