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#### Goal

Find the circumference and area of circles.

## **Key Words**

- circle
- center
- radius
- diameter
- circumference
- central angle
- sector

A **circle** is the set of all points in a plane that are the same distance from a given point, called the **center** of the circle. A circle with center *P* is called "circle *P*," or  $\bigcirc P$ .

The distance from the center to a point on the circle is the **radius**. The plural of radius is *radii*.

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The distance across the circle, through the center, is the **diameter**. The diameter *d* is twice the radius *r*. So, d = 2r.

The **circumference** of a circle is the distance around the circle.



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For any circle, the ratio of the circumference to its diameter is denoted by the Greek letter  $\pi$ , or *pi*. The number  $\pi$  is 3.14159..., which is an irrational number. This means that  $\pi$  neither terminates nor repeats. So, an approximation of 3.14 is used for  $\pi$ .

#### **CIRCUMFERENCE OF A CIRCLE**

**Words** Circumference =  $\pi$ (diameter) =  $2\pi$ (radius)

**Symbols**  $C = \pi d$  or  $C = 2\pi r$ 



4 in.

#### EXAMPLE 1 Find the Circumference of a Circle

Find the circumference of the circle.

#### Solution

$C = 2\pi r$	Formula for the circumference
$= 2\pi(4)$	Substitute 4 for r.
$= 8\pi$	Simplify.
$\approx 8(3.14)$	Use 3.14 as an approximation for $\pi$ .
= 25.12	Multiply.

ANSWER > The circumference is about 25 inches.

# Student Help

When simplifying an expression involving  $\pi$ , substitute 3.14 for  $\pi$ . You can also use the  $\pi$  key on your calculator, as in Examples 2 and 3.

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Checkpoint Find the Circumference of a Circle

Find the circumference of the circle. Round your answer to the nearest whole number.



7 cm



**Words** Area =  $\pi$ (radius)<sup>2</sup>

**Symbols**  $A = \pi r^2$ 

# EXAMPLE 2 Find the Area of a Circle

Find the area of the circle.



#### **KEYSTROKE HELP** If your calculator has

 $\pi$  written above a key, use the following keystrokes to simplify 49 $\pi$ : Solution $A = \pi r^2$ Formula for the area of a circle $= \pi (7)^2$ Substitute 7 for r. $= 49\pi$ Simplify. $\approx 153.94$ Use a calculator.

ANSWER > The area is about 154 square centimeters.

## EXAMPLE 3 Use the Area of a Circle

Find the radius of a circle with an area of 380 square feet.

# $\mathbf{r} \mathbf{A} = 380 \text{ ft}^2$

#### Solution

$A = \pi r^2$	Formula for the area of a circle
<b>380</b> = $\pi r^2$	Substitute 380 for A.
$120.96 \approx r^2$	Divide each side by $\pi$ . Use a calculator.
$11 \approx r$	Take the positive square root.

ANSWER > The radius is about 11 feet.

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Checkpoint Find the Area of a Circle

Find the area of the circle. Round your answer to the nearest whole number.



**Central Angles** An angle whose vertex is the center of a circle is a **central angle** of the circle.

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A region of a circle determined by two radii and a part of the circle is called a **sector** of the circle.

Because a sector is a portion of a circle, the following proportion can be used to find the area of a sector.



Area of sector	_	Measure of central angle
Area of entire circle	_	Measure of entire circle

#### EXAMPLE 4 Find the Area of a Sector

Find the area of the blue sector.

#### Solution

**1** First find the area of the circle.

 $A = \pi r^2 = \pi(9)^2 \approx 254.47$ 

The area of the circle is about 254 square meters.

**2** Then find the area of the sector. Let *x* equal the area of the sector.

9 m

120°

Area of sector Area of entire circle	Measure of central angle Measure of entire circle	
$\frac{x}{254} =$	$=\frac{120^{\circ}}{360^{\circ}}$	Substitute.
360 <i>x</i> =	= 254 • 120	Cross product property
360x =	= 30,480	Simplify.
$\frac{360x}{360} =$	$=\frac{30,480}{360}$	Divide each side by 360.
$X \approx$	≈ 84.67	Simplify.



# Student Help

Vocabulary TIP The term *radius* is also used to name a segment that connects the center of a circle to a point on the circle. Two such radii are used to determine a *sector* of a circle.

## Visualize It!

A circle contains two straight angles. So, there are  $180^\circ + 180^\circ$ , or  $360^\circ$ , in a circle.....



# Chackpoint Find the Area of a Sector

In Exercises 7 and 8, A represents the area of the entire circle and x represents the area of the blue sector. Complete the proportion used to find x. Do not solve the proportion.



Find the area of the blue sector. Round your answer to the nearest whole number.



# 8.7 Exercises

# **Guided Practice**

- **Vocabulary Check**
- **1.** Sketch a circle. Sketch and label a *radius* and a *diameter* of the circle.
- 2. Describe how to find the *circumference* of a circle given its radius.

#### **Skill Check**

Copy and complete the table below.





Write an equation for the area A or the circumference C by filling in the missing number.



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# **Practice and Applications**

#### **Extra Practice**

See p. 690.

**Finding Circumference** Find the circumference of the circle. Round your answer to the nearest whole number.



- **13.** A circle with a radius of 13 yards
- 14. A circle with a diameter of 15 meters





**21. Cranberries** To harvest cranberries, the field is flooded so that the berries float. What area of cranberries can be gathered into a circular region with a radius of 5.5 meters?



**22. Error Analysis** A student was asked to find the area of the circle below. Describe any errors.



#### Homework Help

**Example 1:** Exs. 10–14 **Example 2:** Exs. 15–20 **Example 3:** Exs. 24–29 **Example 4:** Exs. 31–35 23. You be the Judge One of your classmates states that if the radius of a circle is doubled, then its area doubles. Do you agree or disagree? Explain your reasoning using the circles at the right.





**HOMEWORK HELP** Extra help with problem solving in Exs. 24–26 is at classzone.com **Using Algebra** Use the area *A* of the circle to find the radius *r*. Round your answer to the nearest whole number.



- 27. A circle has an area of 50 square units. What is its radius?
- 28. A circle has an area of 452 square units. What is its diameter?
- 29. A circle has an area of 28 square units. What is its diameter?
- **30. Challenge** The circle at the right has an area of 78.5 square yards. What is its circumference?

**Sectors and Proportions** In Exercises 31 and 32, *A* represents the area of the entire circle and *x* represents the area of the blue sector. Complete the proportion used to find *x*. Do not solve the proportion.

 $A = 78.5 \text{ yd}^2$ 



**Area of Sectors** Find the area of the blue sector. Start by finding the area of the circle. Round your answer to the nearest whole number.



**Landscaping** The diagram shows the area of a lawn covered by a water sprinkler. Round your answer to the nearest whole number.

- **36.** What is the area of the lawn that is covered by the sprinkler?
- **37.** Suppose the water pressure is weakened so that the radius is 12 feet. What is the area of lawn that will be covered?







LANDSCAPE ARCHITECTS use engineering knowledge and creativity to design natural environments, such as parks, gardens, and recreational areas.







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Finding Complex Areas Use the method in the example above to find the area of the shaded region. Round your answer to the nearest whole number.





#### **Standardized Test** Practice

- 40. Multi-Step Problem Earth has a radius of about 3960 miles at the equator. Suppose a cable is wrapped around Earth at the equator, as shown in the diagram.
  - **a.** Find the length of the cable by finding the circumference of Earth. (Assume that Earth is perfectly round. Use 3.14 for  $\pi$ .)
  - **b.** Suppose 10 miles is added to the cable length in part (a). Use this length as the circumference of a new circle. Find the radius of the larger circle. (Use 3.14 for  $\pi$ .)
  - **c.** Suppose you are standing at the equator. How far are you from the cable in part (b)?



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# Quiz 3

Find the area of the figure. In Exercises 5 and 6, round your answer to the nearest whole numbers. (Lessons 8.5–8.7)



In Exercises 7–9, *A* gives the area of the figure. Find the missing measure. In Exercise 9, round your answer to the nearest whole number. (*Lessons 8.5–8.7*)

