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Geometry · Lesson 9/9 · ●●● Advanced

The Pythagorean theorem

Why is a² + b² = c²? We see it by counting the small squares built on the sides of a right triangle. Then the formulas: for the hypotenuse you add, for a leg you subtract, and finally the square root.

In this video we solve 3 exercises step by step: the hypotenuse, a leg and a real-life problem with a ladder leaning against a wall.

The method

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

$$c = \sqrt{a^2 + b^2}$$

$$a = \sqrt{c^2 - b^2}$$

Worked examples

Exercise 1

The legs of a right triangle are 6 cm and 8 cm. How long is the hypotenuse?

Data: $\hat{C} = 90° \cdot AC = 6\ \text{cm} \cdot BC = 8\ \text{cm}$

1. **AC and BC are the legs, AB is the hypotenuse**

$$AB^2 = AC^2 + BC^2$$

2. **Squares of the legs, then the sum**

$$AB^2 = 6^2 + 8^2$$

$$AB^2 = 36 + 64 = 100$$

Result: $AB^2 = 100$

3. **Square root: we find the hypotenuse**

$$AB = \sqrt{100} = 10 \text{ cm}$$

💡 √100 = 10 because 10 × 10 = 100

Result: $AB = 10 \text{ cm}$

✓ Check

$$6^2 + 8^2 = 36 + 64 = 100 = 10^2 \checkmark$$

Exercise 2

In a right triangle the hypotenuse is 13 cm and one leg is 5 cm. How long is the other leg?

Data: $\hat{C} = 90° \cdot AB = 13 \text{ cm} \cdot AC = 5 \text{ cm}$

1. **We are looking for a leg: subtract!**

$$BC^2 = AB^2 - AC^2$$

2. **Squares and difference**

$$BC^2 = 13^2 - 5^2$$

$$BC^2 = 169 - 25 = 144$$

Result: $BC^2 = 144$

3. **Square root: we find the leg**

$$BC = \sqrt{144} = 12 \text{ cm}$$

> 💡 Careful: for a leg you subtract, never add

Result: $BC = 12$ cm

✓ Check

$$5^2 + 12^2 = 25 + 144 = 169 = 13^2 \checkmark$$

Exercise 3

A 2.5 m ladder leans against a wall. The foot of the ladder is 0.7 m from the wall. How high up the wall does it reach?

Data: $\text{ladder} = 2.5 \text{ m} \cdot \text{foot} = 0.7 \text{ m}$

1. **Wall and floor make a right angle**

$$AC^2 + BC^2 = AB^2$$

> 💡 The ladder is the hypotenuse: the side opposite the right angle

2. **We are looking for a leg: hypotenuse² – leg²**

$$AC^2 = 2.5^2 - 0.7^2$$

$$AC^2 = 6.25 - 0.49 = 5.76$$

Result: $AC^2 = 5.76$

3. **Square root: the height reached**

$$AC = \sqrt{5.76} = 2.4 \text{ m}$$

Result: $AC = 2.4$ m

✔ **Check**

$$0.7^2 + 2.4^2 = 0.49 + 5.76 = 6.25 = 2.5^2 \checkmark$$

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