LESSON MAKER PRO

Wave Tracker

Model, sketch, and solve with sine and cosine.

HIGH SCHOOL · MA.912.T.3.3

MA.912.T.3.3 "Solve and graph mathematical and real-world problems that are modeled with trigonometric functions. Interpret key features and determine constraints in terms of the context."

NAME _____ DATE _____

KEY FEATURES OF A WAVE

For y = A sin(Bx) + D or y = A cos(Bx) + D, the amplitude is |A|, the period is 2pi/|B|, and the midline is y = D. The range goes from D - |A| to D + |A|, and a negative A reflects the basic curve across its midline.

WORKED EXAMPLE

Sketch one cycle of y = 9 sin(4x) + 5 by listing its five key points.

1. Amplitude = |9| = 9, midline: y = 5.
2. Period = 2pi/4 = pi/2.
3. Divide one period into four equal parts: 0, pi/8, pi/4, 3pi/8, pi/2.
4. Use sine values 0, 1, 0, -1, 0 to find the y-values.

Answer: (0, 5), (pi/8, 14), (pi/4, 5), (3pi/8, -4), (pi/2, 5)

PRACTICE 6 problems

1 Sketch one cycle of y = 8 sin(x) - 2 by listing its five key points from x = 0 to x = 2pi.

ANSWER _____

2 For y = -6 cos(x) + 3, state the amplitude, midline, range, and whether the graph is reflected across its midline.

ANSWER _____

3 Solve 2 sin(x) = sqrt(3) for 0 <= x < 2pi.

ANSWER _____

4 Solve cos(3x) = 0 for 0 <= x < 2pi.

ANSWER _____

5 Sketch one cycle of y = 7 sin(pi x) by listing its five key points.

ANSWER _____

6 For y = 10 cos(x/2) - 1, state the amplitude, period, midline, and range.

ANSWER _____

APPLY IT Show your work

1 At a school festival, a Ferris wheel rider's height H, in meters, is modeled by H(t) = 14 - 8 cos(pi t/6), where t is time in minutes and 0 <= t <= 12. Find the minimum and maximum heights. Then find every time when the rider is 14 meters above the ground.

WORK SPACE

ANSWER _____

2 A concert light display has brightness B(t) = 40 + 30 sin(pi t/8), where t is measured in seconds and 0 <= t <= 16. Find the period, the greatest and least brightness, and the times when each occurs. List five key points that could be used to sketch the display.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A ride's height has a minimum of 6 meters and a maximum of 18 meters. It completes one cycle every 12 seconds and starts at its maximum height when t = 0. Write a cosine model h(t). Then find every time the ride is at its midline height during 0 <= t <= 24.

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ANSWER KEY

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Sketch one cycle of y = 8 sin(x) - 2 by listing its five key points from x = 0 to x = 2pi.	**(0, -2), (pi/2, 6), (pi, -2), (3pi/2, -10), (2pi, -2)**
2	For y = -6 cos(x) + 3, state the amplitude, midline, range, and whether the graph is reflected across its midline.	**Amplitude: 6; midline: y = 3; range: -3 <= y <= 9; reflected across the midline.**
3	Solve 2 sin(x) = sqrt(3) for 0 <= x < 2pi.	**x = pi/3, 2pi/3**
4	Solve cos(3x) = 0 for 0 <= x < 2pi.	**x = pi/6, pi/2, 5pi/6, 7pi/6, 3pi/2, 11pi/6**
5	Sketch one cycle of y = 7 sin(pi x) by listing its five key points.	**(0, 0), (1/2, 7), (1, 0), (3/2, -7), (2, 0)**
6	For y = 10 cos(x/2) - 1, state the amplitude, period, midline, and range.	**Amplitude: 10; period: 4pi; midline: y = -1; range: -11 <= y <= 9**

PART 2 · APPLY IT

1. **Minimum height: 6 meters at t = 0 and t = 12. Maximum height: 22 meters at t = 6. The rider is 14 meters high at t = 3 and t = 9.** The midline is 14 and the amplitude is 8, so the heights range from 6 to 22 meters. Set cos(pi t/6) = 0 to get t = 3 and t = 9 in the stated domain.
2. **Period: 16 seconds. Greatest brightness: 70 at t = 4. Least brightness: 10 at t = 12. Key points: (0, 40), (4, 70), (8, 40), (12, 10), (16, 40).** The period is 2pi/(pi/8) = 16, and the brightness is 40 plus or minus 30. Use the quarter-period times 0, 4, 8, 12, and 16 to locate the key points.

CHALLENGE

h(t) = 12 + 6 cos(pi t/6). The midline height is 12 meters, reached at t = 3, 9, 15, and 21 seconds.

Accept equivalent ordered pairs, equivalent angle forms, and equivalent interval notation for ranges. For graphing items, accept a smooth sinusoidal curve through the listed key points.