

**A circle is a set of points in a plane that are the same distance from one other point in the plane, called the center of the circle.** Arcs were used in construction in Lessons 4.7 and 4.8. Arcs are parts of circles. They can be used in precise constructions because every point in the arc is the same distance from the compass point.

Circles are used in glassware, bowls, plates, furniture, pools, light fixtures, gears, and anything that uses wheels. Professionals who rely on circles include potters, carpenters, electricians, mechanics, and automotive engineers.

Circles have no sides like polygons do, but rays and segments pertaining to circles project some interesting geometry. Arcs, angles, and special circle segments will be studied in this chapter. Much of this will be new to your child.

Lesson 9.1 opens the chapter with a brief review of the special segments in circles. It also defines the central angle and arc measures. Lesson 9.2 discusses tangents and secants of circles and how the radius can relate to them. Lesson 9.3 looks at angles inscribed in a circle and the arcs they intercept. Lesson 9.4 examines angles formed by secants and tangents. Lesson 9.5 examines segments formed by tangents, secants, and chords. Lesson 9.6 studies circles in the coordinate plane, including circle formulas.

The following activity will introduce your child to concepts about tangents and secants and how they relate to circles. Review the activity with your child to encourage an interest in this chapter.

### **PROBLEM FOR DISCUSSION (See textbook page 573)**

The photograph on page 573 was taken by an astronaut during a space walk. The space shuttle is orbiting Earth from right to left. If it were not for the gravitational pull of the Earth, the shuttle would continue in a straight line in the direction of its momentum. It would quite literally “go off on a tangent.” What does it mean to go off on a tangent?

1. Discuss the three different ways a line can relate to a circle. Why can't a line intersect the circle in three points?

**A line can be tangent to a circle, or touch it just once.**

**A line can intersect a circle twice, once going into it and once coming out of it.**

**A line may not intersect the circle at all.**

**It is impossible for a line to intersect a circle in more than two points because a line, by definition, is unbending and straight.**

2. Look at the diagram for a tangent line. Suppose the space shuttle is traveling along the tangent line farther away from the point of tangency. How is that affecting its distance from the circle? What would happen if it kept following that path?

As the space shuttle travels further down the tangent line, it gets farther from the circle.

If it continues, the space shuttle would continue in a straight line, very far away.

3. What geometric figures are formed by the intersection of a secant and a circle?

An arc is formed by the intersection of a secant and a circle. If the secant happens to be a diameter as well, then a semicircle is also formed.

4. Discuss how a secant can form a diameter. Explain why a secant can not form a radius.

A secant can form a diameter if it intersects the center of the circle.

A secant cannot form a radius because it intersects both sides of the circle. A radius is defined as the line whose endpoints are the center and a point on the circle.

The following are complete worked out solutions to selected exercises in the student textbook. These solutions are provided to you so that you can help your child with their homework. Your child's classroom notes, example problems in the text, and these worked out solutions are all useful tools to help you and your child work through their assignment.

## Lesson 9.1

13.  $\overline{ED}$  or  $\overline{AC}$

27.  $m\widehat{VS} = m\widehat{VR} + m\widehat{RS} = 26^\circ + 90^\circ = 116^\circ$

36.  $M = \frac{360 \cdot L}{2\pi r}$

$$M = \frac{360^\circ \cdot 3^\circ}{2\pi \cdot 15} = \frac{36^\circ}{\pi} \approx 11.46^\circ$$

45. The radius of the fountain is 10 ft, so the tulips are planted in a circle of radius 11 with an angle measure of
- $6^\circ$
- between each tulip. The arc length between each tulip is

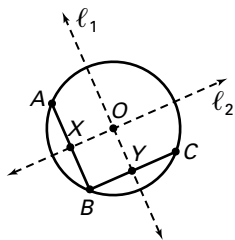
$$\begin{aligned} L &= \frac{6^\circ}{360^\circ}(2\pi \cdot 11) \\ &= \frac{11\pi}{30} \approx 1.15 \text{ ft.} \end{aligned}$$

## Lesson 9.2

- 11.
- $RZ = 7$
- . Thus
- $XR = RZ = RY = 7$
- .

By the Pythagorean Theorem  $2^2 + (XW)^2 = 7^2$ .Thus,  $RW = \sqrt{45} = 3\sqrt{5}$  and  $WZ = \sqrt{45} = 3\sqrt{5}$ .

16. Sample answer:



The center of the circle is the intersection of the two perpendicular bisectors.

20.  $(BS)^2 + (SA)^2 = (BA)^2$

$$1^2 + (SA)^2 = 2^2$$

$$(SA)^2 = 3$$

$$SA = \sqrt{3} \approx 1.73$$

25. Let
- $d$
- be the distance to the horizon.

$$d^2 + 4000^2 = 4155^2$$

$$d = \sqrt{4155^2 - 4000^2} \approx 1124.29 \text{ mi}$$

## Chapter 9

### Lesson 9.3

14.  $m\angle XWZ = m\widehat{XZ} = 60^\circ$

24.  $m\widehat{AB} = 2m\angle BCA = 2(61^\circ) = 122^\circ$

31.  $m\angle B = \frac{1}{2}(87^\circ) = 43.5^\circ$   
 $m\angle A = m\angle B = 43.5^\circ$

43.  $m\angle QDA = 2 \cdot m\angle U = 2 \cdot x^\circ = (2x)^\circ$   
by the Inscribed Angle Theorem.

44.  $m\widehat{QUA} = 360^\circ - m\widehat{QDA} = (360 - 2x)^\circ$   
because the sum of the measures of the arcs in a circle is  $360^\circ$ .

### Lesson 9.4

13.  $m\angle 1 = \frac{1}{2}(m\widehat{CB} + m\widehat{AD}) = \frac{1}{2}(60^\circ + 110^\circ) = 85^\circ$

19.  $m\angle AVC = \frac{1}{2}m\widehat{AC} = \frac{1}{2}(2x + 4) = (x + 2)^\circ$

24.  $m\angle CAF = \frac{1}{2}(m\widehat{AC}) = \frac{1}{2}(m\widehat{AD} + m\widehat{DC})$   
 $= \frac{1}{2}(103^\circ + 105^\circ) = 104^\circ$

32.  $\widehat{AXC}$

40. interior of circle

46. secant and tangent

## Chapter 9

### Lesson 9.5

12.  $\overline{EF}$

17.  $6x = 9 \cdot 4 \Rightarrow x = \frac{36}{6} = 6$

20. By the Pythagorean Theorem,

$$\begin{aligned}(AP)^2 + (AV)^2 &= (PV)^2 \Rightarrow 3^2 + 6^2 = (PV)^2 \\ \Rightarrow (PV)^2 &= 9 + 36 \\ \Rightarrow PV &= \sqrt{45} = 3\sqrt{5} \approx 6.71 \text{ cm}\end{aligned}$$

26.  $WA \cdot WB = WC \cdot WD$

$$\begin{aligned}6 \cdot x &= 5(x + 3) \\ 6x &= 5x + 15 \\ x &= 15\end{aligned}$$

31. 2 secant segments

39.  $CL \cdot BL = AL \cdot XL$

$$CL = CB + BL = 32 + 20 = 52$$

$$20 \cdot 52 = 23 \cdot LX$$

$$\frac{1040}{23} = LX$$

$$\Rightarrow LX \approx 45.22 \text{ km}$$

### Lesson 9.6

13. x-intercepts:  $x^2 + 0^2 = 50$

$$\begin{aligned}x &= \pm\sqrt{50} = \pm 5\sqrt{2} \\ (5\sqrt{2}, 0); (-5\sqrt{2}, 0)\end{aligned}$$

y-intercepts:  $0^2 + y^2 = 50$

$$\begin{aligned}y &= \pm\sqrt{50} = \pm 5\sqrt{2} \\ (0, 5\sqrt{2}); (0, -5\sqrt{2})\end{aligned}$$

20.  $(x - 2)^2 + (y - 3)^2 = 4^2 \Rightarrow (x - 2)^2 + (y - 3)^2 = 16$

30.  $(x - (-5))^2 + (y - 2)^2 = 4^2$

center:  $(-5, 2)$

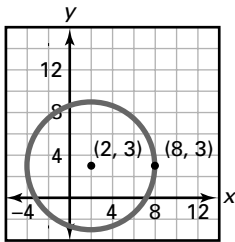
radius: 4

34.  $(x - 2)^2 + (y - 1)^2 = (2 - (-1))^2$

$$\Rightarrow (x - 2)^2 + (y - 1)^2 = 9$$

## Chapter 9

44.



With center  $(2, 3)$ , the circle has equation  $(x - 2)^2 + (y - 3)^2 = r^2$ . Substitute the values for  $x$  and  $y$  to get  $r$ .

$$(8 - 2)^2 + (3 - 3)^2 = r^2$$

$$36 + 0 = r^2$$

$$6 = r$$

The equation is  $(x - 2)^2 + (y - 3)^2 = 6^2$  or

$$(x - 2)^2 + (y - 3)^2 = 36$$

49.  $(x - 8)^2 + y^2 = 9$

