

48. **TAKS REASONING** Explain why there is more than one tangent function whose graph passes through the origin and has asymptotes at $x = -\pi$ and $x = \pi$.
49. **CHALLENGE** Find a tangent function whose graph intersects the graph of $y = 2 + 2 \sin x$ only at minimum points of the sine graph.

PROBLEM SOLVING

EXAMPLE 3
on p. 916
for Exs. 50–51

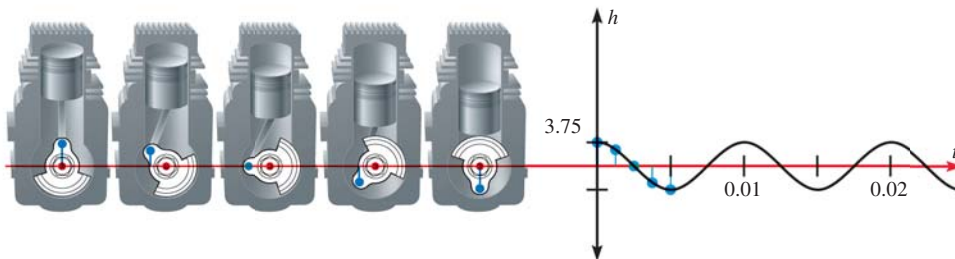
50. **WATER WHEEL** The Great Laxey wheel, located on the Isle of Man, is one of the largest working water wheels in the world. The wheel was built in 1854 to pump water from the mines underneath it. The height h (in feet) above the viewing platform of a bucket on the wheel can be approximated by the function

$$h = 36.25 \sin \frac{\pi}{12}t + 34.25$$

where t is time (in seconds). Graph the function. Find the diameter of the wheel if the lowest point on the wheel is 2 feet below the viewing platform.

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51. **AUTOMOTIVE MECHANICS** The pistons in an engine force the crank pins to rotate in a circle around the center of the crankshaft. The graph shows the height h (in inches) of a crank pin relative to the axle as a function of time t (in seconds). Write a cosine function for the height of the crank pin.



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52. **BLOOD PRESSURE** For a certain person at rest, the blood pressure P (in millimeters of mercury) at time t (in seconds) is given by this function:

$$P = 100 - 20 \cos \frac{5\pi}{3}t$$

Graph the function. If one cycle is equivalent to one heartbeat, what is the person's pulse rate in heartbeats per minute?

EXAMPLE 6
on p. 918
for Ex. 53

53. **MULTI-STEP PROBLEM** You are standing 300 feet from the base of a 200-foot cliff. Your friend is rappelling down the cliff.
- Write a model that gives your friend's distance d (in feet) from the top of the cliff as a function of the angle of elevation θ .
 - Graph the function from part (a).
 - Determine the angle of elevation if your friend has rappelled halfway down the cliff.

