

## Lesson 1: Review of Right Triangle Trigonometry

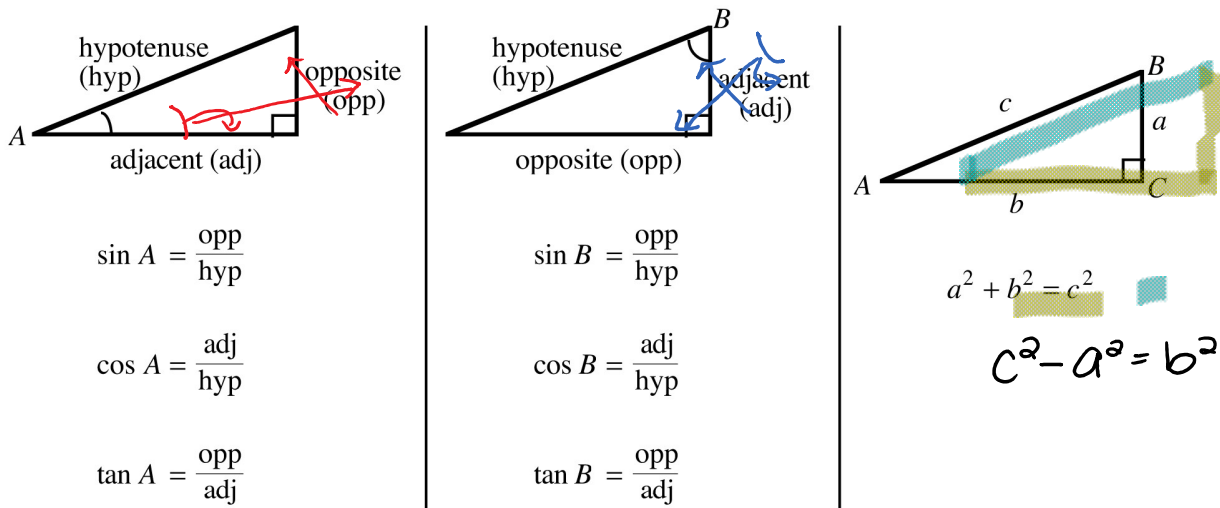
# Trigonometry - Sine and Cosine Laws Lesson #1: Review of Right Triangle Trigonometry

## Ratios of Sides in a Right Triangle

When solving problems in right triangle trigonometry we need to be given a right angle, a side length, and one other angle or side.

Note the following points emphasized in the right triangle diagrams below.

- The opposite and adjacent sides can switch depending on the angle being used.
- The Pythagorean Theorem can be used if two sides of the triangle are known and the third side is required.



Consider the following triangle.

- a) Use the Pythagorean Theorem to calculate the length of  $ST$ .

$$25^2 - 7^2 = ST^2$$

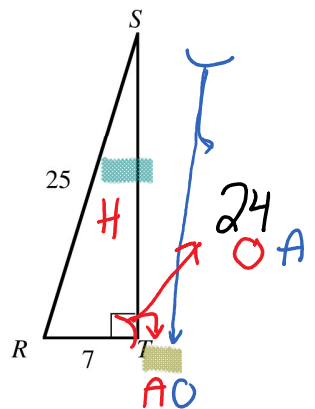
$$576 = ST^2$$

$$ST = 24$$

- b) State, as rational numbers, the values of the following trigonometric ratios.

$$\sin R = \frac{24}{25} \quad \cos R = \frac{7}{25} \quad \tan R = \frac{24}{7}$$

$$\sin S = \frac{7}{25} \quad \cos S = \frac{24}{25} \quad \tan S = \frac{7}{24}$$



- c) Comment on any relationships you see from your answers in b).

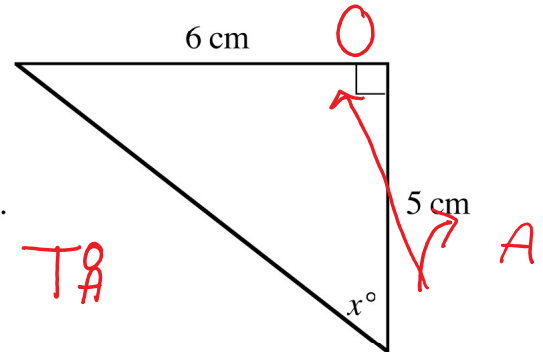
$$\sin R = \cos S \quad \cos R = \sin S \quad \tan R \text{ \& } \tan S \text{ are reciprocal}$$

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**Calculating Angles in Right Triangles**

Complete the following example to review how to calculate an angle measure using SOHCAHTOA.

In the diagram we are required to determine the measure of the angle marked  $x^\circ$  to the nearest degree.



Relative to the angle  $x^\circ$ , the OPPOSITE side is 6 and the ADJACENT side is 5 so we use the TANGENT ratio.

We write  $\tan x^\circ = \frac{6}{5} = 1.2$ .

If  $\tan x^\circ = 1.2$ , the measure of the angle  $x^\circ$  can be determined by using the inverse tangent function  $\tan^{-1}$ .

If  $\tan x^\circ = 1.2$ , then  $\tan^{-1}(1.2) = x$ .

On a calculator, access the inverse tangent function by pressing 

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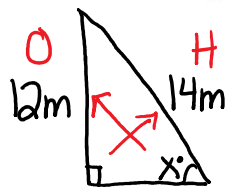
Use your calculator to complete the solution.

$\tan x^\circ = 1.2$  so  $x^\circ = \underline{50^\circ}$  (to the nearest degree).



A telephone pole is 12 metres high and is supported by a wire, 14 metres long, fixed to the top of the pole and to the ground.

Draw a sketch to illustrate the information and calculate, to the nearest degree, the angle between the wire and the ground.



SOH

$$\sin x = \frac{12}{14}$$

$$x = \sin^{-1}(12 \div 14)$$

$$x = 59^\circ$$

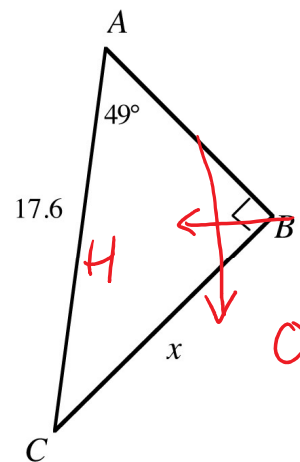
**Calculating Sides in Right Triangles**

Complete the following examples to review how to calculate a side using SOHCAHTOA.

a) In the diagram we are required to determine the measure of the side BC.

Relative to the angle of 49°, the given side is the HYPOTENUSE and the required side is the OPPOSITE so we use the SINE ratio.

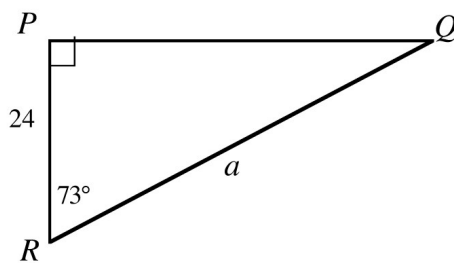
- We write  $(17.6) \sin 49^\circ = \frac{x}{17.6}$
- Cross multiply to get  $(17.6) \sin 49^\circ = x$
- To one decimal place,  $x = 13.3$  so  $BC = 13.3$



b) In the diagram we are required to determine the measure of the side QR.

Relative to the angle of 73°, the given side is the ADJACENT and the required side is the HYPOTENUSE so we use the COSINE ratio.

- We write  $\cos 73^\circ = \frac{24}{a}$
- Cross multiply to get  $(a) \cos 73^\circ = 24$
- Divide both sides by  $\cos 73^\circ$  to get  $a = \frac{24}{\cos 73^\circ}$
- To one decimal place,  $a = 82.1$  so  $QR = 82.1$

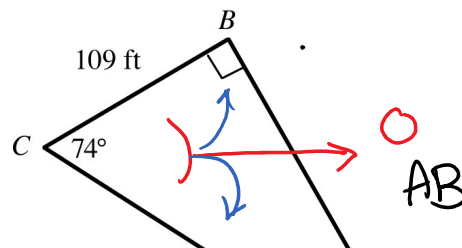


$24 \div (\cos 73)$



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

TOA  $\tan 74 = \frac{AB}{109}$   
 $109 \tan 74 = AB$

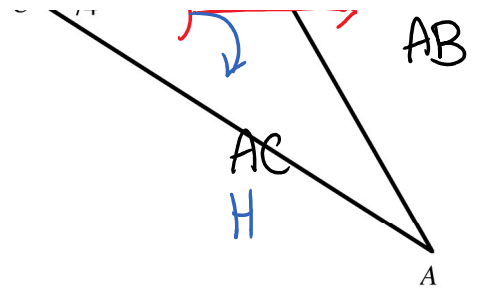


$$109 \tan 74 = AB$$

$$\boxed{AB = 308 \text{ ft}}$$

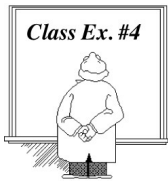
$$\text{CAH} \quad \cos 74 = \frac{109}{AC}$$

$$AC = \frac{109}{\cos 74} \quad \boxed{AC = 395 \text{ ft}}$$



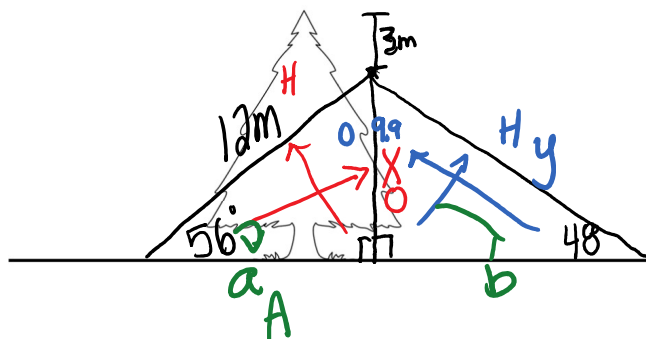
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A large tree is to be transported to a new location. The tree is held vertical by means of two guy wires of unequal length on opposite sides of the tree. One of the wires makes an angle of  $48^\circ$  with the ground. The other wire is 12 m long and makes an angle of  $56^\circ$  with the ground. Both wires are attached 3 m down from the top of the tree.

a) Illustrate this scenario below.



b) Determine the height of the tree to one decimal place.

$$\text{SH} \quad \sin 56 = \frac{x}{12}$$

$$x = 12 \sin 56$$

$$x = 9.9$$

height of the tree

$$9.9 + 3 = \boxed{12.9 \text{ m}}$$

c) Determine the length of the other wire to the nearest tenth of a metre.

$$\text{SH} \quad \sin 48 = \frac{9.9}{y}$$

$$y = \frac{9.9}{\sin 48}$$

$$\boxed{y = 13.3 \text{ m}}$$

d) Determine, to the nearest tenth of a metre, the horizontal distance at ground level between the two guy wires.

$$\text{CAH} \quad \cos 56 = \frac{a}{12}$$

$$a = 12 \cos 56$$

$$a = 6.7 \text{ m}$$

$$\text{TA} \quad \tan 48 = \frac{9.9}{b}$$

$$b = \frac{9.9}{\tan 48}$$

$$b = 8.9 \text{ m}$$

total ground distance  $6.7 + 8.9 = \boxed{15.6 \text{ m}}$

total ground distance  $6.7 + 8.9 = 15.6\text{m}$

- e) ~~The~~ The guy wire in c) breaks and a new wire of the same length is attached 2 m down from the top of the tree. Calculate, to the nearest degree, the angle which this guy wire makes with the ground.

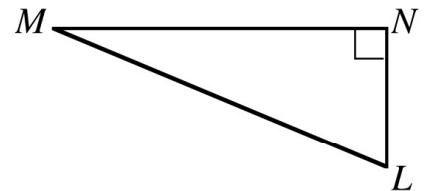
**Complete Assignment Questions #1 - #8**

#1-5

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# Assignment

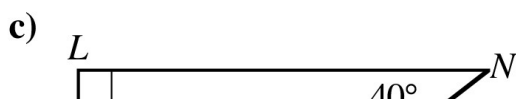
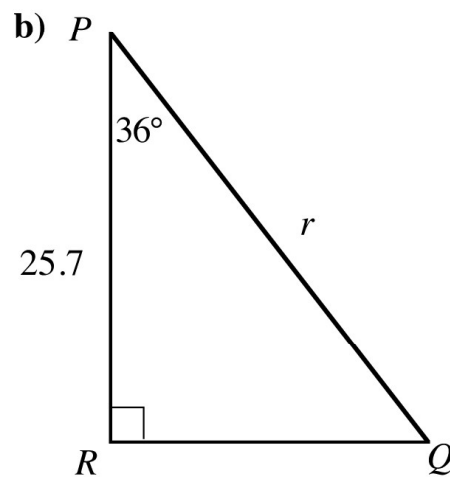
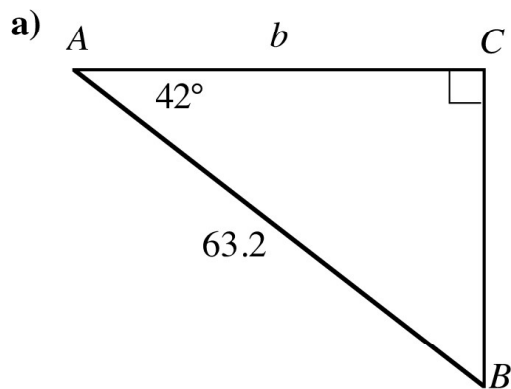
1. Consider  $\triangle LMN$ .

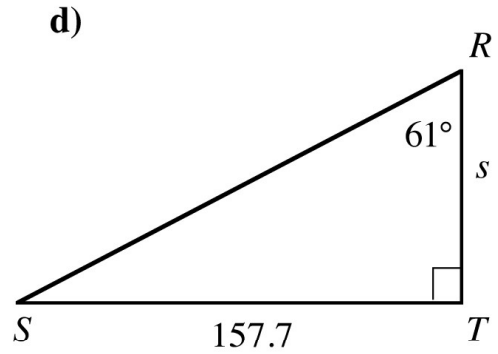
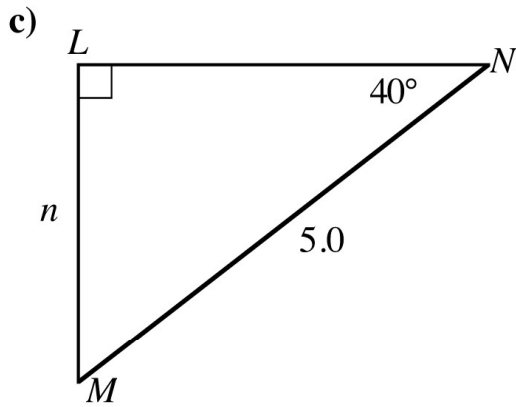


Write the ratio of sides for each of the following.

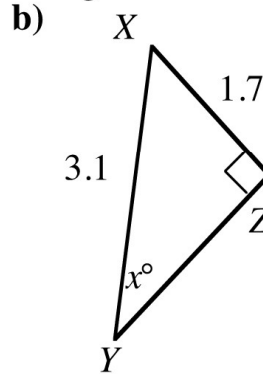
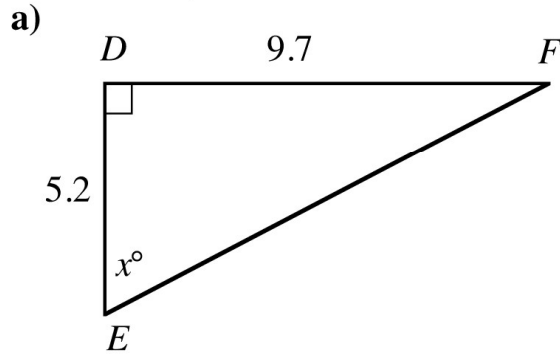
- i)  $\sin L =$       ii)  $\cos L =$       iii)  $\tan L =$   
 iv)  $\sin M =$       v)  $\cos M =$       vi)  $\tan M =$

2. In each case, determine the length of the indicated side to the nearest tenth.





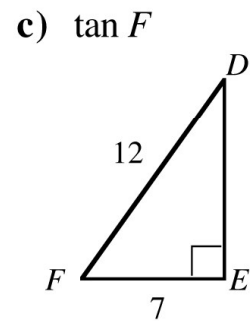
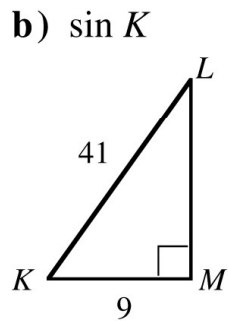
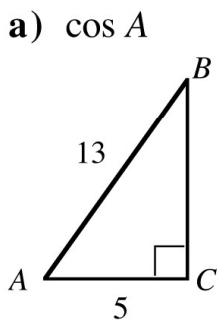
3. In each case, determine the measure of the indicated angle to the nearest degree.



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4. Determine, to 2 decimal places, the value of each trigonometric ratio.



5. Determine the exact value of the following.

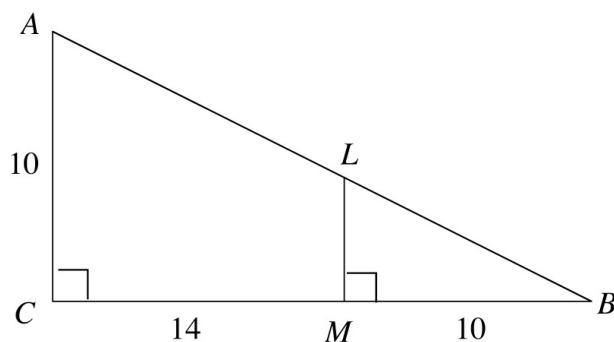


5. Determine the exact value of the following.

a)  $\tan \angle ABC$

b)  $LM$

c)  $\sin \angle BAC$



6. Christine places a ladder against the side of a house so that the top of the ladder makes an angle of  $52^\circ$  with the side of the house. The bottom of the ladder is 1.20 m from the house.

a) Calculate, to the nearest hundredth of a metre, the vertical distance from the top of the ladder to the ground.

b) Calculate, to the nearest hundredth of a metre, the length of the ladder.

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**Multiple Choice** 7. In a right triangle  $PQR$ ,  $PQ = 50$  units,  $PR = 48$  units and  $RQ = 14$  units. The value of  $\sin Q$  and  $\cos Q$  are respectively

A.  $\frac{7}{25}$  and  $\frac{24}{25}$

B.  $\frac{24}{25}$  and  $\frac{7}{25}$



- B.  $\frac{24}{25}$  and  $\frac{7}{25}$
- C.  $\frac{24}{7}$  and  $\frac{7}{24}$
- D.  $\frac{24}{7}$  and  $\frac{7}{25}$

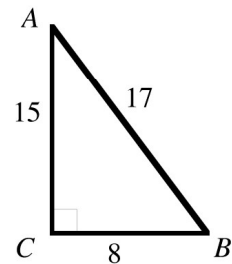
Use the following information to answer the next question.

Three statements are made for the right triangle  $ABC$ .

Statement 1:  $\tan A = \frac{\sin A}{\cos A}$

Statement 2:  $1 + (\tan A)^2 = \frac{1}{(\cos A)^2}$

Statement 3:  $(\sin B)^2 + (\cos B)^2 = 1$



8. How many of the statements are true?
- A. Zero
- B. One
- C. Two
- D. Three

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**Answer Key**

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## Answer Key

1. i)  $\frac{MN}{LM}$     ii)  $\frac{LN}{LM}$     iii)  $\frac{MN}{LN}$     iv)  $\frac{LN}{LM}$     v)  $\frac{MN}{LM}$     vi)  $\frac{LN}{MN}$

2. a) 47.0    b) 31.8    c) 3.2    d) 87.4    3. a)  $62^\circ$     b)  $33^\circ$

4. a) 0.38    b) 0.98    c) 1.39    5. a)  $\frac{5}{12}$     b)  $\frac{25}{6}$     c)  $\frac{12}{13}$

6. a) 0.94 m    b) 1.52 m    7. B    8. D

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