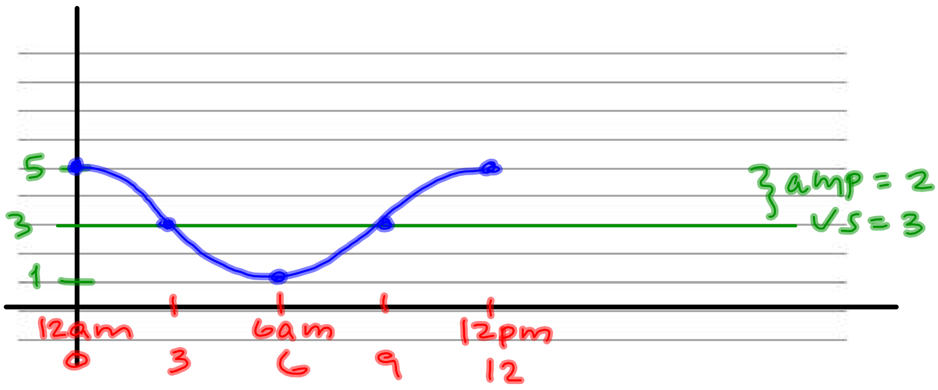
1. ***Tide Problem.*** At high tide the ocean generally reaches the 5-foot mark on a retaining wall. At low tide the water reaches the 1-foot mark. Assume that high tide occurs at 12 noon and at midnight, and that low tide occurs at 6 pm and 6 am.

(a) Write a function to show how the height of the water varies over time.
(b) Determine the height of the water at 2:30 pm.
(c) Determine the first time after 6 am that the tide will reach the 4 foot mark.



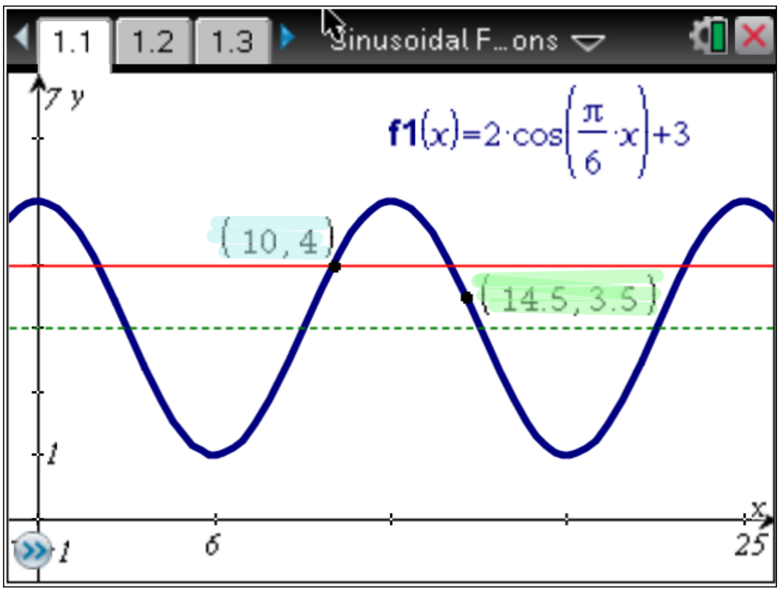
D: [0, 12]
R: [1, 5]

$y = 2\cos\frac{\pi}{6}(x) + 3$

$\uparrow$
$\frac{2\pi}{12}$

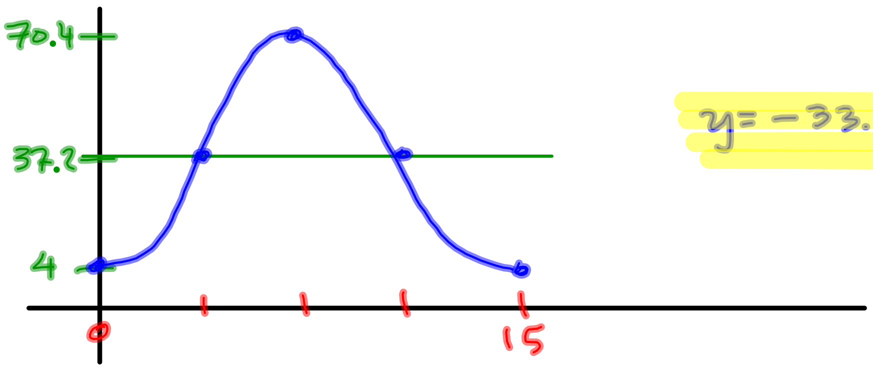
1. ***Tide Problem.*** At high tide the ocean generally reaches the 5-foot mark on a retaining wall. At low tide the water reaches the 1-foot mark. Assume that high tide occurs at 12 noon and at midnight, and that low tide occurs at 6 pm and 6 am.

(a) Write a function to show how the height of the water varies over time.
(b) Determine the height of the water at 2:30 pm. 3.5 ft
(c) Determine the first time after 6 am that the tide will reach the 4 foot mark. 10am



2. ***Ferris Wheel Problem.*** There is a ferris wheel every year at the North Georgia Fair. This year the wheel has a radius of 33.2 feet and makes a complete revolution every 15 seconds. For clearance, the bottom of the ferris wheel is 4 feet above the ground.

(a) Write a function to show how one passenger's height above the ground varies with time as he rides the ferris wheel.
(b) Determine how far above ground the passenger is 52 seconds into the ride.
(c) Determine the number of seconds the passenger has been on the ride when he first reaches a height of 27 feet.



$y = -33.2 \cos \frac{2\pi}{15}(x) + 37.2$

D: [0,15]
R: [4,70.4]

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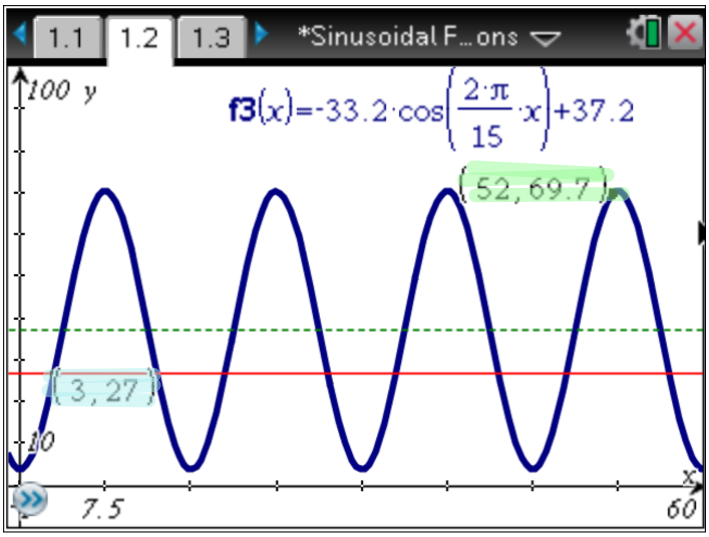
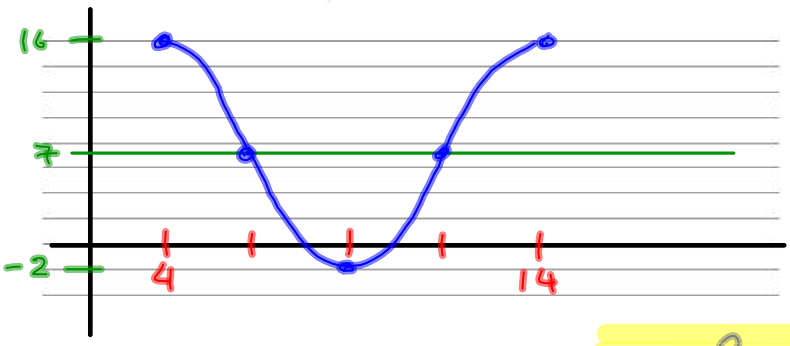
(a) Write a function to show how one passenger's height above the ground varies with time as he rides the ferris wheel.
(b) Determine how far above ground the passenger is 52 seconds into the ride. 69.7 feet
(c) Determine the number of seconds the passenger has been on the ride when he first reaches a height of 27 feet. 3 seconds



3. ***Steamboat Problem.*** Mark Twain sat on the deck of a river steamboat. As the paddle wheel turned, a point on the paddle blade moved so that its distance, d, from the water's surface was a sinusoidal function of time. When Twain's stopwatch read 4 seconds, the point was at its highest, 16 feet above the water's surface. The wheel's diameter was 18 feet, and it completed a revolution every 10 seconds.

(a) Sketch the graph of the sinusoid and write a function to represent your graph.
(b) What is the lowest the point goes? Why is it reasonable for this value to be negative?
(c) How far above the surface was the point when Mark's stopwatch read 17 seconds?
(d) What is the FIRST positive value of time at which the point was at the water's surface? At that time, was the point going into or coming out of the water?



D: [4,14]
R: [-2,16]

$y = 9\cos\frac{\pi}{5}(x-4)+7$

$\frac{2\pi}{10}$

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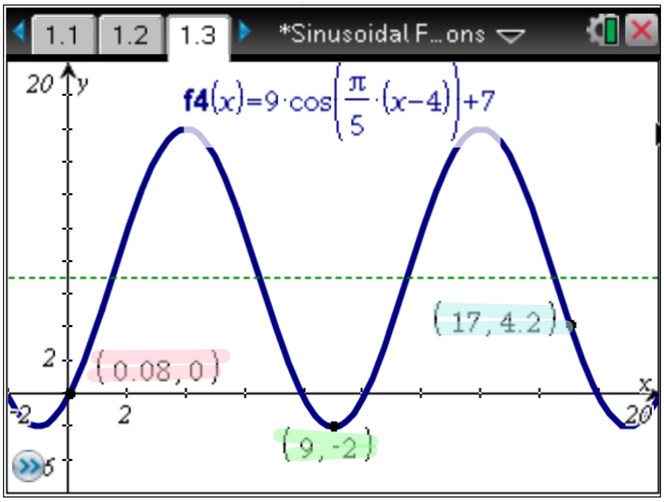
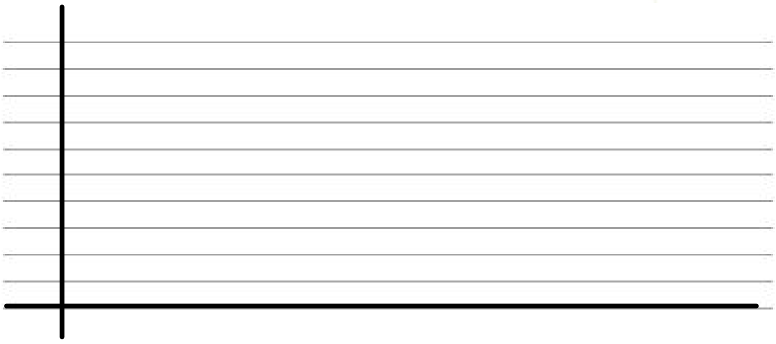
below water
−2
4.2 feet
0.08 sec → out of water



4. ***Fox Population Problem.*** Naturalists find that populations of some kinds of predatory animals vary periodically with time. Assume that the population of foxes in a certain forest varies sinusoidally with time. Records started being kept at time $t = 0$ *year*. A minimum number of 200 foxes appeared at $t = 2.9$ years. The next maximum, 800 foxes, occurred at $t = 5.1$ years.

(a) Sketch the graph of this sinusoid and write an equation expressing the number of foxes as a function of time.
(b) Predict the fox population when $t = 7, 8, 9,$ *and* 10 years.
(c) Foxes are declared an endangered species when their population drops below 300. Between what two nonnegative values of t did the foxes first become endangered?



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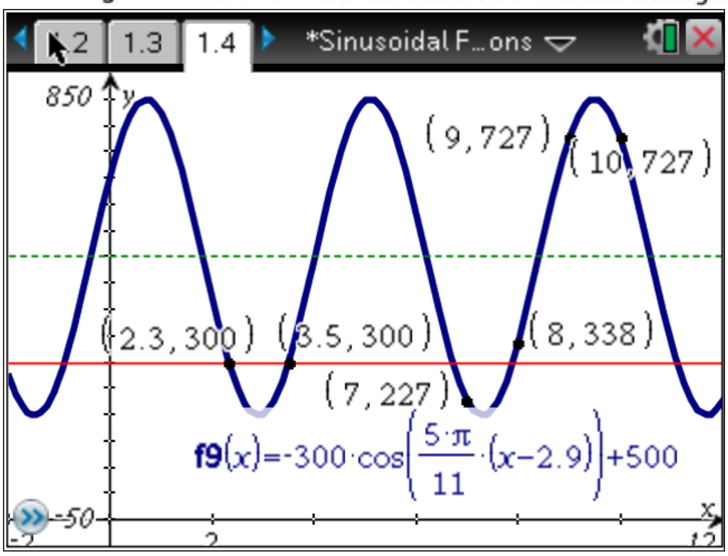
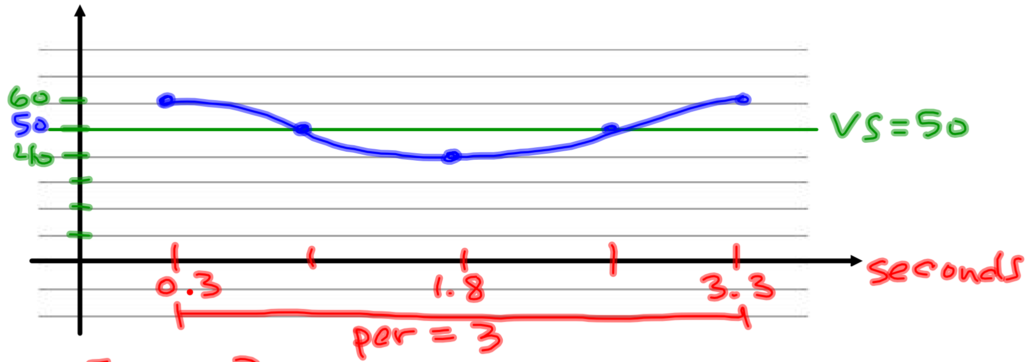


5. ***Bouncing Spring Problem.*** A weight attached to the end of a long spring is bouncing up and down as shown in the diagram. As it bounces, its distance from the floor varies sinusoidally with time. You start a stopwatch. When the stopwatch reads 0.3 seconds, the weight first reaches a high point 60 cm above the floor. The next low point, 40 cm above the floor, occurs at 1.8 seconds.

(a) Graph and find an equation for the distance from the floor as a function of time.
(b) What is the distance from the floor when the stopwatch reads 17.2 seconds?
(c) What was the distance from the floor when you started the stopwatch?
(d) What is the first positive value of time when the weight is 59 cm above the floor?



D: [0.3, 3.3]

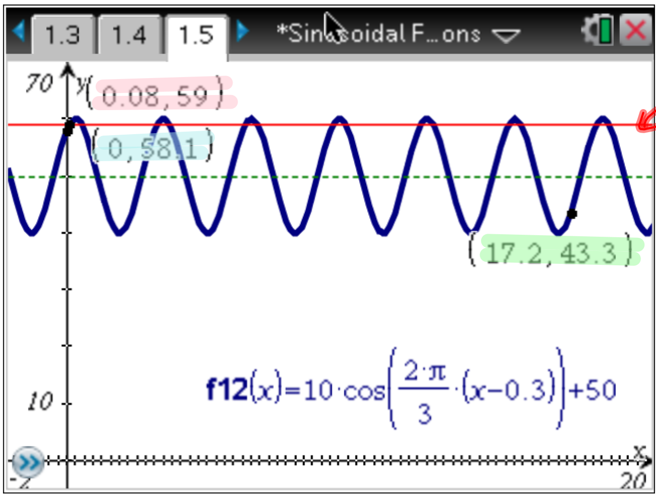
R: [40, 60]

$y = 10\cos\frac{2\pi}{3}(x-0.3)+50$

$\frac{2\pi}{3}$

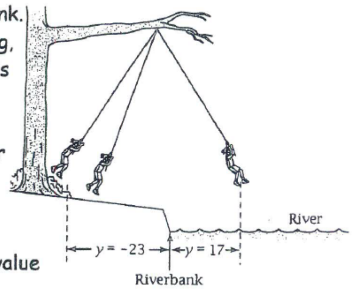
5. ***Bouncing Spring Problem.*** A weight attached to the end of a long spring is bouncing up and down as shown in the diagram. As it bounces, its distance from the floor varies sinusoidally with time. You start a stopwatch. When the stopwatch reads 0.3 seconds, the weight first reaches a high point 60 cm above the floor. The next low point, 40 cm above the floor, occurs at 1.8 seconds.

(a) Graph and find an equation for the distance from the floor as a function of time.
(b) What is the distance from the floor when the stopwatch reads 17.2 seconds? 43.3 cm
(c) What was the distance from the floor when you started the stopwatch? 58.1 cm
(d) What is the first positive value of time when the weight is 59 cm above the floor? 0.08 sec



$y_2 = 52$

6. ***Rope Swing Problem.*** Zoey is at summer camp. One day she is swinging on a rope tied to a tree branch, going back and forth alternately over land and water. Nathan starts a stopwatch. When $x = 2$ seconds, Zoey is at one end of her swing, at a distance $y = -23$ feet from the riverbank. (see diagram) When $x = 5$ seconds, she is at the other end of her swing, at a distance $y = 17$ feet from the riverbank. Assume that while she is swinging, y varies sinusoidally with x.



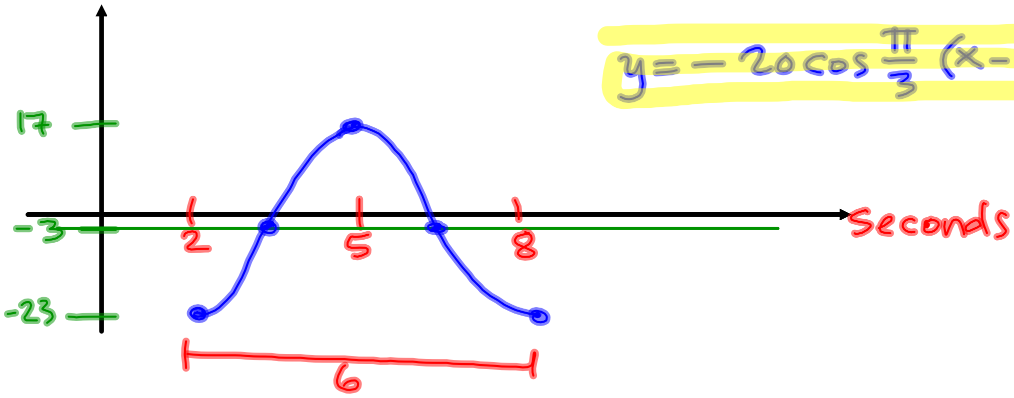
(a) Sketch a graph and write an equation to model this problem.

(b) Find y when $x = 13.2$ seconds. Was Zoey over land or over water at this time?

(c) Find the first positive time when Zoey was directly over the riverbank ($y = 0$).

(d) Zoey lets go of the rope and splashes into the water. What is the value of y for the end of the rope when it comes to rest? What part of the mathematical model tells you this?

$$y = -20\cos\frac{\pi}{3}(x-2) - 3$$



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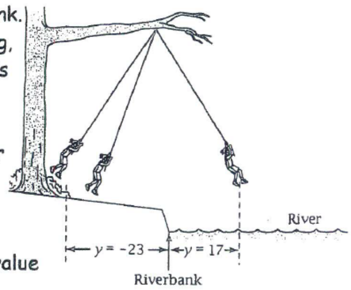

(a) Sketch a graph and write an equation to model this problem.

(b) Find y when $x = 13.2$ seconds. Was Zoey over land or over water at this time? −16.4 feet

(c) Find the first positive time when Zoey was directly over the riverbank ($y = 0$). 0.36 sec.

(d) Zoey lets go of the rope and splashes into the water. What is the value of y for the end of the rope when it comes to rest? What part of the mathematical model tells you this? −3 ft.