

§4.8: Simple Harmonic Motion

Solve these problems. Draw the picture and show work. Show all work on A SEPARATE SHEET OF PAPER.

- 1) An engineer puts up a 75-foot cell phone telephone tower. Find the angle of elevation to the top of the tower at a point on level ground 50 feet from its base.

- 2) A wire holding up a 40-foot telephone pole is 38 feet long. The wire attaches to the telephone pole 10.5 feet below the top. What is the angle of elevation of the wire?

- 3) Two boats leave an island at the same time. Boat A travels due north for 21 miles and Boat B travels due west for 18 miles. How far apart are the boats and what is the angle of depression from Boat A?

Solve. Show all work on A SEPARATE SHEET OF PAPER. Verify work on a graphing calculator.

4) Given $d = 9 \cos\left(\frac{6\pi}{5}t\right)$

- (a) What is the maximum displacement from its resting position?
 - (b) What is the frequency?
 - (c) The value of d when $t = 5$
 - (d) The least positive value of t for which $d = 0$
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- 5) Suppose the displacement d (in meters) of an object at time t (in seconds) satisfies the equation, $d = 10 \sin(5t)$:
- (a) What is the maximum displacement from its resting position?
 - (b) What is the time required for one oscillation?
 - (c) What is the frequency?

- 6) Researchers find a creature from an alien planet. Its body temperature is varying sinusoidally with time. 35 minutes after they start timing, it reaches a high of 120°F . 20 minutes after that it reaches its next low, 104°F .
- (a) Sketch a graph of this sinusoid.
 - (b) Write an equation expressing temperature in terms of minutes since they started timing.
 - (c) What was its temperature when they first started timing?
- 7) 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 0.5 seconds, the weight first reaches a high point of 52 centimeters above the floor. The next low point, 28 centimeters above the floor, occurs at 1.8 seconds.
- (a) Sketch the graph of the sinusoid.
 - (b) Write an equation of the sinusoid.
 - (c) Predict the distance from the floor when the stopwatch reads 12 seconds
 - (d) What was the distance from the floor when you started the stopwatch?
 - (e) Predict the first positive value of time at which the weight is 50 centimeters above the floor.
- 8) Naturalists find the populations of some kinds of predatory animals vary periodically. Assume that the populations in a certain forest varies sinusoidally with time. Records started being kept when time $t = 0$ years. A minimum number, 200 foxes, occurred when $t = 2.9$ years. The next maximum, 800 foxes, occurred at $t = 5.1$ years.
- (a) Sketch the graph of the sinusoid.
 - (b) Write an equation of the sinusoid as a function of time, t .
 - (c) Predict the population when $t = 7$.
 - (d) Foxes are declared to be an endangered species when their population drops below 300. Between the two non-negative values of t were foxes first endangered?