Warm Up on the problems below.

Classwork - Pythagorean Theorem

Warm Up: Solve the following eqations using inverse operations.

A) $\sqrt{x^2} = \sqrt{9}$

$x = \pm 3$

B) $\sqrt{x}^2 = 7^2$

$x = 49$

C) $x^2 + 8 = 33$

$-8 \quad -8$

$\sqrt{x^2} = \sqrt{25}$

$x = \pm 5$

D) $x^2 + 11 = 180$

$-11 \quad -11$

$\sqrt{x^2} = \sqrt{169}$

$x = \pm 13$

Vocabulary Start-Up

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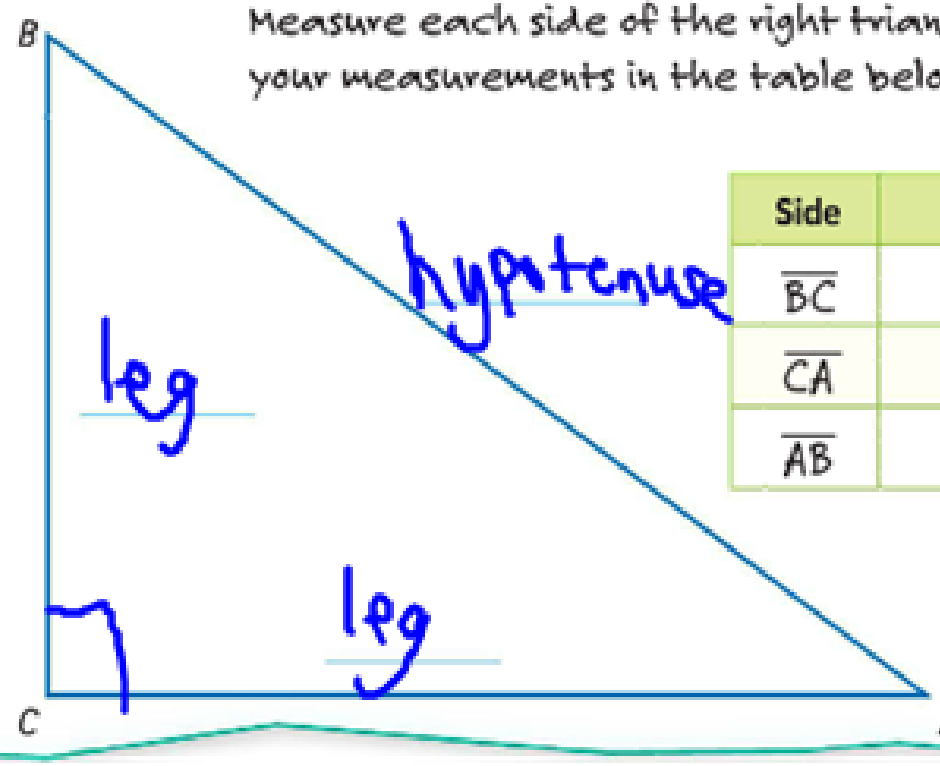
A right triangle is a triangle with one right angle. The **legs** are the sides that form the right angle. The **hypotenuse** is the side opposite the right angle. It is the longest side of the triangle.

Complete the graphic organizer. Label the legs and the hypotenuse.

Draw a right angle symbol on the right angle. Measure each side of the right triangle and write your measurements in the table below.

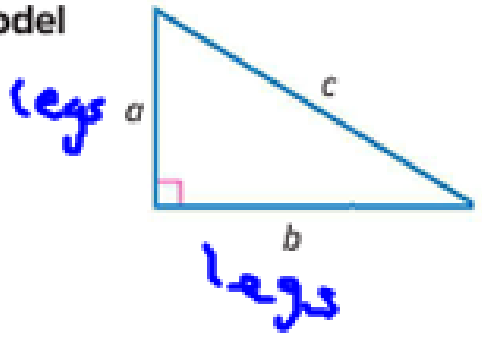


Side	Length (cm)
$\overline{BC}$	
$\overline{CA}$	
$\overline{AB}$	

Pythagorean Theorem

Words In a right triangle, the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.

Model



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

The **Pythagorean Theorem** describes the relationship between the lengths of the legs and the hypotenuse for *any* right triangle.

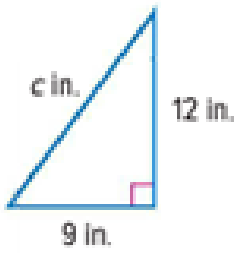
You can use the Pythagorean Theorem to find the length of a side of a right triangle when you know the other two sides.

Examples

Tutor

Write an equation you could use to find the length of the missing side of each right triangle. Then find the missing length. Round to the nearest tenth if necessary.

1.



$9^2 + 12^2 = c^2$

$\sqrt{225} = \sqrt{c^2}$

$\pm 15 = c$

$c = 15$ in

$a^2 + b^2 = c^2$	Pythagorean Theorem
$12^2 + 9^2 = c^2$	Replace a with 12 and b with 9.
$144 + 81 = c^2$	Evaluate 12^2 and 9^2.
$225 = c^2$	Add 81 and 144.
$\pm\sqrt{225} = c$	Definition of square root
$c = 15$ or -15	Simplify.

The equation has two solutions, 15 and −15. However, the length of a side must be positive. So, the hypotenuse is 15 inches long.

Check:

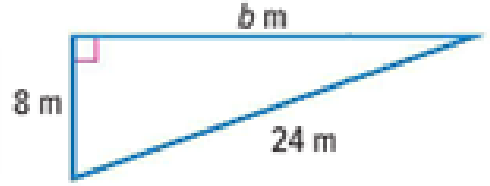
$$a^2 + b^2 = c^2$$

$$12^2 + 9^2 \stackrel{?}{=} 15^2$$

$$144 + 81 \stackrel{?}{=} 225$$

$$225 = 225 \checkmark$$

2.



$64 + b^2 = 576$
$-64 \qquad -64$
$\sqrt{b^2} = \sqrt{512}$

$a^2 + b^2 = c^2$	Pythagorean Theorem
$8^2 + b^2 = 24^2$	Replace a with 8 and c with 24.
$64 + b^2 = 576$	Evaluate 8^2 and 24^2
$64 - 64 + b^2 = 576 - 64$	Subtract 64 from each side.
$b^2 = 512$	Simplify.
$b = \pm\sqrt{512}$	Definition of square root
$b \approx 22.6$ or -22.6	Use a calculator.

$b = \pm 22.6$

22.6 m

$\sqrt{512}$ m

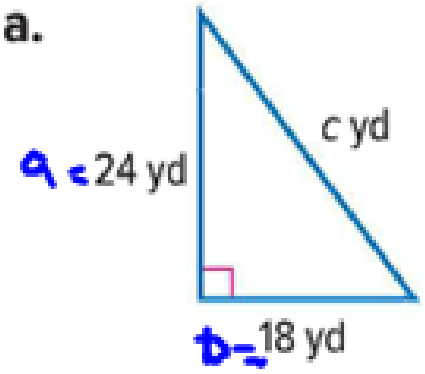
The length of side b is about 22.6 meters.

Check for Reasonableness

The hypotenuse is always the longest side in a right triangle. Since 22.6 is less than 24, the answer is reasonable.

Got It? Do these problems to find out. $a^2 + b^2 = c^2$

a.



$24^2 + 18^2 = c^2$

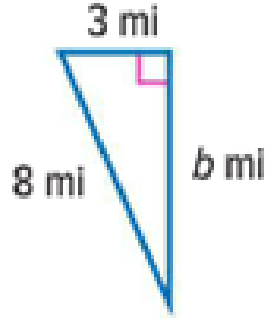
$576 + 324 = c^2$

$\sqrt{900} = \sqrt{c^2}$

$\pm 30 = c$

30 yards

b.



$3^2 + b^2 = 8^2$

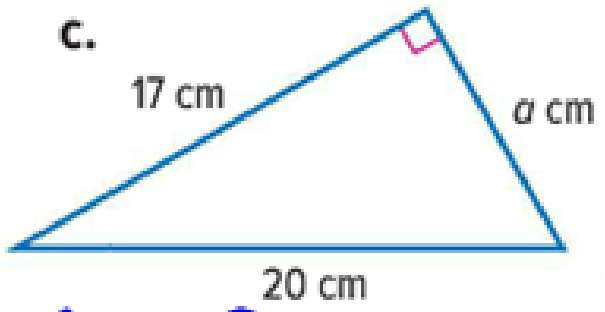
$9 + b^2 = 64$

$-9 \quad -9$

$\sqrt{b^2} = \sqrt{55}$

$b = 7.4$ mi

c.



$a^2 + 17^2 = 20^2$

$a^2 + 289 = 400$

$-289 \quad -289$

$\sqrt{a^2} = \sqrt{111}$

$a = 10.5$ cm

$a = \sqrt{111}$ cm

Converse of Pythagorean Theorem

If the sides of a triangle have lengths a, b, and c units such that $a^2 + b^2 = c^2$, then the triangle is a right triangle.

If you reverse the parts of the Pythagorean Theorem, you have formed its **converse**.

Statement: If a **triangle is a right triangle**, then $a^2 + b^2 = c^2$.

Converse: If $a^2 + b^2 = c^2$, then the **triangle is a right triangle**.

The converse of the Pythagorean Theorem is also true.

Example

Tutor

3. **The measures of three sides of a triangle are 5 inches, 12 inches, and 13 inches. Determine whether the triangle is a right triangle.**

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

$5^2 + 12^2 \stackrel{?}{=} 13^2$ $a = 5, b = 12, c = 13$

$25 + 144 \stackrel{?}{=} 169$ Evaluate 5^2, 12^2, and 13^2.

$169 = 169$ ✓ Simplify.

The triangle is a right triangle.

3, 4, 6

$3^2 + 4^2 = 6^2$

$9 + 16 = 36$

$25 \neq 36$

NO

Got It? **Do these problems to find out.**

Determine whether each triangle with sides of given lengths is a right triangle. Justify your answer.

d. 36 mi, 48 mi, 60 mi

YES

$36^2 + 48^2 = 60^2$

$1296 + 2304 = 3600$

$3600 = 3600$

e. 4 ft, 7 ft, 5 ft

$4^2 + 5^2 = 7^2$

$16 + 25 = 49$

$41 \neq 49$

NO