

6.5 Using the Pythagorean Theorem

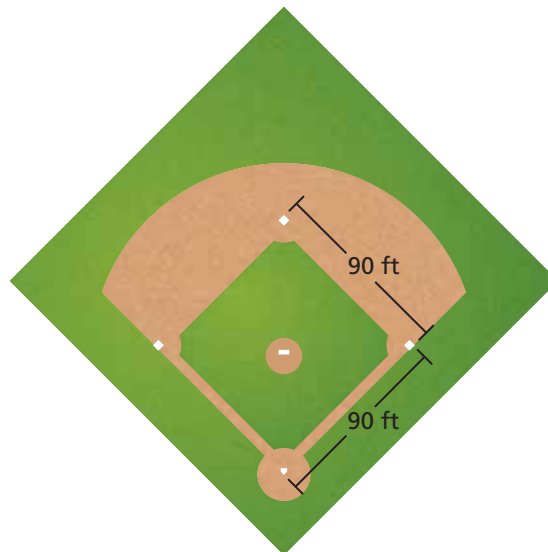
Essential Question How can you use the Pythagorean Theorem to solve real-life problems?



1 ACTIVITY: Using the Pythagorean Theorem

Work with a partner.

- A baseball player throws a ball from second base to home plate. How far does the player throw the ball? Include a diagram showing how you got your answer. Decide how many decimal points of accuracy are reasonable. Explain your reasoning.
- The distance from the pitcher's mound to home plate is 60.5 feet. Does this form a right triangle with first base? Explain your reasoning.



2 ACTIVITY: Firefighting and Ladders

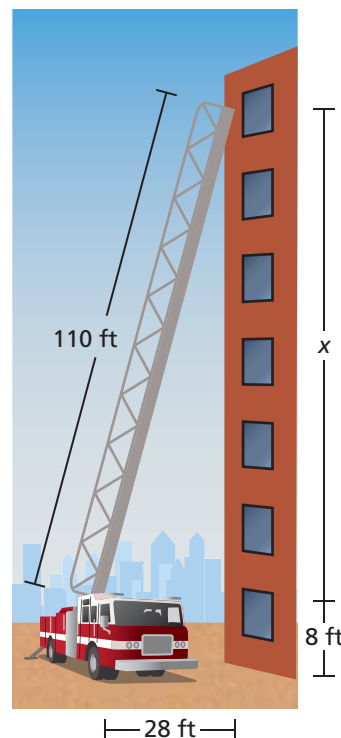
Work with a partner.

The recommended angle for a firefighting ladder is 75° .

When a 110-foot ladder is put up against a building at this angle, the base of the ladder is about 28 feet from the building.

The base of the ladder is 8 feet above the ground.

How high on the building will the ladder reach? Round your answer to the nearest tenth.

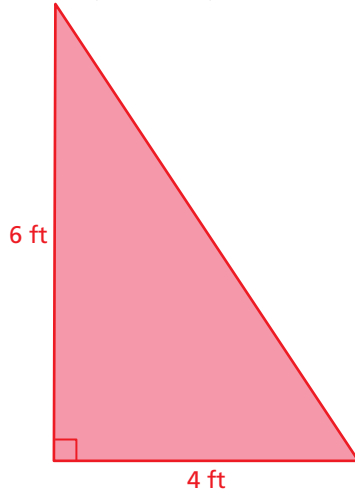


3 ACTIVITY: Finding Perimeters

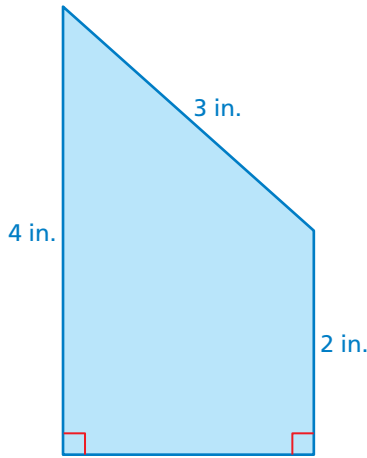
Work with a partner.

Find the perimeter of each figure. Round your answer to the nearest tenth. Did you use the Pythagorean Theorem? If so, explain.

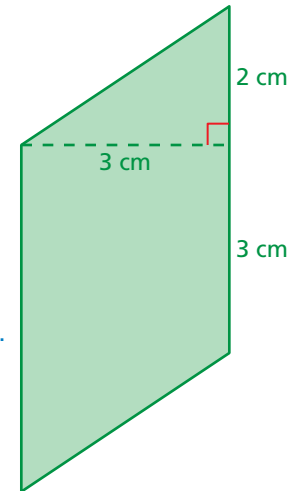
a. Right triangle



b. Trapezoid



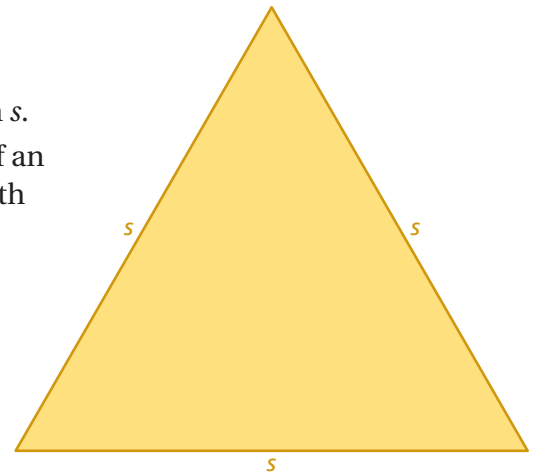
c. Parallelogram



4 ACTIVITY: Writing a Formula

Work with a partner.

- Write a formula for the area of an equilateral triangle with side length s .
- Use your formula to find the area of an equilateral triangle with a side length of 10 inches.



What Is Your Answer?

- IN YOUR OWN WORDS** How can you use the Pythagorean Theorem to solve real-life problems?
- Describe a situation in which you could use the Pythagorean Theorem to help make decisions. Give an example of a real-life problem.

Practice

Use what you learned about using the Pythagorean Theorem to complete Exercises 3–5 on page 262.

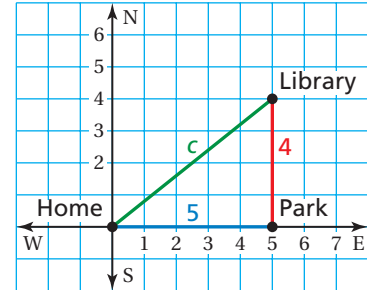
EXAMPLE 1 Finding a Distance in a Coordinate Plane

Key Vocabulary

Pythagorean triple,
p. 261

The park is 5 miles east of your home. The library is 4 miles north of the park. How far is your home from the library? Round your answer to the nearest tenth.

Plot a point for your home at the origin in a coordinate plane. Then plot points for the locations of the park and the library to form a right triangle.



$$a^2 + b^2 = c^2 \quad \text{Write the Pythagorean Theorem.}$$

$$4^2 + 5^2 = c^2 \quad \text{Substitute 4 for } a \text{ and 5 for } b.$$

$$16 + 25 = c^2 \quad \text{Evaluate powers.}$$

$$41 = c^2 \quad \text{Add.}$$

$$\sqrt{41} = \sqrt{c^2} \quad \text{Take positive square root of each side.}$$

$$6.4 \approx c \quad \text{Use a calculator.}$$

∴ Your home is about 6.4 miles from the library.

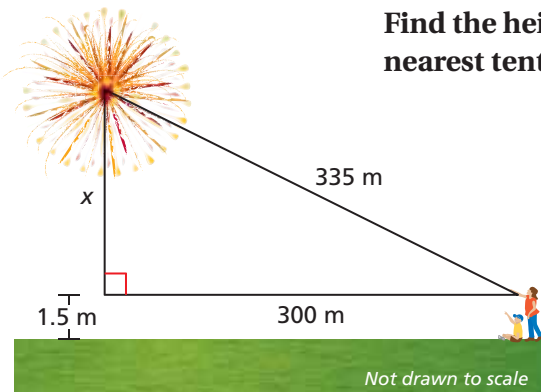
On Your Own

Now You're Ready
Exercises 6–8

- The post office is 3 miles west of your home. Your school is 2 miles north of the post office. How far is your home from your school? Round your answer to the nearest tenth.

EXAMPLE 2 Real-Life Application

Find the height of the firework. Round your answer to the nearest tenth.



$$a^2 + b^2 = c^2 \quad \text{Write the Pythagorean Theorem.}$$

$$x^2 + 300^2 = 335^2 \quad \text{Substitute.}$$

$$x^2 + 90,000 = 112,225 \quad \text{Evaluate powers.}$$

$$x^2 = 22,225 \quad \text{Subtract 90,000 from each side.}$$

$$\sqrt{x^2} = \sqrt{22,225} \quad \text{Take positive square root of each side.}$$

$$x \approx 149.1 \quad \text{Use a calculator.}$$

∴ The height of the firework is about $149.1 + 1.5 = 150.6$ meters.

On Your Own

2. **WHAT IF?** In Example 2, the distance between you and the firework is 350 meters. Find the height of the firework. Round your answer to the nearest tenth.

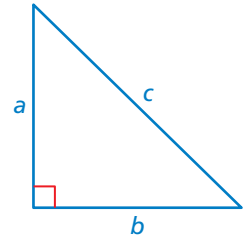
A **Pythagorean triple** is a set of three positive integers a , b , and c where $a^2 + b^2 = c^2$.

Key Idea

Converse of the Pythagorean Theorem

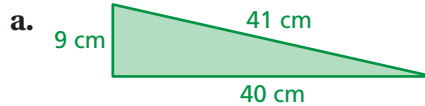
If the equation $a^2 + b^2 = c^2$ is true for the side lengths of a triangle, then the triangle is a right triangle.

When using the converse of the Pythagorean Theorem, always substitute the length of the longest side for c .



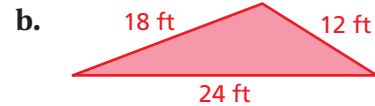
EXAMPLE 3 Identifying a Right Triangle

Tell whether the given triangle is a right triangle.



$$\begin{aligned} a^2 + b^2 &= c^2 \\ 9^2 + 40^2 &\stackrel{?}{=} 41^2 \\ 81 + 1600 &\stackrel{?}{=} 1681 \\ 1681 &= 1681 \quad \checkmark \end{aligned}$$

∴ It is a right triangle.

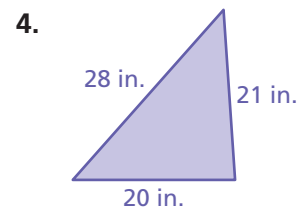
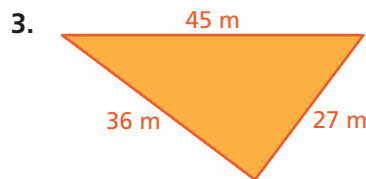


$$\begin{aligned} a^2 + b^2 &= c^2 \\ 12^2 + 18^2 &\stackrel{?}{=} 24^2 \\ 144 + 324 &\stackrel{?}{=} 576 \\ 468 &\neq 576 \quad \times \end{aligned}$$

∴ It is *not* a right triangle.

On Your Own

Tell whether the triangle with the given side lengths is a right triangle.



5. $1\frac{1}{2}$ yd, $2\frac{1}{2}$ yd, $3\frac{1}{2}$ yd

6. 1.25 mm, 1 mm, 0.75 mm

Vocabulary and Concept Check

- WRITING** How can the Pythagorean Theorem be used to find distances in a coordinate plane?
- WHICH ONE DOESN'T BELONG?** Which set of numbers does *not* belong with the other three? Explain your reasoning.

3, 6, 8

6, 8, 10

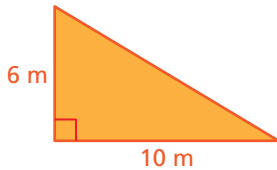
5, 12, 13

7, 24, 25

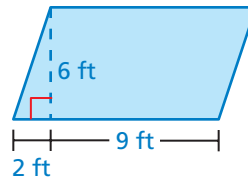
Practice and Problem Solving

Find the perimeter of the figure. Round your answer to the nearest tenth.

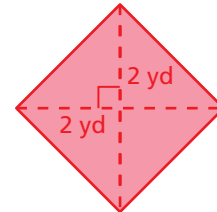
3. Right triangle



4. Parallelogram

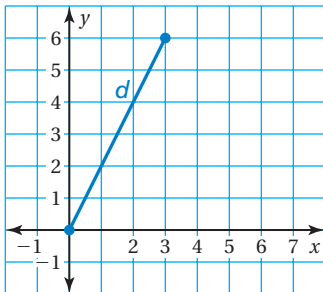


5. Square

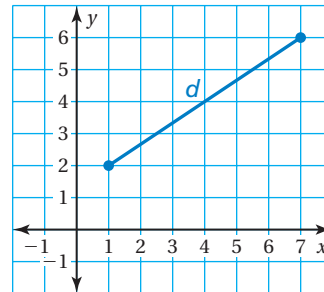


Find the distance d . Round your answer to the nearest tenth.

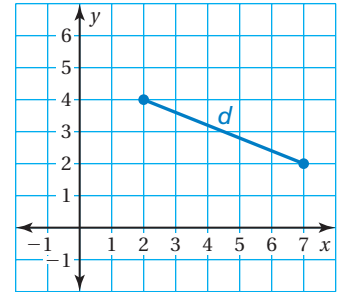
1 6.



7.

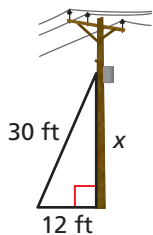


8.

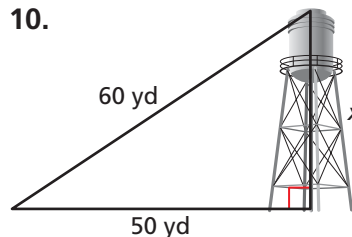


Find the height x . Round your answer to the nearest tenth.

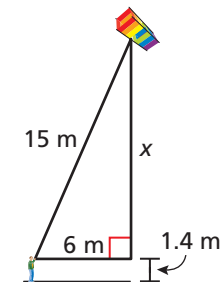
2 9.



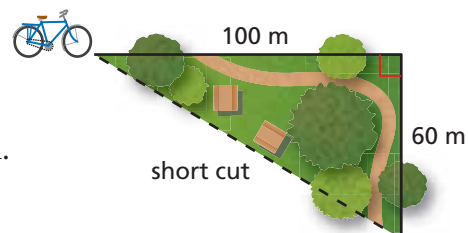
10.



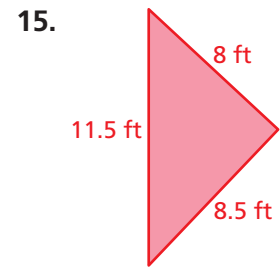
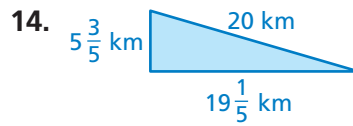
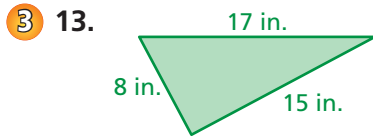
11.



12. **BICYCLE** You ride your bicycle along the outer edge of a park. Then you take a shortcut back to where you started. Find the length of the shortcut. Round your answer to the nearest tenth.



Tell whether the triangle with the given side lengths is a right triangle.

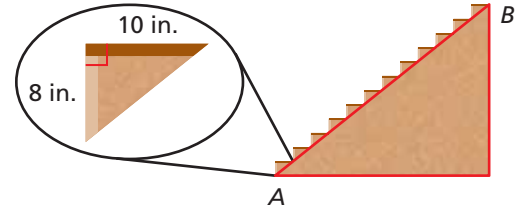


16. 14 mm, 19 mm, 23 mm

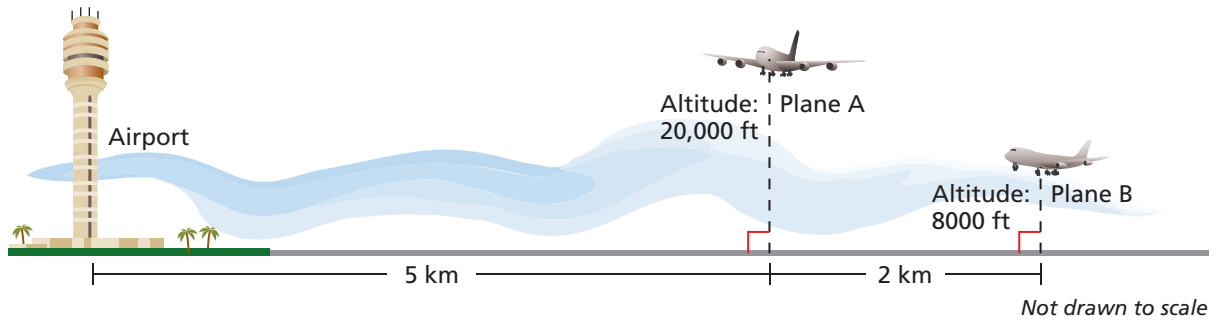
17. $\frac{9}{10}$ mi, $1\frac{1}{5}$ mi, $1\frac{1}{2}$ mi

18. 1.4 m, 4.8 m, 5 m

19. **STAIRS** There are 12 steps in the staircase. Find the distance from point A to point B (in feet). Round your answer to the nearest tenth.

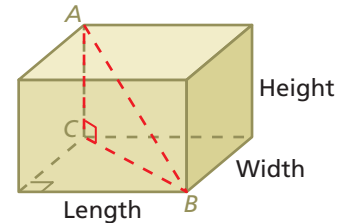


20. **AIRPORT** Which plane is closer to the tower? Explain.



21. **PROJECT** Find a shoebox or some other small box.

- Measure the dimensions of the box.
- Without measuring, find length BC and length AB .
- Use a piece of string and a ruler to check the lengths you found in part (b).



22. **Critical Thinking** Plot the points $(-1, -2)$, $(2, 1)$, and $(-3, 6)$ in a coordinate plane. Are the points the vertices of a right triangle? Explain.



Fair Game Review What you learned in previous grades & lessons

Find the mean, median, and mode of the data. (*Skills Review Handbook*)

23. 12, 9, 17, 15, 12, 13

24. 21, 32, 16, 27, 22, 19, 10

25. 67, 59, 34, 71, 59

26. **MULTIPLE CHOICE** What is the sum of the angle measures of an octagon? (*Section 5.3*)

(A) 720°

(B) 1080°

(C) 1440°

(D) 1800°