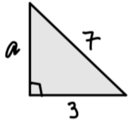
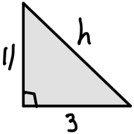
Finding the length of a side of a triangle.





METHOD 1: If you have the length of two of the sides, then use Pythagorus's Theorem $a^2 + b^2 = h^2$ where h is the length of the hypotenuse.

Step 1: Identify the side that is the hypotenuse (side opposite right angle).

Step 2A: If you have the length of the hypotenuse h and the length of one of the other sides is b, then

$$a^2 + b^2 = h^2 \Rightarrow a^2 = h^2 - b^2 \Rightarrow a = \sqrt{h^2 - b^2} \text{ units.}$$

Step 2B: If you do no have the length of the hypotenuse, but do have the other side lengths, a and b, then

$$h^2 = a^2 + b^2 \Rightarrow h = \sqrt{a^2 + b^2} \text{ units.}$$

Examples: In the first triangle above, we have the length of the hypotenuse $h = 7$, so

$$a^2 + 3^2 = 7^2 \Rightarrow a^2 + 9 = 49 \Rightarrow a^2 = 40 \Rightarrow a = \sqrt{40} = \sqrt{4}\sqrt{10} = 2\sqrt{10} \text{ units.}$$

In the second triangle above, we do not have the length of the hypotenuse, so

$$h^2 = 3^2 + 11^2 \Rightarrow h^2 = 9 + 121 = 130 \Rightarrow h = \sqrt{130} \text{ units.}$$

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METHOD 2: If you have an angle $\theta \neq 90^o$ and the length of one of the sides of the triangle, you can use SOHCAHTOA.

Step 1: Identify the "types" (H, O, A) of the sides of your triangle with respect to your angle θ.
H is always the hypotenuse
O is the side opposite θ
A is the side adjacent to θ

Step 2: You will use two of these "types":

- The "type" of the side you know the length of
- The "type" of the side you want to know the length of

to identify which trigonometric function to select in SOHCAHTOA.

Step 3 The 3 letters in SOHCAHTOA give the equation

$$\text{Function}(\theta) = \frac{\text{Type A}}{\text{Type B}} \text{ which is used to find the side length.}$$

(Some examples are on the following page.)

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Examples: In the first triangle above, we have the angle $\theta = 30^o$, and the side of length 3 is H and the side a is O (opposite θ), so we use SOH, which means

$$\sin(30^o) = \frac{a}{3} \Rightarrow 3\sin(30^o) = a \Rightarrow a = \frac{3}{2} \text{ units.}$$

In the second triangle above, we have the angle $\theta = 50^o$,and the side of length 4 is A (adjacent to θ) and h is H, so we use CAH, which means

$$\cos(50^o) = \frac{4}{h} \Rightarrow h\cos(50^o) = 4 \Rightarrow h = \frac{4}{\cos(50^o)} \approx 6.22 \text{ units.}$$

In the second example, the exact answer is $h = \frac{4}{\cos(50^o)}$ units. You should always provide this answer. If asked to give the answer within 2 decimal places you would say $h \approx 6.22$ units.