Name: KEY Hour: _____ Date: _____

NOTES: Section 13.1 – Use Trigonometry and Right Triangles

Goals: #1 - I can evaluate the 6 trigonometric functions for an angle, θ, when given two sides in a right triangle.

#2 - I can evaluate the 6 trigonometric functions, without a calculator, for 30, 45, and 60 degree angles.

#3 - I can evaluate the other 5 trigonometric functions for an angle, θ, when given one of the ratios.

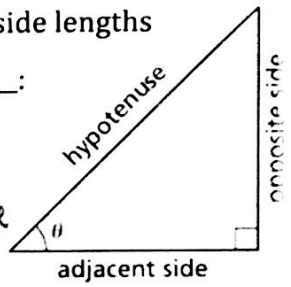
#4 - I can use trigonometry to find 2 unknown sides of a right triangle when given one acute angle measure and one side length.

#5 - I can use trigonometry to find unknowns in a real life application.

Homework: Lesson 13.1 Worksheet

Notes:

Consider one of the acute angles θ of a right triangle. Ratios of a right triangle's side lengths are used to define the six trigonometric functions:



Sine $\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$ **Cosine** $\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$

Tangent $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$ **Cotangent** $\cot\theta = \frac{\text{adjacent}}{\text{opposite}}$

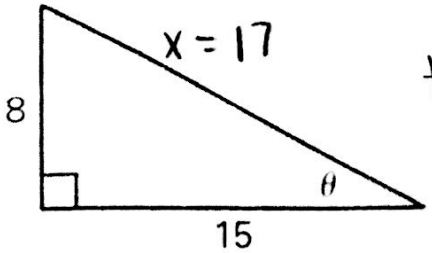
Soh-Cah-Toa

$\frac{1}{\tan}$

Cosecant $\theta = \frac{\text{hypotenuse}}{\text{opposite}}$ Secant $\theta = \frac{\text{hypotenuse}}{\text{adjacent}}$

$\frac{1}{\sin}$ $\frac{1}{\cos}$

Example #1: Evaluate the six trigonometric functions of the angle θ.



$\sin\theta = \frac{o}{h} = \frac{8}{17}$ $\cos\theta = \frac{a}{h} = \frac{15}{17}$

$\tan\theta = \frac{o}{a} = \frac{8}{15}$ $\cot\theta = \frac{a}{o} = \frac{15}{8}$

$\sec\theta = \frac{h}{a} = \frac{17}{15}$ $\csc\theta = \frac{h}{o} = \frac{17}{8}$

$8^2 + 15^2 = x^2$

$289 = x^2$

$17 = x$

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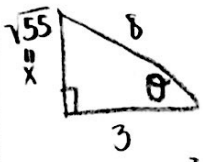
Example #2: If θ is an acute angle of a right triangle and $\cos\theta = \frac{3}{8}$, find the values of the other five trigonometric functions of θ.



$x^2 + 3^2 = 8^2$

$x^2 = 55$

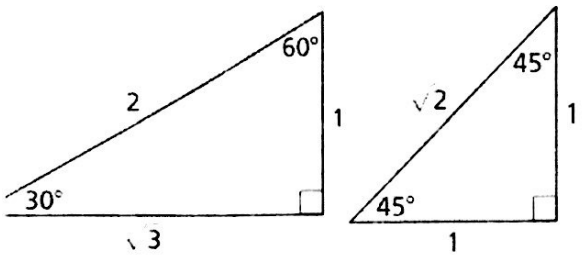
$x = \sqrt{55}$

$\sin\theta = \frac{\sqrt{55}}{8}$ $\cos\theta = \frac{3}{8}$ $\tan\theta = \frac{\sqrt{55}}{3}$

$\csc\theta = \frac{8}{\sqrt{55}} \cdot \frac{\sqrt{55}}{\sqrt{55}} = \frac{8\sqrt{55}}{5}$ $\sec\theta = \frac{8}{3}$ $\cot\theta = \frac{3}{\sqrt{55}} \cdot \frac{\sqrt{55}}{\sqrt{55}} = \frac{3\sqrt{55}}{55}$

Exploration #1: Work with a partner and answer the following questions.

1. Find the exact values of the sine, cosine, and tangent functions for the angles 30°, 45°, and 60°



$\sin 30° = \frac{1}{2}$ $\cos 30° = \frac{\sqrt{3}}{2}$ $\tan 30° = \frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3}$

$\sin 45° = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$ $\cos 45° = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$ $\tan 45° = \frac{1}{1} = 1$

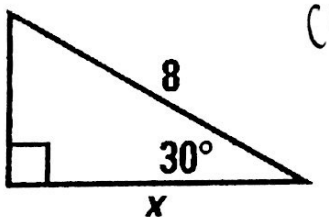
$\sin 60° = \frac{\sqrt{3}}{2}$ $\cos 60° = \frac{1}{2}$ $\tan 60° = \frac{\sqrt{3}}{1} = \sqrt{3}$

Notes: $\frac{h}{o}$ $\frac{h}{a}$ $\frac{a}{o}$

θ	$\sin\theta$	$\cos\theta$	$\tan\theta$	$\csc\theta$	$\sec\theta$	$\cot\theta$
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{3}$	2	$\frac{2\sqrt{3}}{3}$	$\sqrt{3}$
45°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	1	$\sqrt{2}$	$\sqrt{2}$	1
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$	$\frac{2\sqrt{3}}{3}$	2	$\frac{\sqrt{3}}{3}$

Example #3: Find the exact value of x in the triangles below.

1.



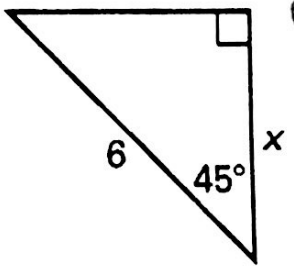
$\cos 30° = \frac{x}{8}$

$\frac{\sqrt{3}}{2} = \frac{x}{8}$

$2x = 8\sqrt{3}$

$\boxed{x = 4\sqrt{3}}$

2.



$\cos 45° = \frac{x}{6}$

$\frac{\sqrt{2}}{2} = \frac{x}{6}$

$2x = 6\sqrt{2}$

$\boxed{x = 3\sqrt{2}}$

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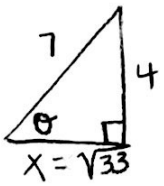
You practice:

1. If θ is an acute angle of a right triangle and $\sin\theta = \frac{4}{7}$, find the values of the other five trigonometric functions of θ.



$x^2 + 4^2 = 7^2$

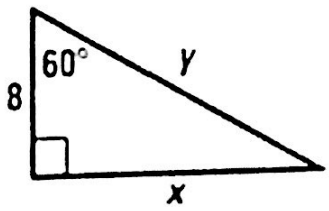
$x^2 = 33$

$x = \sqrt{33}$

$\sin\theta = \frac{4}{7}$ $\quad \cos\theta = \frac{\sqrt{33}}{7}$ $\quad \tan\theta = \frac{4}{\sqrt{33}} \cdot \frac{\sqrt{33}}{\sqrt{33}} = \frac{4\sqrt{33}}{33}$

$\csc\theta = \frac{7}{4}$ $\quad \sec\theta = \frac{7}{\sqrt{33}} \cdot \frac{\sqrt{33}}{\sqrt{33}} = \frac{7\sqrt{33}}{33}$ $\quad \cot\theta = \frac{\sqrt{33}}{4}$

2. Find the exact value of x and y in the triangle below.



$\tan 60° = \frac{x}{8}$ $\quad \cos 60° = \frac{8}{y}$

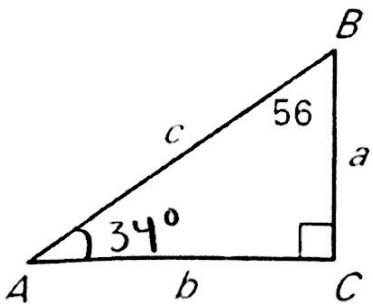
$\sqrt{3} = \frac{x}{8}$ $\quad \frac{1}{2} = \frac{8}{y}$

$\boxed{x = 8\sqrt{3}}$ $\quad \boxed{y = 16}$

Notes:

Solving a triangle is finding ALL unknown side lengths and angle measures.

Example #4: Solve ΔABC. Round answers to the nearest tenth, when necessary.



$13 \cdot \tan 56° = \frac{b}{13} \cdot 13$

$b = 13 \cdot \tan 56°$

$\boxed{b \approx 19.3}$

$(13)^2 + (19.3)^2 = c^2$

$541.49 = c^2$

$\boxed{c = 23.3}$

$\angle A = 180° - 90° - 56°$

$\boxed{\angle A = 34°}$

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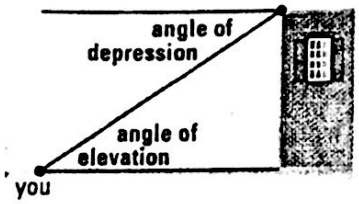
Notes:

Angles of Sight:

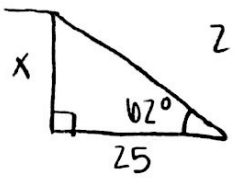
If you look at a point above you, the angle that your line of sight makes with a line parallel to the ground is called the angle of elevation.

The angle between a line parallel to the group and your line of sight is called the angle of depression.

These angles have the same measure.



Example #5: You are measuring the height of your school building. You stand 25 feet from the base of the school. The angle of elevation from a point on the ground to the top of the school is 62°. Estimate the height of the school to the nearest foot.



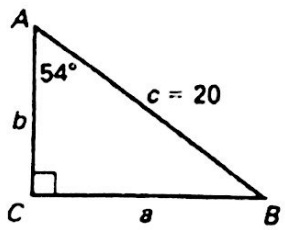
$25 \cdot \tan 62° = \frac{x}{25} \cdot 25$

$25 \tan 62° = x$

$x \approx \boxed{47 \text{ ft}}$

You practice:

1. Solve ΔABC. Round answers to the nearest tenth, when necessary.



$20 \cdot \sin 54° = \frac{a}{20} \cdot 20$

$20 \sin 54° = a$

$\boxed{a \approx 16.2}$

$\angle B = 180° - 90° - 54°$

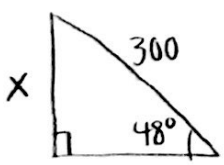
$\boxed{\angle B = 36°}$

$(16.2)^2 + b^2 = (20)^2$

$b^2 = 137.56$

$\boxed{b \approx 11.7}$

2. A parasailer is attached to a boat with rope 300 feet long. The angle of elevation from the boat to the parasailer is 48°. Estimate the parasailer's height above the boat.



$300 \cdot \sin 48° = \frac{x}{300} \cdot 300$

$300 \sin 48° = x$

$\boxed{x \approx 223 \text{ ft}}$