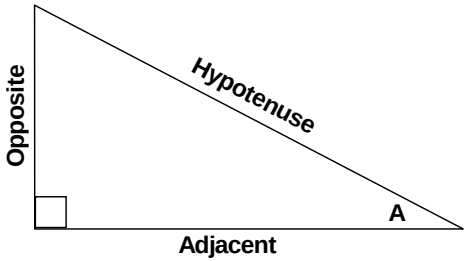
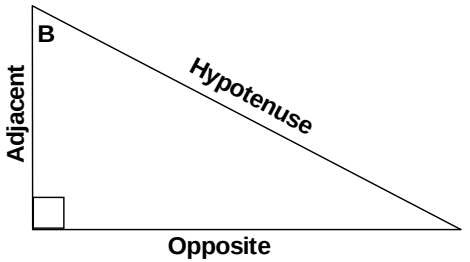
Trigonometry





Naming the Sides

There are *three* different names for the three different sides of a right-angled triangle.

The **hypotenuse** is always the longest side.

The other two names, opposite and adjacent, depend on which *angle* you're currently looking at in the triangle.

The **opposite** side is the side opposite the angle we're looking at.

The **adjacent** side is the side of the triangle that *touches* the angle we're looking at, but which is *not* the hypotenuse.

Side Ratios

Trigonometry is all about the *ratio* of the side lengths in the triangle. For the triangle with angle A:

$$\text{cosine A} = \cos A = \frac{\text{Length of adjacent side}}{\text{Length of hypotenuse side}}$$

$$\text{sine A} = \sin A = \frac{\text{Length of opposite side}}{\text{Length of hypotenuse side}}$$

$$\text{tangent A} = \tan A = \frac{\text{Length of opposite side}}{\text{Length of adjacent side}}$$

There's an easy way to remember what all these ratios are – **SOH CAH TOA**

SOH = **(S)**in : **(O)**pposite over **(H)**ypotenuse

CAH = **(C)**os : **(A)**djacent over **(H)**ypotenuse

TOA = **(T)**an : **(O)**pposite over **(A)**djacent

Check with Pythagoras' Theorem

You can check side length answers with Pythagoras' Theorem:

$$\text{Hypotenuse}^2 = \text{opposite}^2 + \text{adjacent}^2 \text{ ???}$$

Say the hypotenuse is 8, and you work out the adjacent side is 6.128 and the opposite side is 5.142.

$$8^2 = 5.142^2 + 6.128^2 \text{ ???}$$

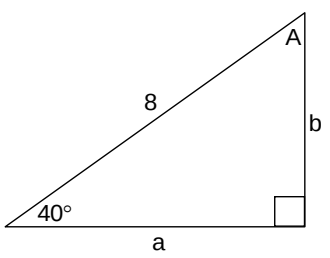
$$64 = 26.44 + 37.55 \text{ ???}$$

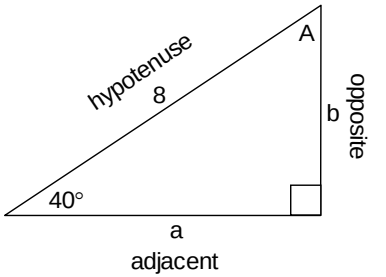
$$64 = 63.99 \text{ ???}$$

$$64 \approx 63.99$$

The sides match up so you've probably got the right answer.

Using Trigonometry to work out side lengths





Say we want to find how long side 'a' is. What we can do is write a trigonometric ratio which has 'a' in it. We only know one side length – we know the hypotenuse is 8 long. What we want is a trigonometric ratio that involves both the side we're trying to work out (side a) and the side we already know.

So since we're using the 40° angle, we want a ratio which involves the adjacent side and the hypotenuse. Let's go through our SOH CAH TOA:

(S)in is the (O)pposite over the (H)ypotenuse, so it won't work.

(C)os is the (A)djacent over the (H)ypotenuse – bingo, that's what we want.

So we can write a trigonometric ratio using *cosine*:

$$\cos 40° = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{a}{8}$$

$$\cos 40° = \frac{a}{8}$$

$$a = 8 \cos 40°$$

$$a \approx 6.1$$