

# Pythagoras' theorem

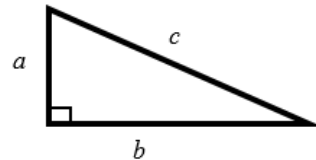
## A LEVEL LINKS

Scheme of work: 2a. Straight-line graphs, parallel/perpendicular, length and area problems

### Key points

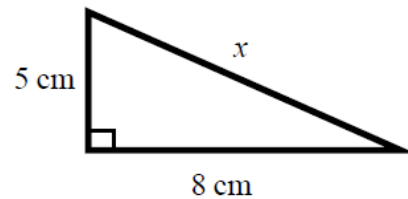
- In a right-angled triangle the longest side is called the hypotenuse.
- Pythagoras' theorem states that for a right-angled triangle the square of the hypotenuse is equal to the sum of the squares of the other two sides.

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

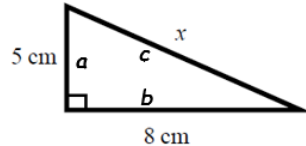


### Examples

**Example 1** Calculate the length of the hypotenuse.  
Give your answer to 3 significant figures.



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



$$x^2 = 5^2 + 8^2$$

$$x^2 = 25 + 64$$

$$x^2 = 89$$

$$x = \sqrt{89}$$

$$x = 9.433\ 981\ 13\dots$$

$$x = 9.43\text{ cm}$$

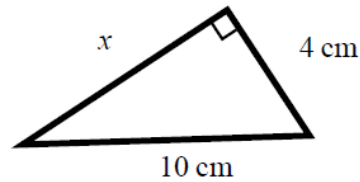
**1** Always start by stating the formula for Pythagoras' theorem and labelling the hypotenuse  $c$  and the other two sides  $a$  and  $b$ .

**2** Substitute the values of  $a$ ,  $b$  and  $c$  into the formula for Pythagoras' theorem.

**3** Use a calculator to find the square root.

**4** Round your answer to 3 significant figures and write the units with your answer.

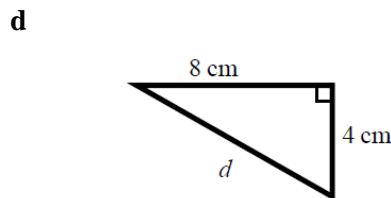
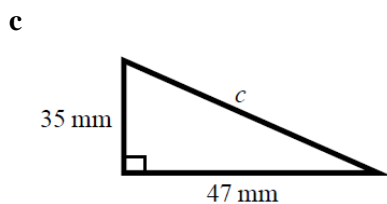
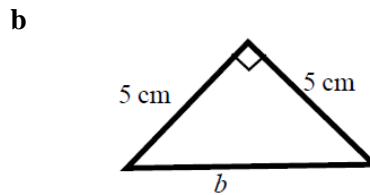
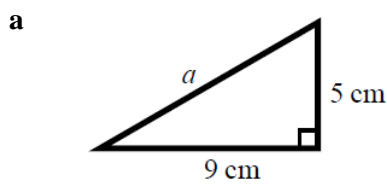
**Example 2** Calculate the length  $x$ .  
Give your answer in surd form.



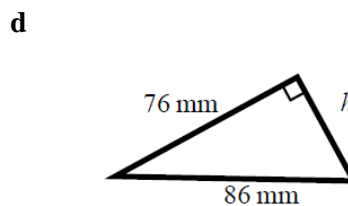
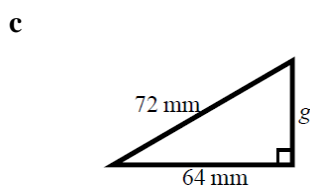
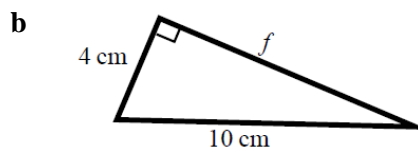
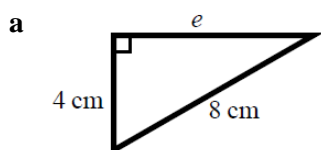
|  |   |
|--|---|
| $c^2 = a^2 + b^2$ $10^2 = x^2 + 4^2$ $100 = x^2 + 16$ $x^2 = 84$ $x = \sqrt{84}$ $x = 2\sqrt{21} \text{ cm}$ | <ol style="list-style-type: none"> <li><b>1</b> Always start by stating the formula for Pythagoras' theorem.</li> <li><b>2</b> Substitute the values of <math>a</math>, <math>b</math> and <math>c</math> into the formula for Pythagoras' theorem.</li> <li><b>3</b> Simplify the surd where possible and write the units in your answer.</li> </ol> |
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## Practice

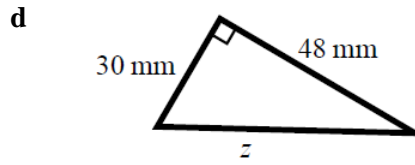
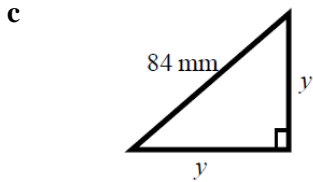
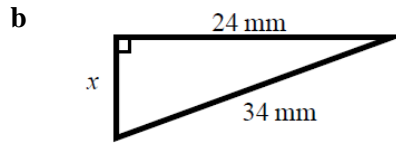
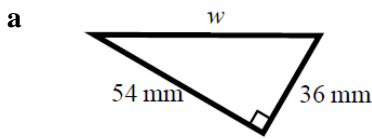
**1** Work out the length of the unknown side in each triangle.  
Give your answers correct to 3 significant figures.



**2** Work out the length of the unknown side in each triangle.  
Give your answers in surd form.



- 3 Work out the length of the unknown side in each triangle.  
Give your answers in surd form.



- 4 A rectangle has length  $84 \text{ mm}$  and width  $45 \text{ mm}$ .  
Calculate the length of the diagonal of the rectangle.  
Give your answer correct to 3 significant figures.

**Hint**

Draw a sketch of the rectangle.

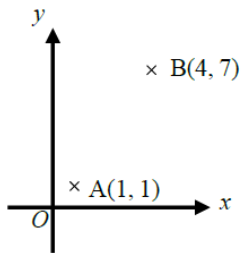
## Extend

- 5 A yacht is  $40 \text{ km}$  due North of a lighthouse.  
A rescue boat is  $50 \text{ km}$  due East of the same lighthouse.  
Work out the distance between the yacht and the rescue boat.  
Give your answer correct to 3 significant figures.

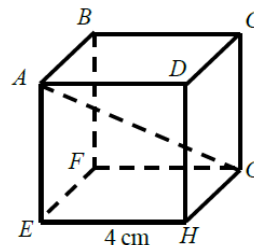
**Hint**

Draw a diagram using the information given in the question.

- 6 Points A and B are shown on the diagram.  
Work out the length of the line AB.  
Give your answer in surd form.



- 7 A cube has length  $4 \text{ cm}$ .  
Work out the length of the diagonal  $AG$ .  
Give your answer in surd form.



## Answers

- 1**   **a**   10.3 cm                      **b**   7.07 cm  
         **c**   58.6 mm                      **d**   8.94 cm
- 2**   **a**    $4\sqrt{3}$  cm                      **b**    $2\sqrt{21}$  cm  
         **c**    $8\sqrt{17}$  mm                      **d**    $18\sqrt{5}$  mm
- 3**   **a**    $18\sqrt{13}$  mm                      **b**    $2\sqrt{145}$  mm  
         **c**    $42\sqrt{2}$  mm                      **d**    $6\sqrt{89}$  mm
- 4**   95.3 mm
- 5**   64.0 km
- 6**    $3\sqrt{5}$  units
- 7**    $4\sqrt{3}$  cm