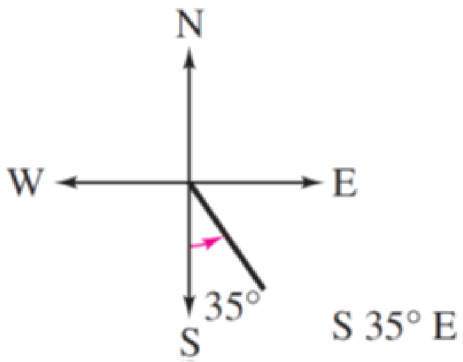
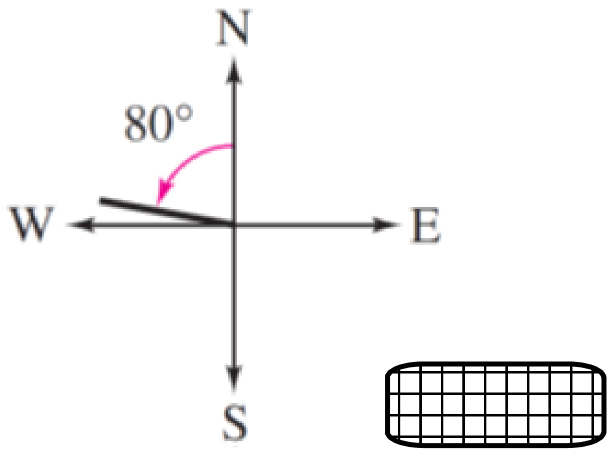
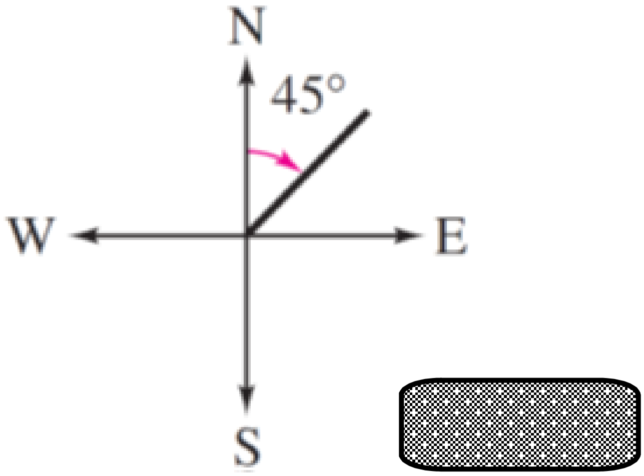
4.8 Applications and Models

In surveying and navigation, directions are generally given in terms of **bearings.** A bearing measures the acute angle a path or line of sight makes with a fixed north-south line, as shown in Figure 4.81. For instance, the bearing of S 35° E in Figure 4.81(a) means 35° degrees east of south.

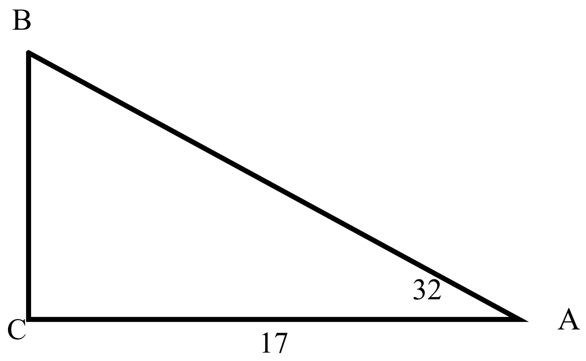



N
80°
W
E
S


N
45°
W
E
S

Solve the triangle:

(Find all side and angle measurements)



Regression for sinusoidal.

Month	Temperature
Jan	40
Feb	45
March	56
April	62
May	73
June	75
July	80
Aug	92
Sept	80
Oct	76
Nov	56
Dec	43

Given the equation for simple harmonic motion, find:

$$d = 5 \sin 4\pi t$$

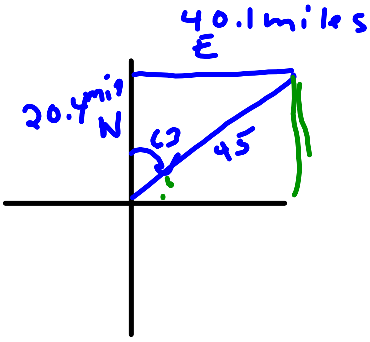
(a) the maximum displacement

(b) the period of the simple harmonic motion

(c) the value of d when t = 4

(e) the least positive value of t for which d = 0
how long it takes to get back to equilibrium

A bike travels 15 miles per hour at a heading $N\ 63^o\ E$ from BCHS. After 3 hours, how far north and east is the biker from BCHS? Make a sketch and label appropriately.



15(3) = 45

sin 63 = $\frac{E}{45}$

40.1 miles East

cos 63 = $\frac{N}{45}$

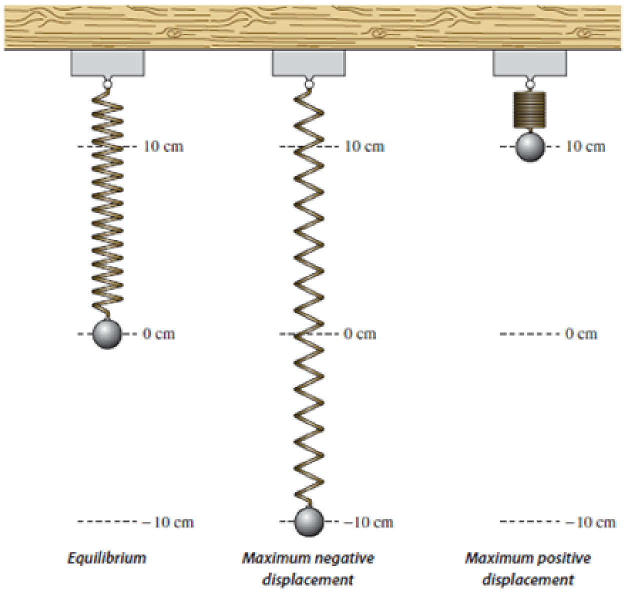
45 cos 63

20.4 miles North

Harmonic Motion

The periodic nature of the trigonometric functions is useful for describing the motion of a point on an object that vibrates, oscillates, rotates, or is moved by wave motion.

For example, consider a ball that is bobbing up and down on the end of a spring, as shown in Figure 4.83.



Definition of Simple Harmonic Motion

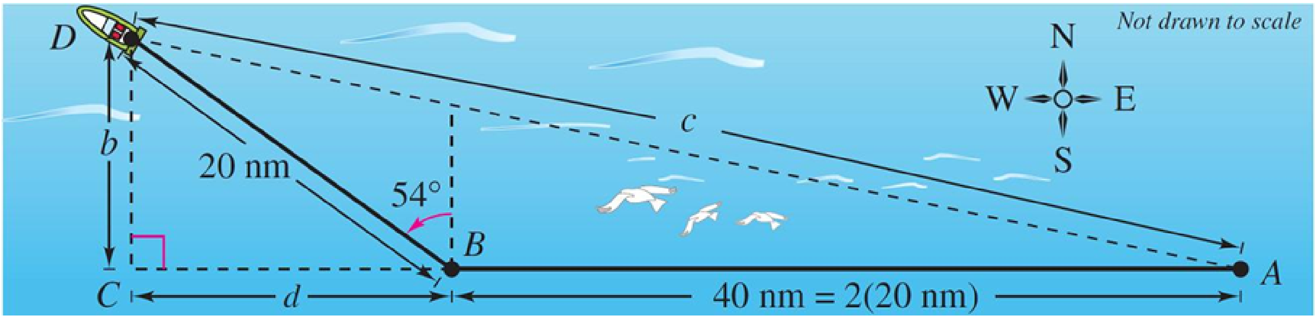
A point that moves on a coordinate line is said to be in **simple harmonic motion** when its distance d from the origin at time t is given by either

$$d = a \sin \omega t \qquad \text{or} \qquad d = a \cos \omega t$$

where a and ω are real numbers such that $\omega > 0$. The motion has amplitude $|a|$, period $2\pi/\omega$, and frequency $\omega/(2\pi)$.

A swimming pool is 20 meters long. The bottom of the pool is slanted so that the water depth is 1.3 meters at the shallow end and 4 meters at the deep end. Find the angle of depression to the bottom of the pool.

A ship leaves port at noon and heads due west at 20 knots, or 20 nautical miles (nm) per hour. At 2 P.M. the ship changes course to N 54° W, as shown in Figure 4.82. Find the ship's bearing and distance from the port of departure at 3 P.M.



For triangle *BCD* you have

$$B = 90° - 54°$$

$$= 36°.$$

The two sides of this triangle can be determined to be $b = 20 \sin 36°$ and $d = 20 \cos 36°$.

In triangle ACD, you can find angle A as follows.

$$\tan A = \frac{b}{d + 40} = \frac{20 \sin 36^\circ}{20 \cos 36^\circ + 40} \approx 0.2092494$$

$A \approx \arctan\ 0.2092494$

≈ 0.2062732 radian

≈ 11.82

So, the bearing of the ship is N 78.18° Finally, from triangle *ACD* you have

$$\sin A = \frac{b}{c}$$

which yields

$$c = \frac{b}{\sin A}$$

$$= \frac{20 \sin 36^\circ}{\sin 11.82^\circ}$$

$\approx$ 57.39 nautical miles Distance from port

The angle with the north-south line is

90° – 11.82° = 78.18°.