

Lesson 6.7 - Applications of Sinusoidal Functions

1. During high tide, the water depth in a harbour is 20 m, and during low tide it is 8 m. Assume a 12 h cycle (ie. period).

- a) State where the water level is at
- A maximum.
 - A minimum
- b) Find the amplitude "a", the average sea level (ie. "c" the horizontal axis) and the "k" value. We will find the phase shift "d" later.

- c) Draw a graph of the function for a 48 h duration



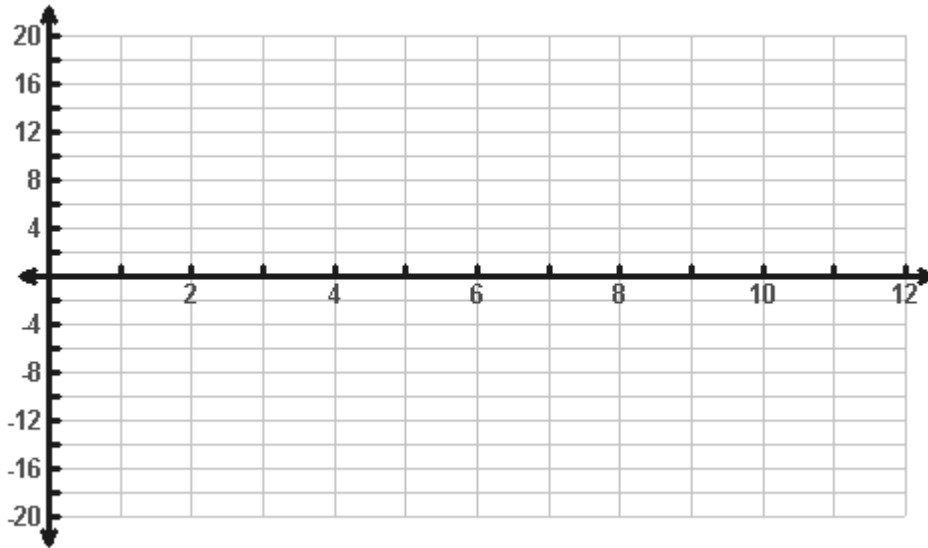
- d) From the graph, what is the phase shift "d"? Find an equation for water depth "y" for "x" hours

- e) Calculate with your equation what the water depth will be at 57 hours.

2. The table shows the average monthly high temperature for one year that an environmentalist or weather forecaster would consider.

"x" time (months)	J	F	M	A	M	J	J	A	S	O	N	D
"y" temperature(°C)	-17.6	-15.2	-8.1	1.4	9.6	14.9	18.3	15.3	12.1	6.2	-5.3	-12.8

(a) Draw a scatter plot of the data and the curve of best fit. January is month 1.



x

Phase shift "d"

=

(b) What type of model best describes the graph? Why?

(c) Find the max, min, amplitude, average temperature "c", period, k value and phase shift "d" for this situation.

(d) Find the equation of the sine model for the above situation using $y = a \sin k(x - d) + c$

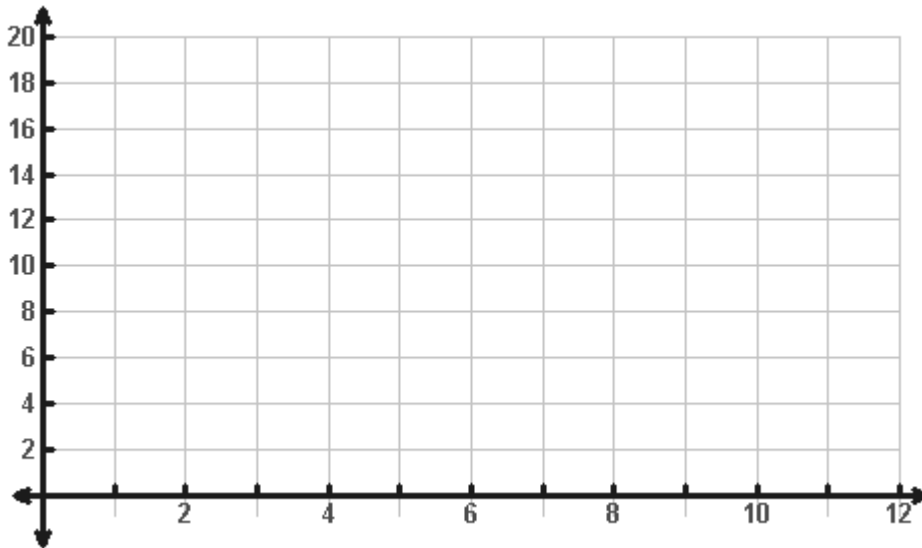
(e) Use your equation to calculate the average monthly temperature for the 18th month, showing all your steps.

3. The depth of water in a harbour on the Bay of Fundy changes each hour, as shown.

"x" time (h)	00	01	02	03	04	05	06	07	08	09	10	11	12
"y" depth (m)	5.4	6.2	8.4	11.4	14.4	16.4	17.4	16.6	14.4	11.4	8.5	6.3	5.5

- a) Graph a scatter plot of the data in the table above for a 12 hour period.
After doing so, find an equation $y = a \sin k(x - d) + c$ that models the situation.

y



x

- (b) Use the equation you found to calculate the depth of water at 6.5 hours. Verify your answer using by checking its accuracy with the graph you made.

- (c) By reading and showing this on your graph, estimate the times when the water is 9 m deep?

4. The maximum height of a Ferris wheel is 40 m. The wheel takes 180 seconds to make one revolution (one full turn). Passengers board the Ferris at time $t = 0$ s when the wheel is 2 m above the ground at the bottom of its rotation.

a) Draw a sketch of the Ferris wheel showing the heights described.

b) Make a graph that starts at $t = 0$ s and a height of 2m for a 360s duration.

“y” height of a passenger above the ground in meters

“x” the time of the Ferris wheel in seconds

c) Write an equation to represent this situation.

d) Calculate with your equation how high the passenger is after 65 s?

e) The ride lasts for 6 min. At what times will the passenger be at the maximum height during this ride? (hint: graphing your equation will help you see this).

Answers

Question 1

- a) i) 20 m ii) 8m
 b) $a = 6\text{m}$ $c = 14\text{m}$ $k = 30$
 d) $d = 0^\circ$ $f(x) = 6 \sin 30(x) + 14$
 e) 8 m

Question 2

- b) A sinusoidal model $f(x) = a \sin k(x-d) + c$, since it has a max and a minimum, and it appears periodic.
 c) $\text{max} = 18.3^\circ\text{C}$ $\text{min} = -17.6^\circ\text{C}$ $a = 17.95^\circ\text{C}$ $c = 0.35^\circ\text{C}$
 $\text{pd.} = 12 \text{ months}$ $k = 30$ $d = 4 \text{ months}$
 d) $f(x) = 17.95 \sin 30(x-4) + 0.35$
 e) 15.89°C

Question 3

- a) $y = 6 \sin 30(x-3) + 11.4$
 b) 17.196 m
 c) 2.5 hours and 10 hours

Question 4

- c) $f(x) = 19 \sin 0.5(x-45) + 21$
 d) 24.306m
 e) 90s, 270s, 450s,