

Graphing Waves: Sine and Cosine Models

Grade 11 – Algebra 2 math · Worksheet · Standards: F-TF.B.5, F-IF.C.7e

Name: _____ Date: _____ Class: _____

These problems train amplitude, period, midline and phase shift of sine and cosine, reading equations from graphs, and modeling periodic situations, as in standards F-TF.B.5 and F-IF.C.7e.

The first problems read features from equations. Later ones build models for a Ferris wheel, tides, daylight and temperature.

Standards: F-TF.B.5, F-IF.C.7e · **Level:** Grade 11 Algebra 2

Problem 1 Amplitude and period of sine (easy)

State the amplitude and period of $y = 4 \sin x$.

Problem 2 Period of a compressed cosine (easy)

Find the period and amplitude of $y = \cos 3x$.

Problem 3 Reflected sine (easy)

Describe $y = -2 \sin x$: amplitude, period and what the negative sign does.

Problem 4 Vertical shift (easy)

Find the midline, maximum and minimum of $y = \sin x + 5$.

Problem 5 Range of a cosine function (medium)

Find the maximum, minimum and range of $y = 3 \cos x - 1$.

Problem 6 Period with π in the coefficient (medium)

Find the period of $y = \sin(\pi x/4)$.

Problem 7 Write an equation from a graph (medium)

The graph shows a sine wave through the origin. Write its equation.



A sine wave with maximum 3 and minimum -3 .

Problem 8 Phase shift to the right (medium)

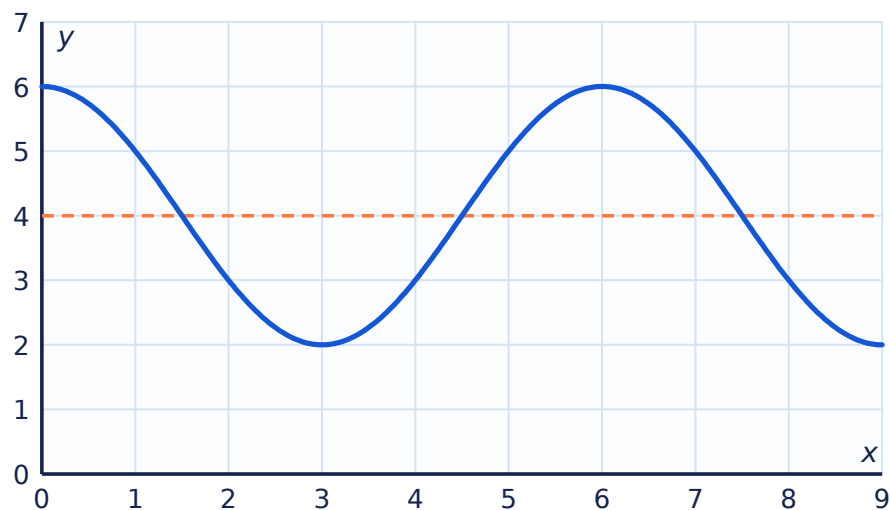
Describe the graph of $y = \sin(x - \pi/3)$ compared with $y = \sin x$, and give the x -values where it first crosses the midline going up and its first maximum.

Problem 9 Shift left and down (medium)

State the amplitude, phase shift and midline of $y = 2 \cos(x + \pi/2) - 3$.

Problem 10 Read features from a graph (medium)

The graph shows $y = 2 \cos(\pi x/3) + 4$. Read the maximum, minimum, midline, amplitude and period.



Cosine wave with midline $y = 4$.

Problem 11 Cosine from a description (medium)

Write a cosine function with midline $y = 6$, amplitude 4, period 12, and a maximum at $x = 0$.

Problem 12 Sine from a description (medium)

Write a sine function with midline $y = 0$, amplitude 2.5, period 10, that starts at the midline and rises.

Problem 13 All features at once (medium)

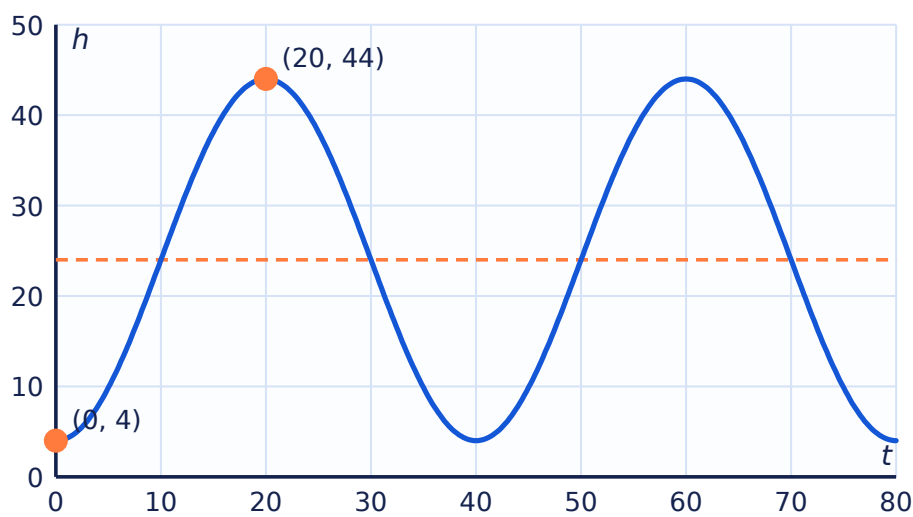
State the amplitude, period and phase shift of $y = 3 \sin(2x - \pi/2)$.

Problem 14 Locate maximum points (hard)

Find the x-coordinates of all maximum points of $y = 5 \sin 4x$ on the interval $[0, \pi]$.

Problem 15 Ferris wheel model (hard)

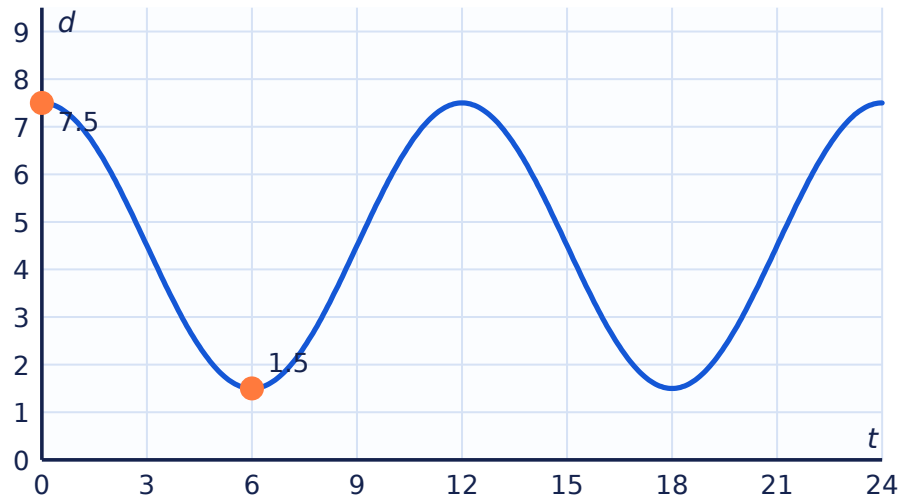
A Ferris wheel has radius 20 feet, its center is 24 feet above the ground, and one rotation takes 40 seconds. A rider starts at the bottom, so $h(t) = -20 \cos(\pi t/20) + 24$. Find the rider's height at $t = 15$ seconds, to the nearest hundredth.



The rider's height over two rotations.

Problem 16 Tide model (hard)

At a harbor the water is 7.5 feet deep at high tide ($t = 0$) and 1.5 feet deep at low tide six hours later. Model the depth with a cosine function, then find the depth at $t = 2$ hours and the first time the depth is 4.5 feet.



Tide depth (feet) over two cycles.

Problem 17 Daylight hours (hard)

The hours of daylight in a city on day d of the year are modeled by $D(d) = 2.8 \sin(2\pi(d - 80)/365) + 12.1$. Find the longest and shortest daylight, the period, and the daylight on day 120 to the nearest tenth of an hour.

Problem 18 Daily temperature (hard)

The temperature in $^{\circ}\text{F}$, t hours after midnight, is $T(t) = 14 \sin(\pi(t - 9)/12) + 68$. Find the highest and lowest temperatures, when the highest occurs, and $T(12)$ to the nearest tenth.

Problem 19 Show two forms are equal (hard)

Show that $\cos x = \sin(x + \pi/2)$ by comparing values at $x = 0, \pi/2$ and π , and explain with a graph shift.

Problem 20 Find a model from extreme values (hard)

A quantity has a maximum of 10 at $t = 1$ and the next minimum of -2 at $t = 4$. Write a cosine model.