

# 8-1

## The Pythagorean Theorem and Its Converse



### Vocabulary

#### Review

- Write the *square* and the positive *square root* of each number.

Number	Square	Positive Square Root
9	<input type="text"/>	<input type="text"/>
$\frac{1}{4}$	$\frac{1}{16}$	<input type="text"/>

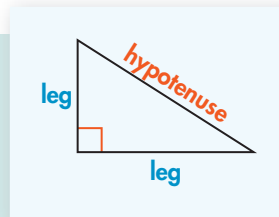
#### Vocabulary Builder

**leg** (noun) leg

**Related Word:** hypotenuse

**Definition:** In a right triangle, the sides that form the right angle are the **legs**.

**Main Idea:** The **legs** of a right triangle are perpendicular. The hypotenuse is the side opposite the right angle.



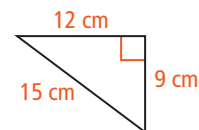
#### Use Your Vocabulary

- Underline the correct word to complete the sentence.

The *hypotenuse* is the longest / shortest side in a right triangle.

Write T for *true* or F for *false*.

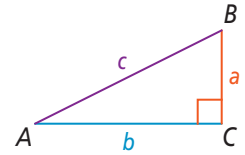
3. The *hypotenuse* of a right triangle can be any one of the three sides.
4. One *leg* of the triangle at the right has length 9 cm.
5. The *hypotenuse* of the triangle at the right has length 15 cm.



## Theorems 8-1 and 8-2 Pythagorean Theorem and Its Converse

**Pythagorean Theorem** If a triangle is a right triangle, then the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.

If  $\triangle ABC$  is a right triangle, then  $a^2 + b^2 = c^2$ .



**Converse of the Pythagorean Theorem** If the sum of the squares of the lengths of two sides of a triangle is equal to the square of the length of the third side, then the triangle is a right triangle.

If  $a^2 + b^2 = c^2$ , then  $\triangle ABC$  is a right triangle.

6. Circle the equation that shows the correct relationship among the lengths of the legs and the hypotenuse of a right triangle.

$$13^2 + 5^2 = 12^2$$

$$5^2 + 12^2 = 13^2$$

$$12^2 + 13^2 = 5^2$$

Underline the correct words to complete each sentence.

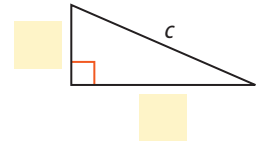
7. A triangle with side lengths 3, 4, and 5 is / is not a right triangle because  $3^2 + 4^2$  is equal / not equal to  $5^2$ .
8. A triangle with side lengths 4, 5, and 6 is / is not a right triangle because  $4^2 + 5^2$  is equal / not equal to  $6^2$ .



### Problem 1 Finding the Length of the Hypotenuse

**Got It?** The legs of a right triangle have lengths 10 and 24. What is the length of the hypotenuse?

9. Label the triangle at the right.
10. Use the justifications below to find the length of the hypotenuse.



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

Pythagorean Theorem

$$\square^2 + \square^2 = c^2$$

Substitute for  $a$  and  $b$ .

$$\square + \square = c^2$$

Simplify.

$$\square = c^2$$

Add.

$$\square = c$$

Take the positive square root.

11. The length of the hypotenuse is  $\square$ .
12. One Pythagorean triple is 5, 12, and 13. If you multiply each number by 2, what numbers result? How do the numbers that result compare to the lengths of the sides of the triangle in Exercises 9–11?

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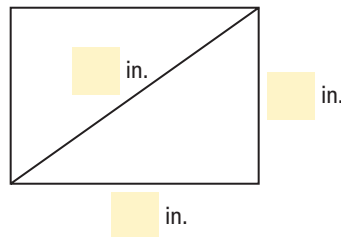


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### Problem 3 Finding Distance

**Got It?** The size of a computer monitor is the length of its diagonal. You want to buy a 19-in. monitor that has a height of 11 in. What is the width of the monitor? Round to the nearest tenth of an inch.



- 13. Label the diagram of the computer monitor at the right.
- 14. The equation is solved below. Write a justification for each step.

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

$$11^2 + b^2 = 19^2$$

$$121 + b^2 = 361$$

$$121 - 121 + b^2 = 361 - 121$$

$$b^2 = 240$$

$$b = \sqrt{240}$$

$$b \approx 15.49193338$$

- 15. To the nearest tenth of an inch, the width of the monitor is  in.



### Problem 4 Identifying a Right Triangle

**Got It?** A triangle has side lengths 16, 48, and 50. Is the triangle a right triangle? Explain.

- 16. Circle the equation you will use to determine whether the triangle is a right triangle.

$$16^2 + 48^2 \stackrel{?}{=} 50^2$$

$$16^2 + 50^2 \stackrel{?}{=} 48^2$$

$$48^2 + 50^2 \stackrel{?}{=} 16^2$$

- 17. Simplify your equation from Exercise 16.

- 18. Underline the correct words to complete the sentence.

The equation is  true / false , so the triangle is  is / is not a right triangle.

A *Pythagorean triple* is a set of nonzero whole numbers  $a$ ,  $b$ , and  $c$  that satisfy the equation  $a^2 + b^2 = c^2$ . If you multiply each number in a Pythagorean triple by the same whole number, the three numbers that result also form a Pythagorean triple.

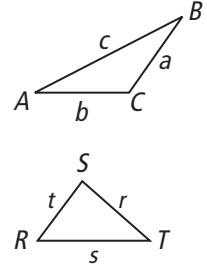
Take note

Theorems 8-3 and 8-4 Pythagorean Inequality Theorems

**Theorem 8-3** If the square of the length of the longest side of a triangle is greater than the sum of the squares of the lengths of the other two sides, then the triangle is obtuse.

**Theorem 8-4** If the square of the length of the longest side of a triangle is less than the sum of the squares of the lengths of the other two sides, then the triangle is acute.

Use the figures at the right. Complete each sentence with *acute* or *obtuse*.



19. In  $\triangle ABC$ ,  $c^2 > a^2 + b^2$ , so  $\triangle ABC$  is   ?  .

\_\_\_\_\_

20. In  $\triangle RST$ ,  $s^2 < r^2 + t^2$ , so  $\triangle RST$  is   ?  .

\_\_\_\_\_



Lesson Check • Do you UNDERSTAND?

**Error Analysis** A triangle has side lengths 16, 34, and 30. Your friend says it is not a right triangle. Look at your friend's work and describe the error.

~~$16^2 + 34^2 \stackrel{?}{=} 30^2$   
 $256 + 1156 \stackrel{?}{=} 900$   
 $1412 \neq 900$~~

21. Underline the length that your friend used as the longest side. Circle the length of the longest side of the triangle.

16                                  30                                  34

22. Write the comparison that your friend should have used to determine whether the triangle is a right triangle.

\_\_\_\_\_

23. Describe the error in your friend's work.

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\_\_\_\_\_



Math Success

Check off the vocabulary words that you understand.

- hypotenuse                   leg                   Pythagorean Theorem                   Pythagorean triple

Rate how well you can use *the Pythagorean Theorem and its converse*.

**Need to review**    0    2    4    6    8    10    **Now I get it!**

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