1-5 Using the Pythagorean Theorem

Check Skills You'll Need

1. **Vocabulary Review** State the *Pythagorean Theorem*.

Find the length of the hypotenuse given the lengths of the two legs, a and b. Round to the nearest tenth.

2. $a = 3$, $b = 4$
3. $a = 7$, $b = 5$

GO for Help Lesson 1-4

What You'll Learn

To use the Pythagorean Theorem to find missing measurements of triangles

Why Learn This?

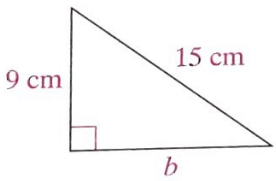
You can use the Pythagorean Theorem to find distances without measuring, including distances in space.

When you know the length of one leg and the hypotenuse of a right triangle, you can use the Pythagorean Theorem to find the length of the other leg.

CONTENT STANDARD 8.G.7

EXAMPLE 1 Finding a Leg of a Right Triangle

Find the missing leg length of the triangle below.



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

$9^2 + b^2 = 15^2$ ← Substitute 9 for a and 15 for c.

$81 + b^2 = 225$ ← Simplify.

$b^2 = 144$ ← Subtract 81 from each side.

$\sqrt{b^2} = \sqrt{144}$ ← Find the positive square root of each side.

$b = 12$ ← Simplify.

The length of the other leg is 12 cm.

Quick Check

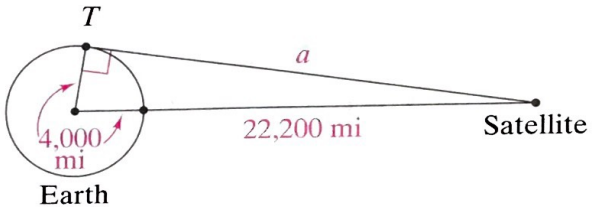
1. The hypotenuse of a right triangle is 20.2 ft long. One leg is 12.6 ft long. Find the length of the other leg to the nearest tenth.

You can substitute the known leg length for either a or b in the Pythagorean Theorem.

EXAMPLE 2 Application: Satellites

Multiple Choice Satellites that relay television signals to Earth cruise at a distance of about 22,200 miles above Earth's surface. The radius of Earth is about 4,000 miles. Find the distance a from the satellite to point T in the diagram below. Round to the nearest hundred miles.

(A) 670,440 mi
(B) 26,000 mi
(C) 25,900 mi
(D) 22,500 mi



Vocabulary Tip

The *radius* of a circle is a segment that connects the center to the circle.

The diagram above shows a right triangle with a hypotenuse of 22,200 miles + 4,000 miles, or 26,200 miles. The length of the known leg is 4,000 miles. The variable a represents the length of the other leg.

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

$a^2 + 4{,}000^2 = 26{,}200^2$ ← Substitute 4,000 for b and 26,200 for c.

$a^2 + 16{,}000{,}000 = 686{,}440{,}000$ ← Find $4{,}000^2$ and $26{,}200^2$.

$a^2 = 670{,}440{,}000$ ← Subtract 16,000,000 from each side.

$\sqrt{a^2} = \sqrt{670{,}440{,}000}$ ← Find the positive square root of each side.

$\sqrt{\ }$ 670,440,000 = 25892.85616 ← Use a calculator.

$a \approx 25{,}900$ ← Round to the nearest hundred.

Test Prep Tip

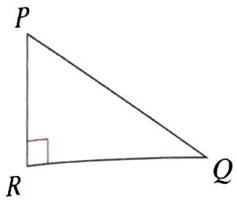
You can eliminate Choice A, because a leg of a right triangle cannot be longer than its hypotenuse.

The distance from the satellite to the horizon is about 25,900 mi. The answer is C.

Quick Check

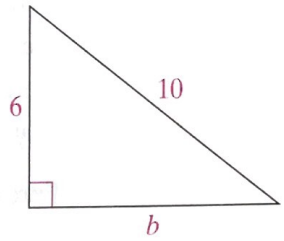
2. Construction The bottom of an 18-ft ladder is 5 ft from the side of a house. Find the distance from the top of the ladder to the ground. Round to the nearest tenth of a foot.

Check Your Understanding



1. **Vocabulary** Name the two legs and the hypotenuse of the triangle at the left.

2. Fill in the blanks for each step to find the missing leg length of the triangle below.



   a. $6^2 + b^2 = \blacksquare^2$

   b. $\blacksquare + b^2 = 100$

   c. $b^2 = \blacksquare$

   d. $b = \blacksquare$

Homework Exercises

For more exercises, see Extra Skills and Word Problems.

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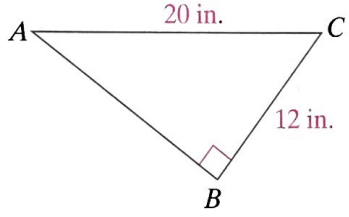
For Exercises	See Examples
3–13	1, 2

Find the missing leg length. For Exercises 7–12, a and b represent leg lengths and c represents the length of the hypotenuse. If necessary, round to the nearest tenth.

3.



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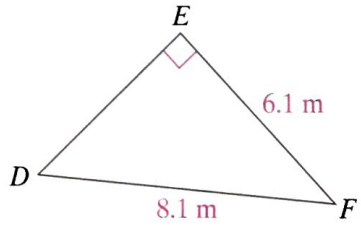

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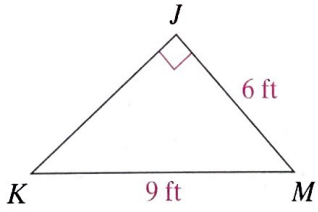

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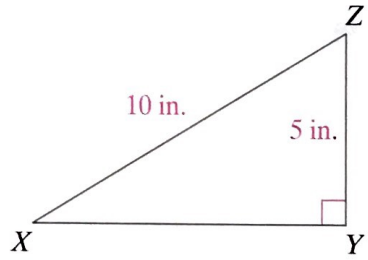

7. $a = 5, c = 12$

8. $a = 7, c = 25$

9. $b = 10.5, c = 20.1$

10. $a = 3.4, c = 6.7$

11. $b = 8.3, c = 16.9$

12. $b = 11, c = 15$

13. A 10-ft-long slide is attached to a deck that is 5 ft high. Find the distance from the bottom of the deck to the bottom of the slide to the nearest tenth.

GPS

14. **Guided Problem Solving** A computer screen has a diagonal length of 17 in. and a height of 9 in. To the nearest tenth of an inch, what is the area of the screen?
   - To the nearest tenth, what is the width of the computer screen?
   - What is the formula for the area of a rectangle?

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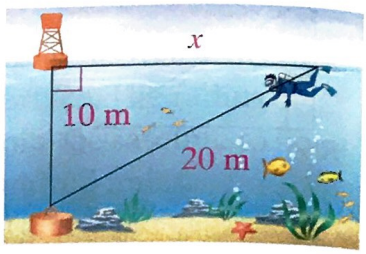
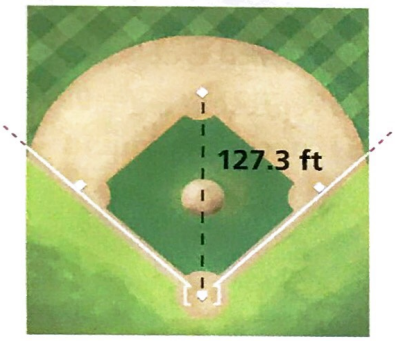
Use the formula $A = \frac{1}{2}bh$ to find the area of a right triangle with a leg of length a and hypotenuse of length c.

15. $a = 4, c = 5$ **16.** $a = 8.6, c = 10$ **17.** $a = 7.3, c = 9.1$

18. Diving A diver swims 20 m under water to the anchor of a buoy that is 10 m below the surface of the water. On the surface, how far is the buoy located from the place where the diver started? Round to the nearest meter.



19. Error Analysis One leg of a right triangle is 3 cm and the hypotenuse is 4 cm. A student evaluates $\sqrt{3^2 + 4^2}$ to find the length of the other leg. What error did the student make?



20. The distance from home plate to second base is about 127.3 ft.

a. Writing in Math Explain how you would find the distance between the bases.

b. Estimation Estimate the distance between the bases to the nearest foot.

c. When you hit a home run, you run around all the bases. How far do you run?

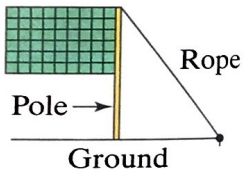
21. Challenge The sides of a right triangle are labelled a, b, and c. Can $a + b = c$? Explain.

Test Prep and Mixed Review

Practice

Multiple Choice

22. The top of a badminton net is 5 feet high. Ropes connect the top of each pole to stakes in the ground. The ropes are 8.5 feet long. Which is closest to the distance from a stake to the base of a pole?



(A) 4 ft (B) 7 ft (C) 9 ft (D) 15 ft

23. Which integer is closest to $\sqrt{10}$?

(F) 2 (G) 3 (H) 4 (J) 5

24. A park has a walking path shaped like a right triangle. Its legs are 50 yards and 120 yards long. What is the total length of the path, in yards?

(A) 130 yd (B) 255 yd (C) 300 yd (D) 340 yd

GO for Help

For Exercises	See Lesson
25–28	1-2

Compare. Use <, >, or =.

25. $\sqrt{24}$ ■ 5.1 **26.** 6.9 ■ $\sqrt{37}$ **27.** $\sqrt{56}$ ■ 8 **28.** 12.1 ■ $\sqrt{120}$