25SCHOOLS

FREE LEARNING NOTES FOR ZAMBIA

FORM 1

Mathematics

Pythagoras theorem

Lesson notes for learners · Competence-Based Curriculum

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A friend says you can walk a shorter way between two opposite corners of a rectangular field than by going round the edges. You can, and the Pythagoras theorem tells you exactly how long the shortcut is. Builders, farmers and engineers use it to work out distances, for example when a ladder leans on a wall or when fencing a piece of land. In this note you learn the rule and use it to solve problems.

AFTER THESE NOTES YOU SHOULD BE ABLE TO

- Identify the hypotenuse of a right-angled triangle
- State the Pythagoras theorem
- Find a missing side of a right-angled triangle
- Use the theorem to solve real-life problems

KEY WORDS

right-angled triangle	a triangle with one angle of 90 degrees
hypotenuse	the longest side of a right-angled triangle, opposite the right angle
square	a number multiplied by itself, such as 6 x 6 = 36
square root	the number which, multiplied by itself, gives the number you started with
Pythagoras theorem	the rule that the square on the hypotenuse equals the sum of the squares on the other two sides

1 The sides of a right-angled triangle

The theorem is named after the ancient Greek mathematician Pythagoras. It describes a special relationship between the sides of a right-angled triangle. You can see the shape when a ladder or a broomstick leans against a wall. The wall, the floor and the ladder form a right-angled triangle, and the ladder is the longest side, the hypotenuse.

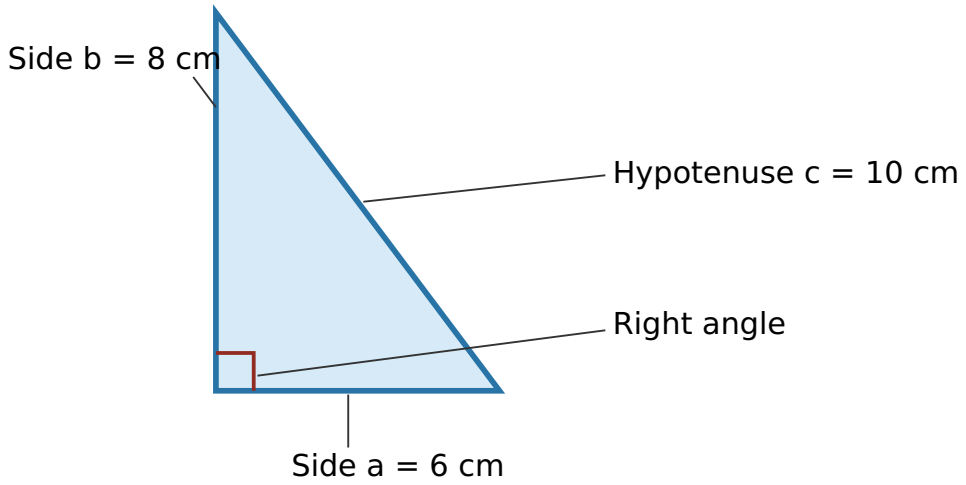

Figure 1. A right-angled triangle with sides 6 cm, 8 cm and 10 cm

2 The rule c2 = a2 + b2

Draw a right-angled triangle with sides 6 cm, 8 cm and 10 cm on squared paper, and draw a square on each side. The squares have areas 36, 64 and 100 square centimetres. The two smaller squares add up to 36 + 64 = 100, which is the area of the biggest square.

This is the Pythagoras theorem. If a and b are the two shorter sides and c is the hypotenuse, then c2 = a2 + b2. In words, the square on the hypotenuse equals the sum of the squares on the other two sides. You can check it with other triangles, for example 5, 12 and 13, where 25 + 144 = 169.

WORKED EXAMPLE

A right-angled triangle has shorter sides 6 cm and 8 cm. Find the hypotenuse.

c2 = a2 + b2

c2 = 6 x 6 + 8 x 8 = 36 + 64

c2 = 100

c = square root of 100 = 10 cm

3 Solving problems

To find the hypotenuse, add the squares of the two shorter sides and take the square root. To find a shorter side, subtract: b2 = c2 - a2, then take the square root. Always draw a sketch and mark the right angle first so you know which side is the hypotenuse.

WORKED EXAMPLE

A ladder 13 m long leans against a wall with its foot 5 m from the wall. How high up the wall does it reach?

The ladder is the hypotenuse, so c = 13 m and one side a = 5 m

b2 = c2 - a2 = 169 - 25

b2 = 144

b = square root of 144 = 12 m

TRY THIS

Use a broomstick or a long stick as a ladder against a wall. In groups, measure how far the foot is from the wall and how high the top is on the wall. Measure the stick, then check that the square of the stick's length equals the sum of the squares of the other two measurements, allowing for small measuring errors.

REMEMBER

- A right-angled triangle has one angle of 90 degrees
- The hypotenuse is the longest side, opposite the right angle
- Pythagoras theorem: c2 = a2 + b2
- To find a shorter side, use b2 = c2 - a2
- Draw a sketch and mark the hypotenuse before you calculate

? Check yourself

1. What is the hypotenuse?
2. State the Pythagoras theorem.
3. A right-angled triangle has shorter sides 3 cm and 4 cm. Find the hypotenuse.
4. A right-angled triangle has hypotenuse 17 cm and one side 8 cm. Find the other side.
5. Is a triangle with sides 5 cm, 12 cm and 13 cm right-angled? Show your working.
6. In a village near Feira, Mr Mwansa wants to fence a right-angled triangular maize field with shorter sides 30 m and 40 m. (a) Find the length of the third side. (b) Find the total length of fence needed. (c) Find the cost of the fence at K12 per metre.
7. A rectangular field is 60 m long and 80 m wide. A learner walks along the two edges from one corner to the opposite corner, and her friend walks straight across along the diagonal. (a) Find the length of the diagonal. (b) Find how far the learner walks along the edges. (c) Say how much shorter the d

ANSWERS

1. The longest side of a right-angled triangle, opposite the right angle.
2. c2 = a2 + b2, where c is the hypotenuse.
3. c2 = 9 + 16 = 25, so c = 5 cm.
4. b2 = 289 - 64 = 225, so b = 15 cm.
5. 5 x 5 + 12 x 12 = 25 + 144 = 169 = 13 x 13, so yes, it is right-angled.
6. (a) c2 = 900 + 1600 = 2500, so c = 50 m. (b) 30 + 40 + 50 = 120 m. (c) 120 x 12 = K1440.
7. (a) c2 = 3600 + 6400 = 10000, so c = 100 m. (b) 60 + 80 = 140 m. (c) 140 - 100 = 40 m shorter.

Written by 25Schools to follow the Form 1 Mathematics syllabus of the Zambian competence-based curriculum. Free for learners to read, download and share. More notes and quizzes at 25schools.com.