

11-1

Squares and Square Roots (pages 470–473)

When you find the product of a number times itself, you are finding the square of the number. For example, $5 \times 5 = 5^2$, or 25. Numbers such as 25, 36, and 49 are called **perfect squares** because they are the squares of whole numbers. The inverse operation to finding a square of a number is finding the **square root** of a number.

Square Root If $a^2 = b$, then a is a square root of b , or $\sqrt{b} = a$.

There are actually two square roots to the above equation, a and $-a$. However, when the symbol $\sqrt{\quad}$, called a **radical sign**, is used to represent a square root, it always represents the positive square root.

EXAMPLES

A Evaluate 9^2 .

$9^2 = 9 \times 9$ *The exponent tells you how many times the base is used as a factor.*
 $= 81$
The square of 9 is 81.

B Find $\sqrt{100}$.

*Since $10^2 = 100$, $\sqrt{100} = 10$.
 The square root of 100 is 10.*

Try These Together

1. Evaluate 12^2 . 2. Find $\sqrt{49}$.
HINT: What is the product of 12 times itself? *HINT: For which number is 49 the square?*

PRACTICE

Find the square of each number.

- | | | | |
|-------|-------|-------|---------|
| 3. 3 | 4. 5 | 5. 14 | 6. 28 |
| 7. 50 | 8. 45 | 9. 37 | 10. 100 |

Find each square root.

- | | | | |
|--------------------|--------------------|--------------------|----------------------|
| 11. $\sqrt{361}$ | 12. $\sqrt{484}$ | 13. $\sqrt{400}$ | 14. $\sqrt{676}$ |
| 15. $\sqrt{1,369}$ | 16. $\sqrt{1,681}$ | 17. $\sqrt{3,481}$ | 18. $\sqrt{160,000}$ |

19. Interior Design Cole is installing 1-inch square tiles in his entryway. What are the dimensions of the square entryway if he is using 1,296 tiles?



20. Standardized Test Practice What is the square of 25?

- A** 5 **B** 50 **C** 625 **D** 15,625

Answers: 1. 144 2. 7 3. 9 4. 25 5. 196 6. 784 7. 2,500 8. 2,025 9. 1,369 10. 10,000 11. 19 12. 22 13. 20 14. 26 15. 37 16. 41 17. 59 18. 400 19. 36 inches \times 36 inches 20. C

11-2

Estimating Square Roots (pages 475–477)

You can estimate to find the square root of a number that is not a perfect square.

EXAMPLE

Estimate $\sqrt{13}$ to the nearest whole number.

Since 13 is not a perfect square, estimate $\sqrt{13}$ by finding the two perfect squares closest to 13.

1, 4, 9, 16, 25, ... List some perfect squares. 13 is between 9 and 16.

$\sqrt{9} < \sqrt{13} < \sqrt{16}$ Find the square root of each number.

$$3 < \sqrt{13} < 4$$

This means that $\sqrt{13}$ is between 3 and 4. Since 13 is closer to 16 than 9, then the best whole number estimate for $\sqrt{13}$ is 4.

Try These Together

Estimate each square root to the nearest whole number.

1. $\sqrt{7}$

HINT: Between which two perfect squares does 7 fall?

2. $\sqrt{48}$

HINT: Between which two perfect squares does 48 fall?

PRACTICE

Estimate each square root to the nearest whole number.

3. $\sqrt{75}$

4. $\sqrt{93}$

5. $\sqrt{119}$

6. $\sqrt{150}$

7. $\sqrt{288}$

8. $\sqrt{464}$

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

9. $\sqrt{30}$

10. $\sqrt{45}$

11. $\sqrt{63}$

12. $\sqrt{90}$

13. $\sqrt{130}$

14. $\sqrt{333}$

15. $\sqrt{750}$

16. $\sqrt{1,122}$

17. **Money Matters** The Etherton family purchased a square lot for their new home that has an area of one acre. An acre is 4,840 square yards. How many yards is one side of their property? Round to the nearest tenth of a yard.



18. **Standardized Test Practice** Find $\sqrt{65}$ to the nearest tenth.

A 8.0

B 8.1

C 9.0

D 9.1

Answers: 1. 3 2. 7 3. 9 4. 10 5. 11 6. 12 7. 17 8. 22 9. 5.5 10. 6.7 11. 7.9 12. 9.5 13. 11.4 14. 18.2 15. 27.4 16. 33.5 17. 69.6 yards 18. B

11-3

The Pythagorean Theorem (pages 479–482)

The longest side of a right triangle is called the **hypotenuse**. The hypotenuse is always opposite the right angle. The other two sides, called **legs**, form the sides of the right angle. Use the **Pythagorean Theorem** to find the lengths of the hypotenuse and the legs of a right triangle.

Pythagorean Theorem	<p>Words: In a right triangle, the square of the length of the hypotenuse (c) equals the sum of the squares of the lengths of the legs (a and b).</p> <p>Algebra: $c^2 = a^2 + b^2$, where a and b are the legs and c is the hypotenuse</p>
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EXAMPLE

A right triangle has legs of 6 cm and 8 cm. What is the length of the hypotenuse?

$$c^2 = 6^2 + 8^2 \quad \text{Use the Pythagorean Theorem. Replace } a \text{ and } b \text{ with the values you know.}$$

$$c^2 = 36 + 64$$

$$c^2 = 100$$

$$c = \sqrt{100} \quad \text{Definition of square root}$$

$$c = 10$$

So, the length of the hypotenuse is 10 cm.

Try These Together

Find the missing measure for each right triangle. Round to the nearest tenth.

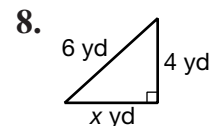
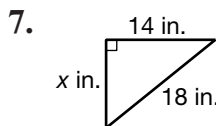
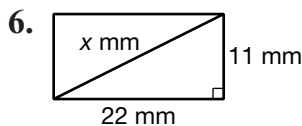
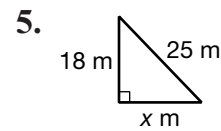
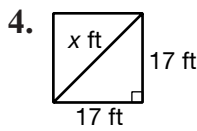
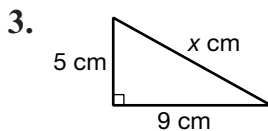
1. $a: 17; b: 4$

2. $a: 20; b: 28$

HINT: Be sure to identify whether a hypotenuse or leg measure is missing before you begin.

PRACTICE

Write an equation to solve for x . Then solve. Round to the nearest tenth.



9. **Construction** Alberto is making a ramp to the door of the chicken coop. The floor of the coop is 14 inches above the ground. The end of the ramp needs to be 3 feet from the coop. How long will the ramp be?



10. **Standardized Test Practice** A rectangle is 12 meters by 9 meters. Find the length of one of its diagonals to the nearest tenth of a meter.

A 7.9 m

B 15.0 m

C 21.0 m

D 22.5 m

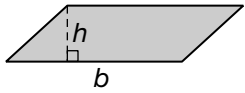
<p>Answers: 1. 17.5 2. 34.4 3. $x^2 = 5^2 + 9^2; 10.3$ cm 4. $x^2 = 17^2 + 17^2; 24.0$ ft 5. $25^2 = x^2 + 18^2; 17.3$ mm 6. $x^2 = 11^2 + 22^2; 24.6$ mm 7. $18^2 = 14^2 + x^2; 11.3$ in. 8. $6^2 = x^2 + 4^2; 4.5$ yd 9. 38.6 in. 10. B</p>

11-4

Area of Parallelograms (pages 483–485)

The **area** (A) of a closed figure is the number of square units needed to cover its surface.

A **parallelogram** is a quadrilateral with opposite sides parallel and opposite sides congruent. One of its sides is called its **base**. The length of the segment perpendicular to the base with endpoints on opposite sides is the **height**.

Area of Parallelograms	The area (A) of a parallelogram equals the product of its base (b) and height (h). $A = bh$	
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EXAMPLES

A Find the area of a parallelogram with a base of 10 cm and a height of 4 cm.

$A = bh$ Write the formula for area.
 $A = 10 \times 4$ Replace b with 10 and h with 4.
 $A = 40$ Multiply.
 The area is 40 cm^2 .

B Find the area of a parallelogram with a base of 13 m and a height of 5 m.

$A = bh$ Write the formula for area.
 $A = 13 \times 5$ Replace b with 13 and h with 5.
 $A = 65$ Multiply.
 The area is 65 m^2 .

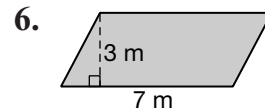
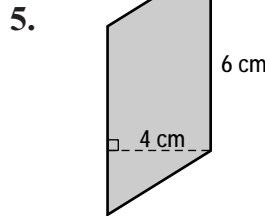
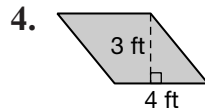
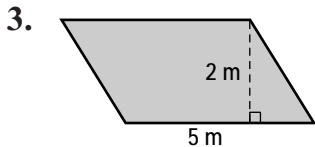
Try These Together

- Find the area of a parallelogram with a base of 12 in. and a height of 9 in.
- Find the area of a parallelogram with a base of 24 ft and a height of 11 ft.

HINT: The area of a parallelogram is base times height.

PRACTICE

Find the area of each parallelogram.



7. **Standardized Test Practice** The owner of a video store needs to pave a new parking lot. The parking lot is in the shape of a parallelogram with a base of 80 feet and a height of 120 feet. How many square feet of pavement will he need to order?

- A** 960 ft^2 **B** 1,600 ft^2 **C** 9,600 ft^2 **D** 4,800 ft^2

Answers: 1. 108 in^2 2. 264 ft^2 3. 10 m^2 4. 12 ft^2 5. 24 cm^2 6. 21 m^2 7. C

11-5

Area of Triangles and Trapezoids (pages 489–492)

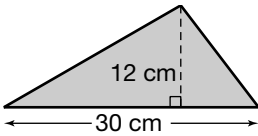
You can use the following formulas to find the area of triangles and trapezoids.

Area of a Triangle	The area (A) of a triangle equals half of the product of its base (b) and height (h), or $A = \frac{1}{2}bh$.
Area of a Trapezoid	The area (A) of a trapezoid equals half the product of the height (h) and the sum of the bases ($b_1 + b_2$), or $A = \frac{1}{2}h(b_1 + b_2)$.

EXAMPLES

Find the area of each figure.

A



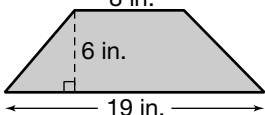
$$A = \frac{1}{2}bh$$

$$A = \frac{1}{2} \times 30 \times 12$$

$$A = 15 \times 12$$

$$A = 180 \text{ cm}^2$$

B



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

$$A = \frac{1}{2}(6)(8 + 19)$$

$$A = (3)(27)$$

$$A = 81 \text{ in}^2$$

Try These Together

Find the area of each triangle or trapezoid to the nearest tenth.

1. base: 4 in.
height: 9 in.

HINT: Substitute values carefully.

2. bases: 8 cm, 2 cm
height: 14 cm

HINT: Do not forget to add the bases.

PRACTICE

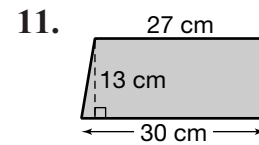
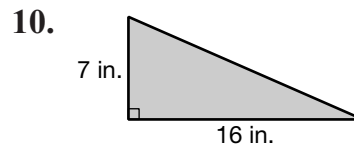
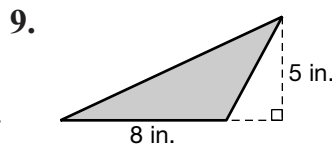
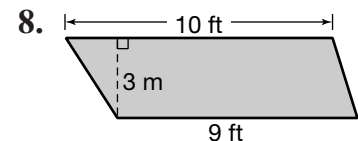
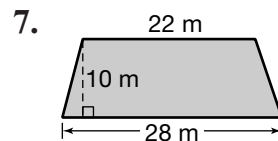
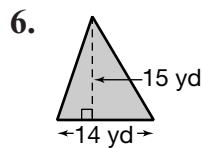
Find the area of each triangle or trapezoid to the nearest tenth.

3. base: 1.2 cm
height: 1.8 cm

4. base: 23 yd
height: 8 yd

5. bases: 5 ft, 13 ft
height: 9 ft

Find the area of each figure to the nearest tenth.



12. **Standardized Test Practice** What is the area of a trapezoid with bases of 9 centimeters and 11 centimeters and a height of 4 centimeters?

A 40 cm²

B 80 cm²

C 160 cm²

D 396 cm²

Answers: 1. 18 in² 2. 70 cm² 3. 1.1 cm² 4. 92 yd² 5. 81 ft² 6. 105 yd² 7. 250 m² 8. 28.5 ft² 9. 20 in² 10. 56 in² 11. 370.5 cm² 12. A

11-6

Area of Circles (pages 493–495)

You can use the formula below to find the area of a circle. You can use your calculator for calculations involving π .

Area of a Circle	The area (A) of a circle equals the product of pi (π) and the square of its radius (r), or $A = \pi r^2$.
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EXAMPLES

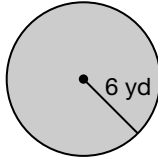
A Find the area of the circle to the nearest tenth.

$$A = \pi r^2$$

$$A = \pi \times 6^2$$

$$A = \pi \times 36$$

$$A \approx 113.1 \text{ yd}^2$$



B Find the length of the radius of a circle with an area of 96 m^2 .

$$A = \pi r^2 \quad \text{Use the formula for the area of a circle.}$$

$$96 = \pi r^2 \quad \text{Substitute the area.}$$

$$\frac{96}{\pi} = \frac{\pi r^2}{\pi} \quad \text{Divide each side by } \pi.$$

$$30.6 \approx r^2 \quad \text{Use a calculator.}$$

$$\sqrt{30.6} \approx r, \text{ so } 5.5 \approx r$$

The radius is about 5.5 m.

Try These Together

Find the area of each circle to the nearest tenth.

- diameter: 5 in.
- diameter: 8 m

HINT: Use the diameter length to find the radius before you use the area formula.

PRACTICE

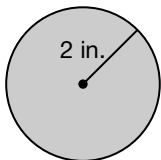
Find the area of each circle to the nearest tenth.

3. radius: 19 cm

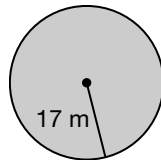
4. radius: 11.3 m

5. radius: 16 yd

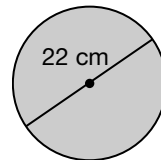
6.



7.



8.



Find the length of the radius of each circle given the following areas. Round to the nearest tenth.

- 18 yd^2
- 60 m^2
- 75 m^2
- 23 cm^2
- 48 in^2
- 32 cm^2

15. Music The diameter of a compact disc (CD) is 12 centimeters. The diameter of its hole is 1.5 centimeters. What is the area of one side of a CD?

16. Standardized Test Practice What is the area of a circle with a diameter of 18 meters?

- A** 2.4 m^2 **B** 5.7 m^2 **C** 254.5 m^2 **D** $1,017.8 \text{ m}^2$

Answers: 1. 19.6 in^2 2. 50.3 m^2 3. $1,134.1 \text{ cm}^2$ 4. 401.1 m^2 5. 804.2 yd^2 6. 12.6 in^2 7. 907.9 m^2 8. 380.1 cm^2 9. 2.4 yd^2 10. 4.4 m 11. 4.9 cm 12. 2.7 cm 13. 3.9 in. 14. 3.2 cm 15. about 111.3 cm^2 16. C

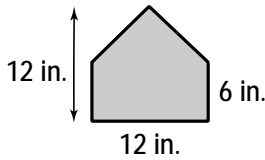
11-7

Area of Complex Figures (pages 498–500)

Complex figures are 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 the figure.



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

Area of Rectangle

$$A = \ell w \quad \text{Area of a rectangle.}$$

$$A = 12 \cdot 6 \quad \text{Replace } \ell \text{ with } 12 \text{ and } w \text{ with } 6.$$

$$A = 72 \quad \text{Multiply.}$$

Area of Triangle

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

$$A = \frac{1}{2}(12)(6) \quad b = 12, h = 12 - 6 \text{ or } 6$$

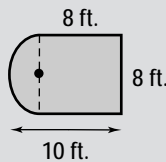
$$A = 36 \quad \text{Multiply.}$$

The area of the figure is $72 + 36$ or 108 square inches.

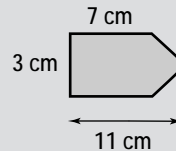
Try These Together

Find the area of each figure to the nearest tenth.

1.



2.

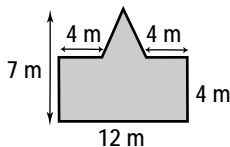


HINT: Find figures for which you know how to find the area.

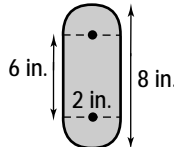
PRACTICE

Find the area of each figure to the nearest tenth.

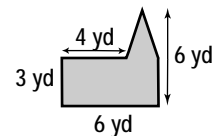
3.



4.



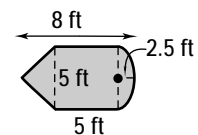
5.



6. **Standardized Test Practice** What is the area of the figure to the nearest tenth?

- A** 36.4 ft²
C 49.8 ft²

- B** 42.3 ft²
D 52.1 ft²



Answers: 1. 70.3 ft² 2. 27 cm² 3. 54 m² 4. 15.1 in² 5. 21 yd² 6. B

11-8

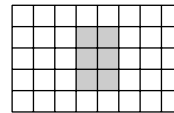
Area Models and Probability (pages 501–503)

You can use area models to find the probability of some events.

Probability	Probability (P) is equal to the ratio of the number of ways a certain event can occur to the number of possible outcomes, or $P = \frac{\text{number of ways a certain event can occur}}{\text{number of possible outcomes}}$
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EXAMPLE

Find the probability that a randomly-dropped counter will fall in the shaded region.



$$P = \frac{\text{number of ways to land in the targeted region}}{\text{number of ways to land in the entire figure}}$$

You are comparing two different areas, so you can substitute these areas into the equation.

$$P = \frac{\text{area of targeted region}}{\text{area of the entire figure}}$$

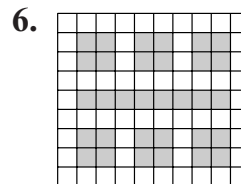
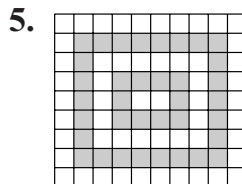
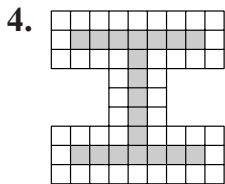
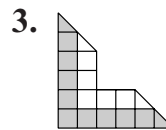
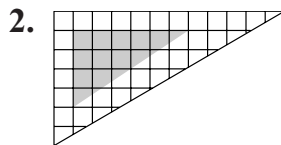
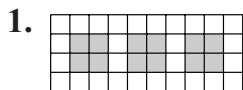
$$P = \frac{6 \text{ square units}}{40 \text{ square units}}, \text{ or } \frac{6}{40}$$

$$P = \frac{6 \div 2}{40 \div 2} \quad \text{Divide the numerator and denominator by the GCF.}$$

$$P = \frac{3}{20}$$

PRACTICE

Find the probability that a randomly-dropped counter will fall in the shaded region.



7. **Standardized Test Practice** A toddler spilled a cup of milk on the floor of a room that has 350 square feet of carpet, and 200 square feet of tile. What is the probability that the toddler spilled the milk on the tile?

A $\frac{7}{11}$

B $\frac{3}{8}$

C $\frac{2}{5}$

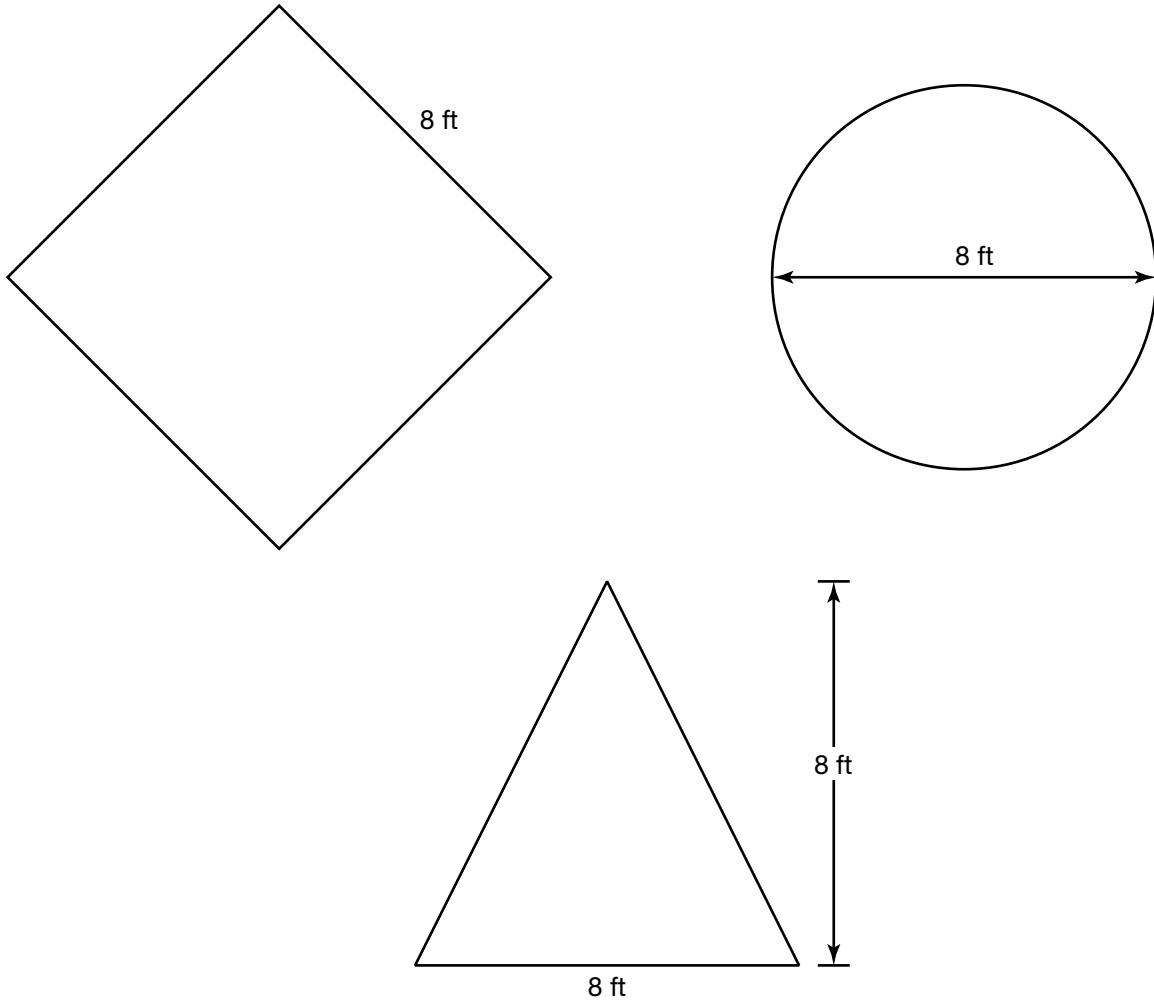
D $\frac{4}{11}$

Answers: 1. $\frac{10}{3}$ 2. $\frac{7}{2}$ 3. $\frac{8}{5}$ 4. $\frac{63}{19}$ 5. $\frac{5}{2}$ 6. $\frac{45}{16}$ 7. D
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Chapter 11 Review

Work Smarter, Not Harder!

Lawanda and the other students in the 4-H club have volunteered with other student organizations to paint the inside of the local youth recreation center. Each club is going to paint a different geometric figure on the wall of the recreation center. Because her group has the fewest members, Lawanda wants to help her club members pick the smallest figure to paint.



Which of the above figures should Lawanda's club pick? Explain your answer.

Answers are located on page 108.