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Pythagoras' Theorem

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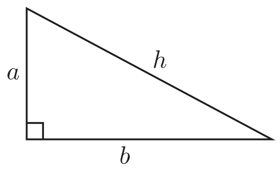
In any **right-angled** triangle, the square of the **hypotenuse** is the sum of the squares of the other two sides.



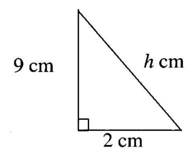
$$a^2 + b^2 = h^2$$

Notes:

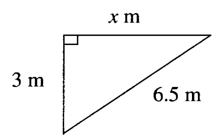
- The hypotenuse is the longest side, opposite the right angle.
- Can use this to calculate any side given the other two.

Exercises:

1. What is the length of the hypotenuse of the following triangle?



2. Find the length of the unknown side.



Solutions:

1. From Pythagoras' Theorem,

$$h^2 = a^2 + b^2 .$$

In this situation, $a = 2\,,\ b = 9\,,\ h = ?\,.$

It would not matter which side we let be a and which side we let be b. So,

$$\begin{aligned} h^2 &= 2^2 + 9^2\,, \\ h^2 &= 85\,, \\ \text{so } h &= \sqrt{85} \approx 9.22\,. \end{aligned}$$

Note the negative square root in this case has no meaning so we disregard it.

The length of the hypotenuse is approximately 9.22 cm.

Solutions (cont)

2. Pythagoras' Theorem states

$$h^2 = a^2 + b^2 .$$

Here, $a = 3$, $b = x$, $h = 6.5\,.$ So,

$$\begin{aligned} (6.5)^2 &= 3^2 + x^2\,, \\ 42.25 &= 9 + x^2\,, \\ 42.25 - 9 &= x^2\,, \\ x^2 &= 33.25\,, \\ \text{so } x &= \sqrt{33.25} \approx 5.8\,. \end{aligned}$$

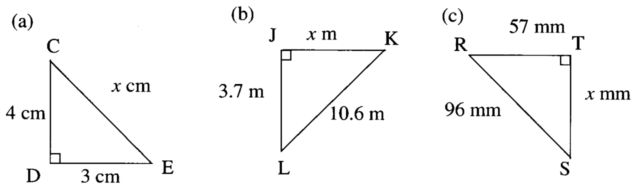
Take 9 from both sides.

Again we disregard the negative square root.

So the length of the unknown side is approximately 5.8 m.

More exercises

1. For the following right angled triangles, find the unknown length (to two decimal places if necessary).



Answers

(a)

$$\begin{aligned} x^2 &= 4^2 + 3^2\,, \\ x^2 &= 16 + 9\,, \\ x^2 &= 25\,, \\ x &= \sqrt{25}\,, \\ x &= 5\,. \end{aligned}$$

Thus the unknown length is 5 cm.

(b)

$$\begin{aligned} (10.6)^2 &= (3.7)^2 + x^2\,, \\ 112.36 &= 13.69 + x^2\,, \\ x^2 &= 112.36 - 13.69\,, \\ x^2 &= 98.67\,, \\ x &= \sqrt{98.67}\,, \\ x &\approx 9.93\,. \end{aligned}$$

Thus the unknown length is approximately 9.93 m.

Answers (cont)

(c)

$$\begin{aligned} 96^2 &= 57^2 + x^2\,, \\ 9\,216 &= 3\,249 + x^2\,, \\ x^2 &= 9\,216 - 3\,249\,, \\ x^2 &= 5\,967\,, \\ x &= \sqrt{5\,967}\,, \\ x &\approx 77.25\,. \end{aligned}$$

Thus the unknown length is approximately 77.25 mm.

Further help
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