

3-6

Using The Pythagorean Theorem

Main IDEA

Use problems using the Pythagorean Theorem.

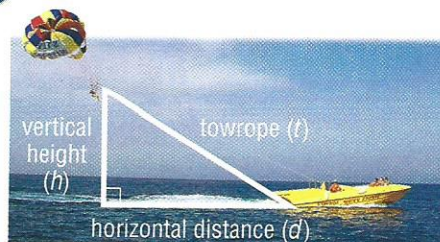
Targeted TEKS 8.7

The student uses geometry to model and describe the physical world. (C) pictures or models demonstrate the Pythagorean Theorem. The student uses direct measurement to solve problems. (A) Use Pythagorean Theorem to solve real-life problems.

GET READY for the Lesson

PARASAILING In parasailing, a towrope is used to attach a parasailor to a boat.

1. What type of triangle is formed by the horizontal distance, the vertical height, and the length of the towrope?
2. Write an equation that can be used to find the length of the towrope.



The Pythagorean Theorem can be used to solve a variety of problems.

Real-World EXAMPLE

- 1 PARASAILING** Find the height of the parasailor above the surface of the water.

Notice that the vertical and horizontal distances, along with the length of the rope form a right triangle. Use the Pythagorean Theorem.

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

$$200^2 = a^2 + 135^2$$

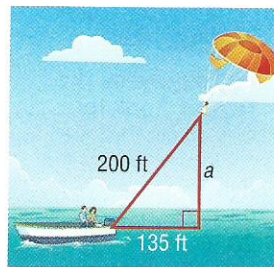
$$40,000 = a^2 + 18,225$$

$$40,000 - 18,225 = a^2 + 18,225 - 18,225$$

$$21,775 = a^2$$

$$\pm\sqrt{21,775} = a$$

$$148 \text{ or } -148 \approx a$$



Pythagorean Theorem

Replace c with 200 and b with 135.

Evaluate 200^2 and 135^2 .

Subtract 18,225 from each side.

Simplify.

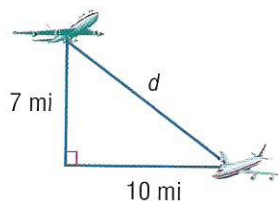
Definition of square root

Simplify.

The parasailor is about 148 feet above the surface of the water.

CHECK Your Progress

- a. **AVIATION** Write an equation that can be used to find the distance between the planes. Then solve. Round to the nearest tenth.



STUDY TIP

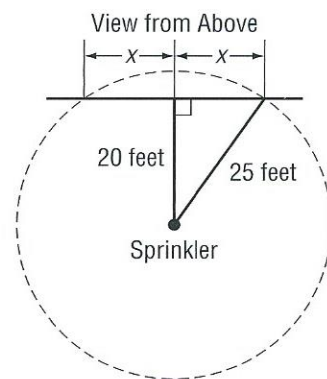
Ignore Roots

In most real-world situations, only the positive square root is considered.

TEST EXAMPLE

- 2 A circular lawn sprinkler with a range of 25 feet is placed 20 feet from the edge of a lawn. Find the length of the section of the lawn's edge that is within the range of the sprinkler.

- A 15 ft
- B 20 ft
- C 25 ft
- D 30 ft



Read the Test Item

From the diagram, you know that the distance of the sprinkler from the lawn's edge, the sprinkler's range, and a section of the lawn's edge all form a right triangle. The section of the lawn's edge within the range of the sprinkler is twice the section forming the right triangle.

Solve the Test Item

Use the Pythagorean Theorem.

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

Pythagorean Theorem

$$20^2 + x^2 = 25^2$$

$a = 20$, $b = x$, and $c = 25$.

$$400 + x^2 = 625$$

Evaluate 20^2 and 25^2 .

$$400 - 400 + x^2 = 625 - 400$$

Subtract 400 from each side.

$$x^2 = 225$$

Simplify.

$$x = \pm\sqrt{225}$$

Definition of square root

$$x = 15 \text{ or } -15$$

Simplify.

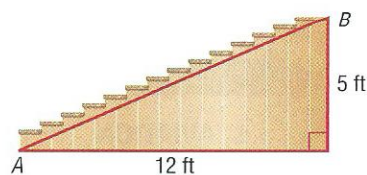
The length of the section of the lawn's edge within the sprinkler's range is $x + x$ or $15 + 15 = 30$ feet. Therefore, choice D is correct.

Test-Taking Tip

Pythagorean Triples Look for measures that are multiples of a 3-4-5 right triangle.
 $25 = 5 \cdot 5$
 $20 = 4 \cdot 5$
 $x = 3 \cdot 5$ or 15

CHECK Your Progress

- b. If the "rise" of the stairs of a building is 5 feet and the "run" is 12 feet, how long is it from point A to point B?



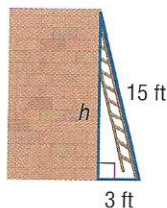
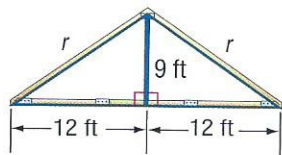
- F 13 ft
- G 12 ft

- H 11 ft
- J 10 ft

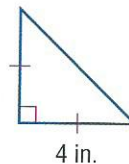
CHECK Your Understanding

Example 1 Write an equation that can be used to answer the question. Then solve. Round to the nearest tenth if necessary.
(p. 167)

- How long is each rafter?
- How high does the ladder reach?

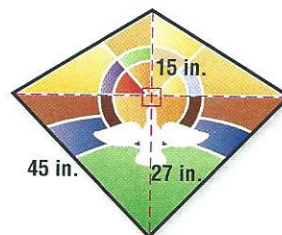


- GEOMETRY** An *isosceles* right triangle is a right triangle in which both legs are equal in length. If one leg of an isosceles triangle is 4 inches long, what is the length of the hypotenuse?



Example 2 **TEST PRACTICE** Abigail designed a stained glass window in the shape of a kite. What is the perimeter of the window?
(p. 168)

- 108 in.
- 114 in.
- 162 in.
- 168 in.



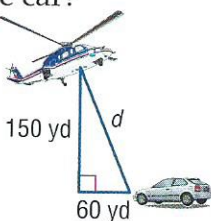
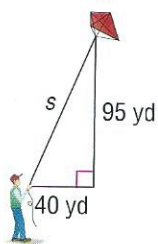
Exercises

WORK HELP

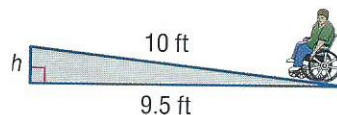
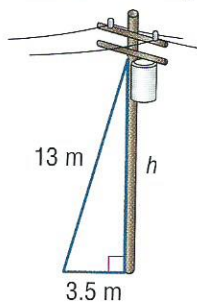
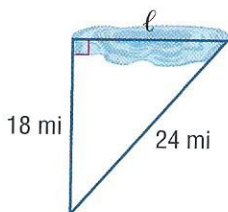
Exercises	See Examples
1	1
2	2

Write an equation that can be used to answer the question. Then solve. Round to the nearest tenth if necessary.

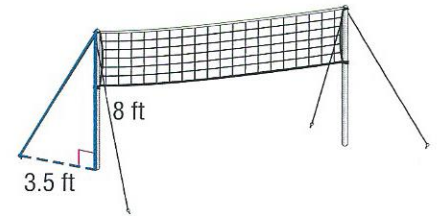
- How long is the kite string?
- How far is the helicopter from the car?
- How high is the ski ramp?



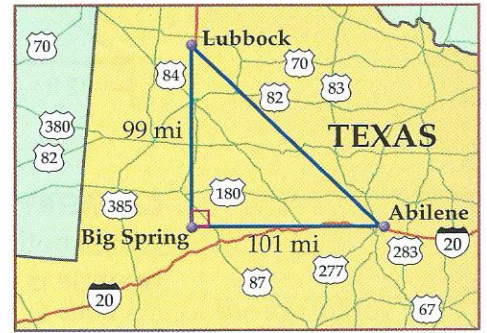
- How long is the lake?
- How high is the wire attached to the pole?
- How high is the wheel chair ramp?



11. **VOLLEYBALL** Two ropes and two stakes are needed to support each pole holding the volleyball net. Find the length of each rope.



12. **GEOGRAPHY** Suppose Lubbock, Big Spring, and Abilene form a right triangle. What is the distance from Lubbock to Abilene?

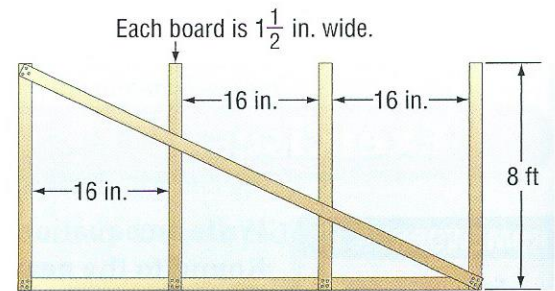


Real-World Link

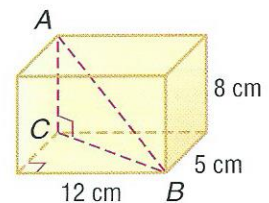
Televisions are advertised by their diagonal measure. The most common sizes are 27–32 inches.

13. **ENTERTAINMENT** Connor loves to watch movies in the widescreen format on his television. He wants to buy a new television with a screen that is at least 25 inches by 13.6 inches. What diagonal size television meets Connor's requirements?

14. **CONSTRUCTION** Home builders add corner bracing to give strength to a house frame. How long will the brace need to be for the frame shown?



15. **GEOMETRY** Find the length of the diagonal \overline{AB} in the rectangular prism at the right. (*Hint*: First find the length of \overline{BC} .)



EXTRAPRACTICE

See pages 702, 730.

Math online

Self-Check Quiz at tx.msmath3.com

16. **FIND THE DATA** Refer to the Texas Data File on pages 16–19. Choose some data and write a real-world problem in which you would use the Pythagorean Theorem.

H.O.T. Problems

17. **OPEN ENDED** Write a problem that can be solved by using the Pythagorean Theorem. Then explain how to solve the problem.
18. **Which One Doesn't Belong?** Each set of numbers represents the side measures of a triangle. Identify the set that does not belong with the other three. Explain your reasoning.

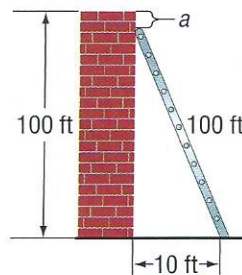
5–12–13

10–24–26

5–7–9

8–15–17

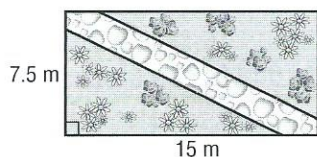
19. **CHALLENGE** Suppose a ladder 100 feet long is placed against a vertical wall 100 feet high. How far would the top of the ladder move down the wall by pulling out the bottom of the ladder 10 feet? Explain your reasoning.



20. **WRITING IN MATH** Write a real-world problem in which you would need to find the length of one side of a right triangle. Then solve the problem.

TEST PRACTICE

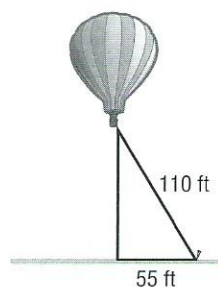
21. Ms. Johnson designed a rectangular garden. She plans to build a walkway through the garden as shown.



Which measure is closest to the length of the walkway?

- A 8 m
- B 11 m
- C 17 m
- D 23 m

22. A hot air balloon is tethered to the ground as shown.



How high above the ground is the balloon?

- F 55.0 ft
- G 95.3 ft
- H 123.0 ft
- J 163.5 ft

Spiral Review

23. **GEOMETRY** Determine whether a triangle with sides 20 inches, 48 inches, and 52 inches long is a right triangle. Justify your answer. (Lesson 3-5)

24. Order $\sqrt{45}$, $6.\bar{6}$, 6.75, and 6.7 from least to greatest. (Lesson 3-4)

Add or subtract. Write in simplest form. (Lesson 2-6)

25. $-3\frac{2}{3} + (-5\frac{3}{4})$

26. $-1\frac{1}{8} - 7\frac{3}{4}$

27. $\frac{3}{5} - 4\frac{1}{2}$

28. $4\frac{7}{8} + (-6\frac{5}{6})$

29. **ARCHAEOLOGY** Stone tools found in Ethiopia are estimated to be 2.5 million years old. That is about 700,000 years older than similar tools found in Tanzania. Write and solve an addition equation to find the age of the tools found in Tanzania. (Lesson 1-9)

GET READY for the Next Lesson

PREREQUISITE SKILL Graph each point on the same coordinate plane. (Page 686)

30. $T(5, 2)$

31. $A(-1, 3)$

32. $M(-5, 0)$

33. $D(-2, -4)$