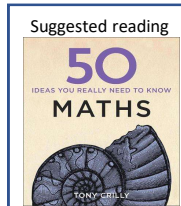


# Year 9 – Reasoning with Geometry

## Pythagoras Theorem



Want to know more?  
Scan the QR code to visit the curriculum overview for Year 9 Maths, including topic summaries, key words, and books that you may want to read in your own time



Scan me

### What do I need to be able to do?

By the end of this unit you should be able to:

- Use square and cube roots
- Identify the hypotenuse
- Calculate the hypotenuse
- Find a missing side in a Right angled triangle
- Use Pythagoras' theorem on axes
- Explore proofs of Pythagoras' theorem

### Keywords

**Square number:** the output of a number multiplied by itself

**Square root:** a value that can be multiplied by itself to give a square number

**Hypotenuse:** the largest side on a right angled triangle. Always opposite the right angle

**Opposite:** the side opposite the angle of interest

**Adjacent:** the side next to the angle of interest

### Squares and square roots



This can also be written as  $6^2$

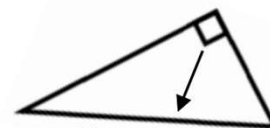
$\sqrt{\quad}$  is the square root symbol

eg  $\sqrt{64} = 8$   
Because  $8 \times 8 = 64$

1 x 1	2 x 2	3 x 3	4 x 4	5 x 5	6 x 6	7 x 7	8 x 8	9 x 9	10 x 10
1	4	9	16	25	36	49	64	81	100

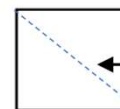
Square numbers

### Identify the hypotenuse



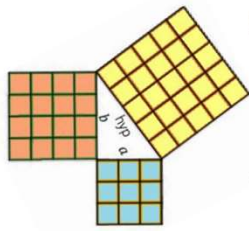
Hypotenuse

The hypotenuse is always the longest side on a triangle because it is opposite the biggest angle.



Polygons can still have a hypotenuse if it is split up into triangles and opposite a right angle.

### Determine if a triangle is right-angled



If a triangle is right-angled, the sum of the squares of the shorter sides will equal the square of the hypotenuse.

$$a^2 + b^2 = \text{hypotenuse}^2$$

eg  $a^2 + b^2 = \text{hypotenuse}^2$

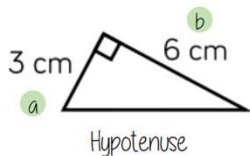
$$3^2 + 4^2 = 5^2$$

$$9 + 16 = 25$$

Substituting the numbers into the theorem shows that this is a right-angled triangle

$a = 3$   $b = 4$   $c = 5$

### Calculate the hypotenuse



Either of the short sides can be labelled a or b

$$a^2 + b^2 = \text{hypotenuse}^2$$

1 Substitute in the values for a and b

$$3^2 + 6^2 = \text{hypotenuse}^2$$

$$9 + 36 = \text{hypotenuse}^2$$

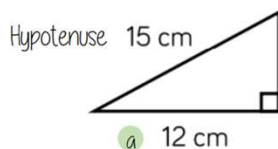
$$45 = \text{hypotenuse}^2$$

2 To find the hypotenuse square root the sum of the squares of the shorter sides

$$\sqrt{45} = \text{hypotenuse}$$

$$6.71\text{cm} = \text{hypotenuse}$$

### Calculate missing sides



Either of the short sides can be labelled a or b

$$a^2 + b^2 = \text{hypotenuse}^2$$

$$12^2 + b^2 = 15^2$$

1 Substitute in the values you are given

$$144 + b^2 = 225$$

$$-144 \quad -144$$

Rearrange the equation by subtracting the shorter square from the hypotenuse squared

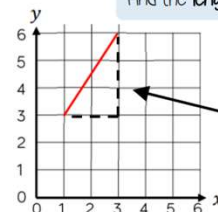
Square root to find the length of the side

$$b^2 = 111$$

$$b = \sqrt{111} = 10.54\text{ cm}$$

### Pythagoras' theorem on a coordinate axis

Find the length of the line segment



The segment can be made into a right-angled triangle by adding the sides on the diagram

The line segment is the hypotenuse

$$a^2 + b^2 = \text{hypotenuse}^2$$

The lengths of a and b are the sides of the triangle.

Be careful to check the scale on the axes