

LESSON 2

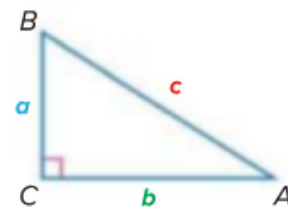
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The Pythagorean Theorem and Its Converse

Theorem 8.4 Pythagorean Theorem

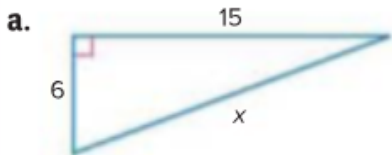
Words In a right triangle, the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.

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



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

Find x.

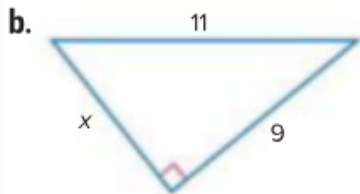


$$x^2 = 6^2 + 15^2$$

$$x^2 = 36 + 225$$

$$\sqrt{x^2} = \sqrt{261} \quad x = \sqrt{9} \sqrt{29}$$

$$x = 3\sqrt{29}$$



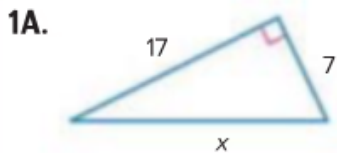
$$11^2 = x^2 + 9^2$$

$$121 = x^2 + 81$$

$$\sqrt{40} = \sqrt{x^2} \quad x = 2\sqrt{10}$$

$$\sqrt{4}\sqrt{10}$$

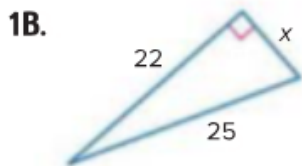
Guided Practice



$$x^2 = 17^2 + 7^2$$

$$\sqrt{x^2} = \sqrt{338} \quad x = \sqrt{169} \sqrt{2}$$

$$13\sqrt{2}$$



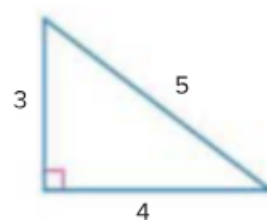
$$25^2 = 22^2 + x^2$$

$$\sqrt{x^2} = \sqrt{141}$$

$$x = \sqrt{141}$$

- 1²
- 2² 4
- 3² 9
- 4² 16
- 5² 25
- 36
- 49
- 64
- 81
- 100
- 121
- 144
- 169

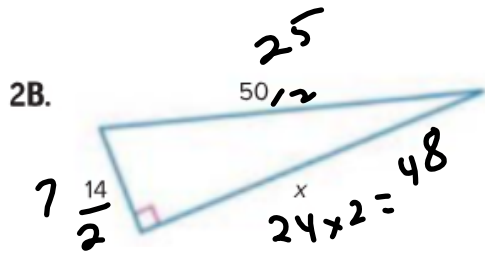
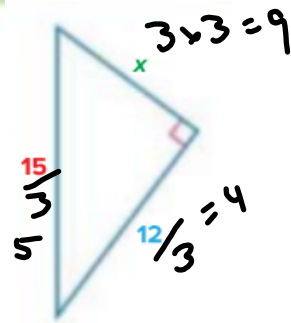
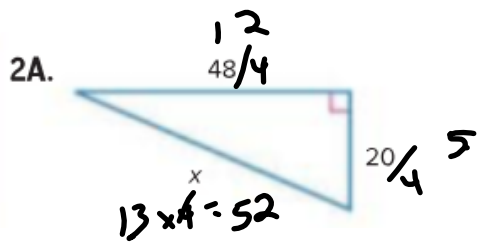
A **Pythagorean triple** is a set of three nonzero whole numbers a , b , and c , such that $a^2 + b^2 = c^2$. One common Pythagorean triple is 3, 4, 5; that is, the sides of a right triangle are in the ratio 3:4:5. The most common Pythagorean triples are shown below in the first row. The triples below these are found by multiplying each number in the triple by the same factor.



Key Concept Common Pythagorean Triples			
3, 4, 5	5, 12, 13	8, 15, 17	7, 24, 25
6, 8, 10	10, 24, 26	16, 30, 34	14, 48, 50
9, 12, 15	15, 36, 39	24, 45, 51	21, 72, 75
$3x, 4x, 5x$	$5x, 12x, 13x$	$8x, 15x, 17x$	$7x, 24x, 25x$

Example 2 Use a Pythagorean Triple

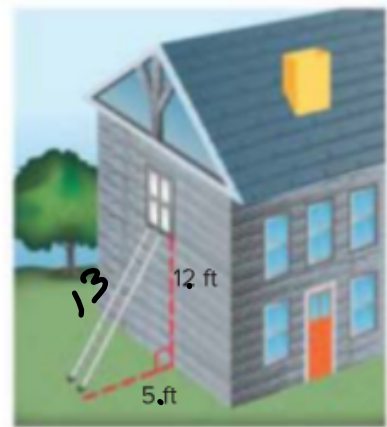
Use a Pythagorean triple to find x . Explain your reasoning.



Example 3 Use the Pythagorean Theorem

Damon is locked out of his house. The only open window is on the second floor, which is 12 feet above the ground. He needs to borrow a ladder from his neighbor. If he must place the ladder 5 feet from the house to avoid some bushes, what length of ladder does Damon need?

- A 7 feet
- B 11 feet
- C 13 feet
- D 17 feet

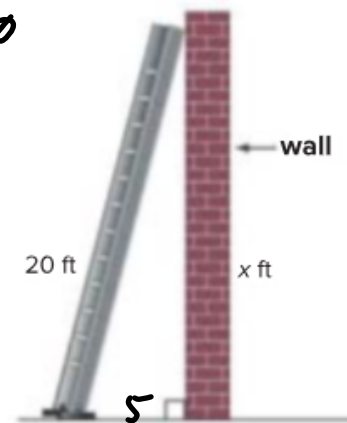


3. The distance from the base of a ladder to a wall that it leans against should be at least one fourth of the ladder's total length. What is the maximum distance x up the wall that a 20-foot ladder will reach, to the nearest tenth?

- A 12 feet
- B 19.4 feet
- C 20.6 feet
- D 30.6 feet

Handwritten notes and equations:

- $\frac{1}{4} \cdot 20 = 5$
- $20^2 = 5^2 + x^2$
- $\sqrt{375} = \sqrt{x^2}$

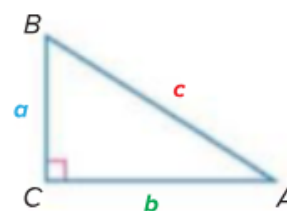


2 Converse of the Pythagorean Theorem The converse of the Pythagorean Theorem also holds. You can use this theorem to help you determine whether a triangle is a right triangle given the measures of all three sides.

Theorem 8.5 Converse of the Pythagorean Theorem

Words If the sum of the squares of the lengths of the shortest sides of a triangle is equal to the square of the length of the longest side, then the triangle is a right triangle.

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

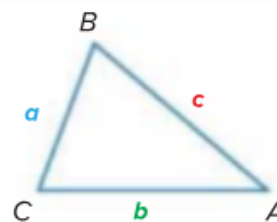


You can also use side lengths to classify a triangle as acute or obtuse.

Theorem Pythagorean Inequality Theorems

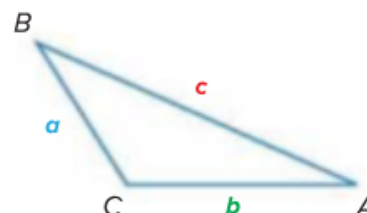
8.6 If the square of the length of the longest side of a triangle is less than the sum of the squares of the lengths of the other two sides, then the triangle is an acute triangle.

Symbols If $c^2 < a^2 + b^2$, then $\triangle ABC$ is acute.



8.7 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 an obtuse triangle.

Symbols If $c^2 > a^2 + b^2$, then $\triangle ABC$ is obtuse.



Example 4 Classify Triangles

Determine whether each set of numbers can be the measures of the sides of a triangle. If so, classify the triangle as *acute*, *right*, or *obtuse*. Justify your answer.

a. 7, 14, 16

$$16^2 \text{ — } 7^2 + 14^2$$

$$256 > 245 \quad \text{obtuse } \triangle$$

b. 9, 40, 41

$$41^2 \text{ — } 9^2 + 40^2$$

$$1681 = 1681 \quad \text{right } \triangle$$

4A. 11, 60, 61

$$61^2 \text{ — } 60^2 + 11^2$$

$$3721 = 3721 \quad \text{Right } \triangle$$

4B. $2\sqrt{3}$, $4\sqrt{2}$, $3\sqrt{5}$

$$(3\sqrt{5})^2 \text{ — } (2\sqrt{3})^2 + (4\sqrt{2})^2$$

$$9 \cdot 5 \quad 4 \cdot 3 \quad 16 \cdot 2$$

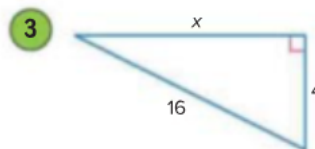
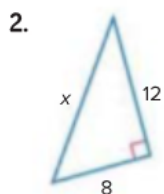
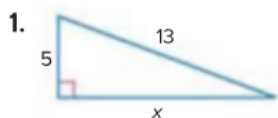
$$45 \text{ — } 12 + 32$$

$$45 > 44 \quad \text{obtuse } \triangle$$

Check Your Understanding

 = Step-by-Step Solution

Example 1 Find x .

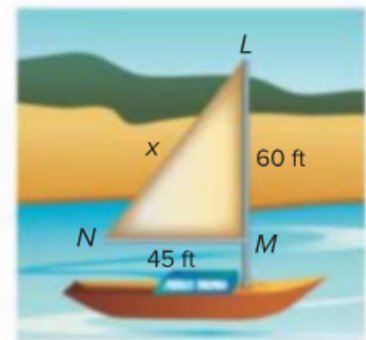


5. MULTIPLE CHOICE The mainsail of a boat is shown.
What is the length, in feet, of \overline{LN} ?

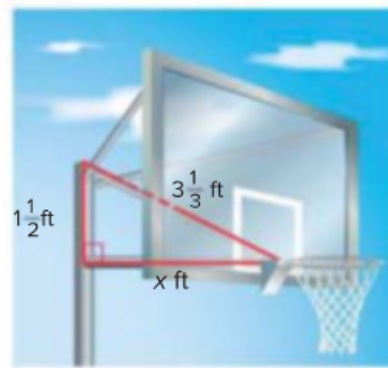
- A 52.5 C 72.5
B 65 D 75

Determine whether each set of numbers can be the measures of the sides of a triangle. If so, classify the triangle as *acute*, *obtuse*, or *right*. Justify your answer.

6. 15, 36, 39 7. 16, 18, 26 8. 15, 20, 24



19. **BASKETBALL** The support for a basketball goal forms a right triangle as shown. What is the length x of the horizontal portion of the support?



20. **DRIVING** The street that Khaliah usually uses to get to school is under construction. She has been taking the detour shown. If the construction starts at the point where Khaliah leaves her normal route and ends at the point where she reenters her normal route, about how long is the stretch of road under construction?

