

# 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

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

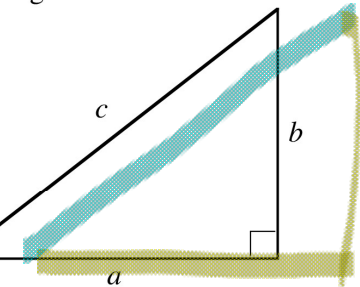
$$c^2 = a^2 + b^2$$

*two short*

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

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

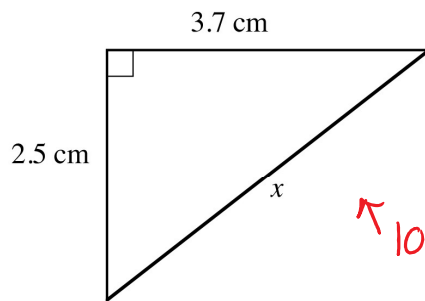
*long & short*



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



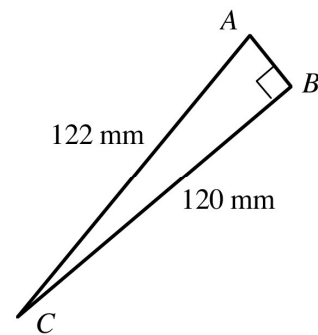
a)



*long side*

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 2.5^2 + 3.7^2 &= c^2 \\ \sqrt{19.94} &= \sqrt{c^2} \\ c &= 4.4654... \\ &= \boxed{4.5} \end{aligned}$$

b)



*c short side*

$$\begin{aligned} c^2 &= 122^2 - 120^2 \\ c^2 &= 484 \\ c &= \boxed{22} \end{aligned}$$

## 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.

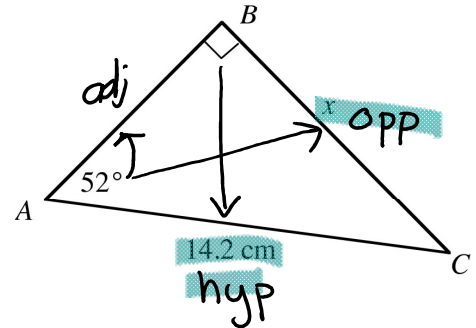
The procedure is demonstrated on the next page.

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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  $52^\circ$ .



We use the sine ratio.

$$14.2 \sin 52^\circ = \frac{x}{14.2} \quad \text{Cross multiply to get} \quad 14.2 \sin 52^\circ = x$$

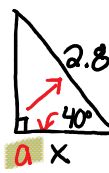
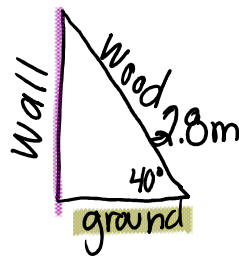
To 1 decimal place,  $x = 11.2$  cm.



Class Ex. #2

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  $40^\circ$ .

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.



SIN CAT A

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

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

$$x = 2.1$$



Class Ex. #3

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

a) using trigonometric ratios

SIN CAT A

$$\sin 40^\circ = \frac{y}{2.8}$$

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

$$y = 1.8$$

b) using the Pythagorean Theorem

$$y^2 = 2.8^2 - 2.1^2$$

$$y^2 = 3.43$$

$$y = 1.85\dots$$

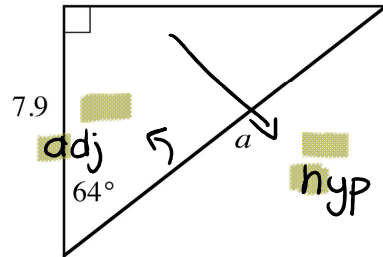
$$y = 1.9$$

Complete Assignment Questions #1 - #4

# 1, 4

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.

In the diagram,  $\cos \frac{7.9}{a}$   
 cross multiply to get  
 $a \cos = 7.9$   
 divide both sides by  $\cos$  to get

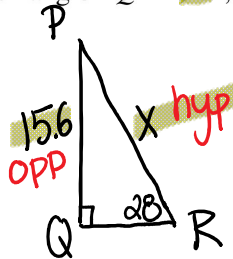


$$a = \frac{7.9}{\cos} \quad 7.9 \div \cos 64$$

$$= 18.0 \text{ (to the nearest tenth)} \quad 7.9 \div 64 \cos =$$



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.



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

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

$$x = 33.2$$

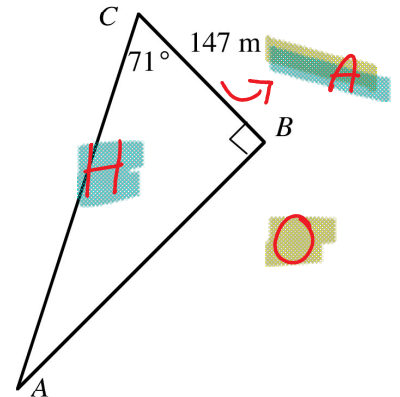


Use trigonometric ratios to determine the lengths of  $AB$  and  $AC$  in the given triangle. Answer correct to the nearest metre.

$$\tan 71 = \frac{0}{147} \quad \cos 71 = \frac{147}{h}$$

$$0 = 147 \tan 71 \quad h = \frac{147}{\cos 71}$$

$$= 426.7 \quad h = 451.5$$



**Complete Assignment Questions #5 - #12**

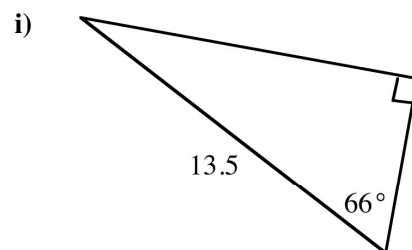
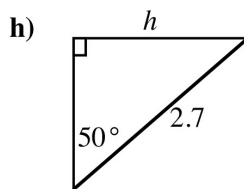
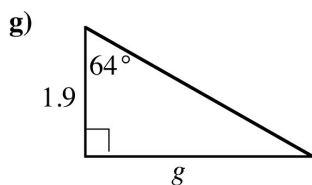
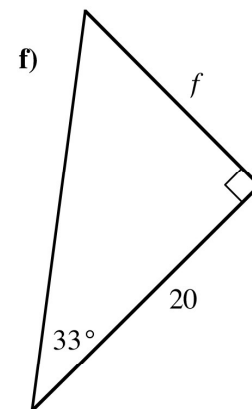
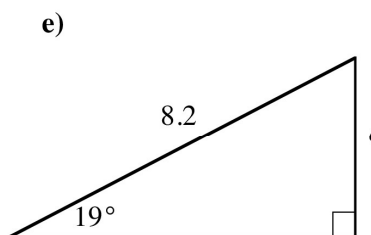
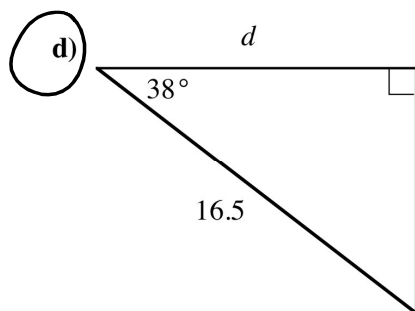
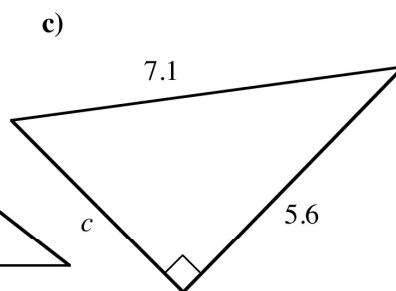
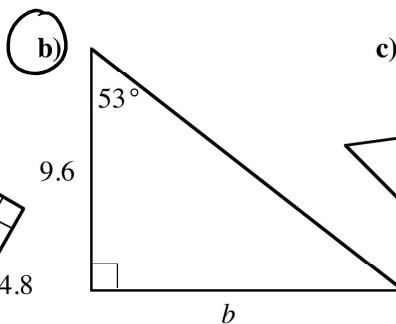
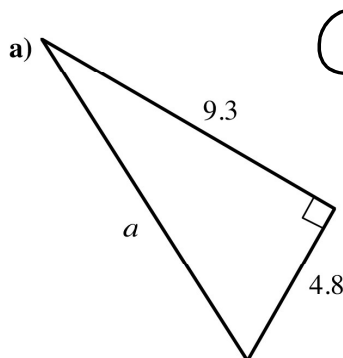
Quiz tomorrow  
 1145 hrf for 7ac.81

Quiz tomorrow

1, 4, 5 bdf, 6ac, 7ac, 8

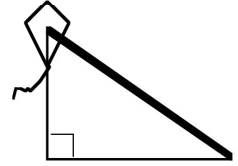
## Assignment

1. Calculate, to the nearest tenth, the length of the indicated side in each triangle.

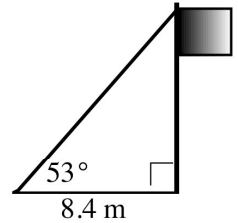




2. A kite string is 65 metres long and makes an angle of  $32^\circ$  with the ground. Calculate, to the nearest metre, the vertical height,  $h$ , of the middle of the kite above the ground.



3. Use the measurements in the diagram to determine the height of the flagpole to the nearest tenth of a metre.



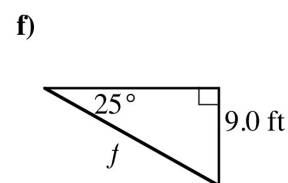
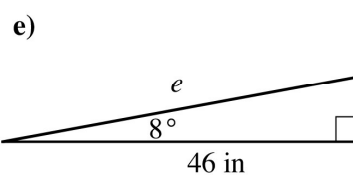
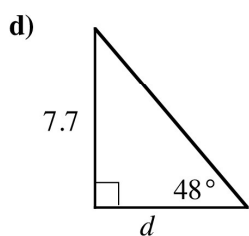
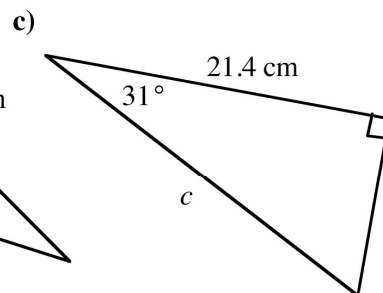
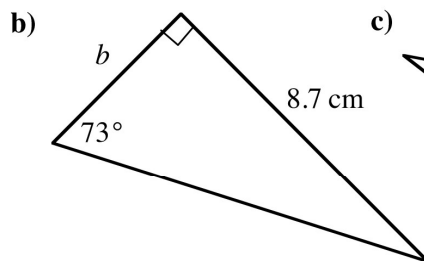
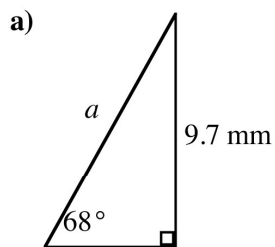
4. A ladder 5.3 m long is inclined at an angle of  $72^\circ$  to the ground.
- How far up the wall, to the nearest tenth of a metre, does the ladder reach?
  - Use trigonometry to determine, to the nearest tenth of a metre, the distance between the bottom of the ladder and the bottom of the wall.
  - Use the answer to a) and the Pythagorean Theorem to determine, to the nearest tenth of a metre, the distance between the bottom of the ladder and the bottom of the wall.
  - Explain why the answers to b) and c) are different.



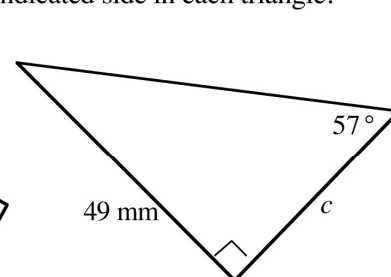
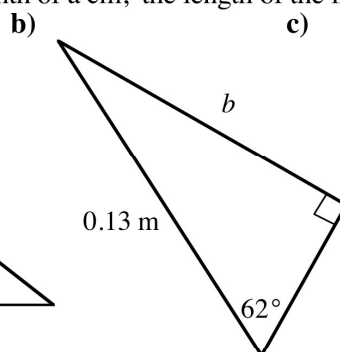
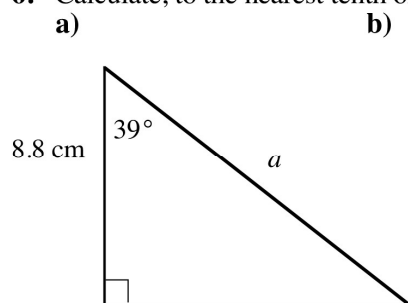


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5. Calculate, to the nearest tenth, the length of the indicated side in each triangle.

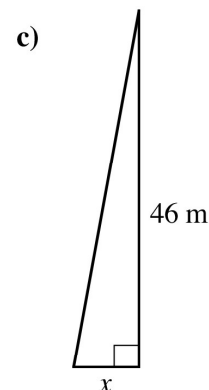
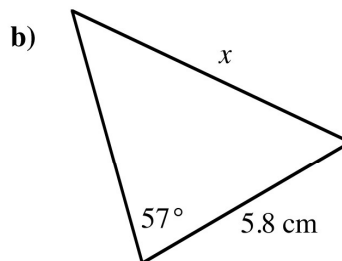
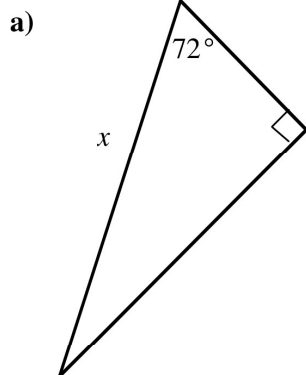


6. Calculate, to the nearest tenth of a cm, the length of the indicated side in each triangle.





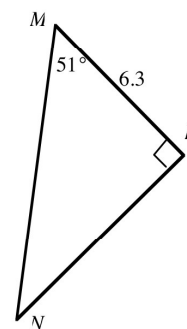
7. Explain why trigonometric ratios could not be used to calculate the side marked  $x$  in each of the following triangles.



8. Determine, to the nearest tenth, the length of the hypotenuse of the following triangles.

- a) Triangle  $PQR$  in which angle  $QPR = 90^\circ$ , angle  $PRQ = 47^\circ$  and  $PQ = 34.1$  mm.    b)  $\triangle ABC$  in which  $\angle ABC = 90^\circ$ ,  $\angle BCA = 29^\circ$  and  $BC = 8.4$  cm.

9. Calculate, to the nearest tenth, the lengths of  $LN$  and  $MN$ .



**Multiple Choice** 10. Triangle  $DEF$  is right-angled at  $F$ . Angle  $DEF = 36^\circ$  and  $DF = 15$  cm. The length of  $DE$ , in cm, is given by

- A.  $15 \sin 36^\circ$   
 B.  $\frac{15}{\cos 36^\circ}$   
 C.  $15 \cos 54^\circ$   
 D.  $\frac{15}{\cos 54^\circ}$

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