Objective: Given a situation in the real world in which something varies sinusoidally, find an equation to model the situation mathematically. Use the equation to make predictions and reach conclusions related to the situation.

1. Ferris Wheel Problem: As you ride a Ferris wheel traveling in a counterclockwise direction, your distance from the ground varies sinusoidally with time. When the last seat is filled and the Ferris wheel starts, your seat is at the position shown in the diagram. Let *t* be the number of seconds that have elapsed since the Ferris wheel started. You find that it takes you 3 seconds to reach the top, 43 feet above the ground, and that the wheel makes a revolution once every 8 seconds. The diameter of the wheel is 40 feet.
   1. Sketch the graph of this sinusoid. (Show two cycles of this function.)
   2. What is the lowest you go as the Ferris wheel turns, and why is this number greater than zero?
   3. Write an equation for this sinusoid (sine or cosine).
   4. Predict your height above the ground when:
      1. t = 6 ii. t = 4 iii. t = 9 iv. t = 0
   5. What is the value of the t the second time you are 18 feet above the ground?
2. Paddleboat Problem: Mark Twain sat on the deck of a river steamboat. As the paddlewheel turned, a point on the paddle blade moved in such a way that its distance, d, from the water’s surface was a sinusoidal function of time. When his 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.
   1. Sketch a graph of this sinusoid.
   2. Write an equation for this situation.
   3. How far above the surface was the point when mark’s stopwatch read:
      1. 5 seconds ii. 17 seconds
   4. What is the first positive value of time at which the point was at the water’s surface? At the time, was it going into, or coming out of the water? Explain.
3. Bouncing Spring Problem: 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. When the stopwatch reads 0.3 second, the weight first reaches a high point of 60 centimeters above the floor. At 1.8 seconds, the weight reaches a low point, 40 centimeters, above the floor.
   1. Sketch a graph of this sinusoidal function.
   2. Write an equation expressing distance from the floor in terms of the number of seconds the stopwatch reads.
   3. Predict the distance from the floor when the stopwatch reads 17.2 seconds.
   4. What was the distance from the floor when you started the stopwatch?
   5. Predict the first positive value of time at which the weight is 59 centimeters above the floor.