Pythagoras' Theorem

Year 11 General Maths
Units 1 and 2

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Learning Objectives

By the end of the lesson, I hope that you understand and can apply the following to a range of questions from the Unit 1 and 2 General Mathematics course.

- To be able to find the length of an unknown side in a right-angled triangle using Pythagoras' theorem.
- To be able to find the length of an unknown side in a three-dimensional diagram.

Recap

This is the second lesson relating to Measurement, Scale and Similarity as part of the Year 11 General Maths course. So far, in the last lesson, we have looked at the really important need to round to decimal places and significant figures alongside being able to express numbers in Scientific Notation.

Now it’s time to recap something you will have been doing since Year 9.

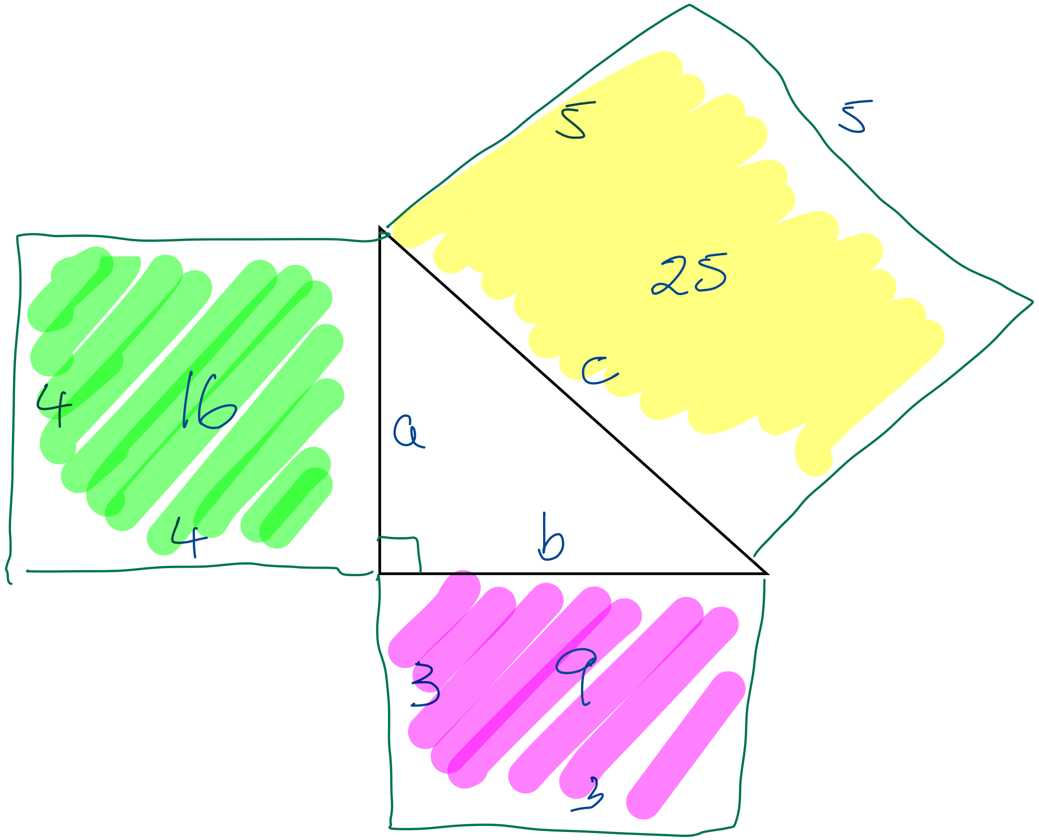
And it relates to the dude on the right …. Who was allegedly a murderer and may not have come up with any of the theories attributed to his name!

Everyone knows the formula!

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

It would seem that the one thing most people remember is the formula shown on the right, but do you really understand where it came from?

Let's look at the following **right-angled** triangle …



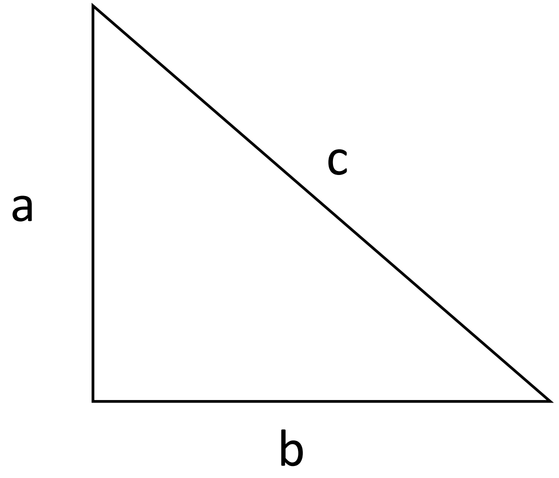
Make sure the hypotenuse is the ‘c’

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

The longest side of a right angled triangle is the **hypotenuse.** This is always going to be the value of ‘c’

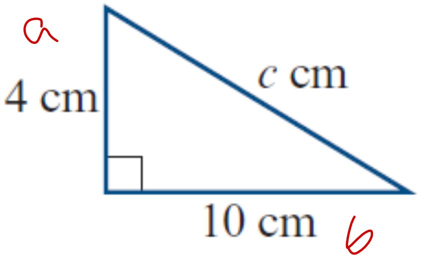
Note: Questions will rarely use the letter ‘c’ and will try and trick you.

It doesn’t matter which way around the a and b are.

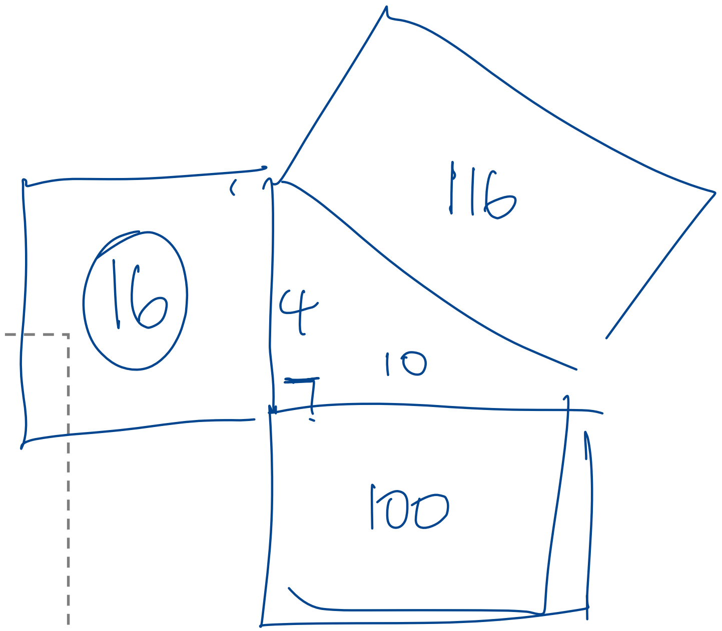


Example

Calculate the length of the hypotenuse in the triangle opposite to two decimal places.



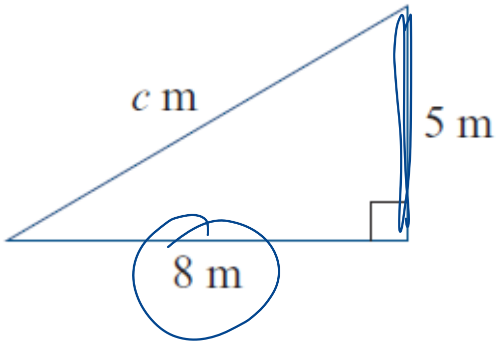
$$c^2 = a^2 + b^2$$
$$c^2 = 4^2 + 10^2$$
$$c^2 = 16 + 100$$
$$c^2 = 116$$

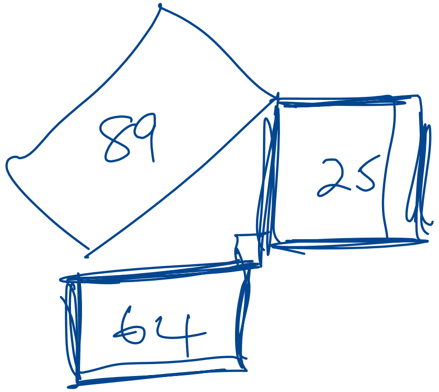


$$c^2 = 116$$
$$c = \sqrt{116}$$
$$= 10.77 \text{ (2dp)}$$

Example

Find the length of the hypotenuse to two decimal places.





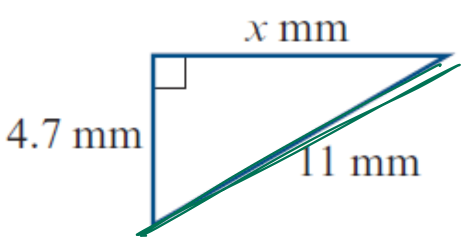
$c^2 = 89$

$c = \sqrt{89}$

$c = 9.43\text{ m} \quad (2\text{dp})$

Example

Calculate the length of the unknown side, x, in the triangle opposite to one decimal place.



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

$11^2 = x^2 + 4.7^2$

$121 = x^2 + 22.09$

$121 - 22.09 = x^2$

$x^2 = 98.91$

Note: One of the easiest ways to trick you is the change the orientation of the triangle.

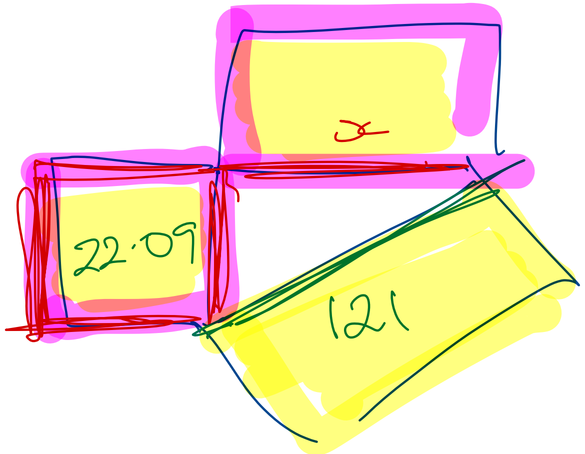
I always think of the right-angle as an **arrow head** pointing to the hypotenuse.

$x^2 = 121 - 22.09$

$x^2 = 98.91$

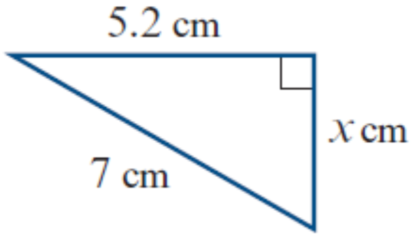
$x = \sqrt{98.91}$

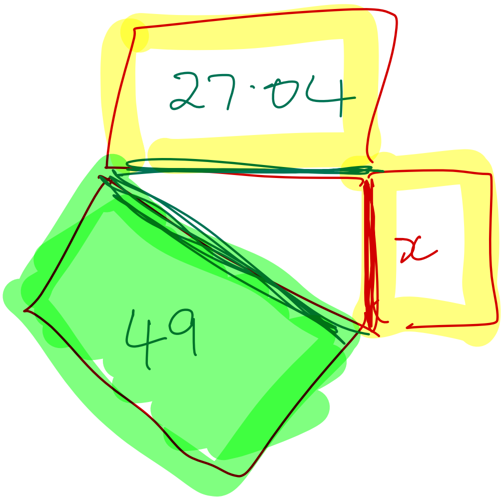
$= 9.9 \text{ mm}$



Example

Find the length of the unknown side to one decimal place.





$x^2 = 49 - 27.04$

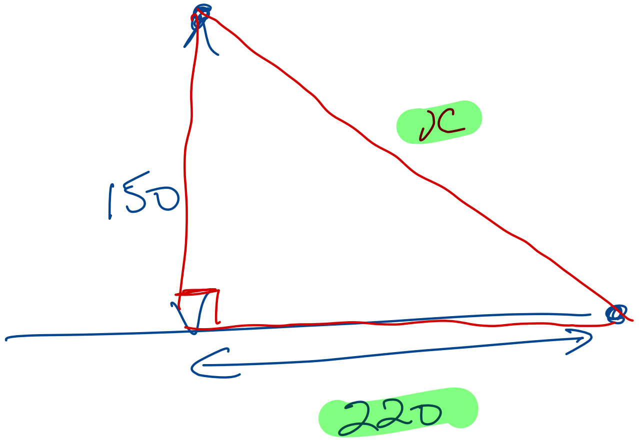
$x^2 = 21.96$

$x = \underline{\underline{4.7 \text{ cm}}}$ (1dp)

Solving practical problems

A helicopter hovers at a height of 150 m above the ground and is a horizontal distance of 220 m from a landing pad. Find the direct distance of the helicopter from the landing pad to two decimal places.

Note: No one likes worded problems! They take practice to master. But, the good news is, there are only so many types of worded questions we can write. Practice the common types and you will be set for life.



$$150^2 + 220^2 = x^2$$

$$22500 + 48400 = x^2$$

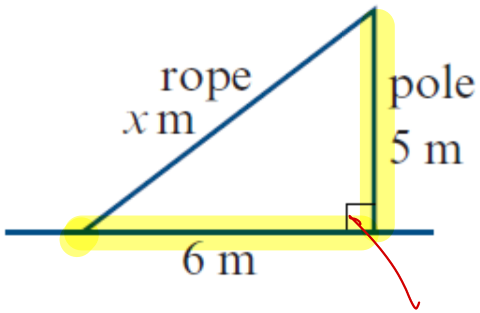
$$70900 = x^2$$

$$x = \sqrt{70900}$$

$$= \underline{\underline{266.27 \text{ m}}}$$

Solving practical problems

A rope tied to the top of a 5 m pole is secured to the ground by a peg, 6 m from the base of the pole. What is the length of the rope to one decimal place?



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$x^2 = 6^2 + 5^2$

$x^2 = 36 + 25$

$x^2 = 61$

$x = \sqrt{61} = \underline{7.8\text{m}}$

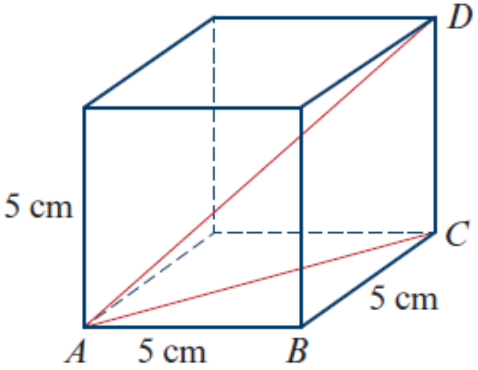
Pythagoras in three dimensions

The cube in the diagram on the right has side lengths of 5 cm.

Find the length:

a AC to one decimal place.

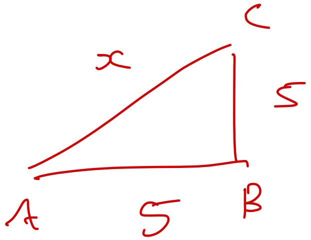
b AD to one decimal place.



In any diagram we need to look for right-angled triangles. Where there is a right-angled triangle we can use Pythagoras' Theorem.

The questions will try and trick you by asking you to use it twice!

Can you see the trick is being used in this commonly used question?



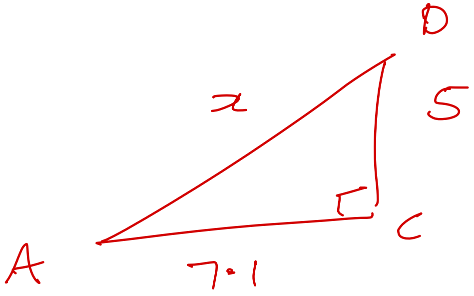
$x^2 = 5^2 + 5^2$

$x^2 = 25 + 25$

$x^2 = 50$

$x = \sqrt{50}$

$x = \underline{7.1\text{ cm}}$



$x^2 = 7.1^2 + 5^2$

$x^2 = 50.41 + 25$

$x^2 = 75.41$

$x = \underline{8.7\text{ cm}}$

Work to complete

The work I am asking to be completed for this topic is shown below.

This is the minimum work which should be completed. The more questions which are answered the better your chance of success in exams. Questions towards the end of the exercises and in the Chapter Review are the best practice you can do.

Questions to complete:
Exercise 10B: All