MATHEMATICS · GRADES 7-9

Pythagorean Theorem

Difficulty level: Intermediate

Mathematics: Grades 7-9

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Overview of the concept

This is how you work out a distance you cannot measure directly. A builder uses it to check a corner is square before pouring a foundation. You use it to work out how long a ladder needs to be to reach a roof, or what size TV actually fits in the space on your wall.



Rule

In a right triangle, $a^2 + b^2 = c^2$, where a and b are the legs and c is the hypotenuse, the side across from the right angle.

The theorem only applies to right triangles.

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Worked examples

EXAMPLE 1

Q A right triangle has hypotenuse 13 and one leg 5. How long is the other leg?

SOLUTION

The theorem says $a^2 + b^2 = c^2$, with c the hypotenuse. Put in what you know: $5^2 + b^2 = 13^2$.

$b^2 = 169 - 25 = 144$

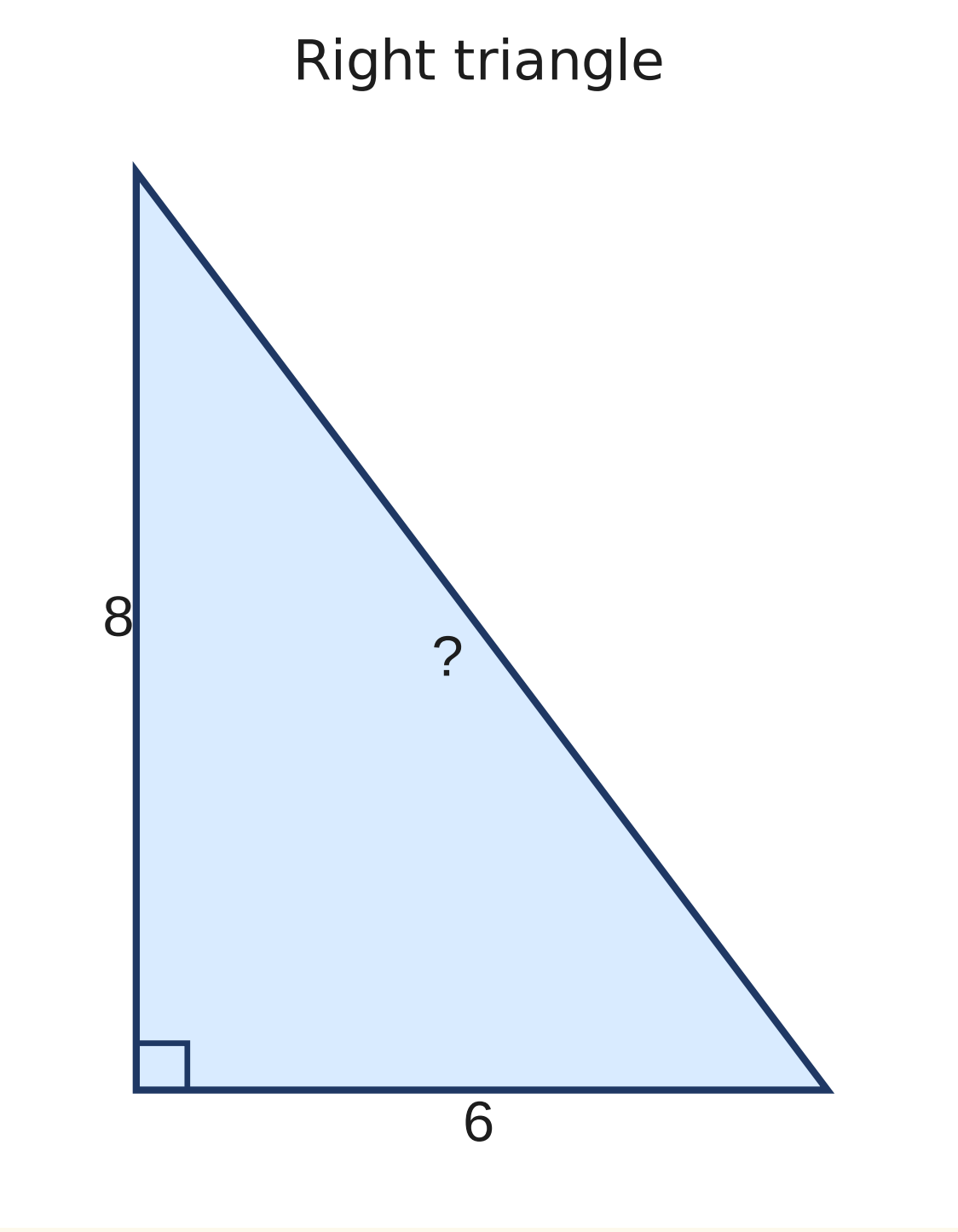
$b = \sqrt{144} = 12$

The other leg is 12. Check: $5^2 + 12^2 = 25 + 144 = 169 = 13^2$

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EXAMPLE 2

Q A ladder's foot is 6 m from a wall and it reaches 8 m up the wall. How long is the ladder?



SOLUTION

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The wall, the ground, and the ladder make a right triangle with one side 6 and the other side 8, and the ladder is the hypotenuse.

$c^2 = 6^2 + 8^2 = 36 + 64 = 100$

$c = \sqrt{100} = 10$ m

The ladder is 10 m long.

Practice questions

1 **A right triangle has legs a and b and hypotenuse c. State the Pythagorean theorem for these sides.**

- **A** $a^2 + b^2 = c^2$
- **B** $a^2 + b^2 = c$
- **C** $a^2 - b^2 = c^2$
- **D** $a + b = c$

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2 A ladder leans against a wall. Its foot is 9 m from the wall and it reaches 12 m up the wall. How long is the ladder?

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3 A right triangle has hypotenuse 25 and one leg 7. How long is the other leg?

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4 A right triangle has one side 5 and the other side 12. Which of these could NOT be the hypotenuse?

- A 13
- B 12
- C 5

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5 A triangle has sides 9, 12, and 15. Is it a right triangle?

- **A** Yes
- **B** No

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6 A ladder 17 m long reaches 15 m up a wall. How far is its foot from the wall?

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7 What is the distance between the points (2, 3) and (5, 7) on a coordinate grid?

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8 A triangle has one angle of 90 degrees. What kind of triangle is it?

- A Right triangle
- B Acute triangle
- C Obtuse triangle
- D Equilateral triangle

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9 A triangle has sides 7, 24, and 25. Which side is the hypotenuse?

- A 7
- B Cannot tell
- C 25
- D 24

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10 A right triangle has two equal legs of length 6. Find c^2.

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ANSWER KEY

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

2. 15 m

3. 24

4. 5

5. Yes

6. 8 m

7. 5 units

8. Right triangle

9. 25

10. 72

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