

Lesson 3: Calculating the Length of a Side in Right Triangles

Friday, August 31, 2018 2:27 AM

Trigonometry Lesson #3: Calculating The Length of a Side in Right Triangles

Review - The Pythagorean Theorem

p3.77

The Pythagorean Theorem can be applied in a right triangle to determine the length of the third side of a triangle in which the lengths of the other two sides are given.

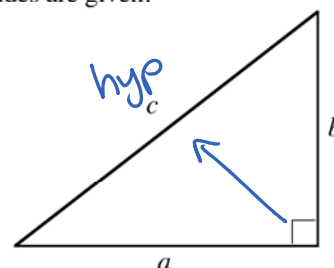
In the triangle shown

$$c^2 = a^2 + b^2$$

hypo

$$a^2 = c^2 - b^2$$

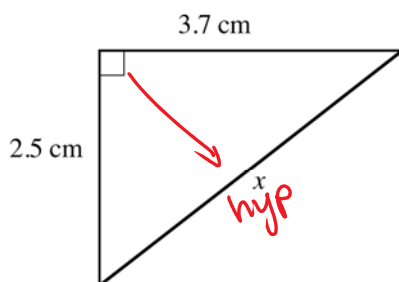
$$b^2 = c^2 - a^2$$



Calculate the length of the third side of each triangle, to the nearest tenth if necessary.

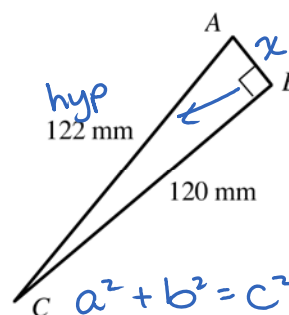


a)



$$\begin{aligned} a^2 + b^2 &= c^2 \\ 2.5^2 + 3.7^2 &= x^2 \\ 6.25 + 13.69 &= x^2 \\ \sqrt{19.94} &= \sqrt{x^2} \\ x &= 4.5 \text{ cm} \end{aligned}$$

b)



$$\begin{aligned} a^2 + b^2 &= c^2 \\ x^2 + 120^2 &= 122^2 \\ x^2 + 14400 &= 14884 \\ -14400 &-14400 \\ \sqrt{x^2} &= \sqrt{484} \\ x &= 22 \text{ mm} \end{aligned}$$

Using the Trigonometric Ratios to Calculate the Length of a Side

At the beginning of this lesson we reviewed the procedure for calculating the third side of a right triangle in which the other two sides were given.

It is also possible to determine the length of a side in a right triangle if the length of one side and the measure of one of the acute angles are given.

The procedure is demonstrated on the next page.

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In right triangle ABC we are given the length of one side and the measure of an acute angle.

The procedure for determining the length of the side marked x is started below.

The given side, 14.2 cm, is the hypotenuse and the side to be determined, x , is opposite the given angle of 52° .

We use the Sine ratio.

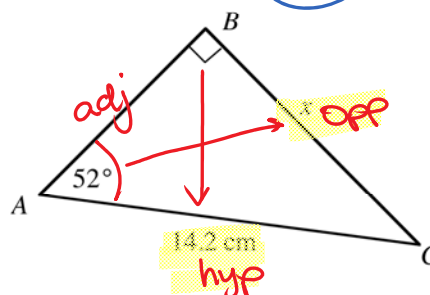
$$14.2 \sin 52^\circ = \frac{x \cdot 14.2}{14.2}$$

Cross multiply to get

$$14.2 \sin 52^\circ = x$$

$$14.2 \times 52 \sin =$$

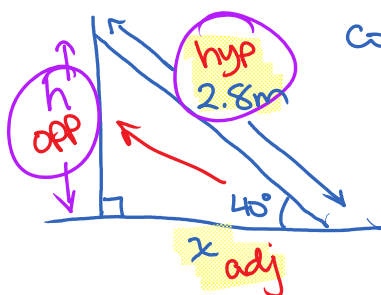
To 1 decimal place, $x = 11.2$ cm.



Caribou jerky, a traditional Inuit food, can be seen drying on wooden racks along the shores of the Arctic Ocean. A piece of wood, 2.8 m long, that could be used to build a drying rack rests against a wall. The angle between the piece of wood and the ground is 40° .

SOH CAH TOA

Make a rough sketch and determine the distance between the bottom of the piece of wood and the bottom of the wall to the nearest tenth of a metre.



$$\cos = \frac{\text{adj}}{\text{hyp}}$$

$$2.8 \cos 40^\circ = \frac{x \cdot 2.8}{2.8}$$

$$x = 2.8 \cos 40^\circ$$

$$x = 2.1 \text{ m}$$

$$2.1449 \dots$$



Determine the height of the wall in Class Ex. #2 to the nearest tenth of a metre.

a) using trigonometric ratios

$$2.8 \sin 40^\circ = \frac{h \cdot 2.8}{2.8}$$

$$h = 2.8 \sin 40^\circ$$

$$h = 1.8 \text{ m}$$

$$\sin = \frac{\text{opp}}{\text{hyp}}$$

b) using the Pythagorean Theorem

$$a^2 + b^2 = c^2$$

$$h^2 + (2.144)^2 = 2.8^2$$

$$h^2 + 4.6007 = 7.84$$

$$h^2 = 7.84 - 4.6007 = 3.2393$$

$$h = 1.8 \text{ m}$$

Complete Assignment Questions #1 - #4

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In all of the previous work, the side which had to be determined was in the numerator of the trigonometric ratio. Complete the work below to determine the length of a side which appears in the denominator of the trigonometric ratio.

opp

the trigonometric ratio. Complete the work below to determine the length of a side which appears in the denominator of the trigonometric ratio.

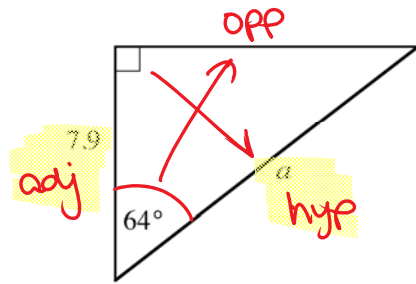
In the diagram, $a \cos 64^\circ = \frac{7.9}{a}$
cross multiply to get

$$a \cos 64^\circ = 7.9$$

divide both sides by $\cos 64^\circ$ to get

$$a = \frac{7.9}{\cos 64^\circ}$$

$$= \underline{18.0} \text{ (to the nearest tenth)}$$



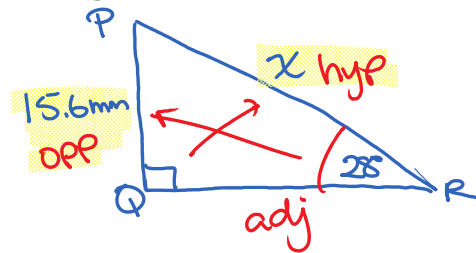
Determine, to one decimal place, the length of the hypotenuse of triangle PQR in which angle $PQR = 90^\circ$, angle $PRQ = 28^\circ$, and $PQ = 15.6$ mm.

$$\cancel{x \sin 28^\circ} = \frac{15.6 \cdot \cancel{x}}{\cancel{x}}$$

$$\frac{x \sin 28^\circ}{\sin 28^\circ} = \frac{15.6}{\sin 28^\circ}$$

$$x = \frac{15.6}{\sin 28^\circ}$$

$$x = 33.2 \text{ mm}$$



$$\sin = \frac{\text{opp}}{\text{hyp}}$$



Use trigonometric ratios to determine the lengths of AB and AC in the given triangle. Answer correct to the nearest metre.

Find x

$$147 \tan 71^\circ = \frac{x \cdot 147}{147}$$

$$x = 147 \tan 71^\circ$$

$$x = 427 \text{ m}$$

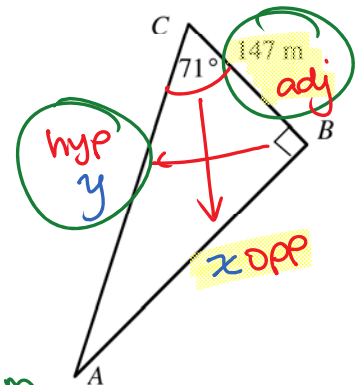
Find y

$$y \cos 71^\circ = \frac{147 \cdot y}{y}$$

$$\frac{y \cos 71^\circ}{\cos 71^\circ} = \frac{147}{\cos 71^\circ}$$

$$y = \frac{147}{\cos 71^\circ}$$

$$y = 452 \text{ m}$$



Complete Assignment Questions #5 - #12