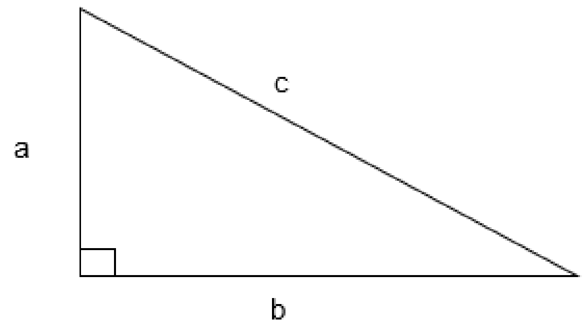
Pythagoras's Theorem

Study Development Factsheet

Pythagoras's Theorem is used to find the length of the sides of a right-angle triangle.



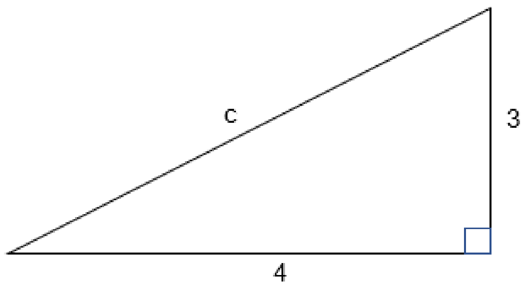
The theorem states that for a right-angle triangle with side lengths a, b and c:

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

a and b are the two shorter sides, and c is always the longest side, which is the one opposite the right angle.

This allows us to find one of a, b, or c given two other side lengths.

For example:

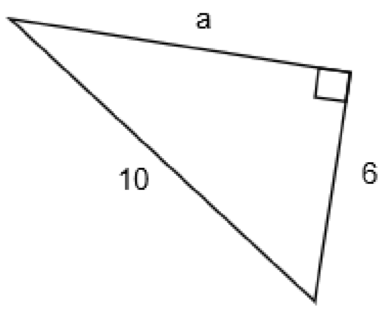


What is the length of c?

Using Pythagoras's Theorem:

$4^2 + 3^2 = c^2$, which give us $c^2 = 16 + 9 = 25$, therefore $c = \sqrt{25} = 5$

We can also find a shorter side length using Pythagoras's Theorem. For example:

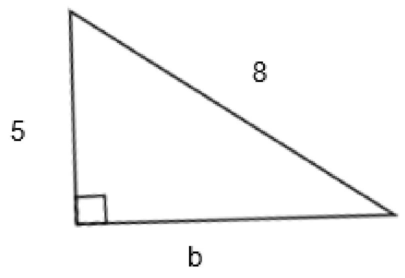


If we want to find the length a, we have:

$a^2 + 6^2 = 10^2$, which gives us $a^2 + 36 = 100$, and so $a^2 = 100 - 36 = 64$. So, finally, $a = \sqrt{64} = 8$.

Note: If you are more familiar with square roots, you may have noticed that we don't list -8 or -5 as a solution to $\sqrt{64}$ or $\sqrt{25}$. This is because the root function here holds a slightly different meaning to normal. Since we are using the root to find a side length, we can only have a positive answer, as negative side lengths don't really make sense.

We may also have solutions that don't come out as nice integer numbers- in fact, this is a lot more common. For example:



Using Pythagoras's Theorem, we have

$$5^2 + b^2 = 8^2$$

$$b^2 = 64 - 25$$

$$b^2 = 39$$

$$b = \sqrt{39}$$

We generally leave these as roots, or you can convert them to decimals and round them.

Fun fact: When Pythagoras came up with his theorem, it was a groundbreaking idea. Supposedly, Pythagoras formed a cult around his mathematics, and membership was a very big deal. At this time, however, there was no concept of a 'square root'- instead, they thought of the root as being the length of one side of a square, and the number being 'rooted' was the area of the square. One day, a member of the cult asked Pythagoras what the length of the longest side would be when the two shorter sides had length 1. We now know this would be $\sqrt{2}$, however this is an irrational number, so Pythagoras had no way to express the length. Out of fear that his power would be taken away by this supposed exception to his theorem, he took the cult member out to a lake and killed him, so that no one else would hear the exception.

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