CHAPTER 11

# Geometry: Measuring Two-Dimensional Figures

## "What does landscape design have to do with math?"

In designing a circular path, pool, or fountain, landscape architects calculate the area of the region. **They use the formula $A = \pi r^2$, where $r$ is the radius of the circle.** There are many formulas involving two-dimensional figures that are useful in real life.

You will solve problems involving areas of circles in Lesson 11-6.

# GETTING STARTED

## ▶ Diagnose Readiness

**Take this quiz to see if you are ready to begin Chapter 11. Refer to the lesson or page number in parentheses for review.**

### Vocabulary Review

**State whether each sentence is *true* or *false*. If *false*, replace the underlined word or number to make a true sentence.**

1. 0.5 is a <u>rational</u> number. (Lesson 5-4)
2. $\pi$ is approximately equal to <u>3.14</u>. (Lesson 6-9)
3. A triangle with angle measures of 60°, 90°, and 30° is an <u>acute</u> triangle. (Lesson 10-4)

### Prerequisite Skills

**Replace each ● with <, >, or = to make a true sentence.** (Page 556)

4. $67 \bullet 8.2 \cdot 8.2$
5. $11.1 \times 11.1 \bullet 123$
6. $5.9(5.9) \bullet 34.9$
7. $12.25 \bullet 3.5 \cdot 3.5$

**Evaluate each expression.** (Lesson 1-2)

8. $3^2$
9. 8 squared
10. 5 to the third power
11. 6 to the second power

**Find each value.** (Lesson 1-3)

12. $\frac{1}{2}(5)(6)$
13. $\frac{1}{2}(4)(12 + 18)$
14. $9(3 + 3)$
15. $7(2)(8)$

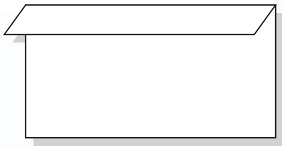
**Find the probability of rolling each number on a number cube.** (Lesson 9-1)

16. $P(3)$
17. $P(6 \text{ or } 2)$
18. $P(\text{odd})$
19. $P(\text{greater than } 4)$

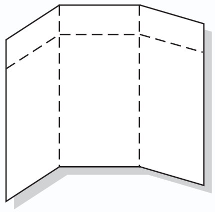
FOLDABLES Study Organizer

**Measuring Figures** Make this Foldable to help you organize your notes. Begin with a piece of 11″ by 17″ paper.

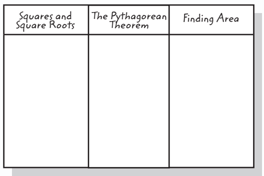
**STEP 1 Fold**
Fold a 2″ tab along the long side of the paper.



**STEP 2 Open and Fold**
Unfold the paper and fold in thirds widthwise.



**STEP 3 Open and Label**
Draw lines along the folds and label the head of each column as shown. Label the front of the folded table with the chapter title.




Noteables

**Chapter Notes** Each time you find this logo throughout the chapter, use your *Noteables™: Interactive Study Notebook with Foldables™* or your own notebook to take notes. Begin your chapter notes with this Foldable activity.

Math Online

**Readiness** To prepare yourself for this chapter with another quiz, visit **msmath2.net/chapter_readiness**

# 11-1 Squares and Square Roots

## What You'll LEARN

Find squares of numbers and square roots of perfect squares.

## NEW Vocabulary

square
perfect squares
square root
radical sign

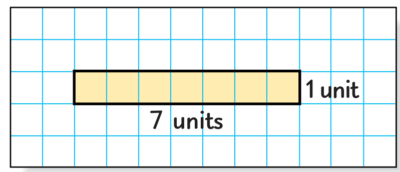
## HANDS-ON Mini Lab

**Materials**

- grid paper

*Work with a partner.*

The rectangle has a perimeter of 16 units and an area of 7 square units.

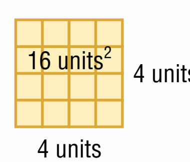



1. On grid paper, draw and label three other rectangles that have a perimeter of 16 units.
2. Summarize the dimensions and areas of the rectangles that you drew in a table like the one shown below.

| Drawing | Dimensions (units) | Area (sq units) |
|---|---|---|
| | $1 \times 7$ | 7 |
| | | |

3. Draw three different rectangles that have a perimeter of 12 units and find their areas.
4. What do you notice about the rectangles with the greatest areas?

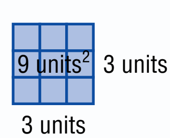
The area of the square at the right is $4 \cdot 4$ or 16 square units. The product of a number and itself is the **square** of the number. So, the square of 4 is 16.




## EXAMPLES Find Squares of Numbers

**1 Find the square of 3.**

$3 \cdot 3 = 9$




**2 Find the square of 15.**

15 $\boxed{x^2}$ $\boxed{\text{ENTER}}$ 225

**Your Turn** **Find the square of each number.**

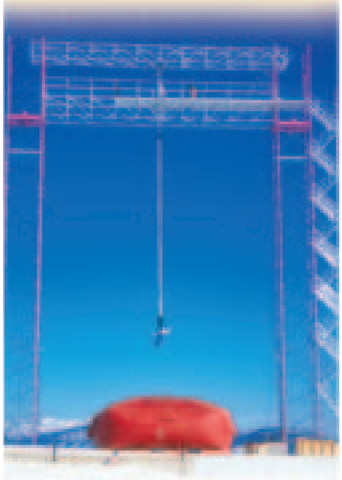
a. 8 b. 12 c. 23

## READING Math

**Square a Number**
To *square a number* means to multiply that number by itself.

**REAL-LIFE MATH**

**PHYSICAL SCIENCE** The bungee bridge in Squaw Valley, California, is at an elevation of 8,200 feet, the highest in the world.



## EXAMPLE Find a Square to Solve a Problem

**3** **PHYSICAL SCIENCE The falling distance of an object in feet $d$ after $t$ seconds is given by the formula $d = \frac{1}{2}(32)t^2$. If you went bungee jumping, how far would you fall 2.5 seconds after being released?**

$d = \frac{1}{2}(32)t^2$ Write the formula.

$= \frac{1}{2}(32)(2.5)^2$ Replace $t$ with 2.5.

$= \frac{1}{2}(32)(6.25)$ Use a calculator to square 2.5.

$= 100$ Simplify.

So, after 2.5 seconds, you would fall 100 feet.

Numbers like 9, 16, 225, and 6.25 are called **perfect squares** because they are squares of rational numbers. The factors multiplied to form perfect squares are called **square roots**.

**Noteables™** **Key Concept: Square Root**

| | | |
|---|---|---|
| **Words** | A square root of a number is one of its two equal factors. | |
| **Symbols** | Arithmetic | Algebra |
| | $4 \cdot 4 = 16$, so 4 is a square root of 16. | If $x \cdot x$ or $x^2 = y$, then $x$ is a square root of $y$. |

Both $4 \cdot 4$ and $(-4)(-4)$ equal 16. So, 16 has two square roots, 4 and $-4$. A **radical sign**, $\sqrt{\phantom{x}}$, is the symbol used to indicate the *positive* square root of a number. So, $\sqrt{16} = 4$.

**READING Math**

**Square Roots** Read $\sqrt{81} = 9$ as *the square root of 81 is 9.*

## EXAMPLES Find Square Roots

**4** **Find $\sqrt{81}$.**

$9 \cdot 9 = 81$, so $\sqrt{81} = 9$.

**5** **Find $\sqrt{196}$.**

2nd [$\sqrt{\phantom{x}}$] 196 ENTER 14

So, $\sqrt{196} = 14$.

**6** **SPORTS A boxing ring is a square with an area of 400 square feet. What are the dimensions of the ring?**

2nd [$\sqrt{\phantom{x}}$] 400 ENTER 20 Find the square root of 400.

So, a boxing ring measures 20 feet by 20 feet.

**Your Turn** **Find each square root.**

**d.** $\sqrt{25}$ **e.** $\sqrt{64}$ **f.** $\sqrt{289}$

Math Online msmath2.net/extra_examples



Mark Gibson/H. Armstrong Roberts

## Skill and Concept Check

1. **Writing Math** Explain how finding the square of a number is similar to finding the area of a square.

2. **OPEN ENDED** Write a number whose square is between 200 and 300.

3. **Which One Doesn't Belong?** Identify the number that is not a perfect square. Explain your reasoning.

| 256 | 121 | 529 | 116 |
|---|---|---|---|

### GUIDED PRACTICE

**Find the square of each number.**

4. 6   5. 10   6. 17   7. 30

**Find each square root.**

8. $\sqrt{9}$   9. $\sqrt{121}$   10. $\sqrt{169}$   11. $\sqrt{529}$

12. **PHYSICAL SCIENCE** A model rocket is launched straight up into the air at an initial speed of 115 feet per second. The height of the rocket $h$ after $t$ seconds is given by the formula $h = -16t^2 + 115t$. What is the height of the rocket 3.5 seconds after it is launched?

## Practice and Applications

**HOMEWORK HELP**

| For Exercises | See Examples |
|---|---|
| 13–20, 29–30, 34–35 | 1–3 |
| 21–28, 31–33, 36 | 4–6 |

**Extra Practice**
See pages 590, 606.

**Find the square of each number.**

13. 5   14. 1   15. 7   16. 11

17. 16   18. 20   19. 18   20. 34

**Find each square root.**

21. $\sqrt{4}$   22. $\sqrt{49}$   23. $\sqrt{144}$   24. $\sqrt{225}$

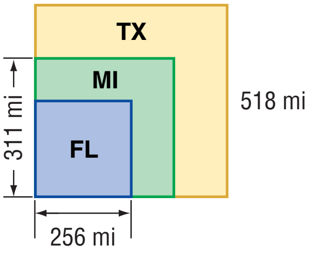
25. $\sqrt{729}$   26. $\sqrt{625}$   27. $\sqrt{1{,}225}$   28. $\sqrt{1{,}600}$

29. What is the square of $-22$?   30. Square 5.8.

31. Find both square roots of 100.   32. Find $-\sqrt{361}$.

33. **ALGEBRA** Evaluate $a^2 + \sqrt{b}$ if $a = 36$ and $b = 256$.

**GEOGRAPHY For Exercises 34–36, refer to the squares in the diagram at the right. They represent the approximate areas of Texas, Michigan, and Florida.**

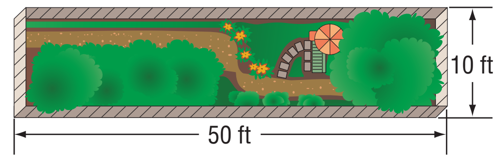



34. What is the area of Michigan?

35. How much larger is Texas than Florida?

36. The water areas of Texas, Michigan, and Florida are about 6,724 square miles, 40,000 square miles, and 11,664 square miles, respectively. Make a similar diagram comparing the water areas of these states. Label the squares.

**MEASUREMENT** **For Exercises 37 and 38, refer to the garden, which is enclosed on all sides by a fence.**




37. Could the garden area be made larger using the same fencing? Explain.
38. Describe the largest garden area possible using the same amount of fencing. How do the perimeter and area compare to the original garden?

39. **PROBABILITY** A set consists of all the perfect squares from 1 to 100. What is the probability that a number chosen at random from this set is divisible by 4 or 5?

**ALGEBRA** **For Exercises 40–44, let the $x$-axis of a coordinate plane represent the side length of a square.**

40. Let the $y$-axis represent the area. Graph the points for squares with sides 0, 1, 2, 3, 4, and 5 units long. Draw a line or curve that goes through each point.
41. On the same coordinate plane, let the $y$-axis represent the perimeter of a square. Graph the points for squares with sides 0, 1, 2, 3, 4, and 5 units long. Draw a line or curve that goes through each point.
42. Compare and contrast the two graphs.
43. For what side lengths is the value of the perimeter greater than the value of the area? When are the values equal?
44. Why do these graphs only make sense in the first quadrant?

45. **CRITICAL THINKING** The area of a square 8 meters by 8 meters is how much greater than the area of a square containing 9 square meters? Explain.

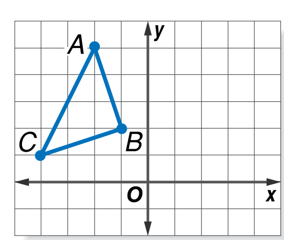
## Spiral Review with Standardized Test Practice

46. **MULTIPLE CHOICE** A square plot of land has an area of 1,156 square feet. What is the perimeter of the plot?

    (A) 34 ft  (B) 102 ft  (C) 136 ft  (D) 289 ft

47. **SHORT RESPONSE** The perimeter of a square is 128 centimeters. Find its area.

**For Exercises 48 and 49, refer to $\triangle ABC$ at the right. Find the vertices of $\triangle A'B'C'$ after each transformation. Then graph the triangle and its reflected or translated image.**




48. $\triangle ABC$ reflected over the $y$-axis (Lesson 10-9)
49. $\triangle ABC$ translated 5 units right and 1 unit up (Lesson 10-8)

## GETTING READY FOR THE NEXT LESSON

**PREREQUISITE SKILL** **Replace each ● with <, >, or = to make a true sentence.** (Lesson 4-5)

50. $7 \bullet \sqrt{49}$  51. $\sqrt{25} \bullet 4$  52. $7.9 \bullet \sqrt{64}$  53. $10.5 \bullet \sqrt{100}$

# Study Skill

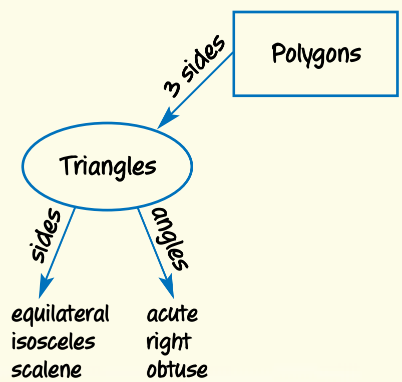
# Use a Web

## Studying Math Vocabulary

**If you've surfed the World Wide Web, you know it is a collection of documents linked together to form a huge electronic library. In mathematics, a web helps you understand how concepts are linked together.**

A *web* can help you understand how math concepts are related to each other. To make a web, write the major topic in a box in the center of a sheet of paper. Then, draw "arms" from the center for as many categories as you need. You can label the arms to indicate the type of information that you are listing.

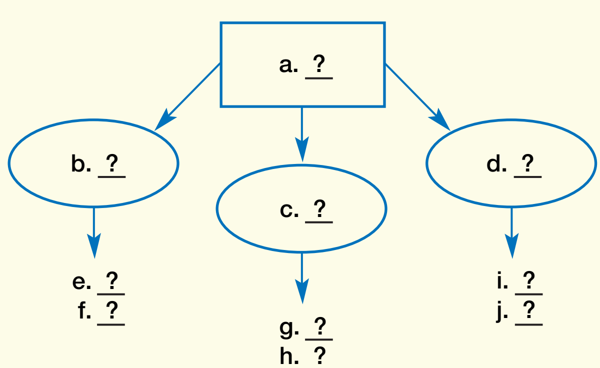
Here is a partial web for the major topic of *polygons*.




## SKILL PRACTICE

**1.** Continue the web above by adding an arm for *quadrilaterals*.

**2.** In Lesson 5-8, you learned that the set of rational numbers contains fractions, terminating and repeating decimals, and integers. You also know that there are proper and improper fractions and that integers are whole numbers and their opposites. Complete the web below for *rational numbers*.



# 11-2 Estimating Square Roots

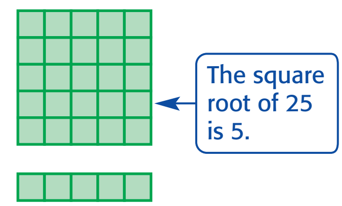
## HANDS-ON Mini Lab

**Materials**
- algebra tiles

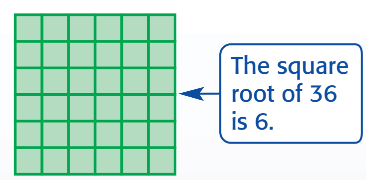
*Work with a partner.*

You can use algebra tiles to estimate the square root of 30.

- Arrange 30 tiles into the largest square possible. In this case, the largest possible square has 25 tiles, with 5 left over.




- Add tiles until you have the next larger square. So, add 6 tiles to make a square with 36 tiles.




- The square root of 30 is between 5 and 6. $\sqrt{30}$ is closer to 5 because 30 is closer to 25 than to 36.

**Use algebra tiles to estimate the square root of each number to the nearest whole number.**

**1.** 40 **2.** 28 **3.** 85 **4.** 62

**5.** Describe another method that you could use to estimate the square root of a number.

### What You'll LEARN

Estimate square roots.

### NEW Vocabulary

irrational number

### REVIEW Vocabulary

**rational number:** a number that can be written as a fraction (Lesson 5-4)

Recall that the square root of a perfect square is a rational number. You can find an estimate for the square root of a number that is *not* a perfect square.

## EXAMPLE Estimate the Square Root

**1** **Estimate $\sqrt{75}$ to the nearest whole number.**

List some perfect squares.

1, 4, 9, 16, 25, 36, 49, 64, 81, …

75

$64 < 75 < 81$ 75 is between the perfect squares 64 and 81.

$\sqrt{64} < \sqrt{75} < \sqrt{81}$ Find the square root of each number.

$8 < \sqrt{75} < 9$ $\sqrt{64} = 8$ and $\sqrt{81} = 9$

So, $\sqrt{75}$ is between 8 and 9. Since 75 is closer to 81 than to 64, the best whole number estimate is 9. Verify with a calculator.

### READING in the Content Area

For strategies in reading this lesson, visit **msmath2.net/reading**.

**Real Numbers** The sets of rational and irrational numbers together make up the set of real numbers.

In Lesson 5-8, you learned that any number that can be written as a fraction is a rational number. These include integers as well as terminating and repeating decimals. A number that *cannot* be written as a fraction is an **irrational number**.

**Rational Numbers** $\sqrt{4}, 3\frac{1}{7}, 0.\overline{63}$

**Irrational Numbers** $\sqrt{2}, \pi, 0.636336333\ldots$

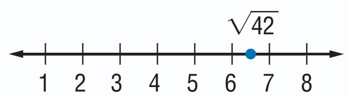
The square root of any number that is not a perfect square is an irrational number. You can use a calculator to estimate square roots that are irrational numbers.

## EXAMPLE Use a Calculator to Estimate

**1** **Use a calculator to find the value of $\sqrt{42}$ to the nearest tenth.**

2nd [$\sqrt{\ }$] 42 ENTER 6.480740698

$\sqrt{42} \approx 6.5$




**Check** $6^2 = 36$ and $7^2 = 49$. Since 42 is between 36 and 49, the answer, 6.5, is reasonable.

**Your Turn** **Use a calculator to find each square root to the nearest tenth.**

**a.** $\sqrt{6}$ **b.** $\sqrt{23}$ **c.** $\sqrt{309}$

## Skill and Concept Check

1. **Writing Math** Explain why $\sqrt{30}$ is an irrational number.
2. **OPEN ENDED** List three numbers that have square roots between 4 and 5.
3. **NUMBER SENSE** Explain why 7 is the best whole number estimate for $\sqrt{51}$.

### GUIDED PRACTICE

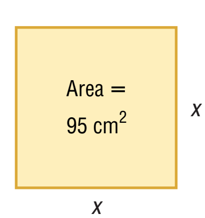
**Estimate each square root to the nearest whole number.**

4. $\sqrt{39}$ 5. $\sqrt{106}$ 6. $\sqrt{90}$ 7. $\sqrt{140}$

**Use a calculator to find each square root to the nearest tenth.**

8. $\sqrt{7}$ 9. $\sqrt{51}$ 10. $\sqrt{135}$ 11. $\sqrt{462}$

12. **GEOMETRY** Use a calculator to find the side length of the square at the right. Round to the nearest tenth.



## Practice and Applications

| HOMEWORK HELP | |
|---|---|
| For Exercises | See Examples |
| 13–20 | 1 |
| 21–32 | 2 |

Extra Practice
See pages 590, 606.

**Estimate each square root to the nearest whole number.**

**13.** $\sqrt{11}$ **14.** $\sqrt{20}$ **15.** $\sqrt{35}$ **16.** $\sqrt{65}$

**17.** $\sqrt{89}$ **18.** $\sqrt{116}$ **19.** $\sqrt{137}$ **20.** $\sqrt{409}$

**Use a calculator to find each square root to the nearest tenth.**

**21.** $\sqrt{15}$ **22.** $\sqrt{8}$ **23.** $\sqrt{44}$ **24.** $\sqrt{89}$

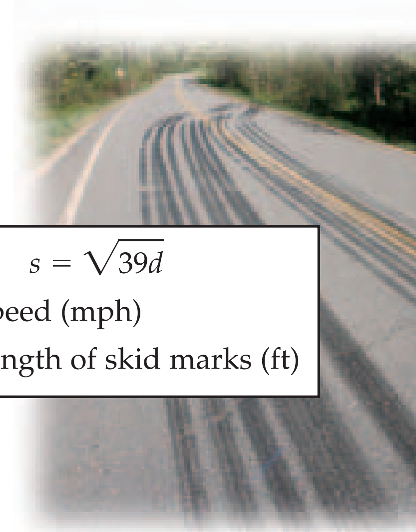
**25.** $\sqrt{160}$ **26.** $\sqrt{573}$ **27.** $\sqrt{645}$ **28.** $\sqrt{2{,}798}$

**29.** Order $\sqrt{87}$, 10, $\pi$, and $\frac{14}{3}$ from least to greatest.

**30.** Graph $\sqrt{34}$ and $\sqrt{92}$ on the same number line.

**31.** **ALGEBRA** Evaluate $\sqrt{a + b}$ if $a = 8$ and $b = 3.7$.

**32.** **DRIVING** Police officers can use a formula and skid marks to calculate the speed of a car. Use the formula at the right to estimate how fast a car was going if it left skid marks 83 feet long. Round to the nearest tenth.

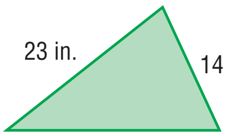


$$s = \sqrt{39d}$$

- $s$ = speed (mph)
- $d$ = length of skid marks (ft)

**33.** **RESEARCH** In the 1990s, over 50 billion decimal places of pi had been computed. Use the Internet or another source to find the current number of decimal places of pi that have been computed.

**34.** **CRITICAL THINKING** You can use *Hero's formula* to find the area $A$ of a triangle if you know the measures of its sides, $a$, $b$, and $c$. The formula is $A = \sqrt{s(s - a)(s - b)(s - c)}$, where $s$ is half of the perimeter. Find the area of the triangle to the nearest tenth.

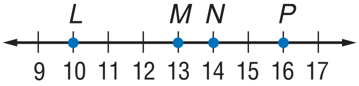



## Spiral Review with Standardized Test Practice

**35.** **MULTIPLE CHOICE** Identify the number that is irrational.

(A) $-4.1$ (B) $0$ (C) $\frac{3}{8}$ (D) $\sqrt{6}$

**36.** **SHORT RESPONSE** Name the point that best represents the graph of $\sqrt{209}$.




**Find each square root.** (Lesson 11-1)

**37.** $\sqrt{169}$ **38.** $\sqrt{2{,}025}$ **39.** $\sqrt{784}$

**40.** Graph $\triangle JLK$ with vertices $J(-1, -4)$, $K(1, 1)$, and $L(3, -2)$ and its reflection over the $x$-axis. Write the ordered pairs for the vertices of the new figure. (Lesson 10-9)

### GETTING READY FOR THE NEXT LESSON

**PREREQUISITE SKILL** **Solve each equation.** (Lesson 1-5)

**41.** $7^2 + 5^2 = c$ **42.** $4^2 + b = 36$ **43.** $3^2 + a = 25$ **44.** $9^2 + 2^2 = c$

# 11-3a HANDS-ON LAB

*A Preview of Lesson 11-3*

## The Pythagorean Theorem

**What You'll LEARN**

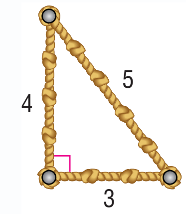
Find the relationship among the sides of a right triangle.

**Materials**

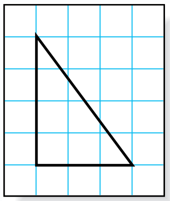
- centimeter grid paper
- ruler
- scissors

**INVESTIGATE** *Work as a class.*

Four thousand years ago, the ancient Egyptians used mathematics to lay out their fields with square corners. They took a piece of rope and knotted it into 12 equal spaces. Taking three stakes, they stretched the rope around the stakes to form a right triangle. The sides of the triangle had lengths of 3, 4, and 5 units.

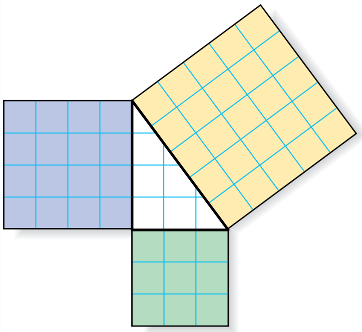



**STEP 1** On grid paper, draw a segment that is 3 centimeters long. At one end of this segment, draw a perpendicular segment that is 4 centimeters long. Draw a third segment to form a triangle. Cut out the triangle.



**STEP 2** Measure the length of the longest side in centimeters. In this case, it is 5 centimeters.

**STEP 3** Cut out three squares: one with 3 centimeters on a side, one with 4 centimeters on a side, and one with 5 centimeters on a side.



**STEP 4** Place the edges of the squares against the corresponding sides of the right triangle.

**STEP 5** Find the area of each square.

## Writing Math

*Work with a partner.*

1. What relationship exists among the areas of the three squares?

**Repeat the activity for each right triangle whose perpendicular sides have the following measures. Write an equation to show your findings.**

2. 6 cm, 8 cm

3. 5 cm, 12 cm

4. **Write** a sentence or two summarizing your findings.

5. **MAKE A CONJECTURE** Determine the length of the third side of a right triangle if the perpendicular sides of the triangle are 9 inches and 12 inches long.

# 11-3 The Pythagorean Theorem

**What You'll LEARN**

Find length using the Pythagorean Theorem.

**NEW Vocabulary**

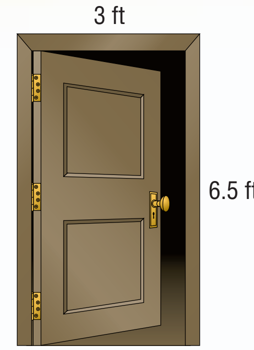
leg
hypotenuse
Pythagorean Theorem

**REVIEW Vocabulary**

**right triangle:** a triangle with exactly one angle that measures 90° (Lesson 10-4)

**WHEN am I ever going to use this?**

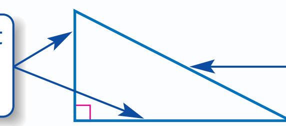
**MOVING** A square mirror 7 feet on each side must be delivered through the doorway.




1. Can the mirror fit through the doorway? Explain.
2. Make a scale drawing on grid paper to solve the problem.

The sides of a right triangle have special names, as shown below.

The two sides adjacent to the right angle are the **legs**.



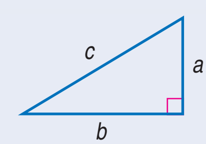
The side opposite the right angle is the **hypotenuse**.

The **Pythagorean Theorem** describes the relationship between the length of the hypotenuse and the lengths of the legs.

**Noteables** — **Key Concept: Pythagorean Theorem**

**Words** In a right triangle, the square of the length of the hypotenuse equals the sum of the squares of the lengths of the legs.

**Model**

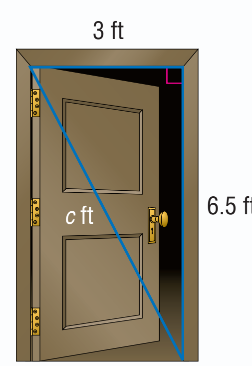



**Symbols** $c^2 = a^2 + b^2$

You can use the Pythagorean Theorem to find the length of the hypotenuse of a right triangle if the measures of both legs are known.

## EXAMPLE Find the Length of the Hypotenuse

**1 MOVING Determine whether a 7-foot square mirror will fit diagonally through the doorway shown at the right.**




To solve, find the length of the hypotenuse $c$.

| | |
|---|---|
| $c^2 = a^2 + b^2$ | Pythagorean Theorem |
| $c^2 = 3^2 + 6.5^2$ | Replace $a$ with 3 and $b$ with 6.5. |
| $c^2 = 9 + 42.25$ | Evaluate $3^2$ and $6.5^2$. |
| $c^2 = 51.25$ | Add. |
| $\sqrt{c^2} = \sqrt{51.25}$ | Take the square root of each side. |
| $c \approx 7.2$ | Simplify. |

The length of the diagonal is about 7.2 feet. So, the mirror will fit through the doorway if it is turned diagonally.

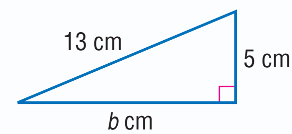
You can also use the Pythagorean Theorem to find the measure of a leg if the measure of the other leg and the hypotenuse are known.

**READING Math**

**Theorem** A *theorem* is a statement in mathematics that can be justified by logical reasoning.

## EXAMPLE Find the Length of a Leg

**1 Find the missing measure of the triangle at the right.**



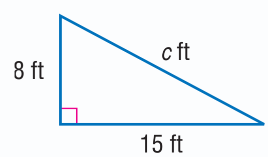

The missing measure is of a leg of the triangle.

| | |
|---|---|
| $c^2 = a^2 + b^2$ | Pythagorean Theorem |
| $13^2 = 5^2 + b^2$ | Replace $a$ with 5 and $c$ with 13. |
| $169 = 25 + b^2$ | Evaluate $13^2$ and $5^2$. |
| $169 - 25 = 25 + b^2 - 25$ | Subtract 25 from each side. |
| $144 = b^2$ | Simplify. |
| $\sqrt{144} = \sqrt{b^2}$ | Take the square root of each side. |
| $12 = b$ | Simplify. |

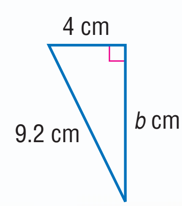
The length of the leg is 12 centimeters.

**Your Turn** **Find the missing measure of each right triangle. Round to the nearest tenth if necessary.**

**a.**




**b.**




**c.** $b = 7$ in., $c = 25$ in.

**REAL-LIFE CAREERS**

**How Does an Archaeologist Use Math?**

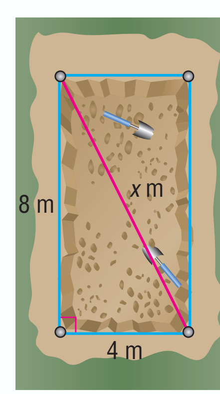
Before digging, archaeologists use the Pythagorean Theorem to calculate the diagonal of an excavation site to be sure that the area is a rectangle.

**Math Online Research**

For information about a career as an archaeologist, visit: msmath2.net/careers

## EXAMPLE Solve a Real-Life Problem

**2 ARCHAEOLOGY Archaeologists placed corner stakes to mark a rectangular excavation site, as shown at the right. If their stakes are placed correctly, what is the measure of the diagonal?**




The diagonal of the rectangle is the hypotenuse of a right triangle. Write an equation to solve for $x$.

| | |
|---|---|
| $c^2 = a^2 + b^2$ | Pythagorean Theorem |
| $x^2 = 8^2 + 4^2$ | Replace $a$ with 8, $b$ with 4, and $c$ with $x$. |
| $x^2 = 64 + 16$ | Evaluate $8^2$ and $4^2$. |
| $x^2 = 80$ | Simplify. |
| $\sqrt{x^2} = \sqrt{80}$ | Take the square root of each side. |
| $x \approx 8.9$ | Simplify. |

The length of the diagonal is about 8.9 meters.



Collin Reid/AP/Wide World Photos

You can determine whether a triangle is a right triangle by applying the Pythagorean Theorem.

## EXAMPLES Identify Right Triangles

**Determine whether a triangle with the given lengths is a right triangle.**

**STUDY TIP**

**Hypotenuse** Remember that the hypotenuse is always the longest side.

**4** **1.5 mm, 2 mm, 2.5 mm**

$c^2 = a^2 + b^2$

$2.5^2 \stackrel{?}{=} 1.5^2 + 2^2$

$6.25 \stackrel{?}{=} 2.25 + 4$

$6.25 = 6.25$ ✔

The triangle is a right triangle.

**5** **4 ft, 6 ft, 8 ft**

$c^2 = a^2 + b^2$

$8^2 \stackrel{?}{=} 4^2 + 6^2$

$64 \stackrel{?}{=} 16 + 36$

$64 \neq 52$

The triangle is *not* a right triangle.

**Your Turn** **Determine whether each triangle with the given lengths is a right triangle. Write *yes* or *no*.**

**d.** 7.5 cm, 8 cm, 12 cm

**e.** 9 in., 40 in., 41 in.

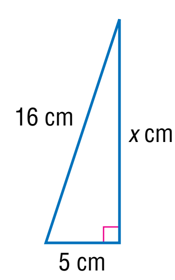
## Skill and Concept Check

**1.** Writing Math Describe the information that you need in order to find the missing measure of a right triangle.

**2.** **OPEN ENDED** Draw and label a right triangle that has one side measuring 14 units. Write the length of another side. Then find the length of the third side to the nearest tenth.

**3.** **FIND THE ERROR** Devin and Jamie are writing an equation to find the missing measure of the triangle at the right. Who is correct? Explain.

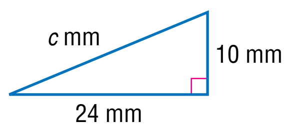
| Devin | Jamie |
|---|---|
| $16^2 = 5^2 + x^2$ | $x^2 = 16^2 + 5^2$ |



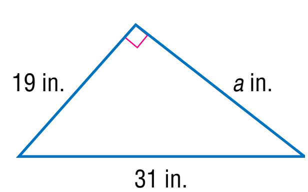

### GUIDED PRACTICE

**Find the missing measure of each right triangle. Round to the nearest tenth if necessary.**

**4.**




**5.**




**6.** $b = 21$ cm, $c = 28$ cm

**Determine whether a triangle with the given side lengths is a right triangle. Write *yes* or *no*.**

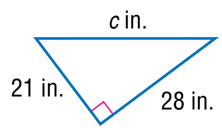
**7.** 1.4 m, 4.8 m, 5 m

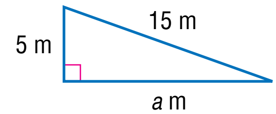
**8.** 21 ft, 24 ft, 30 ft

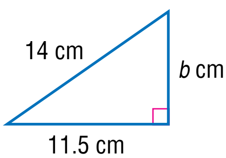
## Practice and Applications

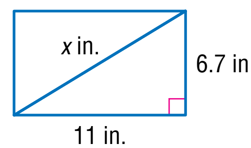
| HOMEWORK HELP | |
|---|---|
| For Exercises | See Examples |
| 9–16 | 1, 2 |
| 17–20 | 4, 5 |
| 21–22 | 3 |
| **Extra Practice** See pages 590, 606. | |

**Find the missing measure of each right triangle. Round to the nearest tenth if necessary.**

**9.**



**10.**



**11.**



**12.**



**13.** $a = 7$ in., $b = 24$ in.

**14.** $a = 13.5$ mm, $b = 18$ mm

**15.** $b = 13$ m, $c = 27$ m

**16.** $a = 2.4$ yd, $c = 3$ yd

**Determine whether a triangle with the given side lengths is a right triangle. Write *yes* or *no*.**

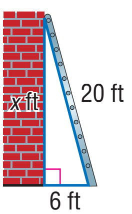
**17.** 12 cm, 16 cm, 20 cm

**18.** 8 m, 15 m, 17 m

**19.** 11 ft, 14 ft, 17 ft

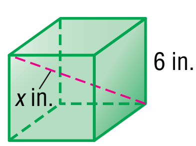
**20.** 18 in., 18 in., 36 in.

**21.** **SAFETY** To the nearest tenth of a foot, how far up the wall $x$ does the ladder shown at the right reach?




**22.** **TRAVEL** You drive 80 miles east, then 50 miles north, then 140 miles west, and finally 95 miles south. Make a drawing to find how far you are from your starting point.

**23.** **CRITICAL THINKING** What is the length of the diagonal of the cube shown at the right?




## Spiral Review with Standardized Test Practice

**24.** **MULTIPLE CHOICE** Find the missing measure of a right triangle if $a = 20$ meters and $c = 52$ meters.

Ⓐ 24 m  Ⓑ 32 m  Ⓒ 48 m  Ⓓ 55.7 m

**25.** **SHORT RESPONSE** An isosceles right triangle has legs that are 8 inches long. Find the length of the hypotenuse to the nearest tenth.

**Estimate each square root to the nearest whole number.** (Lesson 11-2)

**26.** $\sqrt{61}$  **27.** $\sqrt{147}$  **28.** $\sqrt{40}$  **29.** $\sqrt{277}$

**30.** Find $\sqrt{256}$. (Lesson 11-1)

### GETTING READY FOR THE NEXT LESSON

**PREREQUISITE SKILL** **Multiply.** (Lesson 6-4)

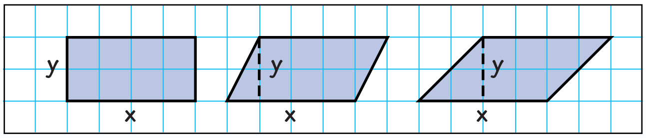
**31.** $17.8 \cdot 12$  **32.** $21.5 \cdot 27.1$  **33.** $3\frac{1}{2} \cdot 8$  **34.** $15\frac{1}{4} \cdot 18$

# 11-4 Area of Parallelograms

## HANDS-ON Mini Lab

**Materials**
- grid paper
- straightedge

*Work with a partner.*




1. What is the value of $x$ and $y$ for each parallelogram?
2. Count the grid squares to find the area of each parallelogram.
3. On grid paper, draw three different parallelograms in which $x = 5$ units and $y = 4$ units. Find the area of each.
4. **Make a conjecture** about how to find the area of a parallelogram if you know the values of $x$ and $y$.

### What You'll LEARN

Find the areas of parallelograms.

### NEW Vocabulary

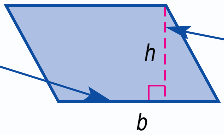
base
height

### REVIEW Vocabulary

**parallelogram:** quadrilateral with opposite sides parallel and opposite sides congruent (Lesson 10-5)

In Lesson 10-5, you learned that a parallelogram is a special kind of quadrilateral. You can find the area of a parallelogram by using the values for the base and height, as described below.

The **base** is any side of a parallelogram.



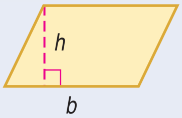

The **height** is the length of the segment perpendicular to the base with endpoints on opposite sides.

## Noteables — Key Concept: Area of a Parallelogram

**Words** The area $A$ of a parallelogram equals the product of its base $b$ and height $h$.

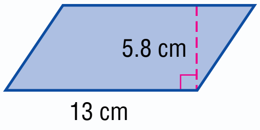
**Symbols** $A = bh$

**Model**




## EXAMPLE Find the Area of a Parallelogram

**1 Find the area of the parallelogram.**




**Estimate** $A = 13 \cdot 6$ or $78 \text{ cm}^2$

$A = bh$ Area of a parallelogram

$A = 13 \cdot 5.8$ Replace $b$ with 13 and $h$ with 5.8.

$A = 75.4$ Multiply.

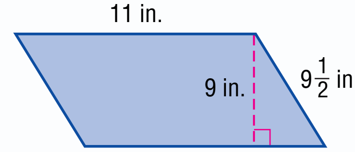
The area of the parallelogram is 75.4 square centimeters. This is close to the estimate.

**STUDY TIP**

**Common Error** When finding the area of a parallelogram, be sure to use the base and the height, not the base and a side.

## EXAMPLE Find the Area of a Parallelogram

**1** **Find the area of the parallelogram at the right.**




The base is 11 inches, and the height is 9 inches.

**Estimate** $A = 10 \cdot 10$ or $100 \text{ in}^2$

$A = bh$ Area of a parallelogram

$A = 11 \cdot 9$ Replace $b$ with 11 and $h$ with 9.

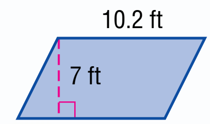
$A = 99$ Multiply.

The area of the parallelogram is 99 square inches. This is close to the estimate.

**Your Turn** **Find the area of each parallelogram.**

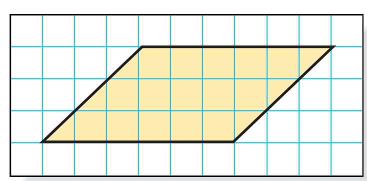
**a.** base = 5 cm
height = 8 cm

**b.**




## Skill and Concept Check

1. **Describe** what values you would substitute in the formula $A = bh$ to find the area of the parallelogram at the right.



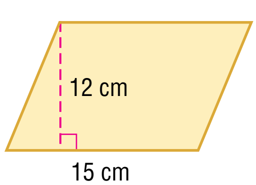
2. **OPEN ENDED** Draw three different parallelograms, each with an area of 24 square units.

3. **Writing Math** *True* or *False*? The area of a parallelogram doubles if you double the base and the height. Explain or give a counterexample to support your answer.

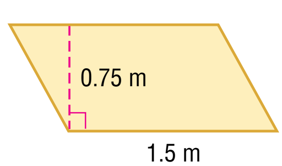
### GUIDED PRACTICE

**Find the area of each parallelogram. Round to the nearest tenth if necessary.**

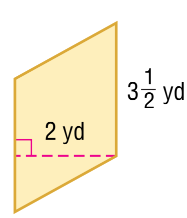
4.




5.




6.




7. base = 16 in.
height = 4 in.

8. base = 3.5 m
height = 5 m

9. What is the area of a parallelogram with a base of 25 millimeters and a height that is half the base?

## Practice and Applications

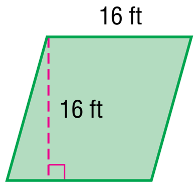
**HOMEWORK HELP**

| For Exercises | See Examples |
|---|---|
| 10–21 | 1, 2 |

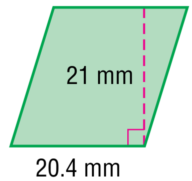
**Extra Practice**
**See pages 591, 606.**

**Find the area of each parallelogram. Round to the nearest tenth if necessary.**

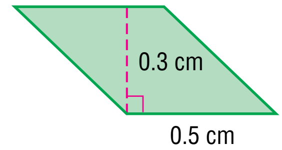
**10.**



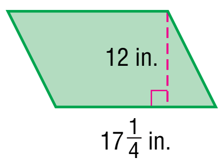

**11.**



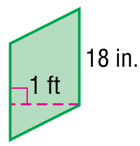

**12.**



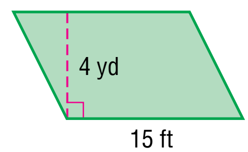

**13.**




**14.**




**15.**




**16.** base = 13 mm
height = 6 mm

**17.** base = 45 yd
height = 35 yd

**18.** base = 8 in.
height = 12.5 in.

**19.** base = 7.9 cm
height = 7.2 cm

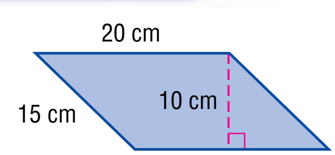
**20.** **MULTI STEP** A quilted block uses eight parallelogram-shaped pieces of cloth, each with a height of $3\frac{1}{3}$ inches and a base of $3\frac{3}{4}$ inches. How much fabric is needed to make the parallelogram pieces for 24 blocks? Write in square feet. (*Hint*: 144 $\text{in}^2$ = 1 $\text{ft}^2$)

**21.** What is the height of a parallelogram if the base is 24 inches and the area is 360 square inches?

**22.** **CRITICAL THINKING** Identify two possible measures of base and height for a parallelogram that has an area of 320 square inches.

## Spiral Review with Standardized Test Practice

**23.** **MULTIPLE CHOICE** Find the area of the parallelogram.




(A) 75 $\text{cm}^2$ (B) 150 $\text{cm}^2$
(C) 200 $\text{cm}^2$ (D) 300 $\text{cm}^2$

**24.** **SHORT RESPONSE** What is the base of a parallelogram if the height is 18.6 inches and the area is 279 square inches?

**Determine whether a triangle with the given side lengths is a right triangle. Write *yes* or *no*.** (Lesson 11-3)

**25.** 8 in., 10 in., 12 in. **26.** 12 ft, 16 ft, 20 ft **27.** 5 cm, 12 cm, 14 cm

**28.** Which is closer to $\sqrt{55}$, 7 or 8? (Lesson 11-2)

### GETTING READY FOR THE NEXT LESSON

**PREREQUISITE SKILL** **Find each value.** (Lesson 1-3)

**29.** 6(4 + 10) **30.** $\frac{1}{2}(8)(8)$ **31.** $\frac{1}{2}(24 + 15)$ **32.** $\frac{1}{2}(5)(13 + 22)$

CHAPTER 11

# Mid-Chapter Practice Test

## Vocabulary and Concepts

1. **Define** *square root*. (Lesson 11-1)
2. **State,** in words, the Pythagorean Theorem. (Lesson 11-3)
3. *True* or *False*? The area of any parallelogram equals the length times the width. Explain. (Lesson 11-4)

## Skills and Applications

**Find the square of each number.** (Lesson 11-1)

4. 4
5. 12

**Find each square root.** (Lesson 11-1)

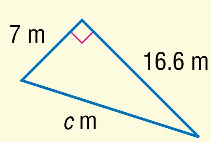
6. $\sqrt{64}$
7. $\sqrt{289}$

8. **LANDSCAPING** A bag of lawn fertilizer covers 2,500 square feet. Describe the largest square that one bag of fertilizer could cover. (Lesson 11-1)

**Estimate each square root to the nearest whole number.** (Lesson 11-2)

9. $\sqrt{32}$
10. $\sqrt{55}$

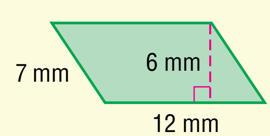
**Find the missing measure of each right triangle. Round to the nearest tenth if necessary.** (Lesson 11-3)

11. 


12. $a = 8.2$ m
$b = 15.6$ m

**Find the area of each parallelogram.** (Lesson 11-4)

13. base = 4.3 in.
height = 9 in.

14. 


## Standardized Test Practice

15. **MULTIPLE CHOICE** Which is the best estimate for $\sqrt{120}$? (Lesson 11-2)

(A) 10 (B) 11 (C) 12 (D) 15

16. **SHORT RESPONSE** Miranda jogs 5 kilometers north and 5 kilometers west. To the nearest kilometer, how far is she from her starting point? (Lesson 11-3)

# The Game Zone

A Place To Practice Your Math Skills


## Tic Tac Root

### GET READY!

**Players:** two to four
**Materials:** index cards, construction paper

### GET SET!

- Use 20 index cards. On each card, write one of the following square roots.

| | | | |
|---|---|---|---|
| $\sqrt{1}$ | $\sqrt{4}$ | $\sqrt{9}$ | $\sqrt{16}$ |
| $\sqrt{25}$ | $\sqrt{36}$ | $\sqrt{49}$ | $\sqrt{64}$ |
| $\sqrt{81}$ | $\sqrt{100}$ | $\sqrt{121}$ | $\sqrt{144}$ |
| $\sqrt{169}$ | $\sqrt{196}$ | $\sqrt{225}$ | $\sqrt{256}$ |
| $\sqrt{289}$ | $\sqrt{324}$ | $\sqrt{361}$ | $\sqrt{400}$ |

- Each player should draw a tic-tac-toe board on construction paper. In each square, place a number from 1 to 20, but do not use any number more than once. See the sample board at the right.

| | | |
|---|---|---|
| 4 | 15 | 9 |
| 11 | 6 | 2 |
| 20 | 12 | 7 |

### GO!

- The dealer shuffles the index cards and places them facedown on the table.
- The player to the left of the dealer chooses the top index card and places it faceup. Any player with the matching square root on his or her board places an X on the appropriate square.
- The next player chooses the top index card and places it faceup on the last card chosen. Players mark their boards accordingly.
- **Who Wins?** The first player to get three Xs in a row wins the game.


John Evans

# 11-5a HANDS-ON LAB

*A Preview of Lesson 11-5*

## Triangles and Trapezoids

**What You'll LEARN**

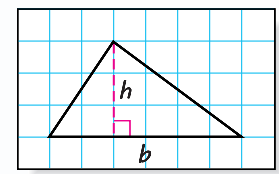
Find the areas of triangles and trapezoids using models.

**Materials**

- centimeter grid paper
- straightedge
- scissors
- tape

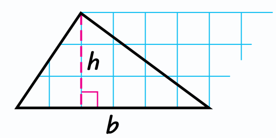
**INVESTIGATE** *Work as a class.*

**STEP 1** On grid paper, draw a triangle with a base of 6 units and a height of 3 units. Label the base *b* and the height *h* as shown.




**STEP 2** Fold the grid paper in half and cut out the triangle through both sheets so that you have two congruent triangles.

**STEP 3** Turn the second triangle upside down and tape it to the first triangle.



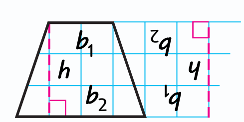

## Writing Math

*Work with a partner.*

1. What figure is formed by the two triangles?
2. Write the formula for the area of the figure. Then find the area.
3. What is the area of each of the triangles? How do you know?
4. Repeat the activity above, drawing a different triangle in Step 1. Then find the area of each triangle.
5. Compare the area of a triangle to the area of a parallelogram with the same base and height.
6. **MAKE A CONJECTURE** Write a formula for the area of a triangle with base $b$ and height $h$.

**For Exercises 7–9, refer to the information below.**

On grid paper, cut out two identical trapezoids. Label the bases $b_1$ and $b_2$, respectively, and label the heights $h$. Then turn one trapezoid upside down and tape it to the other trapezoid as shown.




7. Write an expression to represent the base of the parallelogram.
8. Write a formula for the area $A$ of the parallelogram using $b_1$, $b_2$, and $h$.
9. **MAKE A CONJECTURE** Write a formula for the area $A$ of a trapezoid with bases $b_1$ and $b_2$, and height $h$.

# 11-5 Area of Triangles and Trapezoids

**What You'll LEARN**

Find the areas of triangles and trapezoids.

**REVIEW Vocabulary**

**trapezoid:** quadrilateral with one pair of parallel sides (Lesson 10-5)

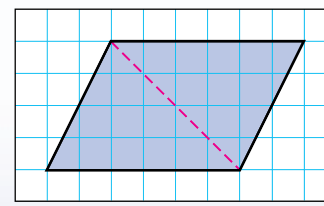
## HANDS-ON Mini Lab

**Materials**

- grid paper
- straightedge
- scissors

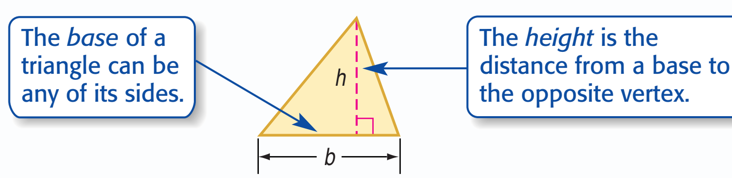
*Work with a partner.*

- Draw a parallelogram with a base of 6 units and a height of 4 units.
- Draw a diagonal as shown.
- Cut out the parallelogram.



1. What is the area of the parallelogram?
2. Cut along the diagonal. What is true about the triangles formed?
3. What is the area of each triangle?
4. If the area of a parallelogram is $bh$, then write an expression for the area $A$ of each of the two congruent triangles that form the parallelogram.

Like parallelograms, you can find the area of a triangle by using the base and height.

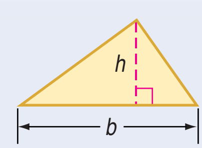



**Noteables** — **Key Concept: Area of a Triangle**

**Words** The area $A$ of a triangle equals half the product of its base $b$ and height $h$.

**Symbols** $A = \frac{1}{2}bh$

**Model**



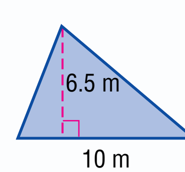

## EXAMPLE Find the Area of a Triangle

**1** **Find the area of the triangle below.** **Estimate** $\frac{1}{2}(10)(7) = 35$

$A = \frac{1}{2}bh$ Area of a triangle

$A = \frac{1}{2}(10)(6.5)$ Replace $b$ with 10 and $h$ with 6.5.

$A = 32.5$ Multiply.




The area of the triangle is 32.5 square meters. This is close to the estimate.

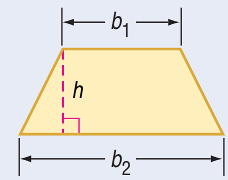
A trapezoid has two bases, $b_1$ and $b_2$. The height of a trapezoid is the distance between the bases.

**Noteables**

**Key Concept: Area of a Trapezoid**

**Words** The area $A$ of a trapezoid equals half the product of the height $h$ and the sum of the bases $b_1$ and $b_2$.

**Model**




**Symbols** $A = \frac{1}{2}h(b_1 + b_2)$

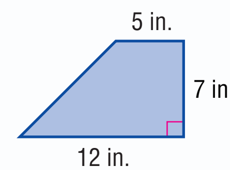
**READING Math**

**Subscripts** Read $b_1$ as *b sub 1*. Read $b_2$ as *b sub 2*. The subscripts mean that $b_1$ and $b_2$ represent different variables.

## EXAMPLE Find the Area of a Trapezoid

**1 Find the area of the trapezoid at the right.**

The bases are 5 inches and 12 inches.
The height is 7 inches.




$A = \frac{1}{2}h(b_1 + b_2)$ Area of a trapezoid

$A = \frac{1}{2}(7)(5 + 12)$ Replace $h$ with 7, $b_1$ with 5, and $b_2$ with 12.

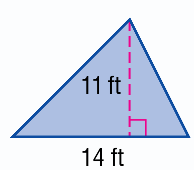
$A = \frac{1}{2}(7)(17)$ Add 5 and 12.

$A = 59.5$ Multiply.

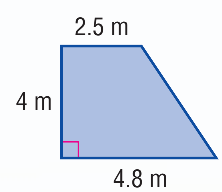
The area of the trapezoid is 59.5 square inches.

**Your Turn** **Find the area of each triangle or trapezoid. Round to the nearest tenth if necessary.**

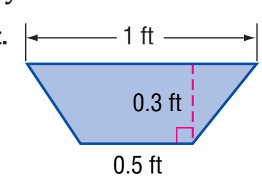
a.




b.



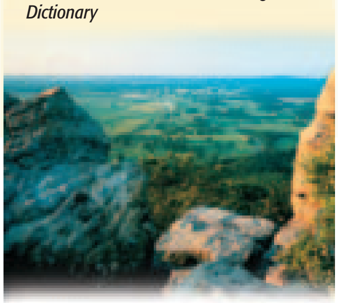

c.




**REAL-LIFE MATH**

**GEOGRAPHY** The actual area of Arkansas is 52,068 square miles.

**Source:** *Merriam Webster's Collegiate Dictionary*



## EXAMPLE Use a Formula to Estimate Area

**2** **GEOGRAPHY** **The shape of the state of Arkansas resembles a trapezoid. Estimate its area in square miles.**


$A = \frac{1}{2}h(b_1 + b_2)$

$A = \frac{1}{2}(235)(280 + 210)$ Replace $h$ with 235, $b_1$ with 280, and $b_2$ with 210.

$A = \frac{1}{2}(235)(490)$ Add 280 and 210.

$A = 57,575$ Multiply.

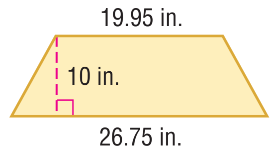
The area of Arkansas is about 57,575 square miles.



David Muench/CORBIS

## Skill and Concept Check

1. **Estimate** the area of the trapezoid at the right.

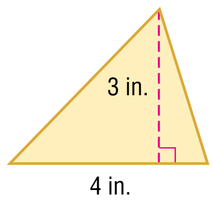


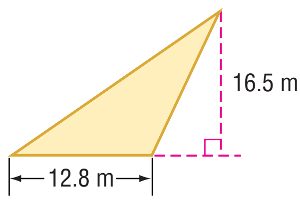

2. **OPEN ENDED** Draw a trapezoid and label the bases and the height. In your own words, explain how to find the area of the trapezoid.

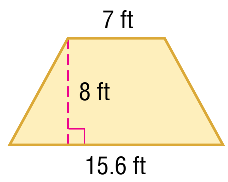
3. **Writing Math** Describe the relationship between the area of a parallelogram and the area of a triangle with the same height and base.

### GUIDED PRACTICE

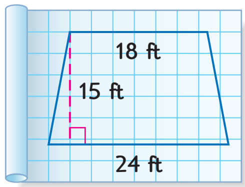
**Find the area of each figure. Round to the nearest tenth if necessary.**

4.



5.



6.



7. **MULTI STEP** The blueprints for a patio are shown at the right. If the cost of the patio is \$4.50 per square foot, what will be the total cost of the patio?

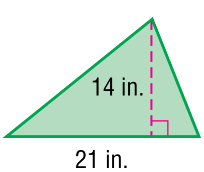


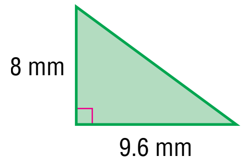

## Practice and Applications

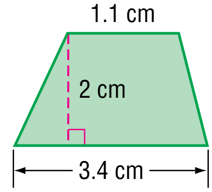
| HOMEWORK HELP | |
|---|---|
| For Exercises | See Examples |
| 8–9, 12, 14 | 1 |
| 10–11, 13, 15 | 2 |
| 20–21 | 3 |

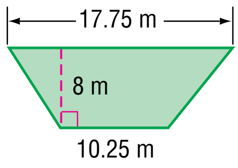
**Extra Practice**
See pages 591, 606.

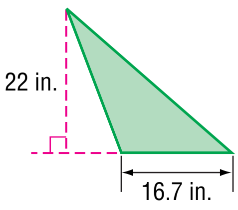
**Find the area of each figure. Round to the nearest tenth if necessary.**

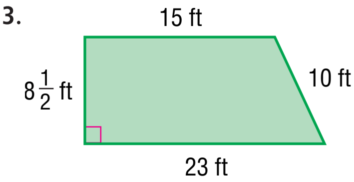
8.



9.



10.



11.



12.



13.



14. triangle: base = 4 cm, height = 7.5 cm
15. trapezoid: bases 13 in. and $1\frac{1}{4}$ ft, height 1 ft

**Draw and label each figure on grid paper. Then find the area.**

16. a triangle with no right angles
17. an isosceles triangle with a height greater than 6 units
18. a trapezoid with a right angle and an area of 40 square units
19. a trapezoid with no right angles and an area less than 25 square units

20. **GEOGRAPHY** Nevada has a shape that looks like a trapezoid, as shown at the right. Find the approximate area of the state.

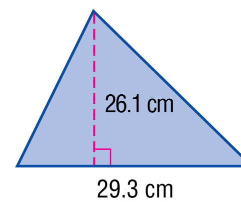

21. **GEOGRAPHY** Delaware has a shape that is roughly triangular with a base of 39 miles and a height of 96 miles. Find the approximate area of the state.

**Data Update** How do the actual areas of Nevada and Delaware compare to your estimates? Visit msmath2.net/data_update to learn more.

22. **CRITICAL THINKING** A triangle has height $h$. Its base is 4. Find the area of the triangle. (*Hint*: Express your answer in terms of $h$.)

## Spiral Review with Standardized Test Practice

23. **SHORT RESPONSE** Find the area of the triangle at the right to the nearest tenth.




24. **MULTIPLE CHOICE** A trapezoid has bases of 15 meters and 18 meters and a height of 10 meters. What is the area of the trapezoid?

Ⓐ 30 $m^2$ Ⓑ 60 $m^2$ Ⓒ 165 $m^2$ Ⓓ 330 $m^2$

25. **GEOMETRY** Find the area of a parallelogram having a base of 2.3 inches and a height of 1.6 inches. Round to the nearest tenth. (Lesson 11-4)

**Find the missing measure of each right triangle. Round to the nearest tenth if necessary.** (Lesson 11-3)

26. $a = 10$ m, $b = 14$ m

27. $a = 13$ ft, $c = 18$ ft

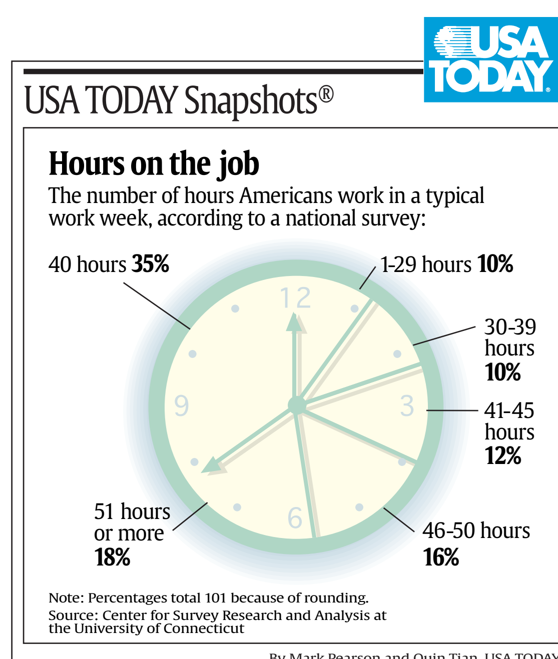
**For Exercises 28–31, refer to the graphic at the right. Classify the angle that represents each category as *acute*, *obtuse*, *right*, or *straight*.** (Lesson 10-1)

28. 30–39 hours

29. 1–29 hours

30. 40 hours

31. 41–50 hours




32. **MUSIC** Use the Fundamental Counting Principle to find the number of piano instruction books in a series if there are Levels 1, 2, 3, and 4 and each level contains five different books. (Lesson 9-3)

## GETTING READY FOR THE NEXT LESSON

**BASIC SKILL** **Use a calculator to find each product to the nearest tenth.**

33. $\pi \cdot 13$ 34. $\pi \cdot 29$ 35. $\pi \cdot 16^2$ 36. $\pi \cdot 4.8^2$

# 11-6 Area of Circles

## HANDS-ON Mini Lab

**Materials**
- large paper plate
- scissors

**What You'll LEARN**

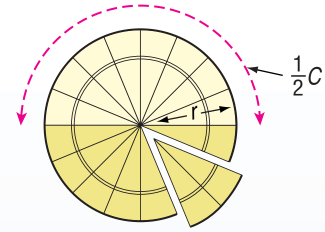
Find the areas of circles.

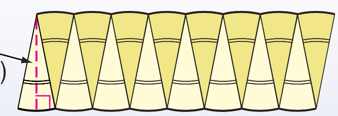
**REVIEW Vocabulary**

**pi ($\pi$):** the Greek letter that represents an irrational number approximately equal to 3.14 (Lesson 6-9)

*Work with a partner.*

- Fold a paper plate in half four times to divide it into 16 equal-sized sections.
- Label the radius $r$ as shown. Let $C$ represent the circumference of the circle.
- Cut out each section; reassemble to form a parallelogram-shaped figure.




1. What is the measurement of the base and the height?
2. Substitute these values into the formula for the area of a parallelogram.
3. Replace $C$ with the expression for the circumference of a circle, $2\pi r$. Simplify the equation and describe what it represents.

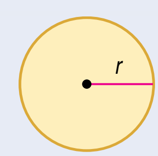
In the Mini Lab, the formula for the area of a parallelogram was used to develop a formula for the area of a circle.

**Noteables** — **Key Concept: Area of a Circle**

**Words** The area $A$ of a circle equals the product of pi ($\pi$) and the square of its radius $r$.

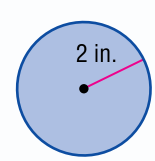
**Symbols** $A = \pi r^2$

**Model**




## EXAMPLES Find the Areas of Circles

**1** **Find the area of the circle at the right.**




$A = \pi r^2$ Area of a circle

$A = \pi \cdot 2^2$ Replace $r$ with 2.

[π] [×] 2 [$x^2$] [ENTER] 12.56637061

The area of the circle is approximately 12.6 square inches.

**2** **Find the area of a circle with a diameter of 15.2 centimeters.**

$A = \pi r^2$ Area of a circle

$A = \pi \cdot 7.6^2$ Replace $r$ with $15.2 \div 2$ or 7.6.

$A \approx 181.5$ Use a calculator.

The area of the circle is approximately 181.5 square centimeters.

## Skill and Concept Check

1. **OPEN ENDED** Draw and label the radius of a circle that has an area less than 10 square units.

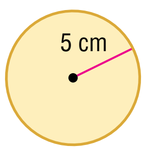
2. **FIND THE ERROR** Carlos and Sean are finding the area of a circle that has a diameter of 12 centimeters. Who is correct? Explain.

| Carlos | Sean |
|---|---|
| $A = \pi(12)^2$ | $A = \pi(6)^2$ |
| $\approx 452\ cm^2$ | $\approx 113\ cm^2$ |

3. **NUMBER SENSE** Without using a calculator, determine which has the greatest value: $2\pi$, $\sqrt{7}$, or $1.5^2$. Explain.

### GUIDED PRACTICE

**Find the area of each circle. Round to the nearest tenth.**

4.
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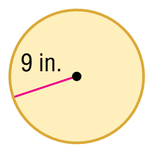


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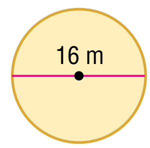
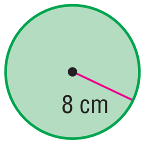


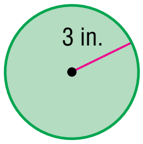

7. radius = 4.2 ft
8. diameter = 13 ft
9. diameter = 24 mm

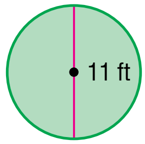
10. **HISTORY** The Roman Pantheon is a circular-shaped structure that was completed about 126 A.D. Find the area of the floor if the diameter is 43 meters.

## Practice and Applications

**Find the area of each circle. Round to the nearest tenth.**

11.



12.



13.
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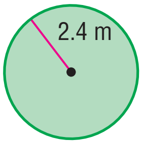


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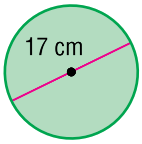


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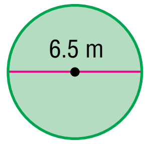
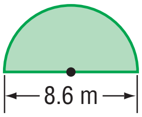



17. radius = 6 ft
18. diameter = 7 ft
19. diameter = 3 cm
20. radius = 10.5 mm
21. radius = $4\frac{1}{2}$ in.
22. diameter = $20\frac{3}{4}$ yd

23. A *semicircle* is half a circle. Find the area of the semicircle at the right to the nearest tenth.



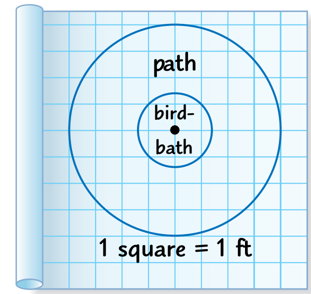

24. **MONEY** Find the area of the face of a Sacagawea $1 coin if the diameter is 26.5 millimeters. Round to the nearest tenth.

**HOMEWORK HELP**

| For Exercises | See Examples |
|---|---|
| 11–16, 25 | 1 |
| 17–22, 24 | 2 |

**Extra Practice**
See pages 591, 606.

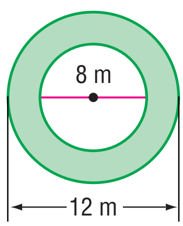
25. **LANDSCAPE DESIGN** A circular stone path is to be installed around a birdbath with radius 1.5 feet, as shown at the right. What is the area of the path? (*Hint*: Find the area of the large circle minus the area of the small circle.)




**For Exercises 26 and 27, refer to the information below.**
Let the $x$-axis of a coordinate plane represent the radius of a circle and the $y$-axis represent the area of a circle.

26. Graph the points that represent the circles with radii 0, 1, 2, and 3 units long. Draw a line or curve that goes through each point.
27. Consider a circle with radius of 1 unit and a circle with a radius of 2 units. Write a ratio comparing the radii. Write a ratio comparing the areas. Do these ratios form a proportion? Explain.

**Find the area of the shaded region in each figure. Round to the nearest tenth.**

28.
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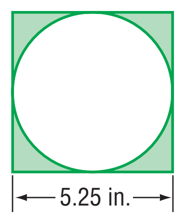


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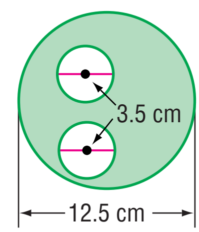
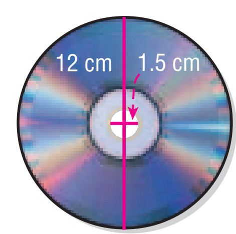



31. **CRITICAL THINKING** Determine whether the area of a circle is *sometimes*, *always*, or *never* doubled when the radius is doubled. Explain.

## Spiral Review with Standardized Test Practice

32. **MULTIPLE CHOICE** A CD has a diameter of 12 centimeters. The hole in the middle of the CD has a diameter of 1.5 centimeters. Find the area of one side of the CD to the nearest tenth. Use 3.14 for $\pi$.

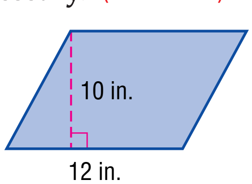
(A) 111.3 $cm^2$ (B) 113.0 $cm^2$ (C) 349.4 $cm^2$ (D) 445.1 $cm^2$

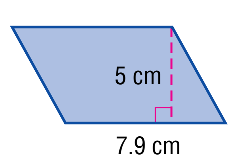


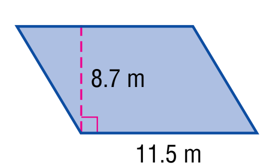

33. **SHORT RESPONSE** Find the radius of a circle that has an area of 42 square centimeters. Use 3.14 for $\pi$ and round to the nearest tenth.

34. **GEOMETRY** Find the area of a triangle with a base of 21 meters and a height of 27 meters. (Lesson 11-5)

**Find the area of each parallelogram. Round to the nearest tenth if necessary.** (Lesson 11-4)

35.



36.



37.



## GETTING READY FOR THE NEXT LESSON

**BASIC SKILL** **Simplify each expression.** (Lessons 1-2 and 1-3)

38. $8.5^2$
39. $3.14 \cdot 6^2$
40. $\frac{1}{2} \cdot 5.4^2 + 11$
41. $\frac{1}{2} \cdot 7^2 + (9)(14)$

# 11-7a Problem-Solving Strategy

*A Preview of Lesson 11-7*

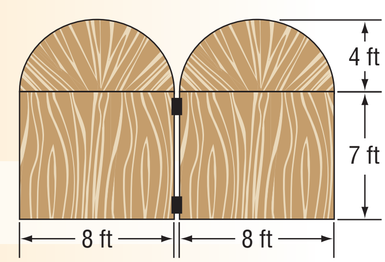
## Solve a Simpler Problem

**What You'll LEARN**

Solve problems by solving a simpler problem.

The diagram shows the backdrop for our fall play. How much wallpaper will we need to cover the entire front?

We need to find the total area of the backdrop. Let's **solve a simpler problem** by breaking it down into separate geometric shapes.




| | |
|---|---|
| **Explore** | We know that the backdrop is made of one large rectangle and two semicircles, which equal an entire circle. |
| **Plan** | We can find the areas of the rectangle and the circle, and then add. |
| **Solve** | area of rectangle: $A = \ell w$<br>$A = (8 + 8)7$ or 112<br>area of circle: $A = \pi r^2$<br>$A = \pi \cdot 4^2$ or about 50.3<br>total area: $112 + 50.3$ or 162.3 square feet<br>So, we need at least 162.3 square feet of wallpaper. |
| **Examine** | Use estimation to check. The backdrop is 16 feet long and 11 feet high. However, it is less than a complete rectangle, so the area should be *less than* $16 \cdot 11$ or 176 feet.<br>The area, 162.3 square feet, is less than 176 feet, so the answer is reasonable. |

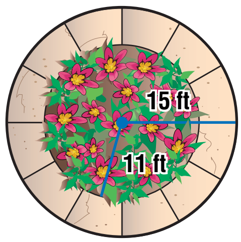
## Analyze the Strategy

1. **Explain** why simplifying this problem is a good strategy to solve this problem.
2. **Describe** another way that the problem could have been solved.
3. **Write** a problem that can be solved by breaking it down into a simpler problem. Solve the problem and explain your answer.

## Apply the Strategy

**Solve. Use the solve a simpler problem strategy.**

4. **LANDSCAPING** James is helping his father pour a circular sidewalk around a flower bed, as shown below. What is the area, in square feet, of the sidewalk? Use 3.14 for $\pi$.




5. **COMMUNICATION** According to a recent report, one city has 2,945,000 phone lines assigned to three different area codes. How many of the phone lines are assigned to each area code?

| Area Code | Percent |
|---|---|
| 888 | 44.3% |
| 777 | 23.7% |
| 555 | 31.5% |

## Mixed Problem Solving

**Solve. Use any strategy.**

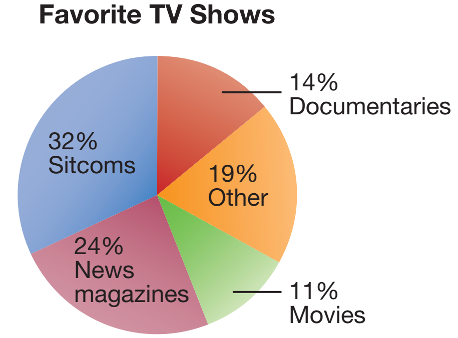
6. **EARTH SCIENCE** Earth's atmosphere exerts a pressure of 14.7 pounds per square inch at the ocean's surface. The pressure increases by 12.7 pounds per square inch for every 6 feet that you descend. Find the pressure at 18 feet below the surface.

7. **SALES** Deirdre is trying to sell $3,000 in ads for the school newspaper. The prices of the ads and the number of ads that she has sold are shown in the table. Which is the smallest ad she could sell in order to meet her quota?

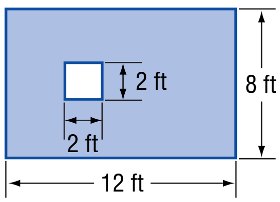
| Ad Size | Cost Per Ad | Number Sold |
|---|---|---|
| quarter-page | $75 | 15 |
| half-page | $125 | 8 |
| full-page | $175 | 4 |

8. **THEATER** Mr. Marquez is purchasing fabric for curtains for a theatrical company. The front of the stage is 15 yards wide and 5 yards high. The fabric is sold on bolts that are 60 inches wide and 20 yards long. How many bolts are needed to make the curtains?

9. **TELEVISION** The graph shows the results of a survey in which 365,750 people were asked to name their favorite television programs. Estimate how many people chose sitcoms as their favorite.




10. **STANDARDIZED TEST PRACTICE** Kara is painting one wall in her room, as shown by the shaded region below. What is the area that she is painting?




Ⓐ 92 $ft^2$
Ⓑ 94 $ft^2$
Ⓒ 96 $ft^2$
Ⓓ 100 $ft^2$

# 11-7 Area of Complex Figures

## What You'll LEARN

Find the areas of complex figures.

## NEW Vocabulary

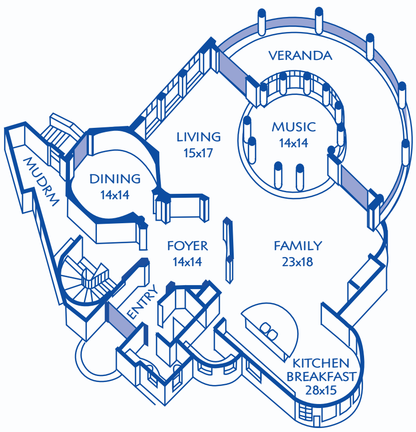
complex figure

## Link to READING

***Everyday Meaning of Complex:*** a whole made up of interrelated parts, as in a retail complex that is made up of many different stores

## WHEN am I ever going to use this?

**ARCHITECTURE** Rooms in a house are not always square or rectangular, as shown in the diagram at the right.

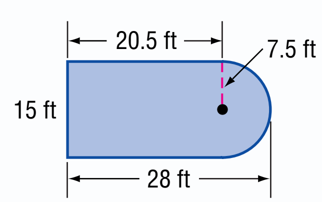



1. Describe the shape of the kitchen.
2. How could you determine the area of the kitchen?
3. How could you determine the total square footage of a house with rooms shaped like these?

A **complex figure** is made of circles, rectangles, squares, and other two-dimensional figures. To find the area of a complex figure, separate it into figures whose areas you know how to find, and then add the areas.

## EXAMPLE Find the Area of an Irregular Room

**1** **ARCHITECTURE** **Refer to the diagram of the house above. The kitchen is 28 feet by 15 feet, as shown at the right. Find the area of the kitchen. Round to the nearest tenth.**




The figure can be separated into a rectangle and a semicircle.

Area of Rectangle

$A = \ell w$ Area of a rectangle

$A = 20.5 \cdot 15$ Replace $\ell$ with 20.5 and $w$ with 15.

$A = 307.5$ Multiply.

Area of Semicircle

$A = \frac{1}{2}\pi r^2$ Area of a semicircle

$A = \frac{1}{2}\pi(7.5)^2$ Replace $r$ with 7.5.

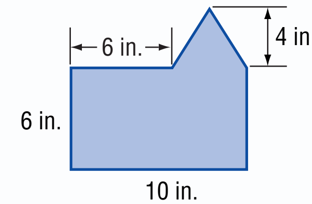
$A \approx 88.4$ Simplify.

The area of the kitchen is approximately 307.5 + 88.4 or 395.9 square feet.

Standardized Test Practice

## EXAMPLE Find the Area of a Complex Figure

**2** **GRID-IN TEST ITEM** **Find the area of the figure at the right in square inches.**




**Read the Test Item**

The figure can be separated into a rectangle and a triangle. Find the area of each.

**Solve the Test Item**

Area of Rectangle

$A = \ell w$ Area of a rectangle

$A = 10 \cdot 6$ Replace $\ell$ with 10 and $w$ with 6.

$A = 60$ Multiply.

Area of Triangle

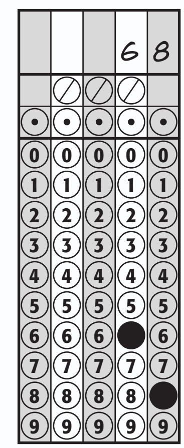
$A = \frac{1}{2}bh$ Area of a triangle

$A = \frac{1}{2}(4)(4)$ $b = 10 - 6$ or 4, $h = 4$

$A = 8$ Multiply.

The area is 60 + 8 or 68 square inches.

**Fill in the Grid**

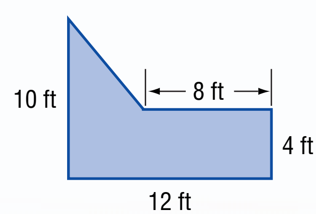



**Test-Taking Tip**

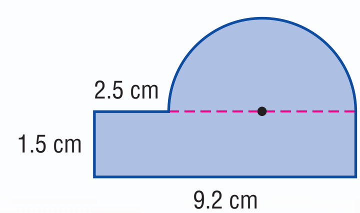
**Drawings** Be sure to add the areas of all the separate figures and not stop once you find the area of part of the figure.

**Your Turn** **Find the area of each figure. Round to the nearest tenth if necessary.**

**a.**

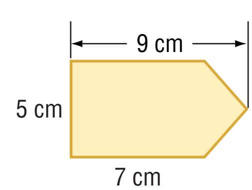



**b.**




## Skill and Concept Check

1. **Writing Math** Describe how you would find the area of the figure at the right.

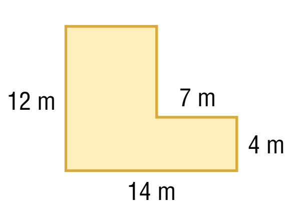



2. **OPEN ENDED** Sketch a complex figure and describe how you could find the area.

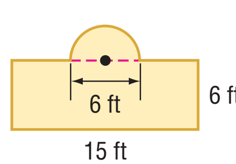
### GUIDED PRACTICE

**Find the area of each figure. Round to the nearest tenth if necessary.**

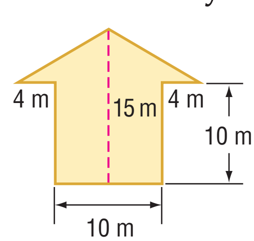
3.




4.




5.



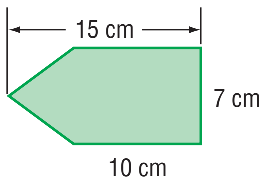
## Practice and Applications

| HOMEWORK HELP | |
|---|---|
| For Exercises | See Examples |
| 6–12 | 1, 2 |

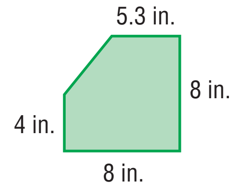
**Extra Practice**
See pages 592, 606.

**Find the area of each figure. Round to the nearest tenth if necessary.**

6.




7.

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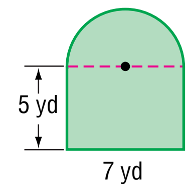
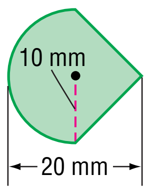
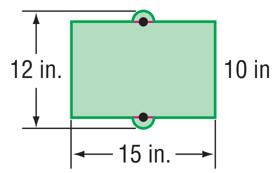


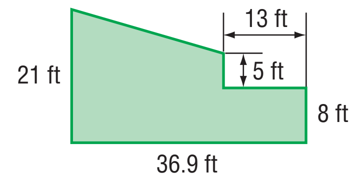

9.



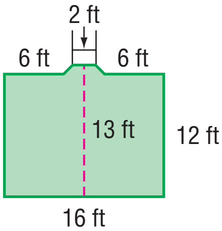

10.




11.

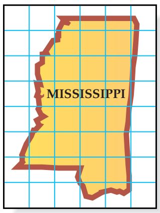



12. **INTERIOR DESIGN** The Eppicks' living room, shown at the right, has a bay window. They are planning to have the hardwood floors in the room refinished. What is the total area that needs to be refinished?

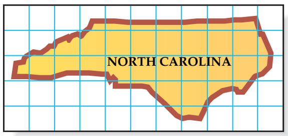



**CRITICAL THINKING** **Describe how you could estimate the area of each state.**

13.

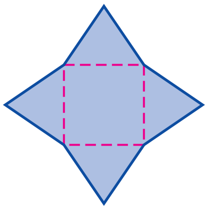



14.




## Spiral Review with Standardized Test Practice

15. **SHORT RESPONSE** Find the area of the figure if each triangle has a height of 3.5 inches and the square has side lengths of 4 inches.



16. **MULTIPLE CHOICE** A rectangular room 14 feet by 12 feet has a semicircular sitting area attached with a diameter of 12 feet. What is the total area of the room and the sitting area?

Ⓐ 168 ft$^2$ Ⓑ 224.5 ft$^2$ Ⓒ 281.1 ft$^2$ Ⓓ 620.4 ft$^2$

**Find the area of each circle. Round to the nearest tenth.** (Lesson 11-6)

17. radius = 4.7 cm
18. radius = 12 in.
19. diameter = 15 in.

20. Find the area of a triangle that has a base of 3.8 meters and a height of 9 meters. (Lesson 11-5)

### GETTING READY FOR THE NEXT LESSON

**PREREQUISITE SKILL** **Find the probability of rolling each number on a number cube.** (Lesson 9-1)

21. $P(2)$
22. $P(\text{even})$
23. $P(3 \text{ or } 4)$
24. $P(\text{less than } 5)$

# 11-8 Probability: Area Models

**HANDS-ON Mini Lab**

**Materials**

- two number cubes

*Work with a partner.*

- Roll the number cubes and find the product of the numbers rolled.
- Repeat nine more times.
- Collect the data for the entire class. Organize the outcomes in a table.

1. Do certain products occur more often?
2. Make and complete a table like the one at the right to find all the possible outcomes.

| × | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 3 | | | |
| 2 | 2 | 4 | 6 | | | |
| 3 | | | | | | |

**What You'll LEARN**

Find probability using area models.

**REVIEW Vocabulary**

**probability:** the ratio of the number of ways an event can occur to the number of possible outcomes (Lesson 9-1)

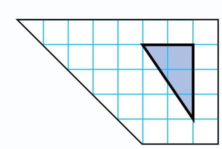
The grid at the right shows the possible products when two number cubes are rolled. The area of the grid is 36 square units. Notice that 6 and 12 make up $\frac{8}{36}$ of the area. So, the probability of rolling two numbers whose product is 6 or 12 is $\frac{8}{36}$.

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | 4 | 6 | 8 | 10 | 12 |
| 3 | 6 | 9 | 12 | 15 | 18 |
| 4 | 8 | 12 | 16 | 20 | 24 |
| 5 | 10 | 15 | 20 | 25 | 30 |
| 6 | 12 | 18 | 24 | 30 | 36 |

The area of geometric shapes can be used to find probabilities.

## EXAMPLE Use Area Models to Find Probability

**1** **PROBABILITY** **A randomly-dropped counter falls somewhere in the squares. Find the probability that it falls on the shaded squares.**



$$\text{probability} = \frac{\text{number of ways to land in shaded squares}}{\text{number of ways to land on squares}}$$

$$= \frac{\text{area of shaded squares}}{\text{area of all squares}}$$

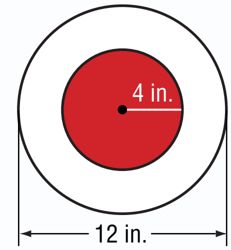
| Area of Shaded Squares | | Area of All Squares | |
|---|---|---|---|
| $A = \frac{1}{2}bh$ | Area of a triangle | $A = \frac{1}{2}h(b_1 + b_2)$ | Area of a trapezoid |
| $A = \frac{1}{2}(2)(3)$ | $b = 2$ and $h = 3$ | $A = \frac{1}{2}(5)(8 + 3)$ | $h = 5, b_1 = 8, b_2 = 3$ |
| $A = 3$ | Simplify. | $A = 27.5$ | Simplify. |

So, the probability of a counter falling in the shaded squares is $\frac{3}{27.5}$ or about 10.9%.

msmath2.net/extra_examples

## EXAMPLE Find the Probability of Winning a Game

**1** **GAMES Suppose a dart is equally likely to hit any point on the board. What is the probability that it hits the white section?**




First, find the area of the white section. It equals the area of the large circle minus the area of the small circle.

Area of Large Circle

$A = \pi r^2$ Area of a circle

$A = \pi(6)^2$ Replace $r$ with 6.

$A \approx 113.1$ Simplify.

Area of Small Circle

$A = \pi r^2$ Area of a circle

$A = \pi(4)^2$ Replace $r$ with 4.

$A \approx 50.3$ Simplify.

Area of White Section $= 113.1 - 50.3$ large circle − small circle

$= 62.8$ Subtract.

$P(\text{white}) = \dfrac{62.8}{113.1}$ ← area of white section ← area of entire model

$\approx 0.5553$ Use a calculator.

So, the probability of hitting the white section is about 55.6%.

**REAL-LIFE MATH**

**GAMES** The arrangement of numbers around a standard dartboard dates back over 100 years.

**Source:** mathpages.com

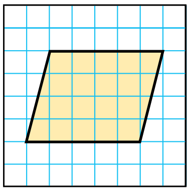

## Skill and Concept Check

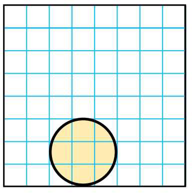
1. **Writing Math** Explain how area models are used to solve probability problems.

2. **OPEN ENDED** Draw a spinner in which the probability of spinning and landing on a blue region is $\frac{1}{6}$. Explain your reasoning.

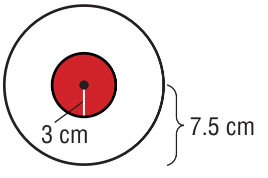
### GUIDED PRACTICE

**A randomly-dropped counter falls in the squares. Find the probability that it falls in the shaded regions. Write as a percent. Round to the nearest tenth if necessary.**

3. 

4. 

5. **GAMES** Suppose a dart is equally likely to hit any point on the dartboard at the right. What is the probability that it hits the red section?





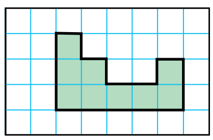

Doug Martin

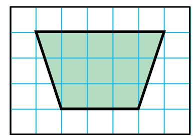
## Practice and Applications

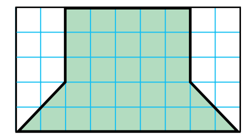
| HOMEWORK HELP | |
|---|---|
| For Exercises | See Examples |
| 6–11 | 1 |
| 12–14 | 2 |

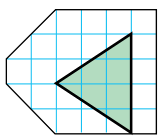
**Extra Practice**
**See pages 592, 602.**

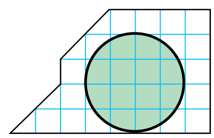
**A randomly-dropped counter falls in the squares. Find the probability that it falls in the shaded regions. Write as a percent. Round to the nearest tenth if necessary.**

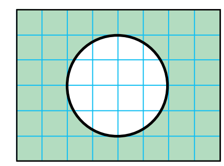
**6.** 

**7.** 

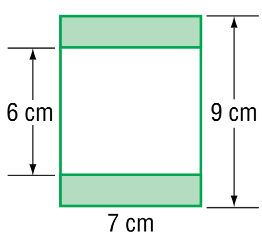
**8.** 

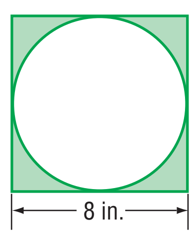
**9.** 

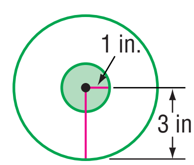
**10.** 

**11.** 

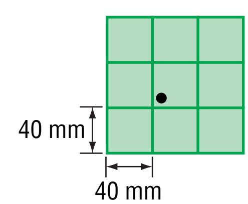
**GAMES** **Each figure represents a dartboard. If it is equally likely that a thrown dart will land anywhere on the dartboard, find the probability that it lands in the shaded region.**

**12.** 


**13.** 

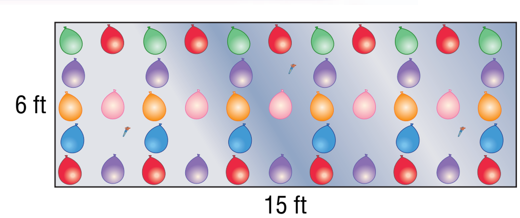

**14.** 


**15.** **CRITICAL THINKING** A quarter is randomly tossed on the grid board at the right. If a quarter has a radius of 12 millimeters, what is the probability that it does *not* touch a line when it lands? (*Hint*: Find the area where the center of the coin could land so that the edges do not touch a line.)



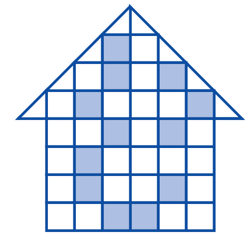

## Spiral Review with Standardized Test Practice

**16.** **MULTIPLE CHOICE** At a carnival, a person wins a prize if their dart pops a balloon on the rectangular wall. If the radius of each circular balloon is 0.4 foot, approximately what is the probability that a person will win? Use 3.14 for $\pi$.




Ⓐ 25% Ⓑ 29% Ⓒ 30% Ⓓ 63%

**17.** **GRID IN** Find the probability that a randomly dropped counter will fall in the shaded region at the right. Write as a fraction.



**18.** Find the area of a figure that is a 6-inch square with a semicircle attached to each side. Each semicircle has a diameter of 6 inches. Round to the nearest tenth. (Lesson 11-7)

**19.** Find the area of a circle with a radius of 5.7 meters. Round to the nearest tenth. (Lesson 11-6)

# CHAPTER 11 Study Guide and Review

## Vocabulary and Concept Check

| | | |
|---|---|---|
| base (p. 483) | irrational number (p. 476) | radical sign (p. 471) |
| complex figure (p. 498) | leg (p. 479) | square (p. 470) |
| height (p. 483) | perfect square (p. 471) | square roots (p. 471) |
| hypotenuse (p. 479) | Pythagorean Theorem (p. 479) | |

**Choose the correct term or number to complete each sentence.**

1. In a right triangle, the square of the length of the hypotenuse is (equal to, less than) the sum of the squares of the lengths of the legs.
2. $A = \frac{1}{2}h(a + b)$ is the formula for the area of a (triangle, trapezoid).
3. The square of 25 is (625, 5).
4. A (square, square root) of 49 is 7.
5. The longest side of a right triangle is called the (leg, hypotenuse).
6. The $\sqrt{\phantom{x}}$ symbol is called a (radical, perfect square) sign.

## Lesson-by-Lesson Exercises and Examples

### 11-1 Squares and Square Roots (pp. 470–473)

**Find the square of each number.**

7. 6
8. 14
9. 23

**Find each square root.**

10. $\sqrt{16}$
11. $\sqrt{256}$
12. $\sqrt{900}$

**Example 1** **Find the square of 9.**

$9^2 = 9 \cdot 9$ or 81

**Example 2** **Find $\sqrt{121}$.**

Since $11 \cdot 11 = 121$, $\sqrt{121} = 11$.

### 11-2 Estimating Square Roots (pp. 475-477)

**Estimate each square root to the nearest whole number.**

13. $\sqrt{6}$
14. $\sqrt{99}$
15. $\sqrt{48}$
16. $\sqrt{76}$
17. $\sqrt{19}$
18. $\sqrt{52}$

**Use a calculator to find each square root to the nearest tenth.**

19. $\sqrt{61}$
20. $\sqrt{132}$
21. $\sqrt{444}$
22. $\sqrt{12}$

**Example 3** **Estimate $\sqrt{29}$ to the nearest whole number.**

$25 < 29 < 36$ 29 is between the perfect squares 25 and 36.

$\sqrt{25} < \sqrt{29} < \sqrt{36}$ Find the square root of each number.

$5 < \sqrt{29} < 6$ $\sqrt{25} = 5$ and $\sqrt{36} = 6$

So, $\sqrt{29}$ is between 5 and 6. Since 29 is closer to 25 than to 36, the best whole number estimate is 5.



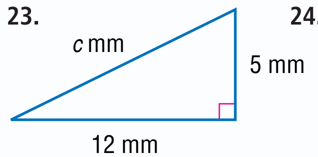
msmath2.net/vocabulary_review

CONTENTS

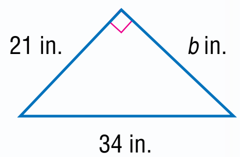
## 11-3 The Pythagorean Theorem (pp. 479–482)

**Find the missing measure of each right triangle. Round to the nearest tenth if necessary.**

**23.**




**24.**



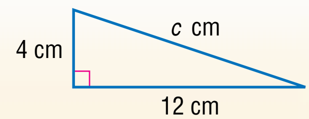

**25.** $a = 5$ ft, $b = 6$ ft

**26.** $b = 10$ yd, $c = 12$ yd

**27.** $a = 7$ m, $c = 15$ m

**28.** $a = 12$ in., $b = 4$ in.

**Example 4** **Find the missing measure of the triangle. Round to the nearest tenth if necessary.**



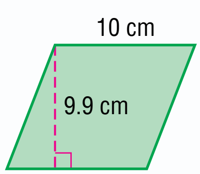

| | |
|---|---|
| $c^2 = a^2 + b^2$ | Pythagorean Theorem |
| $c^2 = 4^2 + 12^2$ | $a = 4$, $b = 12$ |
| $c^2 = 16 + 144$ | Evaluate. |
| $c^2 = 160$ | Add. |
| $c \approx 12.6$ | Take the square root of each side. |

The length of the hypotenuse is about 12.6 centimeters.

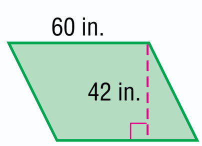
## 11-4 Area of Parallelograms (pp. 483–485)

**Find the area of each parallelogram. Round to the nearest tenth if necessary.**

**29.**



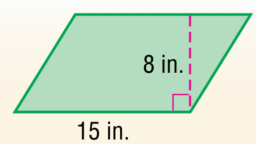

**30.**




**31.** base = 9 cm, height = 15 cm

**32.** base = 24 m, height = 16.2 m

**Example 5** **Find the area of a parallelogram if the base is 15 inches and the height is 8 inches.**

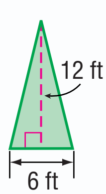



| | |
|---|---|
| $A = bh$ | Area of a parallelogram |
| $A = 15 \cdot 8$ | Replace $b$ with 15 and $h$ with 8. |
| $A = 120 \text{ in}^2$ | Multiply. |

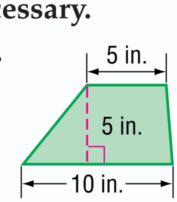
## 11-5 Area of Triangles and Trapezoids (pp. 489–492)

**Find the area of each figure. Round to the nearest tenth if necessary.**

**33.**




**34.**



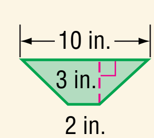

**35.** triangle: base = 24.7 cm, height = 15.2 cm

**36.** trapezoid: bases = 22 yd and 35 yd, height = 18.5 yd

**Example 6** **Find the area of a triangle with a base of 8 meters and a height of 11.2 meters.**

| | |
|---|---|
| $A = \frac{1}{2}bh$ | Area of a triangle |
| $A = \frac{1}{2}(8)(11.2)$ or $44.8 \text{ m}^2$ | $b = 8$, $h = 11.2$ |

**Example 7** **Find the area of the trapezoid.**




| | |
|---|---|
| $A = \frac{1}{2}h(b_1 + b_2)$ | |
| $A = \frac{1}{2}(3)(2 + 10)$ | $h = 3$, $b_1 = 2$, $b_2 = 10$ |
| $A = \frac{1}{2}(3)(12)$ or $18 \text{ in}^2$ | Simplify. |

**Mixed Problem Solving**
For mixed problem-solving practice, see page 606.

## 11-6 Area of Circles (pp. 493–495)

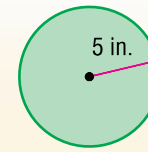
**Find the area of each circle. Round to the nearest tenth.**

**37.** radius = 11.4 in.

**38.** diameter = 44 cm

**39. GARDENING** A lawn sprinkler can water a circular area with a radius of 20 feet. Find the area that can be watered. Round to the nearest tenth.

**Example 8** **Find the area of a circle with a radius of 5 inches.**




$A = \pi r^2$ Area of a circle

$A = \pi(5)^2$ Replace $r$ with 5.

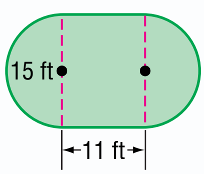
$A \approx 78.5$ Multiply.

The area of the circle is about 78.5 square inches.

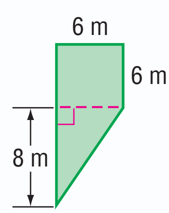
## 11-7 Area of Complex Figures (pp. 498–500)

**Find the area of each figure. Round to the nearest tenth if necessary.**

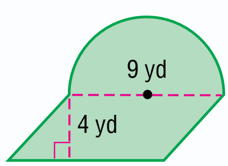
**40.**



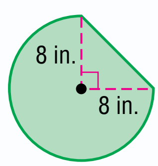

**41.**



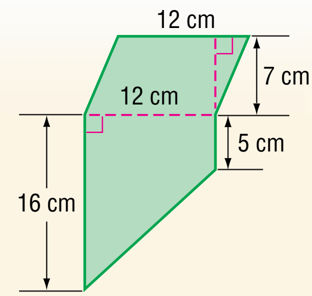

**42.**




**43.**




**Example 9** **Find the area of the figure.**




The figure can be separated into a parallelogram and a trapezoid.

parallelogram: $A = bh = (12)(7)$ or 84

trapezoid: $A = \frac{1}{2}h(b_1 + b_2)$

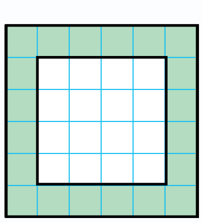
$= \frac{1}{2}(12)(16 + 5)$ or 126

The area of the figure is 84 + 126 or 210 square centimeters.

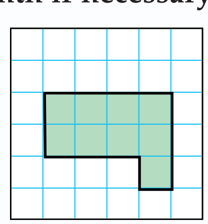
## 11-8 Probability: Area Models (pp. 501–503)

**A randomly-dropped counter falls in the squares. Find the probability that it falls in the shaded regions. Write as a percent. Round to the nearest tenth if necessary.**

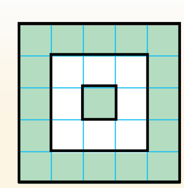
**44.**



**45.**



**Example 10** **Find the probability that a randomly-dropped counter will land on a white square.**



Probability of landing on a white square

$= \dfrac{\text{number of ways to land on white squares}}{\text{number of ways to land on squares}}$

$= \dfrac{\text{area of white squares}}{\text{total area}}$

$= \dfrac{8}{25}$ The probability is $\frac{8}{25}$ or 32%.

# CHAPTER 11 Practice Test

## Vocabulary and Concepts

1. **State** the measurements that you need in order to find the area of a parallelogram.
2. **Describe** how to find the area of a complex figure.

## Skills and Applications

3. Find the square of 9.

4. Find $\sqrt{400}$.

5. **PHYSICAL FITNESS** This morning, Elisa walked 1 mile north, 0.5 mile west, and then walked straight back to her starting point. How far did Elisa walk? Round to the nearest tenth.

6. Estimate $\sqrt{23}$ to the nearest whole number.

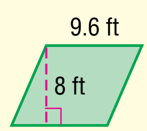
7. Use a calculator to find $\sqrt{133}$ to the nearest tenth.

**Find the missing measure of each right triangle. Round to the nearest tenth if necessary.**

8. $a = 5$ m, $b = 4$ m

9. $b = 12$ in., $c = 14$ in.

**Find the area of each figure. Round to the nearest tenth if necessary.**

10.
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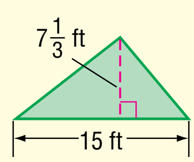


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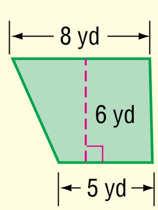
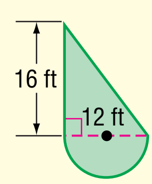



13.


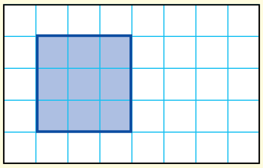

**Find the area of each circle. Round to the nearest tenth.**

14. radius = 9 ft

15. diameter = 5.2 cm

## Standardized Test Practice

16. **MULTIPLE CHOICE** A randomly dropped counter falls in the squares. Find the probability that it falls in the shaded squares. Write as a percent. Round to the nearest tenth if necessary.



Ⓐ 9%  Ⓑ 14.1%  Ⓒ 22.5%  Ⓓ 40%

# CHAPTER 11 Standardized Test Practice

## PART 1 Multiple Choice

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

**1.** Victoria bought 3 notebooks and 2 gel pens. Which expression represents her total cost if $n$ is the cost of each notebook and $p$ is the cost of each gel pen? (Lesson 1-4)

Ⓐ $n + p$ Ⓑ $5(n + p)$
Ⓒ $5n \cdot 2p$ Ⓓ $3n + 2p$

**2.** The table shows the weights of 13 dogs at a dog adoption center. Which measure of central tendency for these data is the least number? (Lesson 2-4)

| Weight (lb) | Number of Dogs |
|---|---|
| 20 | \|\|\| |
| 40 | \|\| |
| 60 | 𝍸 \|\| |
| 80 | \| |

Ⓕ median Ⓖ mean
Ⓗ mode Ⓘ range

**3.** To make muffins, Desiree used $4\frac{1}{8}$ cups of flour, $4\frac{2}{3}$ cups of water, $4\frac{1}{4}$ cups of sugar, and $4\frac{1}{3}$ cups of milk. Desiree used the least amount of which ingredient? (Lesson 5-8)

Ⓐ flour Ⓑ sugar
Ⓒ water Ⓓ milk

**4.** Find $\frac{1}{7} \times \frac{2}{9}$. (Lesson 6-4)

Ⓕ $\frac{1}{63}$ Ⓖ $\frac{2}{63}$ Ⓗ $\frac{3}{16}$ Ⓘ $\frac{9}{14}$

**5.** For his job, Marc drives 15,000 miles every 60 days. What is the average number of miles that Marc drives every day? (Lesson 7-2)

Ⓐ 250 mi Ⓑ 300 mi
Ⓒ 900 mi Ⓓ 1,500 mi

**6.** Trevor drives 45 miles per hour. Robin drives 54 miles per hour. What is the percent of increase from 45 miles per hour to 54 miles per hour? (Lesson 8-4)

Ⓕ 9% Ⓖ 20% Ⓗ 109% Ⓘ 120%

**7.** Chi can take 3 different routes and 4 different modes of transportation to get to school, as shown below.

| Route | Transportation |
|---|---|
| scenic | bike |
| quick | car |
| convenient | bus |
| | walking |

How many possible choices are there for Chi to use to get to school? (Lesson 9-3)

Ⓐ 7 Ⓑ 9 Ⓒ 12 Ⓓ 16

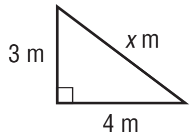
**8.** Which is the square root of 441? (Lesson 11-1)

Ⓕ 21 Ⓖ 22 Ⓗ 23 Ⓘ 24

**9.** Which is a reasonable *estimate* for the square root of 66? (Lesson 11-2)

Ⓐ 7.4 Ⓑ 7.8 Ⓒ 8.1 Ⓓ 8.9

**10.** What is the value of $x$ in the triangle? (Lesson 11-3)




Ⓕ 2 Ⓖ 5
Ⓗ 7 Ⓘ 125

**TEST-TAKING TIP**

**Question 8** You can use the answer choices to help you answer a multiple-choice question. For example, if you are asked to find the square root of a number, you can find the correct answer by calculating the square of the number in each answer choice.

## PART 2 Short Response/Grid In

**Record your answers on the answer sheet provided by your teacher or on a sheet of paper.**

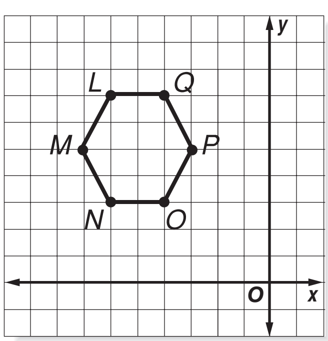
**11.** What value is represented by $(1 \times 10^5) + (2 \times 10^4) + (1 \times 10^3) + (1 \times 10^0)$? (Prerequisite Skill, page 555)

**12.** In the coordinate system, coordinates with a positive $x$ value and a negative $y$ value appear in what quadrant? (Lesson 3-3)

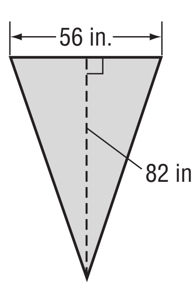
**13.** Write an equation to represent the following statement. (Lesson 4-1)

| |
|---|
| The Palmas have 8 less than 2 times the number of trees in their yard as the Kandinskis have. |

**14.** If you translate hexagon *LMNOPQ* 4 units to the right, what are the new coordinates of point *Q*? (Lesson 10-8)



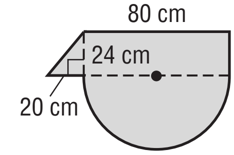

**15.** A window shade is being custom made to cover the triangular window shown at the right. What is the minimum area of the shade? (Lesson 11-5)



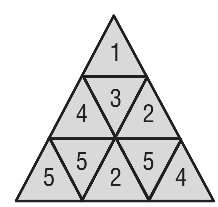

**16.** A kitchen chair has a circular seat that measures 14 inches across. What is the area of the seat on the kitchen chair? Use 3.14 for π and round to the nearest tenth. (Lesson 11-6)

**17.** The Connaught Centre building in Hong Kong has 1,748 circular windows. The diameter of each window is 2.4 meters. Find the total area of the glass in the windows. Round to the nearest tenth. (Lesson 11-6)

**18.** Find the area of the figure shown at the right. Use 3.14 for π. (Lesson 11-7)



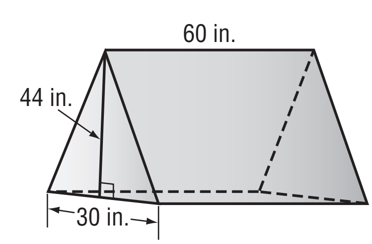

**19.** Amy plays hopscotch by throwing a small stone onto a numbered triangle. What is the probability that Amy's stone will land on a triangle numbered 5? Write as a fraction. (Lesson 11-8)




## PART 3 Extended Response

**Record your answers on a sheet of paper. Show your work.**

**20.** Suppose you bought a new tent with the dimensions shown below.




**a.** Is the area of the parallelogram-shaped side of the tent greater than or less than the area of the floor? Explain. (Lessons 11-3 and 11-4)

**b.** The front and back triangular regions are covered with screens. What is the total area of the screens? (Lesson 11-5)