Pythagoras' theorem
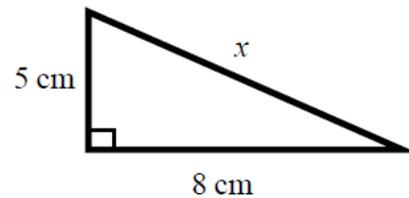
Key points

- 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.
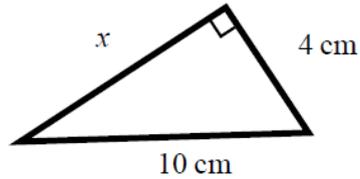$c^2 = a^2 + b^2$
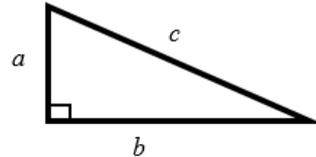
Examples

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

$c^2 = a^2 + b^2$ 	**1** Always start by stating the formula for Pythagoras' theorem and labelling the hypotenuse c and the other two sides a and b.
$x^2 = 5^2 + 8^2$ $x^2 = 25 + 64$ $x^2 = 89$ $x = \sqrt{89}$ $x = 9.433\ 981\ 13...$ $x = 9.43$ cm	**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.

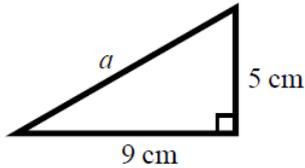**Example 2**   Calculate the length x.
Give your answer in surd form.

|	
$c^2 = a^2 + b^2$ $10^2 = x^2 + 4^2$ $100 = x^2 + 16$ $x^2 = 84$ $x = \sqrt{84}$ $x = 2\sqrt{21}$ cm	**1** Always start by stating the formula for Pythagoras' theorem. **2** Substitute the values of a, b and c into the formula for Pythagoras' theorem. **3** Simplify the surd where possible and write the units in your answer.

Practice

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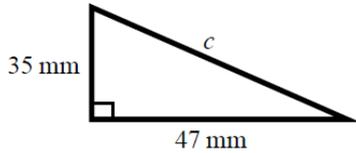Give your answers correct to 3 significant figures.

a

b
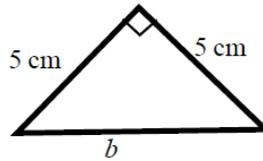
c

d

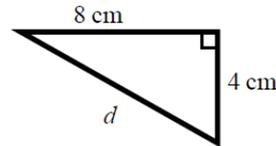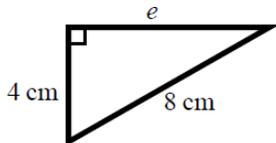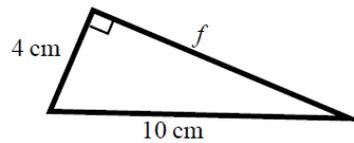**2**   Work out the length of the unknown side in each triangle.
Give your answers in surd form.

a

b

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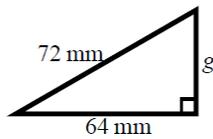
d
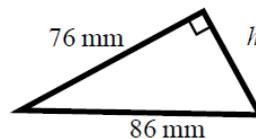
3 Work out the length of the unknown side in each triangle.
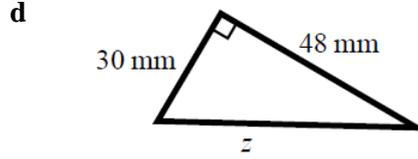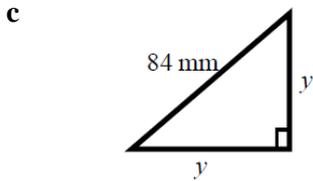Give your answers in surd form.

a

w
54 mm 36 mm

b

24 mm
x
34 mm

c

84 mm
y
y

d

30 mm 48 mm
z
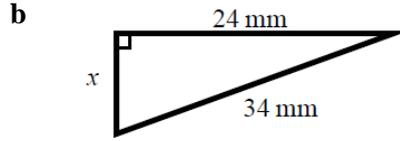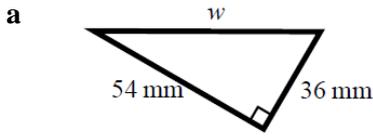
4 A rectangle has length 84 mm and width 45 mm.
Calculate the length of the diagonal of the rectangle.
Give your answer correct to 3 significant figures.

> **Hint**
>
> Draw a sketch of the rectangle.

Extend

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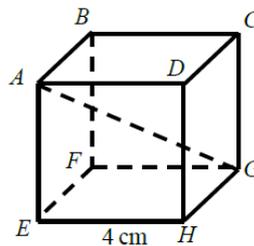Give your answer correct to 3 significant figures.

> **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.

y

× B(4, 7)

× A(1, 1)

O x
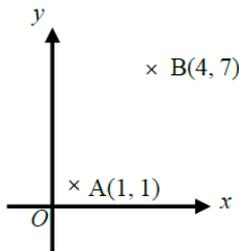
7 A cube has length 4 cm.
Work out the length of the diagonal *AG*.
Give your answer in surd form.

B C
A D
F G
E 4 cm H

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