4-8 The Pythagorean Theorem

Warm Up

Problem of the Day

Lesson Presentation

Warm Up

Find each value to the nearest 10th.

1. $\sqrt{30}$ 5.48
2. $\sqrt{14}$ 3.74
3. $\sqrt{55}$ 7.42
4. $\sqrt{48}$ 6.93

Problem of the Day

A side of a square A is 5 times the length of a side of square B. How many times as great is the area of square A than the area of square B?

25

4-8 The Pythagorean Theorem

Learn to use the Pythagorean Theorem and its converse to solve problems.

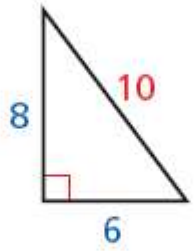
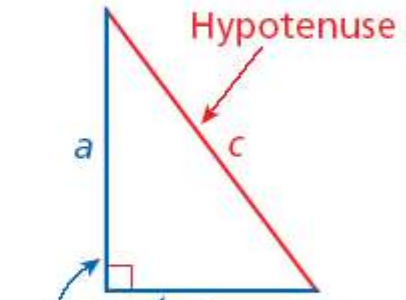
Vocabulary

Pythagorean Theorem
leg
hypotenuse

4-8 The Pythagorean Theorem

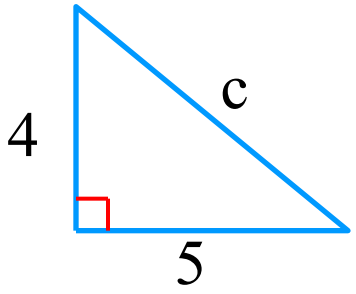
Pythagoras was born on the Aegean island of Samos. He is best known for the **Pythagorean Theorem**, which relates the side lengths of a right triangle.

4-8 The Pythagorean Theorem

THE PYTHAGOREAN THEOREM		
Words	**Numbers**	**Algebra**
In any right triangle, the sum of the squares of the lengths of the two **legs** is equal to the square of the length of the **hypotenuse**.	 $6^2 + 8^2 = 10^2$ $36 + 64 = 100$	 $a^2 + b^2 = c^2$

Additional Example 1A: Finding the Length of a Hypotenuse

Find the length of the hypotenuse to the nearest hundredth.



$a^2 + b^2 = c^2$ *Pythagorean Theorem*

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

$16 + 25 = c^2$ *Simplify powers.*

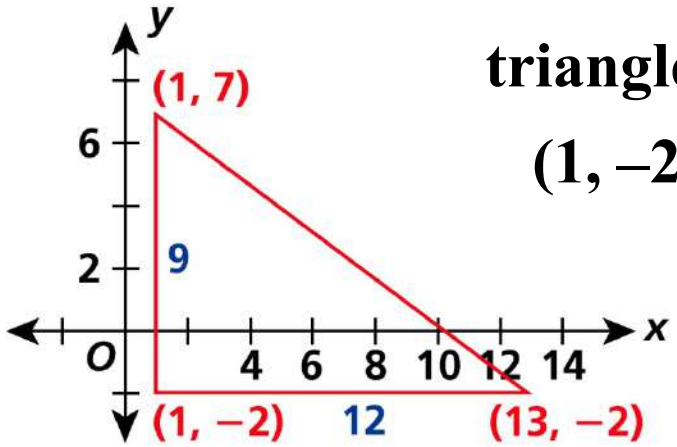
$41 = c^2$

$\sqrt{41} = c$ *Solve for c; c =* $c^2.\sqrt{}$

$6.40 \approx c$

Additional Example 1B: Finding the Length of a Hypotenuse

Find the length of the hypotenuse to the nearest hundredth.



triangle with coordinates

(1, –2), (1, 7), and (13, –2)

$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$9^2 + 12^2 = c^2$ *Substitute for a and b.*

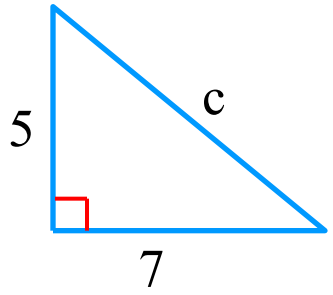
$81 + 144 = c^2$ *Simplify powers.*

$\sqrt{225} = c$ *Solve for c; c =* $c^2.\sqrt{}$

$15 = c$

Check It Out: Example 1A

Find the length of the hypotenuse to the nearest hundredth.



$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$5^2 + 7^2 = c^2$ *Substitute for a and b.*

$25 + 49 = c^2$ *Simplify powers.*

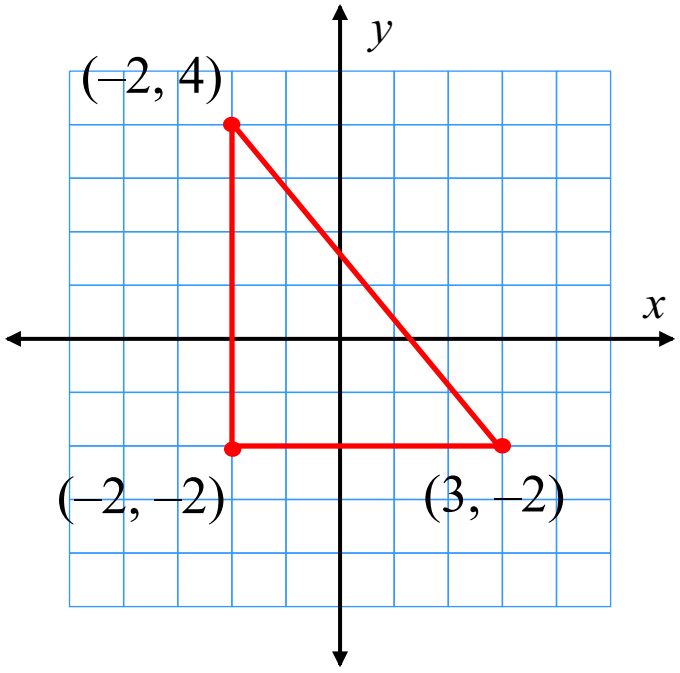
$\sqrt{74} = c$ *Solve for c; c =* $c^2.\sqrt{\ }$

$8.60 \approx c$

Check It Out: Example 1B

Find the length of the hypotenuse to the nearest hundredth.

triangle with coordinates (–2, –2), (–2, 4), and (3, –2)



The points form a right triangle.

$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$6^2 + 5^2 = c^2$ *Substitute for a and b.*

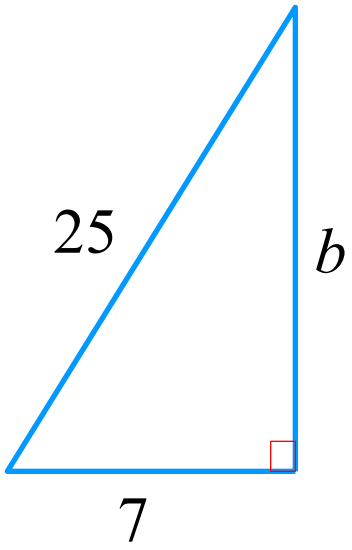
$36 + 25 = c^2$ *Simplify powers.*

$\sqrt{61} = c$ *Solve for c; c =* $c^2.\sqrt{}$

$7.81 \approx c$

Additional Example 2: Finding the Length of a Leg in a Right Triangle

Solve for the unknown side in the right triangle to the nearest tenth.



$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$7^2 + b^2 = 25^2$ *Substitute for a and c.*

$49 + b^2 = 625$ *Simplify powers.*

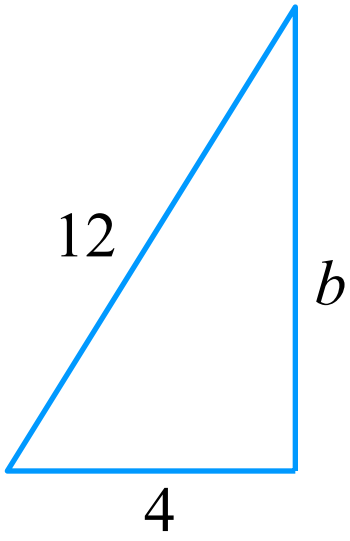
$-49 \quad -49$ *Subtract 49 from each side.*

$b^2 = 576$

$b = 24$ *Find the positive square root*

Check It Out: Example 2

Solve for the unknown side in the right triangle to the nearest tenth.



$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$4^2 + b^2 = 12^2$ *Substitute for a and c.*

$16 + b^2 = 144$ *Simplify powers.*

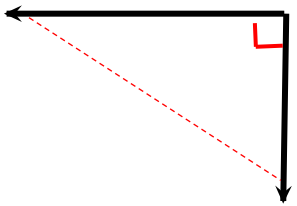
$-16 \quad -16$ *Subtract 16 from both sides.*

$b^2 = 128$

$b \approx 11.31$ *Find the positive square root.*

Additional Example 3: Using the Pythagorean Theorem for Measurement

Two airplanes leave the same airport at the same time. The first plane flies to a landing strip 350 miles south, while the other plane flies to an airport 725 miles west. How far apart are the two planes after they land?



$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$350^2 + 725^2 = c^2$ *Substitute for a and b.*

$122{,}500 + 525{,}625 = c^2$ *Simplify powers.*

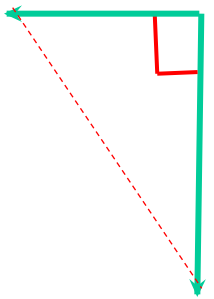
$648{,}125 = c^2$ *Add.*

$805 \approx c$ *Find the positive square root.*

The two planes are approximately 805 miles apart.

Check It Out: Example 3

Two birds leave the same spot at the same time. The first bird flies to his nest 11 miles south, while the other bird flies to his nest 7 miles west. How far apart are the two birds after they reach their nests?



$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$11^2 + 7^2 = c^2$ *Substitute for a and b.*

$121 + 49 = c^2$ *Simplify powers.*

$170 = c^2$ *Add.*

$13 \approx c$ *Find the positive square root.*

The two birds are approximately 13 miles apart.

Lesson Quiz

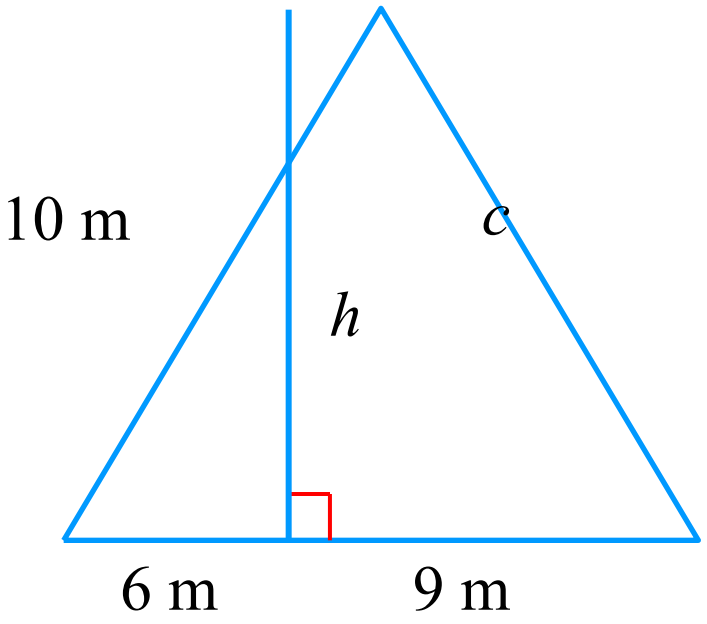
Use the figure for Problems 1 and 2.

1. Find the height h of the triangle.

8 m

2. Find the length of side c to the nearest meter.

12 m



3. An escalator in a shopping mall is 40 ft long and 32 ft tall. What distance does the escalator carry shoppers?

$\sqrt{2624} \approx 51$ ft