

Notes Introduction to Trig

The mathematics field called Trigonometry is the study of Right triangles and the ratios of the sides.

Each angle of a right triangle has a unique decimal value for each trigonometric ratio. Your calculator has these tables memorized for you. Find the SINE, COSINE and TANGENT buttons on your calculator.

1) Press mode and make sure the Degree selection is highlighted. Always check that your calculator is in DEGREE mode. You are responsible to check.

2) Press the Trigonometric function you would like followed by the measure of the angle. **Round to the nearest hundredth.**

Ex 1. $\sin 35^\circ = \underline{.57}$

Ex 2. $\cos 18^\circ = \underline{.95}$

Ex 3. $\tan 87^\circ = \underline{19.08}$

If you are given the ratio and asked for the angle, you just use the ratio backwards. Your calculator needs to be told to do this.

Write the keys you will press and then write the angle to the nearest degree. ^{2nd} Trig

Ex 7. $\sin x^\circ = \frac{8}{17}$ $x^\circ = \underline{28^\circ}$

Ex 8. $\tan x^\circ = 1.875$ $x^\circ = \underline{62^\circ}$

Ex 9. $\cos x^\circ = \frac{1}{2}$ $x^\circ = \underline{60}$

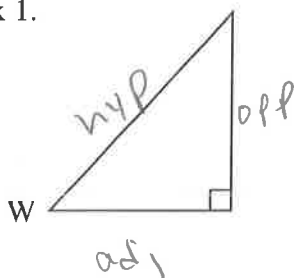
There are 3 of trigonometric relationships that we study.

- Sine is the ratio of the opp side to the hyp.
- Cosine is the ratio of the adj side to the hyp.
- Tangent is the ratio of the opp side to the adj side.

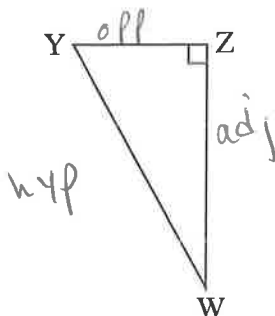
The hyp NEVER changes, but opp and adj are dependent on the angle used. The hyp. 90 angle is NEVER used.

The three sides of the triangles are referred to as Hypotenuse (H), Adjacent (A), and Opposite (O). Label each side of each triangle using angle W as your reference.

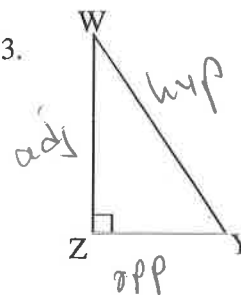
Ex 1.



Ex 2.



Ex 3.



To help you remember these relationships, you can use the phrase Son Can Toa.

The trigonometric ratios are written in an equation form. (**Hint: Write these ratios at the top of EVERY page you are working on.)

$$\text{Sine } x^\circ = \frac{\text{opp}}{\text{hyp}}$$

$$\text{Cosine } x^\circ = \frac{\text{adj}}{\text{hyp}}$$

$$\text{Tangent } x^\circ = \frac{\text{opp}}{\text{adj}}$$

USE THE TRIANGLE AT THE RIGHT to determine the following trigonometric ratios.

$$\text{Ex 4. } \sin 40^\circ = \frac{10}{n}$$

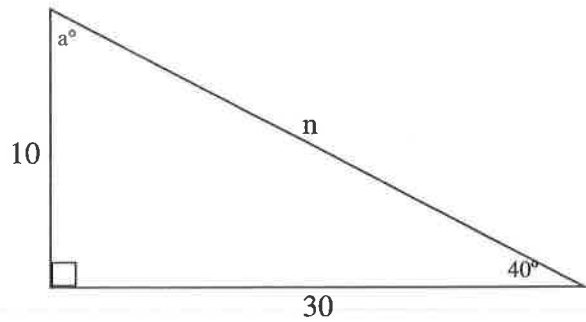
$$\text{Ex 5. } \sin a^\circ = \frac{30}{n}$$

$$\text{Ex 6. } \cos 40^\circ = \frac{30}{n}$$

$$\text{Ex 7. } \cos a^\circ = \frac{10}{n}$$

$$\text{Ex 8. } \tan 40^\circ = \frac{10}{30}$$

$$\text{Ex 9. } \tan a = \frac{30}{10}$$



Use the triangle at the right to write all of the following trigonometric equations.

From 72°

$$\sin 72 = \frac{55}{x}$$

$$\cos 72 = \frac{27}{x}$$

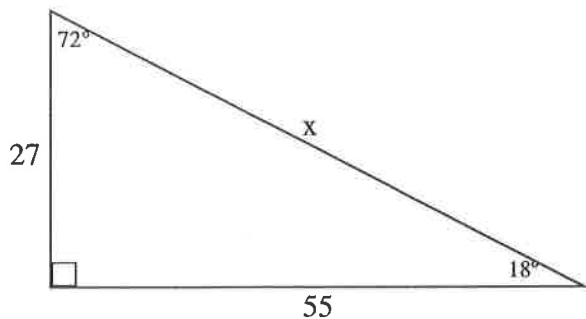
$$\tan 72 = \frac{55}{27}$$

From 18°

$$\sin 18 = \frac{27}{x}$$

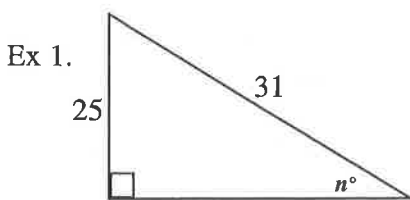
$$\cos 18 = \frac{55}{x}$$

$$\tan 18 = \frac{27}{55}$$

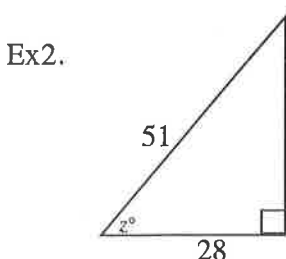


Use Trigonometric Ratios to Solve for Missing Sides and Angles

- 1) Determine which Trig Ratio will fit your information.
- 2) Set up the Trig Ratio
- 3) Round to the nearest degree if it is an angle and round to the nearest hundredth for sides.

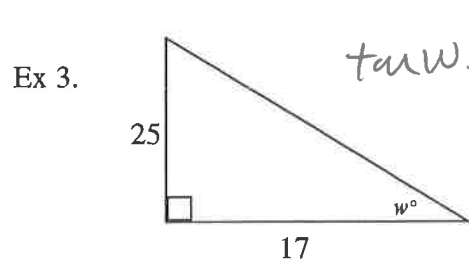


$$\sin n = \frac{25}{31} = 54^\circ$$



$$\cos x = \frac{28}{51}$$

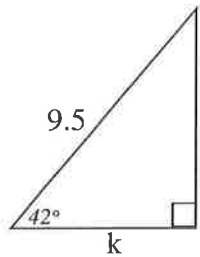
$$x = 56.7^\circ$$



$$\tan w = \frac{25}{17}$$

$$55.8^\circ$$

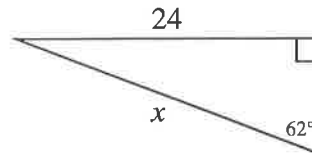
Ex 4.



$$\cos 42 = \frac{k}{9.5}$$

$$k = 7.1$$

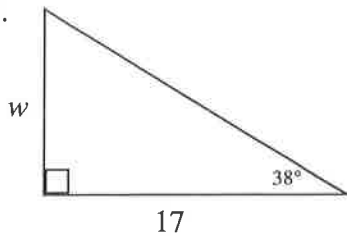
Ex 6.



$$\sin 62 = \frac{24}{x}$$

$$x = 27.2$$

Ex 5.



$$\tan 38 = \frac{w}{17}$$

$$w = 13.3$$

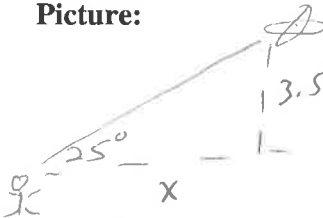
↓ Depression

Angle of depression - angle below the horizontal

Angle of elevation - angle above horizontal ↑ Elevation

Ex 1. Angie looks up at 25 degrees to see an airplane flying toward her. If the plane is flying at an altitude of 3.5 miles, how far is it from being directly above Angie?

Picture:



Equation:

$$\tan 25 = \frac{3.5}{x}$$

Solution:

7.5 miles

Ex 2. A six foot vertical pole casts a shadow of 11 feet. What is the angle of elevation with the ground?

Picture:



Equation:

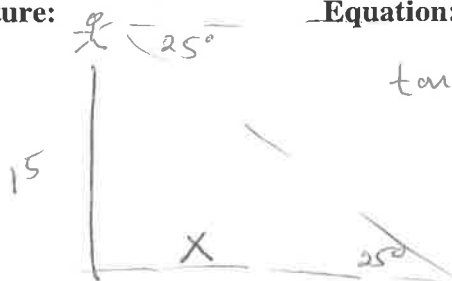
$$\tan x = \frac{6}{11}$$

Solution:

28.6°

Ex 3. Lauren is at the top of a 15 m lookout tower. From an angle of depression of 25°, she sees Evan coming toward her. How far is Evan from the base of the tower?

Picture:



Equation:

$$\tan 25 = \frac{15}{x}$$

Solution:

32 meters

Name Asuiey Period _____

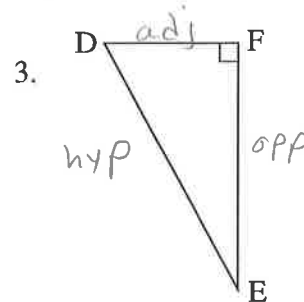
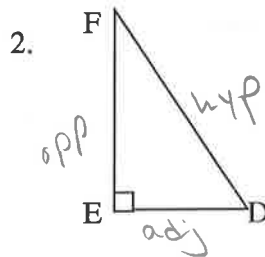
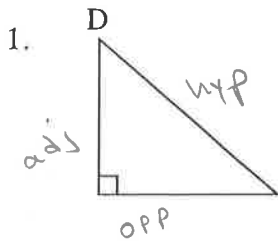
Introduction to Trig Worksheet

Write down what buttons you would push to get the answer for the following problems. Do not forget to include checking the mode. Then answer the problems.

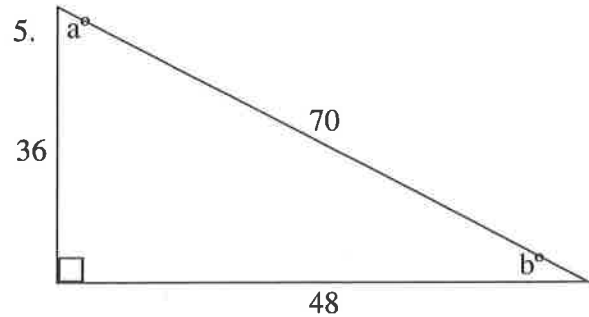
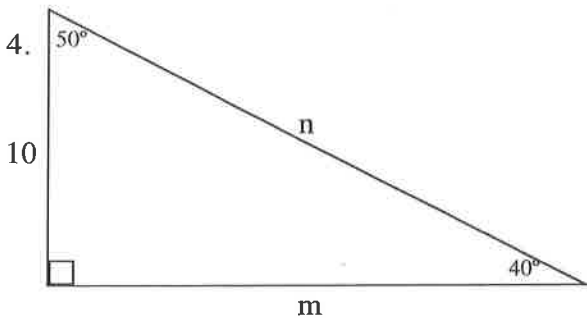
1. $\sin 40^\circ = \boxed{\sin} 40 = .64$

2. $\tan x^\circ = \frac{5}{7.5}$ $x^\circ = \underline{2^{nd}} \tan = 33.7^\circ$

The three sides of the triangles are referred to as Hypotenuse (H), Adjacent (A), and Opposite (O). Label each side of each triangle using angle D as your reference.



Use the triangles below to write all 6 trig equations from the two acute angles.

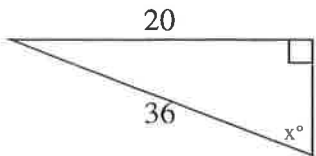


$$\begin{aligned} \sin 50 &= \frac{10}{n} & \sin 40 &= \frac{10}{n} \\ \cos 50 &= \frac{m}{n} & \cos 40 &= \frac{m}{n} \\ \tan 50 &= \frac{10}{m} & \tan 40 &= \frac{10}{m} \end{aligned}$$

$$\begin{aligned} \sin a &= \frac{48}{70} & \sin b &= \frac{36}{70} \\ \cos a &= \frac{36}{70} & \cos b &= \frac{48}{70} \\ \tan a &= \frac{48}{36} & \tan b &= \frac{36}{48} \end{aligned}$$

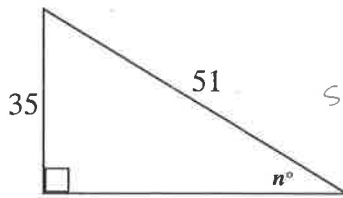
Set up and Solve for variable – round angles to the nearest degree and sides to the nearest hundredths.

6. $x = 33.75^\circ$



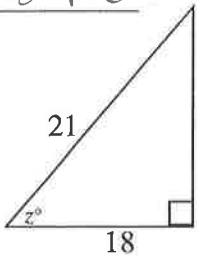
$\sin x = \frac{20}{36}$

7. $n = 43.34^\circ$



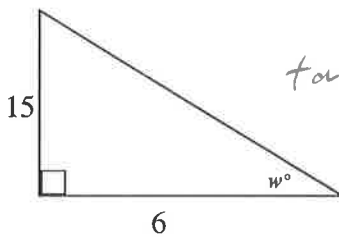
$\sin n = \frac{35}{51}$

8. $z = 31.00^\circ$



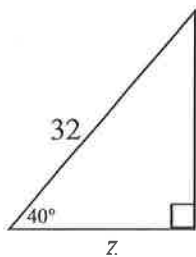
$\cos z = \frac{18}{21}$

9. $w = 68.2^\circ$



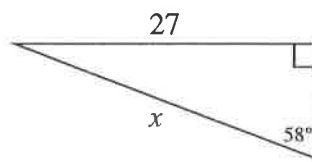
$\tan w = \frac{15}{6}$

10. $z = 24.5$



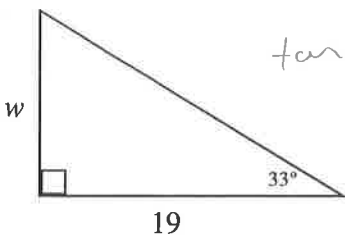
$\cos 40 = \frac{z}{32}$

11. $x = 31.8$



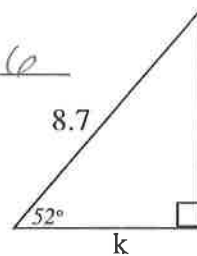
$\sin 58 = \frac{27}{x}$

12. $w = 12.34$



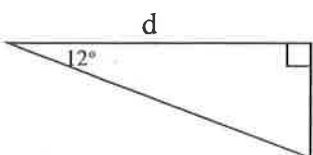
$\tan 33 = \frac{w}{19}$

13. $k = 5.36$



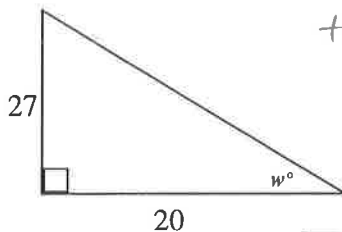
$\cos 52 = \frac{k}{8.7}$

14. $d = 65.86$



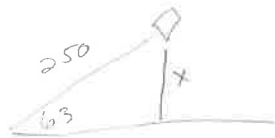
$\tan 12 = \frac{14}{d}$

15. $w = 53.47$



$\tan w = \frac{27}{20}$

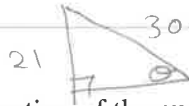
1. A kite is flying at an angle of 63° with the ground. If all 250 feet of string are out, and there is no sag in the string, how high is the kite?



$$\sin 63 = \frac{x}{250}$$

$$x = 222.8 \text{ ft}$$

2. A 30 foot tree broke from its base and fell against a house. If the tree touches the house at 21 feet, what angle is the tree forming with the house?



$$\sin \theta = \frac{21}{30}$$

$$\theta = 44.4^\circ$$

3. A tree casts a shadow of 28 m. The elevation of the sun is 49° . How tall is the tree?



$$\tan 49 = \frac{x}{28}$$

$$x = 32.2 \text{ ft}$$

4. Joey is putting up an antenna. At the 30 foot mark, he attaches a 50 foot guy wire. What angle does the guy wire form with the antenna?



$$\cos \theta = \frac{30}{50}$$

$$\theta = 53.13^\circ$$

5. A freeway entrance ramp has an elevation of 15° . If the vertical lift is 22 feet, what is the distance up the ramp?



$$\sin 15 = \frac{22}{x}$$

$$x = 85 \text{ feet}$$

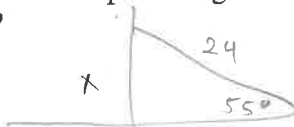
6. A person at the top of a cliff 100 feet tall sees Gilligan's boat. His sighting of the boat is at an angle of depression of 10° . How far is the boat from the base of the cliff?



$$\tan 10 = \frac{100}{x}$$

$$x = 567.13 \text{ ft}$$

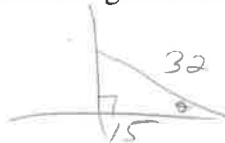
7. A 24 foot ladder is placed against a wall at 55° with the ground. How far away from the wall is the base of the ladder?



$$\sin 55 = \frac{x}{24}$$

$$x = 19.7 \text{ ft}$$

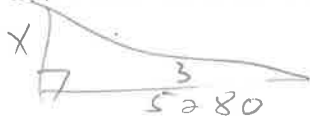
8. A 32 in. bat is leaning against a fence. If the bat is 15 in. away from the base of the fence, what angle is formed between the ground and the bat?



$$\cos \theta = \frac{15}{32}$$

$$\theta = 62^\circ$$

9. Ana knows that she is one mile from the base of a tower. Using a protractor she estimates an angle of elevation to be 3° . How tall is the tower to the nearest foot? (1 mile = 5280 feet)



$$\tan 3 = \frac{x}{5280}$$

$$x = 276.7 \text{ ft}$$

10. A plane takes off at an elevation of 20° . In its path is the tower of 170 feet. If the plane at takeoff is 500 feet away from the tower. What is the altitude of plane? Will it clear the height of the tower? If yes, by how much?



$$\tan 20 = \frac{x}{500}$$

$$x = 181.79 \text{ ft}$$

yes

4. Joey is putting up an antenna. At the 30 foot mark, he attaches a 50 foot guy wire. What angle does the guy wire form with the antenna?



$$\cos \theta = \frac{30}{50}$$

$$\theta = 53.13^\circ$$

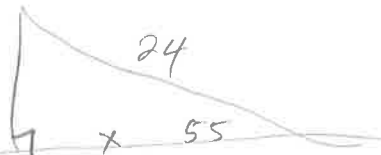
5. A person at the top of a cliff 100 feet tall sees Gilligan's boat. His sighting of the boat is at an angle of depression of 10° . How far is the boat from the base of the cliff?



$$\tan 10 = \frac{100}{x}$$

$$x = 567.13$$

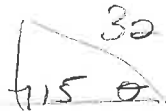
6. A 24 foot ladder is leaned against a wall at 55° with the ground. How far away from the wall is the base of the ladder?



$$\cos 55 = \frac{x}{24}$$

$$x = 13.77$$

7. A 32 in. bat is leaning against a fence. If the bat is 15 in. away from the base of the fence, what angle is formed between the ground and the bat?



$$\cos \theta = \frac{15}{32}$$

$$\theta = 62.05^\circ$$

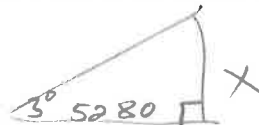
8. A plane takes off at an elevation of 20° . In its path, 500 feet away from the takeoff point, is a 170-ft tall tower. Will the plane clear the tower? If yes, by how much?



$$\tan 20 = \frac{x}{500}$$

$$x = 181.99$$

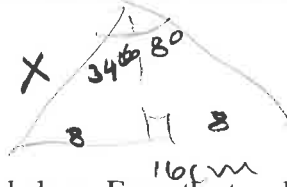
9. Ana knows that she is one mile from the base of a tower. Using a protractor she estimates an angle of elevation to be 3° . How tall is the tower to the nearest foot? (1 mile = 5280 feet)



$$\tan 3 = \frac{x}{5280}$$

$$x = 276.7 \text{ ft}$$

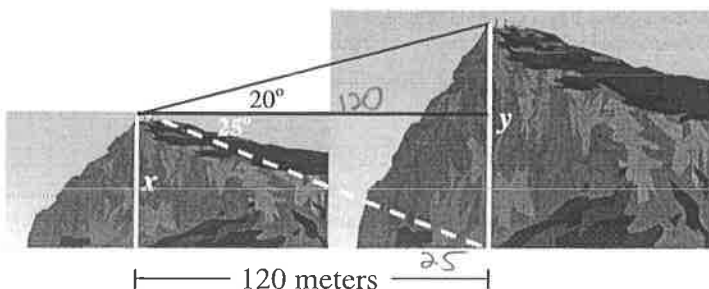
10. The base of an isosceles triangle has a length of 16cm. and the vertex angle measures 68° . What is the length of each leg? Round to the nearest tenth of a cm.



$$\sin 34 = \frac{8}{x}$$

$$x = 14.3 \text{ cm}$$

11. Matt hiked to the top of the smaller cliff shown below. From the top, he could see the bottom of the large cliff at an angle of depression of 25° . He could see the top of the large cliff at an angle of elevation of 20° . Find the height of each cliff (x and y).



$$\tan 20 = \frac{y}{120}$$

$$y = 43.68 + x$$

$$\tan 25 = \frac{x}{120}$$

$$x = 55.96 \text{ m} \quad y = 99.64$$

Name: _____

Period _____

GH

Trigonometry Applications

Set up equations that could be used to solve each problem.

Step 1: Draw a picture

Step 2: Label picture

Step 3: Pick the best trig ratio

Step 4: Set up equation

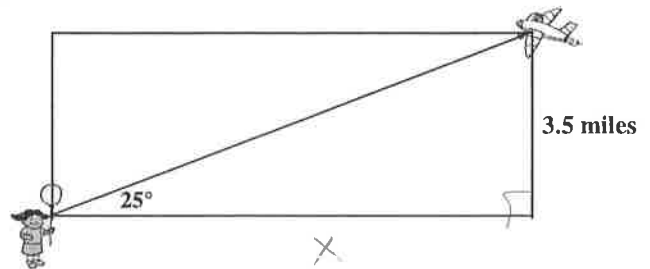
Angle of depression – looking down from a horizontal line

Angle of elevation – looking up from a horizontal line

Ex. 1 Angie looks up at 25 degrees to see an airplane flying toward her. If the plane is flying at an altitude of 3.5 miles, how far is it from being directly above Angie?

$$\tan 25 = \frac{3.5}{x}$$

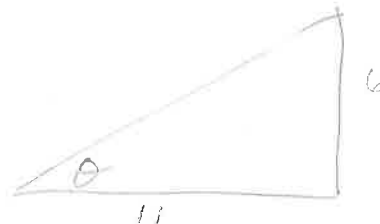
$$x = 7.5 \text{ miles}$$



Ex. 2 A six foot vertical pole casts a shadow of 11 feet. What is the angle of elevation with the ground?

$$\tan \theta = \frac{6}{11}$$

$$\theta = 28.6^\circ$$



Ex. 3 Lauren is at the top of a 15 meter tall lookout tower. She looks down at an angle of depression of 25 degrees and sees Evan coming toward her. How far is Evan from the base of the tower?

$$\tan 25 = \frac{15}{x} \quad x = 32 \text{ meters}$$



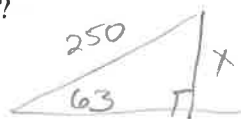
1. What is the angle of elevation if you stand 850 feet away from a cliff that is 400 feet high and look at the top?



$$\tan \theta = \frac{400}{850}$$

$$\theta = 25.2^\circ$$

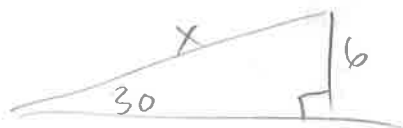
2. The string of a flying kite makes an angle of 63 degrees with the ground. If all 250 feet of string are out, and there is no sag in the string, how high is the kite?



$$\sin 63 = \frac{x}{250}$$

$$x = 222.75$$

3. Tal's hill at Minute Maid Park has an elevation of 30 degrees. If the hill has a six foot vertical rise, how long is its hypotenuse?



$$\sin 30 = \frac{6}{x}$$

$$x = 12$$

Turn the page. Worksheet continues.

You can also take the reciprocal of each trigonometric function.

Turn the page. Worksheet continues.

The Reciprocal Trigonometric Ratios are as follows:

- Reciprocal of Sine Function:

Cosecant (csc) is the ratio of the hyp side to the opp.

$$\sin \theta = \frac{o}{h}$$

Cosecant is also: $\text{csc } \theta = \frac{1}{\sin \theta}$

- Reciprocal of Cosine Function:

Secant (sec) is the ratio of the hyp side to the adj.

$$\cos \theta = \frac{a}{h}$$

Secant is also: $\text{sec } \theta = \frac{1}{\cos \theta}$

- Reciprocal of Tangent Function:

Cotangent (cot) is the ratio of the adj side to the opp.

$$\tan \theta = \frac{o}{a}$$

Cotangent is also: $\text{cot } \theta = \frac{1}{\tan \theta}$

Use the triangle at the right to determine the following ratios. Be sure to simplify your answers!

Ex 9. $\text{csc } \theta = \frac{5}{3}$

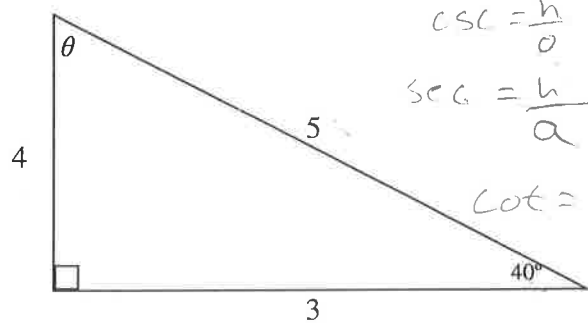
1. $\text{csc } 40^\circ = \frac{5}{4}$

Ex 10. $\text{sec } \theta = \frac{5}{4}$

2. $\text{sec } 40^\circ = \frac{5}{3}$

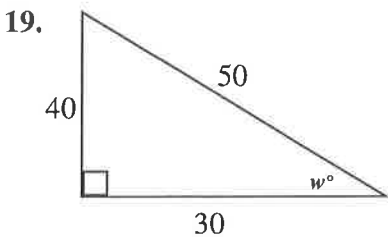
Ex 11. $\text{cot } \theta = \frac{4}{3}$

3. $\text{cot } 40^\circ = \frac{3}{4}$



$\text{csc} = \frac{h}{o}$
 $\text{sec} = \frac{h}{a}$
 $\text{cot} = \frac{a}{o}$

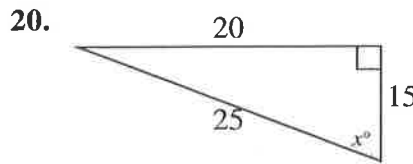
Set up equations using trig ratios that could be used to solve for the variable.



$$\text{csc } w^\circ = \frac{50}{40} = \frac{5}{4}$$

$$\text{sec } w^\circ = \frac{50}{30} = \frac{5}{3}$$

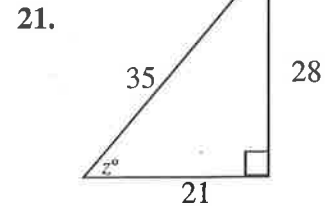
$$\text{cot } w^\circ = \frac{30}{40} = \frac{3}{4}$$



$$\text{csc } x^\circ = \frac{25}{20} = \frac{5}{4}$$

$$\text{sec } x^\circ = \frac{25}{15} = \frac{5}{3}$$

$$\text{cot } x^\circ = \frac{15}{20} = \frac{3}{4}$$



$$\text{csc } z^\circ = \frac{35}{28} = \frac{5}{4}$$

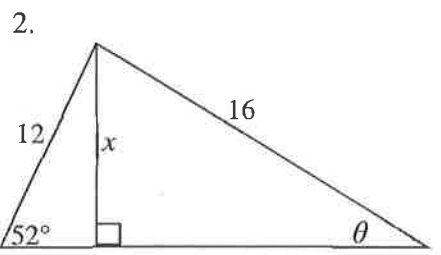
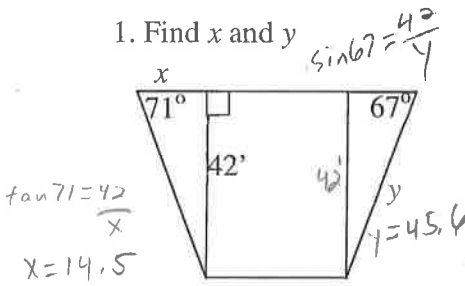
$$\text{sec } z^\circ = \frac{35}{21} = \frac{5}{3}$$

$$\text{cot } z^\circ = \frac{21}{28} = \frac{3}{4}$$

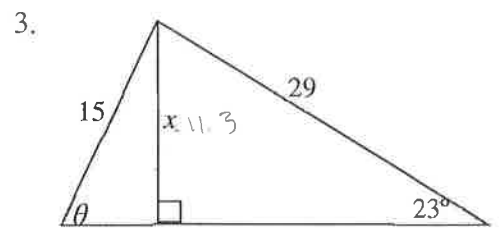
Trigonometry Test Review

Solve each problem. You will need to use your own paper. Please remember to round side lengths to the nearest hundredth and angles to the nearest degree.

1. Find x and y

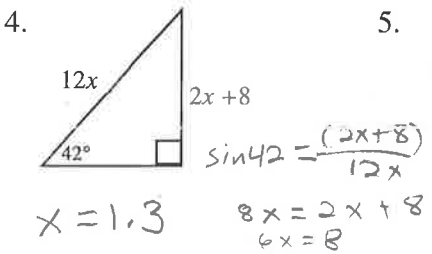


$\sin 52 = \frac{x}{16}$ $\sin \theta = \frac{9.5}{16}$
 $x = 9.5$ $\theta = 36.4^\circ$

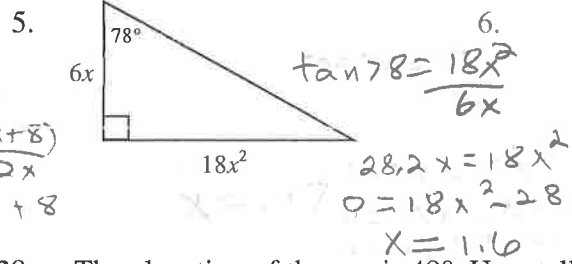


$\sin \theta = \frac{11.3}{15}$ $\sin 23 = \frac{x}{29}$
 $\theta = 48.9$ $x = 11.3$

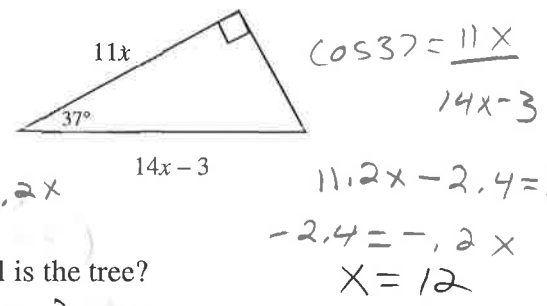
Solve for x .



$\sin 42 = \frac{(2x+8)}{12x}$
 $8x = 2x + 8$
 $6x = 8$
 $x = 1.3$

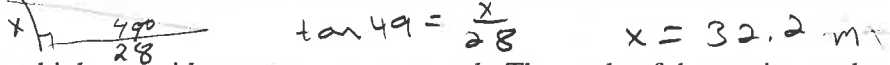


$\tan 78 = \frac{18x^2}{6x}$
 $28.2x = 18x^2$
 $0 = 18x^2 - 28.2x$
 $x = 1.6$



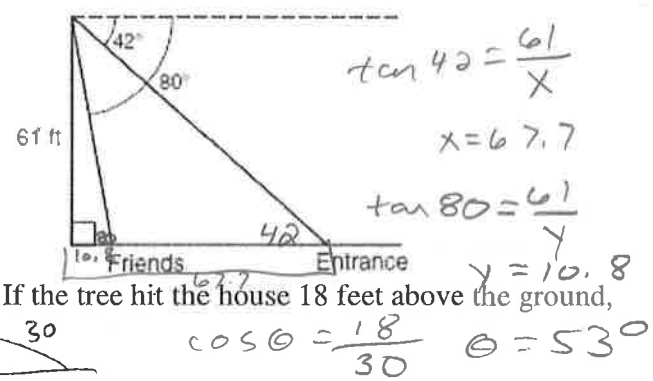
$\cos 37 = \frac{11x}{14x-3}$
 $11.2x - 2.4 = 11x$
 $-2.4 = -1.2x$
 $x = 2$

7. A tree casts a shadow of 28 m. The elevation of the sun is 49° . How tall is the tree?



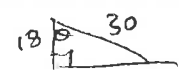
$\tan 49 = \frac{x}{28}$ $x = 32.2 \text{ m}$

8. Shane is 61 feet high on a ride at an amusement park. The angle of depression to the park entrance is 42° , and the angle of depression to his friends standing below is 80° . How far from the entrance are his friends standing?



$\tan 42 = \frac{61}{x}$
 $x = 67.7$
 $\tan 80 = \frac{61}{y}$
 $y = 10.8$
 $\cos \theta = \frac{18}{30}$ $\theta = 53^\circ$

9. A 30 foot tree broke from its base and fell against a house. If the tree hit the house 18 feet above the ground, what angle is the tree forming with the house?



$\cos \theta = \frac{18}{30}$ $\theta = 53^\circ$

10. A freeway entrance ramp has an elevation of 15° . If the vertical lift is 22 feet, what is the distance along the ramp?

11. Lauren is at the top of a 15 m lookout tower. From an angle of depression of 25° , she sees Evan coming toward her. How far is Evan from the base of the tower?

12. Rosalinda has a rocket that can travel 1500 feet before exploding. On the 4th of July, she lights the rocket at an elevation of 75° . How high will the rocket be when it explodes?

13. Mark has two sticks, 25 in. and 20 in. If he places them end to end perpendicularly, what two acute angles would be formed when he added the hypotenuse?