

## Chapter 4 Application Problems

### Section 4.1

- 1) A circle has a radius of 27 inches. Find the length of the arc intercepted by a central angle at  $160^\circ$ .
- 2) The second hand of a clock is 8 cm long. Find the linear speed of the tip of this second hand as it passes around the clock face.
- 3) The circular blade on a saw rotates at 2400 revolutions per minute.
  - a) Find the angular speed of the blade in radians per second.
  - b) The blade has a radius of 4 inches. Find the linear speed of the blade tip in inches per second.
- 4) The number of revolutions made by a figure skater for each type of axel jump is given below. Determine the measure of the angle generated as the skater performs each jump. Give answers in both radians and degrees.
  - a) Single axel: 1.5 revolutions
  - b) Double axel: 2.5 revolutions
  - c) Triple axel: 3.5 revolutions

### Section 4.3 (Draw a diagram to represent each)

- 1) A biologist wants to know the width ( $W$ ) of a river in order to properly set instruments for studying the pollutants in the water. From a point ( $A$ ), the biologist walks downstream 70 feet and sights point  $C$  which was across the river from his original starting point. From this sighting, it is determined that  $\theta = 54^\circ$ . How wide is the river?
- 2) A ramp 17.5 feet in length rises to a loading platform that is 3.5 feet off the ground. Find the angle  $\theta$  that the ramp makes with the ground.
- 3) A 25-meter line is used to tether a helium-filled balloon. Because of the breeze, the line makes an angle of approximately  $75^\circ$  with the ground. What is the height of the balloon?
- 4) In traveling across flat land you notice a mountain directly in front of you. Its angle of elevation (to the peak) is  $3.5^\circ$ . After you drive 13 miles closer to the mountain, the angle of elevation is now  $9^\circ$ . Approximate the height of the mountain.
- 5) Use a calculator to complete table and make a conjecture about the relationship between  $\cos \theta$  and  $\sin(90^\circ - \theta)$ . What are the angles  $\theta$  and  $90^\circ - \theta$  called?

$\theta$	0	20	40	60	80
$\cos \theta$					
$\sin(90^\circ - \theta)$					

- 6) The Johnstown Inclined Plane in Pennsylvania is one of the longest and steepest hoists in the world. The railway cars travel a distance of 896.5 feet at an angle approximately  $35.4^\circ$ , rising to a height of 1693.5 feet above sea level.
  - a) Find the vertical rise of the inclined plane.
  - b) Find the elevation of the lower end of the inclined plane.
  - c) The cars move up the mountain at a rate of 300 feet per minute. Find the rate at which they rise vertically.

#### Section 4.4

1) The normal daily high temperature  $T$  (in degrees Fahrenheit) in Savannah, Georgia can be approximated by

$$T = 76.35 + 15.95 \cos\left(\frac{\pi t}{6} - \frac{7\pi}{6}\right)$$
 where  $t$  is the time (in months), with  $t = 1$  corresponding to January.

Find the normal daily high temperature for each of the following months:

- January
- July
- October

2. Consider an angle in standard position with  $r = 12$  cm. Describe the changes in the magnitudes of  $x$ ,  $y$ ,  $\sin \theta$ ,  $\cos \theta$ , and  $\tan \theta$  as  $\theta$  increases continually from  $0^\circ$  to  $90^\circ$ .

#### Section 4.5

1) You are riding a Ferris wheel. Your height  $h$  (in feet) above the ground at any time  $t$  (in seconds) can be modeled by  $h = 25 \sin \frac{\pi}{15}(t - 75) + 30$ . The Ferris wheel turns for 135 seconds before it stops to let the first passengers off. What are the minimum and maximum heights above the ground?

2) The pressure  $P$  (in millimeters of mercury) against the walls of the blood vessels of a person is modeled by  $P = 100 - \cos \frac{8\pi}{3} t$  where  $t$  is the time (in seconds). One cycle is equivalent to one heartbeat. What is the person's pulse rate in heartbeats per minute?

#### Section 4.7

1) Different types of granular substances naturally settle at different angles when stored in cone-shaped piles. The angle  $\theta$  is called the *angle of repose*. When rock salt is stored in a cone-shaped pile 11 feet high, the diameter of the pile's base is about 34 feet.

- Draw a diagram that gives a visual representation of the problem. Label it.
- Find the angle of repose for rock salt.
- How tall is a pile of rock salt that has a base diameter of 40 feet?