

# 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

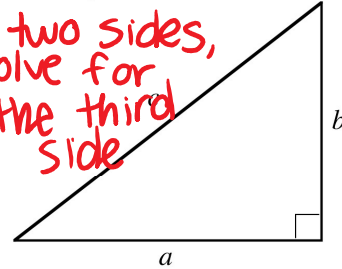
The Pythagorean Theorem can be applied in a right triangle to determine the length of the third side of a triangle in which the lengths of the other two sides are given.

In the triangle shown

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

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

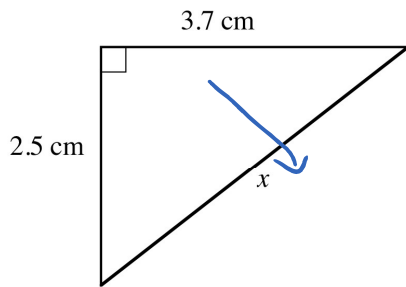
if we have two sides,  
we can solve for  
the third  
side



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



a)

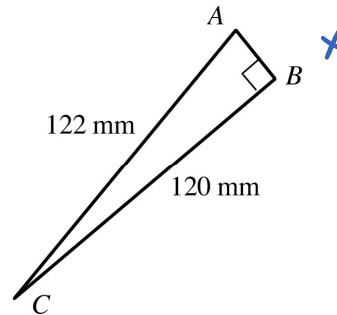


$$x^2 = 2.5^2 + 3.7^2$$

$$\sqrt{x^2} = \sqrt{19.94}$$

$$x = 4.5$$

b)



$$122^2 - 120^2 = x^2$$

$$\sqrt{484} = \sqrt{x^2}$$

$$22 = x$$

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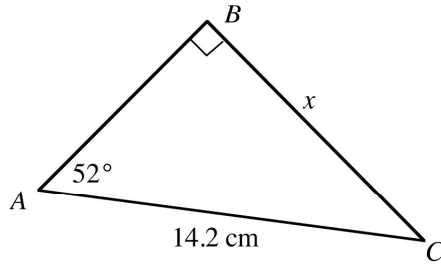
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## 78 Trigonometry Lesson #3: Calculating the Length of a Side in Right Triangles

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.

$$\sin 52^\circ = \frac{x}{14.2} \quad \text{*solve for } x$$

Cross multiply to get

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

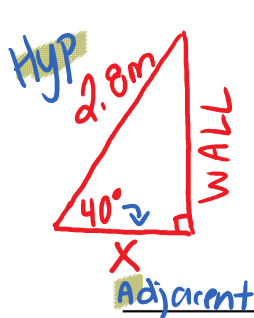
To 1 decimal place,  $x = 11.2$  cm.



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.



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$$2.8 \cos 40^\circ = \frac{x}{2.8} \quad \text{*solve for } x$$

$$2.8 \cos 40^\circ = x \quad \text{*use calculator}$$

$$2.1 = x$$



Class Ex. #3

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

a) using trigonometric ratios

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

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

$$a = 1.8$$

b) using the Pythagorean Theorem

$$2.8^2 - 2.1^2 = x^2$$

$$\sqrt{3.43} = \sqrt{x^2}$$

$$x = 1.9$$

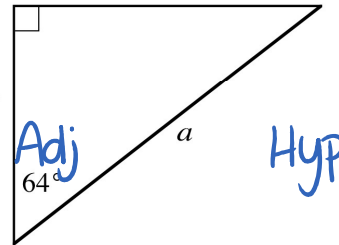
Complete Assignment Questions #1 - #4

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

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

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



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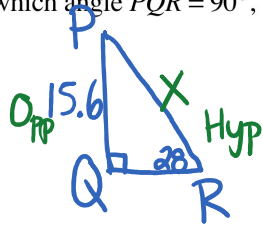
$$a = \frac{7.9}{\cos 64^\circ} \approx 18.0 \text{ (to the nearest tenth)}$$

$7.9 \div (\cos 64^\circ) \leftarrow \text{on calculator}$



Class Ex. #4

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.



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$$x \sin 28^\circ = \frac{15.6}{x} \quad \text{*solve for x}$$

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

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

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



Class Ex. #5

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

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$$h \cos 71^\circ = \frac{147}{h} \quad \text{*solve for h}$$

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

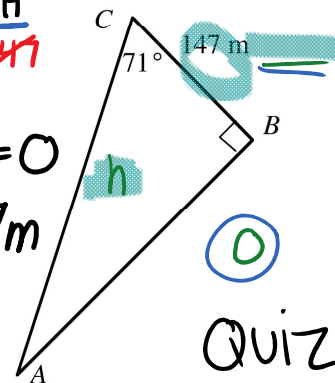
$$h = \frac{147}{\cos 71^\circ} = 452 \text{ m}$$

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

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

$$147 = 147$$



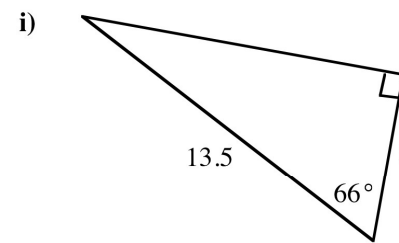
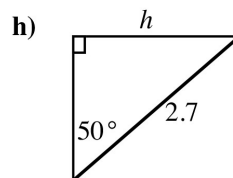
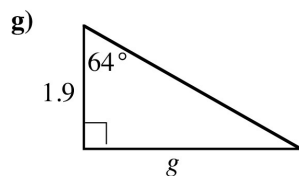
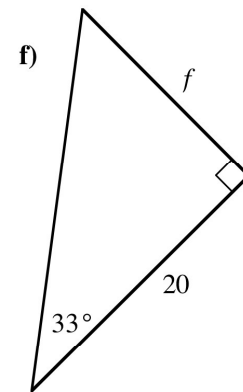
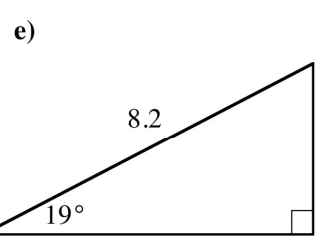
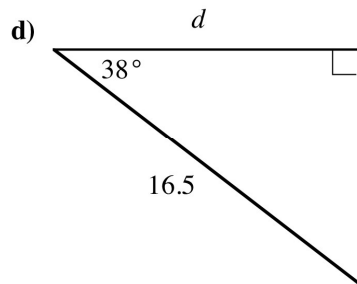
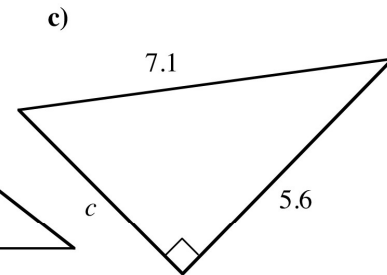
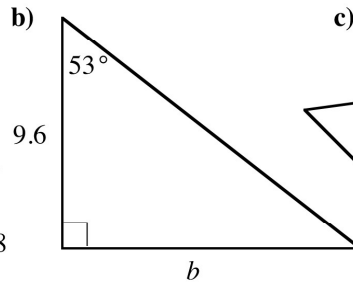
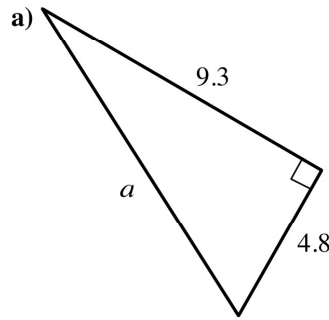
Quiz next day.

Complete Assignment Questions #5 - #12

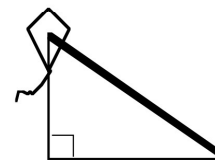
#1 bdfh, 4, 5 bdf, 6 ac, 8

## Assignment

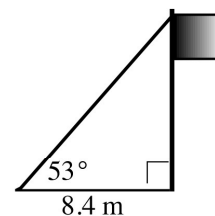
1. Calculate, to the nearest tenth, the length of the indicated side in each triangle.



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.



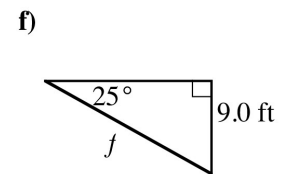
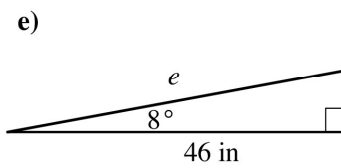
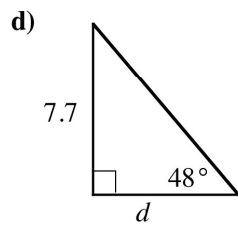
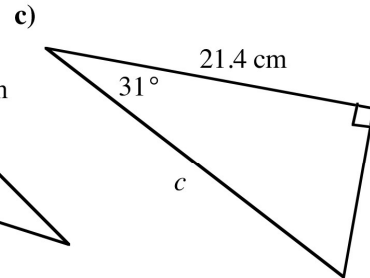
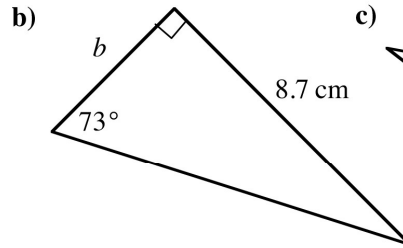
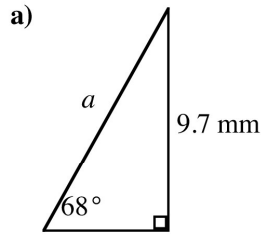
3. Use the measurements in the diagram to determine the height of the flagpole to the nearest tenth of a metre.



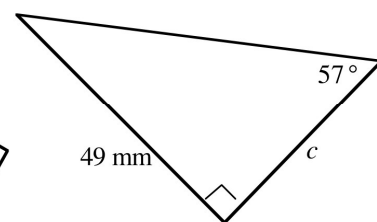
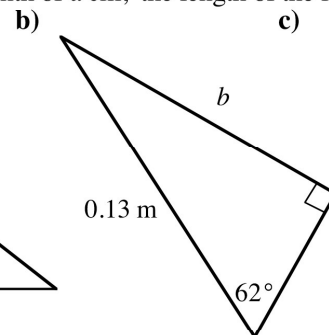
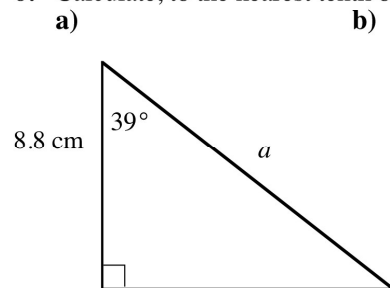
4. A ladder 5.3 m long is inclined at an angle of  $72^\circ$  to the ground.
- How far up the wall, to the nearest tenth of a metre, does the ladder reach?
  - Use trigonometry to determine, to the nearest tenth of a metre, the distance between the bottom of the ladder and the bottom of the wall.
  - 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.



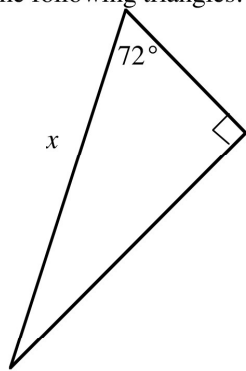
6. Calculate, to the nearest tenth of a cm, the length of the indicated side in each triangle.



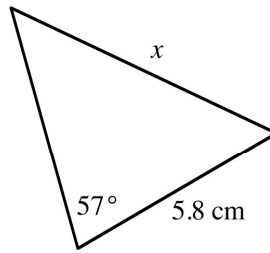
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7. Explain why trigonometric ratios could not be used to calculate the side marked  $x$  in each of the following triangles.

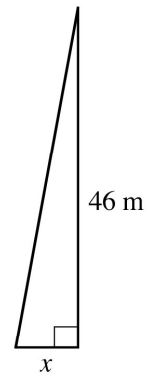
a)



b)



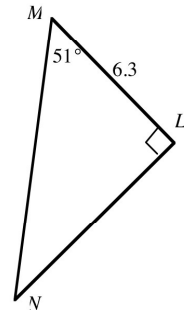
c)



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  $PQ = 34.1 \text{ mm}$ .  
 b)  $\triangle ABC$  in which  $\angle ABC = 90^\circ$ ,  $\angle BCA = 29^\circ$  and  $BC = 8.4 \text{ cm}$ .

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  $DF = 15 \text{ cm}$ . The length of  $DE$ , in cm, is given by

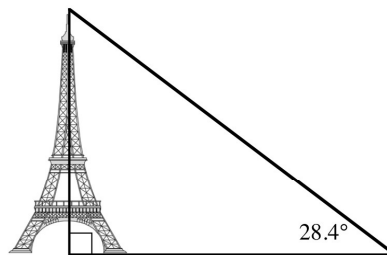
- A.  $15 \sin 36^\circ$
- B.  $\frac{15}{\cos 36^\circ}$
- C.  $15 \cos 54^\circ$
- D.  $\frac{15}{\cos 54^\circ}$

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**Numerical Response**

11. On a particular day, the Eiffel Tower in Paris casts a shadow of 599 m. Use the sketch to determine the height of the tower. To the nearest metre, the height of the tower is



(Record your answer in the numerical response box from left to right)

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12. In right triangle  $ABC$ , angle  $ABC = 90^\circ$ , angle  $BAC = 70^\circ$ , and  $AC = 29$  units.

To the nearest whole number, the perimeter of the triangle is \_\_\_\_\_ units.

(Record your answer in the numerical response box from left to right)

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**Answer Key**

1. a) 10.5    b) 12.7    c) 4.4    d) 13.0    e) 2.7    f) 13.0    g) 3.9    h) 2.1    i) 5.5

2. 34 m      3. 11.1 m      4. a) 5.0 m    b) 1.6 m    c) 1.8 m  
 d) Using a rounded length leads to a less accurate answer.

5. a) 10.5 mm    b) 2.7 cm    c) 25.0 cm    d) 6.9    e) 46.5 in    f) 21.3 ft

6. a) 11.3 cm    b) 11.5 cm    c) 3.2 cm

7. a) There is no side length given.    b) The triangle is not right angled.  
 c) We need the measure of one of the acute angles.

8. a) 46.6 mm    b) 9.6 cm      9.  $LN = 7.8$ ,  $MN = 10.0$       10. D

11. 

3	2	4	
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12. 

6	6		
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