Pythagorean Theorem (relationship)

Question:

Why learn the Pythagorean theorem?

Possible answers to the question are:

1. If you want to get good marks, you better learn it. It is in the school mathematics curriculum.
2. I heard that some people use it but I really don't know what for.
3. My father used it once to check if the garage he was building had square corners.

Response 1 indicates an all too typical response. Sadly, a good number of people leave grade 12 with the attitude that what schooling is all about is getting good grades, or at least passing courses. Who is to blame? The system and those who work in it and those who support it philosophically.

Responses 2 and 3 provide a meager indication that the theorem is used by someone in some way. Appreciation of school mathematics, in general, is low. This is partly due to the reality that much of the mathematics found in school curricula lives inside a "black box". In other words, how the mathematics is used outside of school is not apparent. Sophisticated knowledge and understanding about such domains as science and engineering is typically required to reveal its uses. The exception, of course, is "going to the store" uses of mathematics. Such uses are mostly trivial in nature and do not do much to raise the status of mathematics as something worthwhile to be learned.

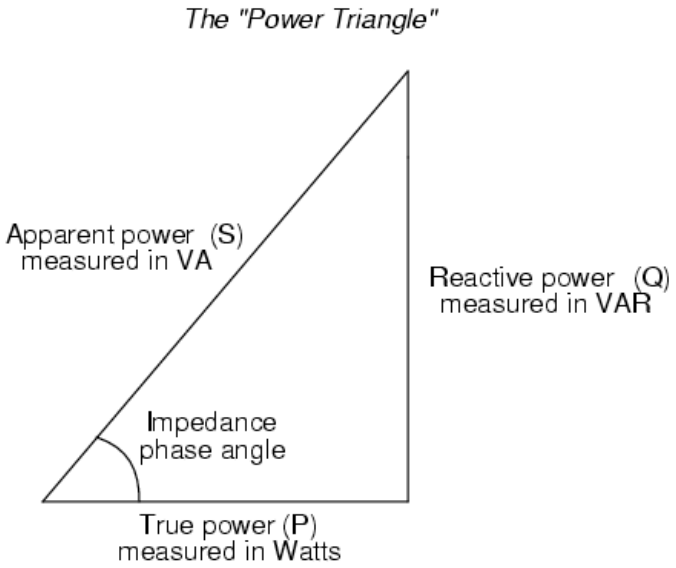
Here is a partial list of occupations that make use of the Pythagorean theorem:

- Computer systems analysts
- Construction engineers and managers
- Surveyors and cartographers
- Mechanical engineers
- Scientists
- Optometrists

Here is a simple example of its use from the world of electrical engineering.

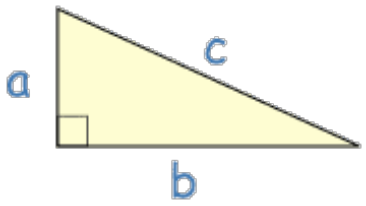
There are three types of electrical power: apparent, reactive, and true power. They are related to each other in a vector manner (refer to the triangle diagram).

The triangle is a right triangle. The Pythagorean theorem provides a way of figuring out particular components of the electrical power.



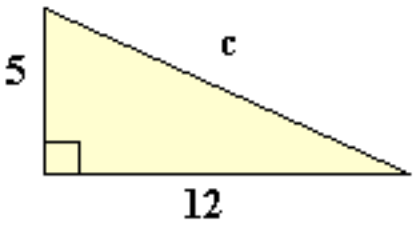
What is the Pythagorean theorem?

It describes the relationship between the three sides of a right triangle. The relationship is: $a^2 + b^2 = c^2$

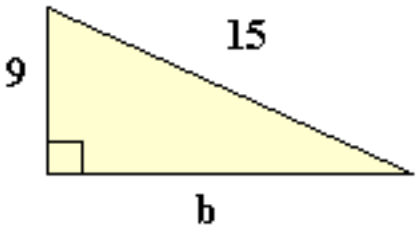


Two examples follow about how to use the relationship to solve simple triangle problems.

$a^2 + b^2 = c^2$
$5^2 + 12^2 = c^2$
$25 + 144 = c^2$
$169 = c^2$
$c^2 = 169$
$c = \sqrt{169}$
$c = 13$



$a^2 + b^2 = c^2$
$9^2 + b^2 = 15^2$
$81 + b^2 = 225$
Subtract 81 from both sides:
$b^2 = 144$
$b = \sqrt{144}$
$b = 12$



Background info about the theorem

Pythagoras did not discover the relationship between the sides of a right triangle. He is credited with proving the theorem, but, the reality is that it may have been someone else of the Pythagorean cult who developed the proof. We do not know either way.

The relationship between the three sides has been known since the days of the ancient cultures such as the Babylonians, Egyptians and Chinese. However, it was not stated in the current form ($a^2 + b^2 = c^2$) by those cultures. It typically was stated as triplets that were the three sides of a right triangle.

An extension of the Pythagorean Theorem

In the 17th century, Pierre de Fermat investigated the problem of whether the theorem can be extended to whole number exponents greater than 2.

For example, he wondered if natural number solutions could be found for the equation:

$a^3 + b^3 = c^3$

The general form of this problem is if natural number solutions can be found for:

$a^n + b^n = c^n$ where 'n' is a whole number greater than 2.

The Pythagorean theorem is a special case of this equation for n = 2, and natural number solutions exist (for example: 3, 4, 5). Fermat thought that there were no natural number solutions when n was greater than 2. He did not leave a proof, though.

This problem became known as Fermat's Last Theorem. It may seem to be a simple problem on the surface, but it is not. Andrew Wiles of Princeton University finally proved Fermat's Last theorem in 1993, a long time after Fermat's death in the 1665. It turned out that Fermat was correct in his thinking.

Refer to: Grade 8 Pythagorean theorem **if more help is needed.**

Visit the website **Pythagorean Theorem** and its many proofs for a large number and variety of proofs of the theorem.