L3 – Using Trig to Solve for Side Lengths Unit 3
MPM2D
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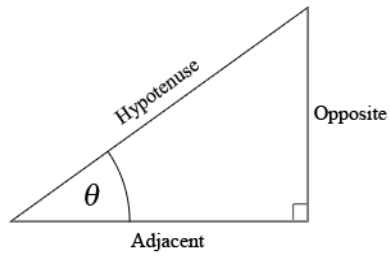
Part 1: Remember $S\frac{O}{H}C\frac{A}{H}T\frac{O}{A}$

If we know a right-angle triangle has an angle of θ, all other right-angle triangles with an angle of θ are **similar** and therefore have equivalent ratios of corresponding sides. The three primary ratios are shown in the diagram to the right.



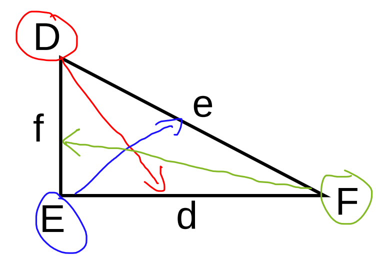
$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

For example, $\sin 30°$ is always equal to $\frac{1}{2}$ because every right-angle triangle with a reference angle of $30°$ is similar and its ratio of $\frac{opposite\ side\ length}{hypotenuse\ length} = \frac{1}{2}$. It's important to understand that the sides lengths are NOT necessarily 1 and 2 respectively, we just know what the ratio has to be.

Another important thing to note is that when labelling triangles, we label angles with CAPITAL LETTERS and the side opposite from the angle with its corresponding lower-case letter.

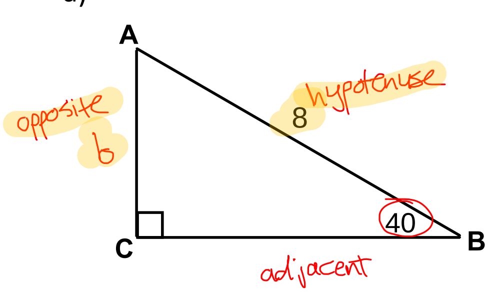


Part 2: Finding Side lengths of a Right-Triangle Using Trigonometry

If we have a right triangle where we know an angle, the calculator can tell us what the ratio of a pair of sides should be equal to. Therefore, if we know one side length, we can solve for the other using the ratio we know must be true.

Example 1: Find the length of side $'b'$ in each of the following triangles

a)

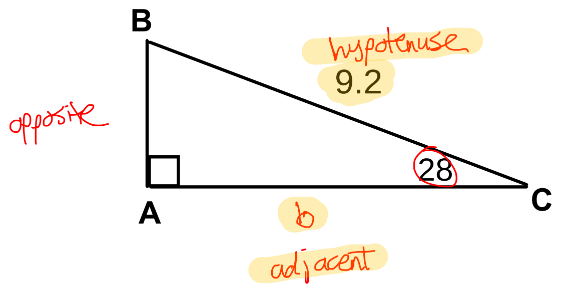


$\sin(40°) = \frac{b}{8}$

$8\sin(40°) = b$

$\boxed{b \simeq 5.14}$

b)



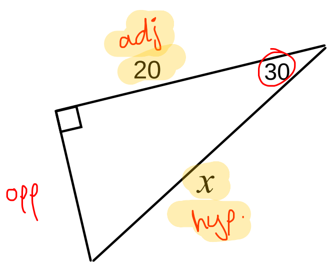
$$\cos(28^\circ) = \frac{b}{9.2}$$

$$9.2\cos(28^\circ) = b$$

$$\boxed{b \simeq 8.12}$$

Example 2: Solve for side x in each triangle

a)



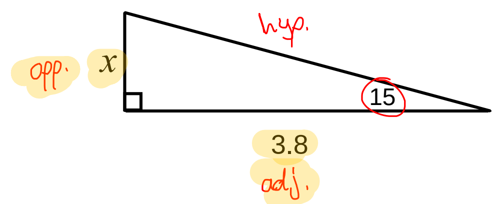
$$\cos(30^\circ) = \frac{20}{x}$$

$$x\cos(30^\circ) = 20$$

$$x = \frac{20}{\cos(30)}$$

$$\boxed{x \simeq 23.09}$$

b)



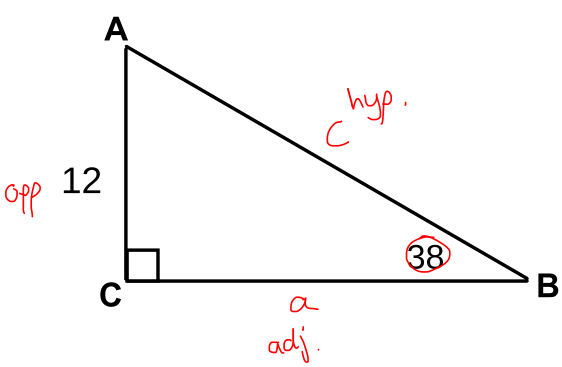
$$\tan(15^\circ) = \frac{x}{3.8}$$

$$3.8\tan(15^\circ) = x$$

$$\boxed{x \simeq 1.02}$$

Example 3: Solve the following triangle.

> ***Note:*** *Solving a triangle means to find all of the missing sides and angles.*



$$\angle A = 90 - 38$$

$$\boxed{\angle A = 52^\circ}$$

$$\tan(38^\circ) = \frac{12}{a}$$

$$a = \frac{12}{\tan(38)}$$

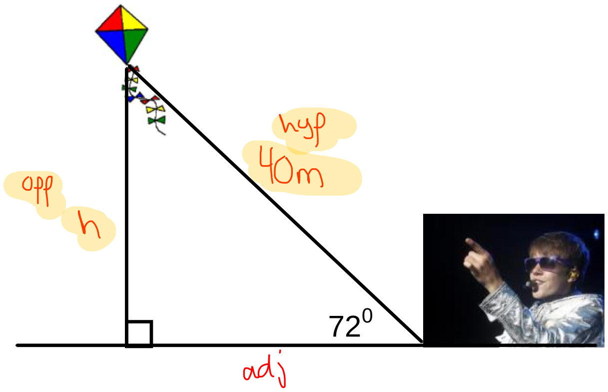
$$\boxed{a \simeq 15.36}$$

$$\sin(38) = \frac{12}{c}$$

$$c = \frac{12}{\sin(38)}$$

$$\boxed{c \simeq 19.49}$$

Example 4: Justin Bieber has let out 40 meters of his kite string, which makes an angle of 72 degrees with the ground. Find the height of the kite, to the nearest meter.



$$\sin(72^\circ) = \frac{h}{40}$$

$$40\sin(72^\circ) = h$$

$$\boxed{h \approx 38\,m}$$