

# PYTHAGORAS' THEOREM

## — Measurement

### 1. What Is Pythagoras' Theorem?

- In a RIGHT-ANGLED triangle, the square of the hypotenuse equals the sum of the squares of the other two sides.
- The hypotenuse is the LONGEST side, opposite the right angle.

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

where  $c$  is the hypotenuse  
and  $a$ ,  $b$  are the two shorter sides

### 2. Finding the Hypotenuse

- When you know both short sides, find the longest side.

$$\begin{aligned} a &= 3, b = 4, \text{ find } c \\ c^2 &= 3^2 + 4^2 = 9 + 16 = 25 \\ c &= \text{sqrt}(25) = 5 \end{aligned}$$

$$\begin{aligned} a &= 5, b = 12, \text{ find } c \\ c^2 &= 25 + 144 = 169 \\ c &= \text{sqrt}(169) = 13 \end{aligned}$$

### 3. Finding a Shorter Side

- When you know the hypotenuse and one short side, find the other.

$$\begin{aligned} c &= 10, a = 6, \text{ find } b \\ b^2 &= c^2 - a^2 = 100 - 36 = 64 \\ b &= \text{sqrt}(64) = 8 \end{aligned}$$

$$\begin{aligned} c &= 15, b = 9, \text{ find } a \\ a^2 &= 225 - 81 = 144 \\ a &= \text{sqrt}(144) = 12 \end{aligned}$$

- Rearrange:  $a^2 = c^2 - b^2$  or  $b^2 = c^2 - a^2$

## 4. Pythagorean Triples

- Sets of three whole numbers that satisfy  $a^2 + b^2 = c^2$ .

Common triples:

3, 4, 5                      5, 12, 13

6, 8, 10                     8, 15, 17

7, 24, 25                    9, 12, 15

Multiples also work: 3, 4, 5 --> 6, 8, 10 --> 9, 12, 15

## 5. Real-World Applications

- **Example:** A ladder 5 m long leans against a wall. Its base is 3 m from the wall.

How high does it reach?

- $h^2 + 3^2 = 5^2$
  - $h^2 = 25 - 9 = 16$
  - $h = 4$  m
- Finding diagonal distances, checking right angles, navigation.

**Pythagoras ONLY works in RIGHT-ANGLED triangles.**

**Always check for the right angle first!**

**The hypotenuse is always opposite the right angle.**