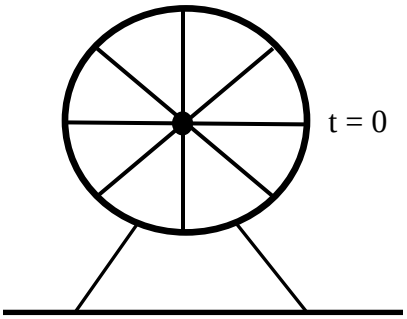
Sinusoidal Examples:

1. Suzie is at the State Fair riding the Ferris Wheel. The bottom of the wheel is 8 feet off the ground and the diameter of the wheel is 50 feet. If the ride makes five revolutions every minute, write an equation describing Suzie's position if she starts at the top of the ride?

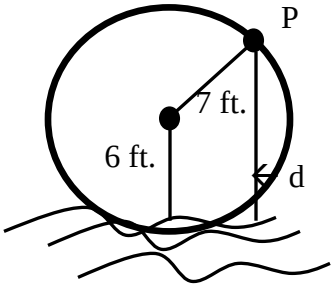


2. Suppose that a waterwheel has a radius of 7 feet and rotates at 6 revolutions per minute (rpm). You start your stopwatch and two seconds later point P on the rim of the wheel is at its greatest point. You are to model the distance d of point P from the surface of the water in terms of the number of seconds t the stopwatch reads.

   A) Sketch a graph of the curve

   B) Write the equation of the curve.

   C) Predict the height of P when t = 5.5



3. A tsunami is a fast moving ocean wave caused by an underwater earthquake. The water first goes down from its normal level, then rises an equal distance above its normal level, and finally returns to its normal level. The period is about 15 minutes. Suppose that a tsunami with an amplitude of 10 meters approaches the pier at Honolulu, where the normal depth of the water is 9 meters.

   A) Sketch a graph of the curve.

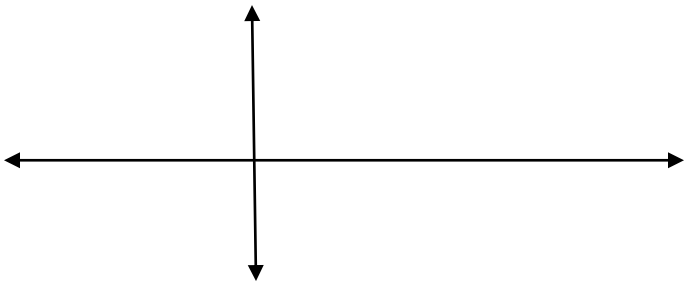
   B) Write the particular equation of this curve. According to your model, what will the minimum depth of the water be? How do you interpret this answer in terms of what will happen in the real world?

   C) Predict the depth of the water at 4 minutes? 12 minutes?

   D) If the tsunami travels at 1200 km per hour, what is its wavelength?

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

A) Draw the graph of the sinusoid. Label all of the key points.

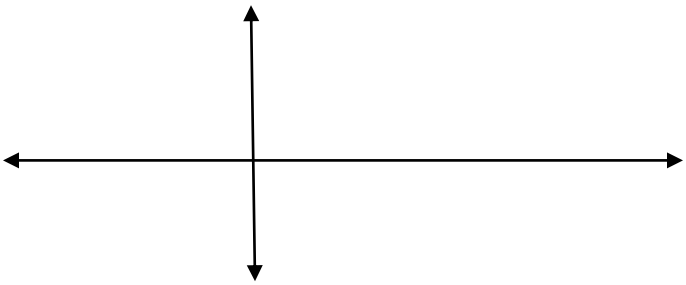


B) Write an equation expressing the number of foxes as a function of time, t. y = _____

C) Foxes are considered to be endangered when their population drops below 300. Between what two non-negative values of "t" were foxes first endangered? _____ & _____

5. A weight attached to the end of a long spring is bouncing up and down. As it bounces, its distance from the floor varies sinusoidally with time. You start a stopwatch and after 0.3 seconds the weight first reaches a high point of 60 centimeters above the floor. The next low point, 40 centimeters above the floor, occurs at 1.8 seconds.

A) Draw the graph of the sinusoid. Label all of the key points.



B) Write an equation expressing the distance from the floor in terms of the number of seconds the stopwatch reads. y = _____

C) What was the distance from the floor when you started the stopwatch? 17.2 seconds later?

Sinusoidal Worksheet

1. If the equilibrium point is at $y = 0$ seconds and $y = -4\cos\left(\frac{\pi}{6}t\right)$ models a buoy bobbing up and down in (inches) the water. Find the period of the function and the location of the buoy at $t = 20$ seconds.

2. The population of predators and prey in a closed ecological system tends to vary periodically over time. In a certain system, the population of hawks (H) can be presented by $H = 45\sin\left(\frac{\pi t}{10}\right) + 150$ where t is the time in years since January 1, 2010.

   a. Find the maximum number of hawks.
   b. When does the maximum occur?
   c. Find the minimum number of hawks.
   d. When does the minimum occur?

3. A leaf floats on the water bobbing up and down. The distance between its highest and lowest point is 4 centimeters. It moves from its highest point down to its lowest point and back to its highest point every 10 seconds. Write a cosine function the models the movement of the leaf in relationship to the equilibrium point.

4. The function $y = 25\sin\left(\frac{\pi}{6}t\right) + 60$ where t is in months and $t = 0$ corresponds to April 15, models the average high temperature in degrees Fahrenheit in Centerville.

   a. Find the period of the function.
   b. What does the period represent?
   c. What is the maximum high temperature?
   d. When does the maximum occur?

5. A person's blood pressure oscillates between 160 and 60. If the heart beats fifty five times every minute, write a sine function that models this person's blood pressure.

6. Paula is jumping rope, and the rope touches the ground every time she jumps. She jumps at the rate of 40 jumps per minute, and the distance from the ground to the midpoint of the rope at its highest point is 5 feet. At $t = 0$ the height of the midpoint is zero.

   a. Write a function for the height of the midpoint of the rope above the ground after t seconds
   b. Find the height of the midpoint of the rope after 32 seconds.

7. Suppose a Ferris wheel has a radius of 20 feet and operates at a speed of 3 revolutions per minute. The bottom car is 12 feet above the ground. Write a model for the height of a person above the ground whose height when t = 0 is 32 feet.