English Spanish

6.5 Using the Pythagorean Theorem

STATE STANDARDS
MA.8.G.2.4
MA.8.A.6.2
MA.8.A.6.4

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

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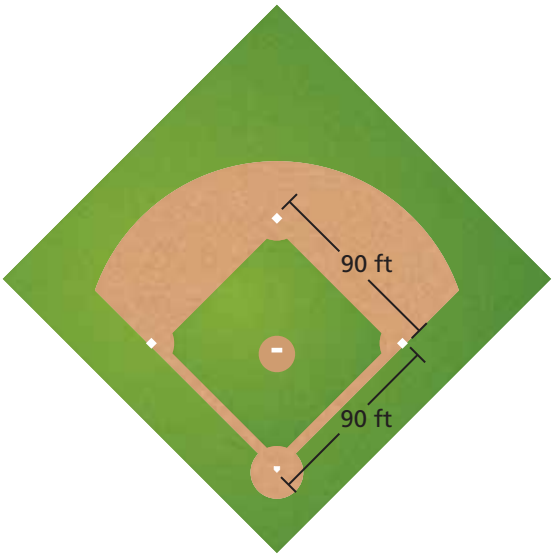
1 ACTIVITY: Using the Pythagorean Theorem

Work with a partner.

a. 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.

b. 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

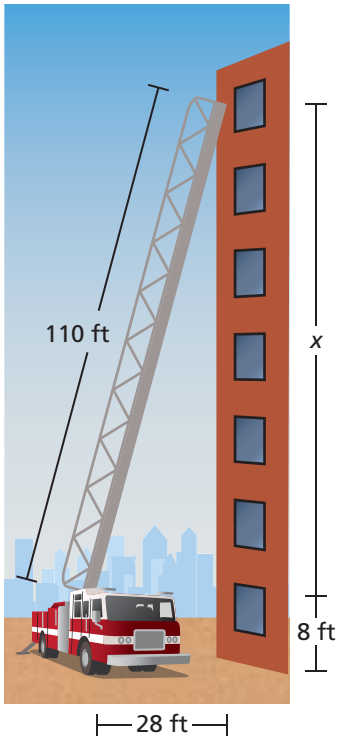
Work with a partner.

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.



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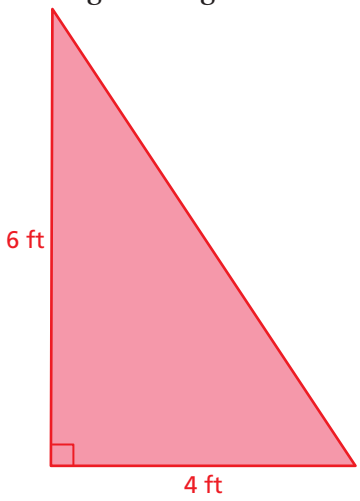
3 ACTIVITY: Finding Perimeters

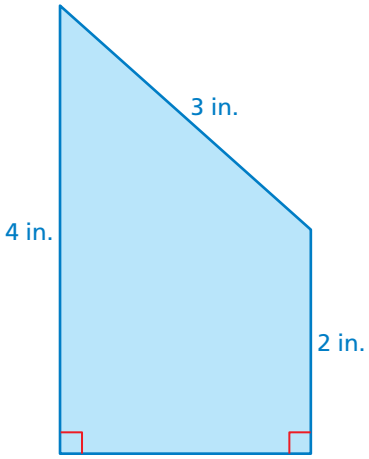
Work with a partner.

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

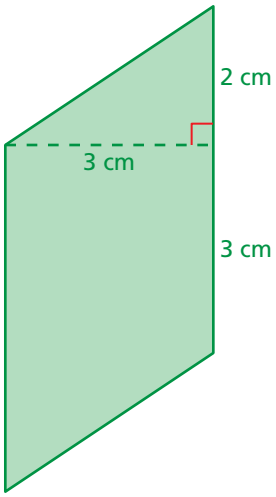
a. Right triangle



b. Trapezoid



c. Parallelogram

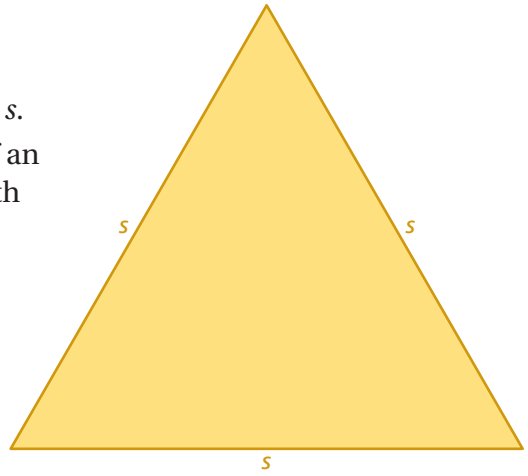


4 ACTIVITY: Writing a Formula

Work with a partner.

a. Write a formula for the area of an equilateral triangle with side length s.

b. Use your formula to find the area of an equilateral triangle with a side length of 10 inches.



What Is Your Answer?

5. **IN YOUR OWN WORDS** How can you use the Pythagorean Theorem to solve real-life problems?

6. 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.

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6.5 Lesson

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Lesson Tutorials
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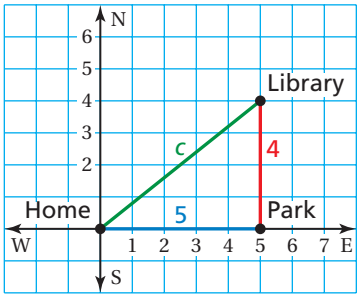
EXAMPLE 1 Finding a Distance in a Coordinate Plane

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.



$a^2 + b^2 = c^2$ Write the Pythagorean Theorem.

$4^2 + 5^2 = c^2$ Substitute 4 for a and 5 for b.

$16 + 25 = c^2$ Evaluate powers.

$41 = c^2$ Add.

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

$6.4 \approx c$ Use a calculator.

∴ Your home is about 6.4 miles from the library.

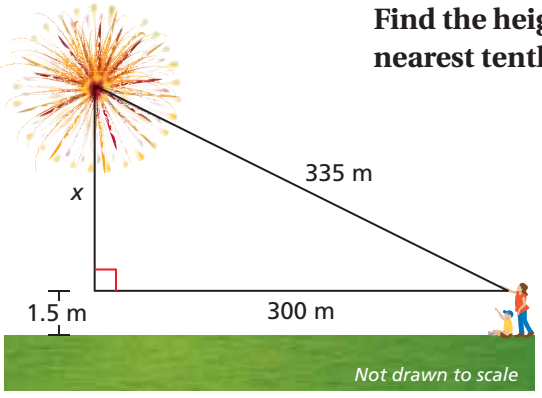
On Your Own

Now You're Ready
Exercises 6–8

1. 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.



$a^2 + b^2 = c^2$ Write the Pythagorean Theorem.

$x^2 + 300^2 = 335^2$ Substitute.

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

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

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

$x \approx 149.1$ Use a calculator.

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

On Your Own

Now You're Ready
Exercises 9–11

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.

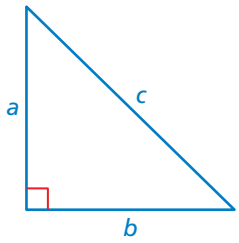
A **Pythagorean triple** is a set of three positive integers a, b, and c where $a^2 + b^2 = c^2$.

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.

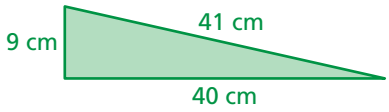
When using the converse of the Pythagorean Theorem, always substitute the length of the longest side for c.



EXAMPLE 3 Identifying a Right Triangle

Tell whether the given triangle is a right triangle.

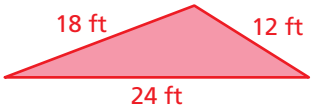
a.



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

∴ It *is* a right triangle.

b.



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

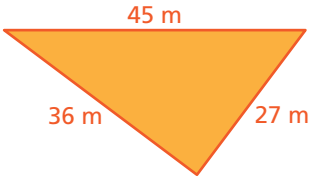
∴ It is *not* a right triangle.

On Your Own

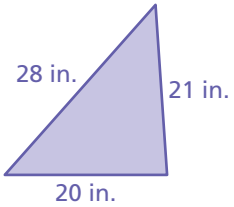
Now You're Ready
Exercises 13–18

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

3.



4.



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

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6.5 Exercises

Check It Out
Help with Homework
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Vocabulary and Concept Check

1. **WRITING** How can the Pythagorean Theorem be used to find distances in a coordinate plane?

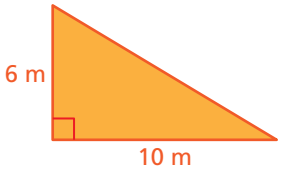
2. **WHICH ONE DOESN'T BELONG?** Which set of numbers does *not* belong with the other three? Explain your reasoning.

3, 6, 8	6, 8, 10	5, 12, 13	7, 24, 25

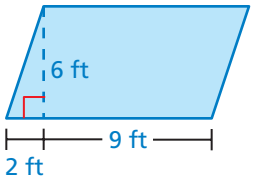
Practice and Problem Solving

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

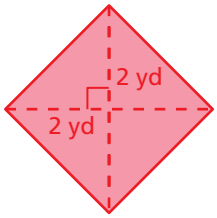
3. Right triangle



4. Parallelogram



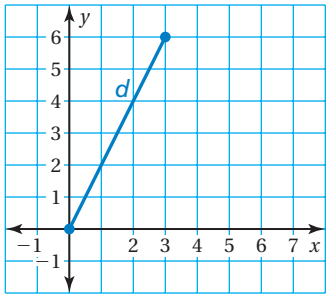
5. Square



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

1

6.



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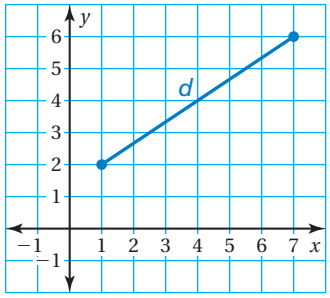

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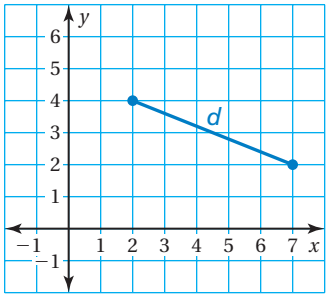
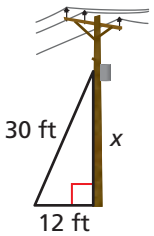


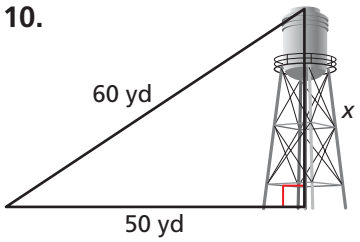
Find the height *x*. Round your answer to the nearest tenth.

2

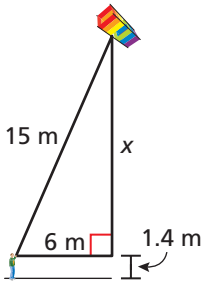
9.



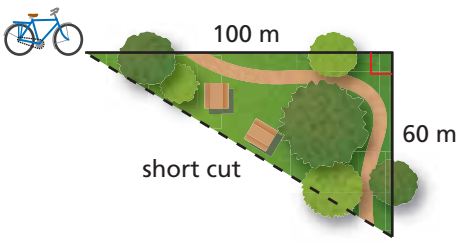
10.



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.



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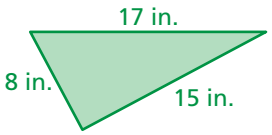
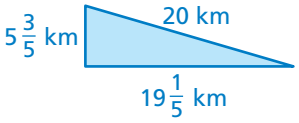
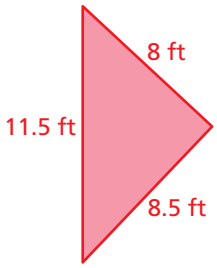
Tell whether the triangle with the given side lengths is a right triangle.

13. 

14. 

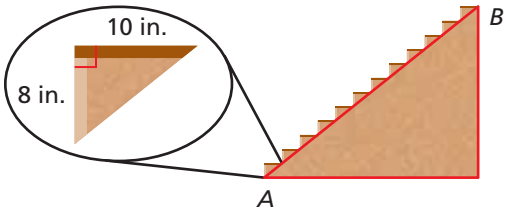
15. 

16. 14 mm, 19 mm, 23 mm

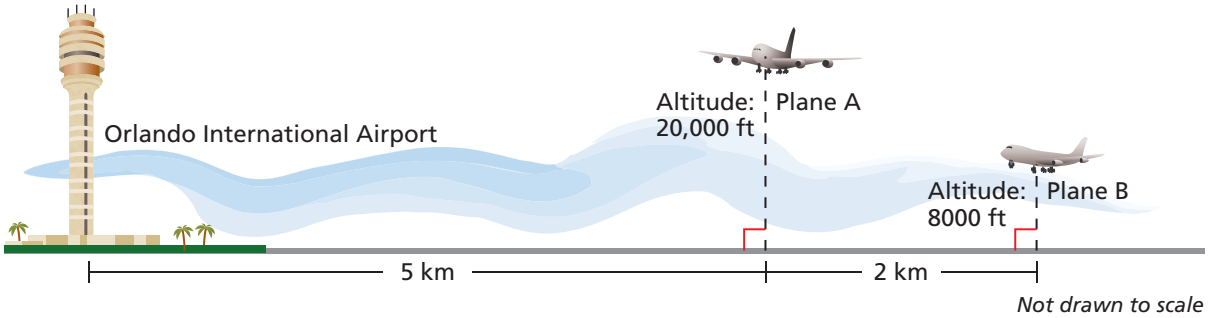
17. $\frac{9}{10}$ mi, $1\frac{1}{5}$ mi, $1\frac{1}{2}$ mi

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.

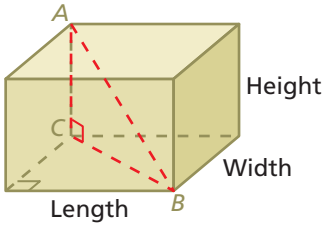


21. PROJECT Find a shoebox or some other small box.

a. Measure the dimensions of the box.

b. Without measuring, find length *BC* and length *AB*.

c. 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

Ⓐ 720° Ⓑ 1080° Ⓒ 1440° Ⓓ 1800°