Make sure calculator is in "Degree" MODE

Unit Three - Trigonometry

Lesson 4 - Finding Missing Sides with SOHCAHTOA

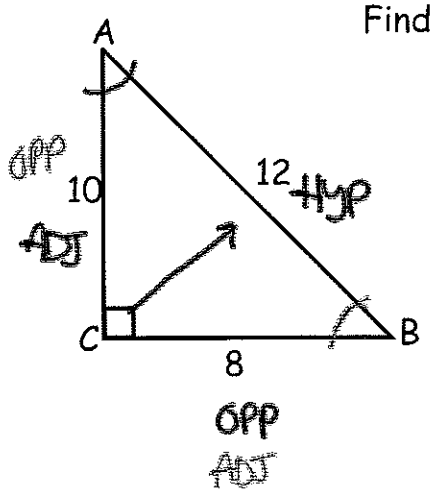
Learning Goals:

- find the lengths of missing sides in a triangle using SOHCATOA
- use the TRIG TABLE and your CALCULATOR to find trig ratios

Writing Ratios - Review of Friday's Lesson

SOHCAHTOA

Find sin A, cos B, and tan A.



$\sin A = \frac{OPP}{HYP} = \frac{8}{12} = \frac{2}{3}$

$\tan A = \frac{OPP}{ADJ} = \frac{8}{10} = \frac{4}{5}$

$\cos B = \frac{ADJ}{HYP} = \frac{8}{12} = \frac{2}{3}$

Notes for Trigonometry

Trig Functions:

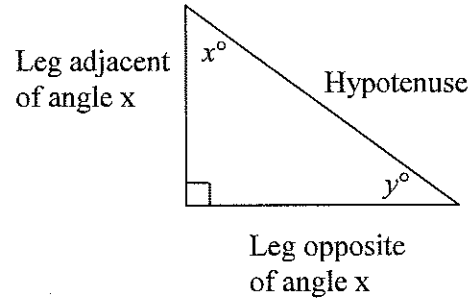
Sine Cosine Tangent

All Trig functions are used for right triangles only. Each one is a proportion and when working the problem should be cross multiplied and solved.

Sine $x^\circ = \dfrac{length\ leg\ opposite\ of\ angle}{length\ of\ hypotenuse}$

Cosine $x^\circ = \dfrac{length\ of\ leg\ adjacent\ of\ angle}{length\ of\ hypotenuse}$

Tangent $x^\circ = \dfrac{length\ of\ leg\ opposite\ of\ angle}{length\ of\ leg\ adjacent\ of\ angle}$



If you use a different angle, then the adjacent and opposite legs reverse. You never use the right angle for trig and the hypotenuse never changes position.

Mnemonic for remember the trig functions

SOHCAHTOA

S-Sine
O-Opposite leg
H-Hypotenuse

C-Cosine
A-Adjacent leg
H-Hypotenuse

T-Tangent
O-Opposite leg
A-Adjacent leg

$$\text{Sin } x^\circ = \frac{\textbf{O}pposite\ leg}{Hypotenuse}$$

$$\text{Cos } \mathbf{x}^\circ = \frac{Adjacent\ leg}{Hypotenuse}$$

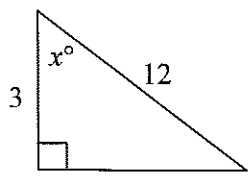
$$\text{Tan } x^\circ = \frac{Opposite\ leg}{Adjacent\ leg}$$

Since Trig is done with angles and angles are measured in degrees, then the calculator set in the right mode. If the calculator is not set to degree mode, then every answer will be wrong. Calculators have 3 modes; grad, rad, and deg. The deg mode is the degree mode. In TI graphing calculators the mode is found using the mode key, and the second line you will find the deg. Select it by using the equals(enter) key. If you have a different calculator, then consult the manual or ask a math teacher to help you. Each calculator can be different, so it is always good to know how your calculator works.

There are two types of trig problems. One you find the missing side, the other your find the missing angle. Each one is worked a different way, so look at the examples carefully.

(calc)
Put in "Degree" MODE

Example 1 Find the missing angle



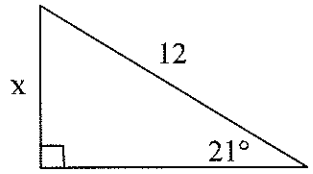
Because the hypotenuse and side adjacent to the angle is given, the trig function using those pieces is cosine. This allows us to set up the following equation. Though it looks like a proportion, do not solve it like a proportion.

$$\cos x^\circ = \frac{3}{12} \qquad x = \cos^{-1}\left(\frac{3}{12}\right)$$

To solve this find $\cos^{-1}$, then type in fraction $(3/12)$. Hit enter, since answer is an angle round to nearest degree. $x = 76^\circ$

Example 2 Using Sine

Find x.



Because the hypotenuse and the side opposite the $21°$ angle is given, the trig function using those 2 pieces of information is sine. This allows use to set up the following equation. Once the equation is set, then solve the proportion.

$\sin 21° = \frac{x}{12}$ Equation

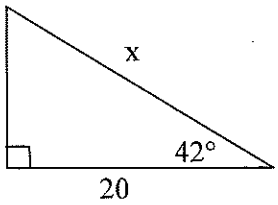
$x = 12 \cdot (\sin 21°)$ cross multiply

$x = 12 \cdot (.3584)$ find sine of 21 degrees

$x = 4.3004$ multiply, round to the nearest ten thousandths

Example 3 Using Cosine

Find x.



Because the hypotenuse and the side adjacent the $42°$ angle is given, the trig function using those 2 pieces of information is cosine. This allows use to set up the following equation. Once the equation is set, then solve the proportion.

$\cos 42° = \frac{20}{x}$ Equation

$x(\cos 42°) = 20$ cross multiply

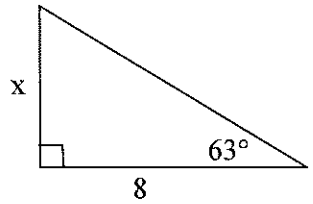
$x = \frac{20}{(\cos 42°)}$ divide each side by cosine 42 degrees

$x = \frac{20}{(.7431)}$ find cosine of 42 degrees

$x = 26.9127$ divide, round to the nearest ten thousandths

Example 4 Using Tangent

Find x.



Because the side opposite and the side adjacent to the $63°$ angle is given, the trig function using those 2 pieces of information is tangent. This allows use to set up the following equation. Once the equation is set, then solve the proportion.

$\tan 63° = \frac{x}{8}$ Equation

$x = 8 \cdot (\tan 63°)$ cross multiply

$x = 8 \cdot (1.9626)$ find tangent of 63 degrees

$x = 15.7009$ multiply, round to the nearest ten thousandths

Try These:

SIN (60) = 0.8660

COS (72) = 0.3090

TAN (45) = 1

SIN^{-1} (.5) = 30°

COS^{-1} (1) = 0°

TAN^{-1}(.707) = 35.3°

[SIN] 60 [=]

60 [SIN] [=]

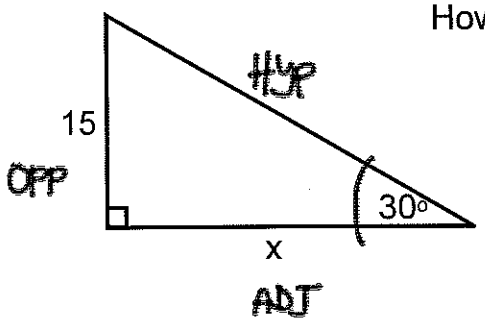
[2nd] [SIN] 0.5 [=]

0.5 [2nd] [SIN] [=]

Finding Missing Sides

SOHCAHTOA

How do I find the side labelled x?



$\tan 30 = \frac{OPP}{ADJ}$

$\frac{\tan 30}{1} = \frac{15}{x}$

$15 = \tan 30 \cdot x$

$15 = 0.577x$

$x = \frac{15}{0.577}$

$x = 25.99 = 26$

Step by Step Process

1) Label the triangle, with respect to the reference angle, with the labels **opposite, adjacent, and hypotenuse**.

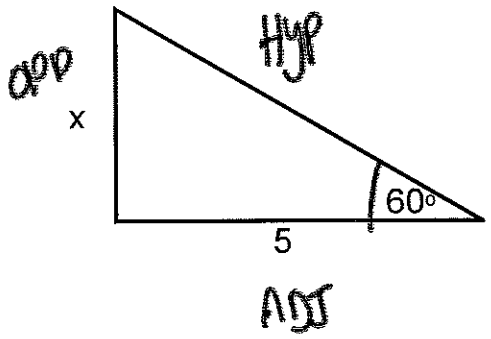
2) Identify which label corresponds to the "missing" side.

3) Identify which ratio includes the "missing" side and the given side length, using **SOHCAHTOA**.

4) Write the ratio as a fraction, including the value of the given angle.

5) Use algebra to solve for the "missing" side.

Example 1:



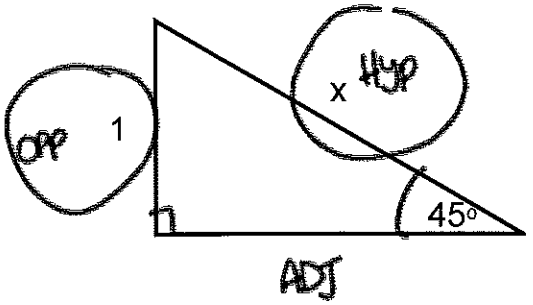
$\tan 60^\circ = \frac{OPP}{ADJ}$

$\frac{\tan 60^\circ}{1} = \frac{x}{5}$

$x = (\tan 60^\circ)(5)$

$x = 8.7$

Example 2:



SOHCAHTOA

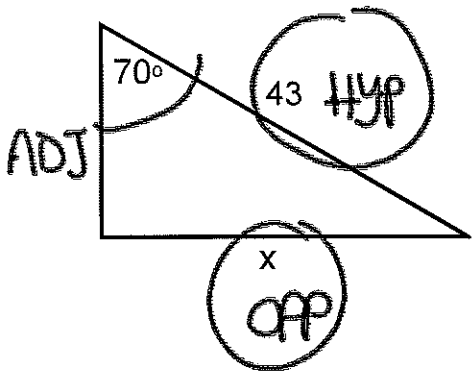
$\sin 45 = \frac{1}{x}$

$x \sin 45 = 1$

$x = \frac{1}{\sin 45}$

$x = 1.4$

Example 3:



SOHCAHTOA

$\sin 70 = \frac{OPP}{HYP}$

$\frac{\sin 70}{1} = \frac{x}{43}$

$43 \sin 70 = x$

$40.4 = x$

Using your calculator to find sin, cos, and tan ratios!

Remember, your calculator has the sin, cos, and tan tables stored inside it. In order to access the information, you have to tell your calculator what you are looking for.

1) Hitting [SIN] then putting in an angle, gives you the sine ratio in decimal form just like the table. $\sin 30^\circ = 0.5$

2) If you want to go backwards from the ratio to find the angle, then hit [SIN^{-1}] and then enter the ratio in decimal form.

$$\sin x = 0.5$$

$$x = \sin^{-1}(0.5)$$

$$x = 30^\circ$$

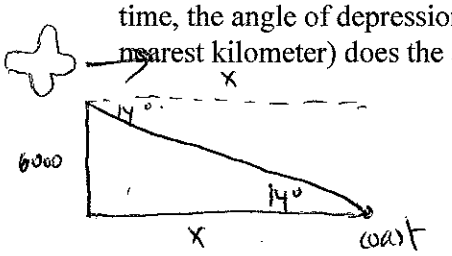
A note on calculators:

1) Some calculators require that you put in the ratio or angle and then press the sin, cos, or tan button. Others require that you press the button before inputting the ratio or angle. Take a second now and figure out which kind of calculator you have.

2) Make sure your calculator is in DEGREE mode. You shoud see a little D or the DEG at the top of your screen. If you see something different then let me know and I will put it in the correct mode. Doing calculations in the wrong mode will result in TOTALLY wrong answers.

Solve the following word problems. For each question, draw a diagram to help you.

31) An airplane is flying at an altitude of 6000 m over the ocean directly toward a coastline. At a certain time, the angle of depression to the coastline from the airplane is 14°. How much farther (to the nearest kilometer) does the airplane have to fly before it is directly above the coastline?

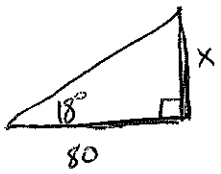


$\tan 14° = \frac{6000}{X}$

$X = \frac{6000}{\tan 14}$

$X \approx 24,064.69$ m

32) From a horizontal distance of 80.0 m, the angle of elevation to the top of a flagpole is 18°. Calculate the height of the flagpole to the nearest tenth of a metre.

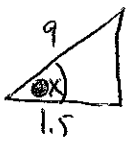


$\tan 18° = \frac{X}{80}$

$X = 80 \tan 18$

$X \approx 25.99$ m

33) A 9.0 m ladder rests against the side of a wall. The bottom of the ladder is 1.5 m from the base of the wall. Determine the measure of the angle between the ladder and the ground, to the nearest degree.

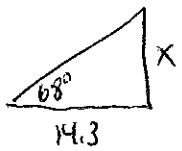


$\cos X = \frac{1.5}{9}$

$X = \cos^{-1}\left(\frac{1.5}{9}\right)$

$X \approx 80.41°$

34) The angle of elevation of the sun is 68° when a tree casts a shadow 14.3 m long. How tall is the tree, to the nearest tenth of a metre?

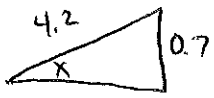


$\tan 68° = \frac{X}{14.3}$

$X = 14.3 \tan 68°$

$X \approx 35.39$ m

35) A wheelchair ramp is 4.2 m long. It rises 0.7 m. What is its angle of inclination to the nearest degree?

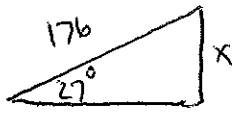


$\sin X = \frac{0.7}{4.2}$

$X = \sin^{-1}\left(\frac{0.7}{4.2}\right)$

$X \approx 9.59°$

36) A person flying a kite has released 176 m of string. The string makes an angle of 27° with the ground. How high is the kite? ~~How far away is the kite horizontally?~~ Answer to the nearest metre.



$\sin 27° = \frac{X}{176}$

$X = 176 \sin 27°$

$X \approx 79.90$ m