Name: Kelly Date: _____

UNIT 6 **LESSON 6**

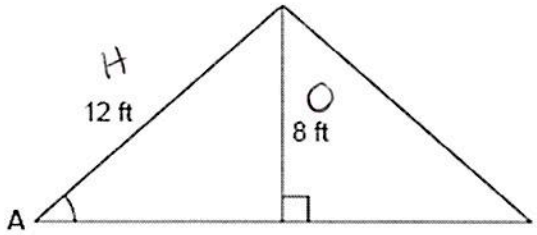
AIM: APPLICATIONS OF FINDING SIDES AND ANGLES USING SOHCAHTOA

Do Now: The center pole of a tent is 8 feet long, and a side of the tent is 12 feet long as shown in the diagram below. If a right angle is formed where the center pole meets the ground, what is the measure of angle *A* to the *nearest degree*?

1) 34
2) 42
3) 48
4) 56

$\sin^{-1}(\sin A) = \left(\frac{8}{12}\right)\sin^{-1}$

$A = 41.8103 \approx 42°$



Using Trigonometry to Find Missing Angles in a Right Triangle
1. Choose sine, cosine, or tangent based on the information.
2. Set up equation.
3. Use inverse trig function (2nd sine/cosine/tangent & (Fraction)).

Example 1: As modeled below, a movie is projected onto a large outdoor screen. The bottom of the 76-foot-tall screen is 24 feet off the ground. The projector sits on the ground at a horizontal distance of 45 feet from the screen.

a) Determine and state, to the *nearest thousandth of a degree*, the measure of $\angle ADC$.

★ Big triangle ★

$\tan^{-1}(\tan x) = \left(\frac{100}{45}\right)\tan^{-1}$

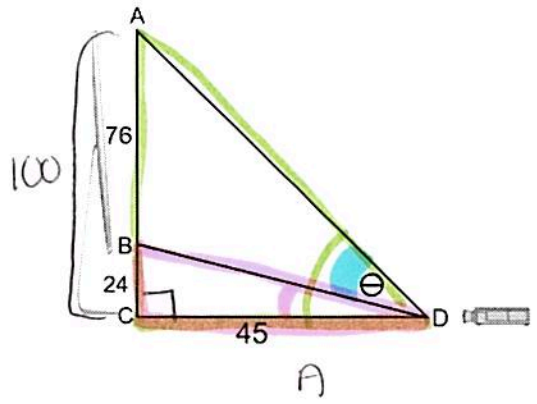
$x = 65.772$

b) Determine and state, to the *nearest thousandth of a degree*, the measure of $\angle BDC$.

★ small triangle ★

$\tan^{-1}(\tan y) = \left(\frac{24}{45}\right)\tan^{-1}$

$y = 28.072$



c) Determine and state, to the *nearest tenth of a degree*, the measure of θ, the projection angle.

Plan: $x - y = \theta$ $\quad 65.772 - 28.072 = \boxed{37.7°}$

NOW YOU TRY ONE!

1. As modeled below, a movie is projected onto a large outdoor screen. The bottom of the 64-foot-tall screen is 14 feet off the ground. The projector sits on the ground at a horizontal distance of 30 feet from the screen. Determine and state, to the *nearest tenth of a degree*, the measure of θ, the projection angle. *(Hint: Find the big angle of elevation, small angle of elevation and subtract!)*

★ Big triangle ★

$\tan^{-1}(\tan x) = \left(\frac{80}{30}\right)\tan^{-1}$

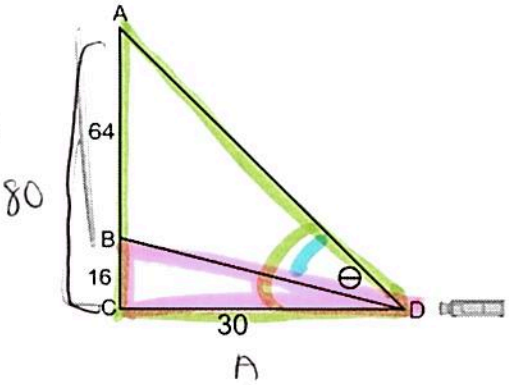
$x = 69.44395$

★ small Δ ★

$\tan^{-1}(\tan y) = \left(\frac{16}{30}\right)\tan^{-1}$

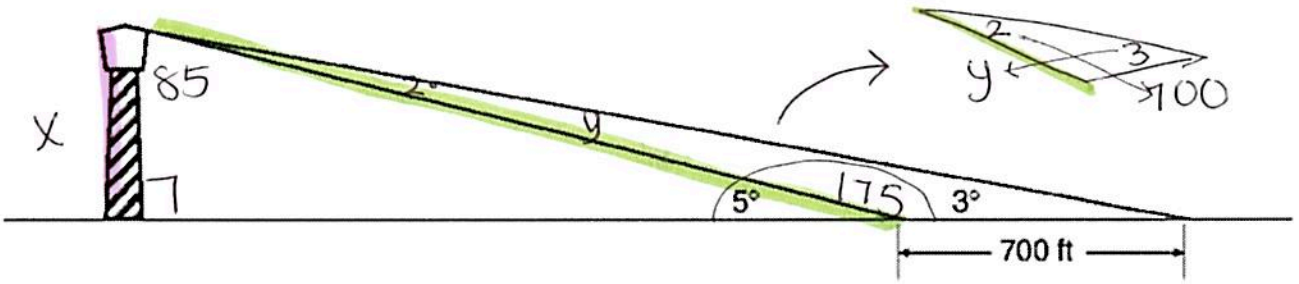
$y = 28.07248$

$\theta \approx 41.4°$



WHAT IF WE SEE AN EXAMPLE LIKE THIS?

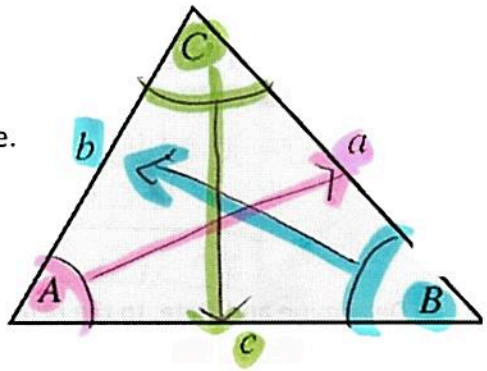
Example 2: While sailing a boat offshore, Donna see a lighthouse and calculates that the angle of elevation to the top of the lighthouse is 3°, as shown in the accompanying diagram before. When she sails her boat 700 feet closer to the lighthouse, she finds that the angle of elevation is now 5°. How tall, to the *nearest tenth of foot*, is the lighthouse?



LAW OF SINES

- The **Law of Sines** states that the sine of an angle is proportional to the side opposite the angle.
- We only use two of the possible ratios (depending on what is given to us), thus producing a proportion we can solve.
- Why use Law of Sines instead of SOHCAHTOA?
  - SOHCAHTOA is restricted to right triangles.
  - Law of Sines can be used in any triangle!

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$



*Now, try solving the example above using Law of Sines! *FIND ALL ANGLE MEASURES FIRST!**

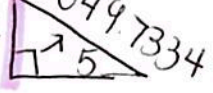
Plan: ① Find side shared between two Δ's (y)

$$\frac{\sin 2}{700} = \frac{\sin 3}{y}$$

$$\frac{y \sin 2}{\sin 2} = \frac{700 \sin 3}{\sin 2}$$

$$y = 1049.7334$$

② use y to help you find x



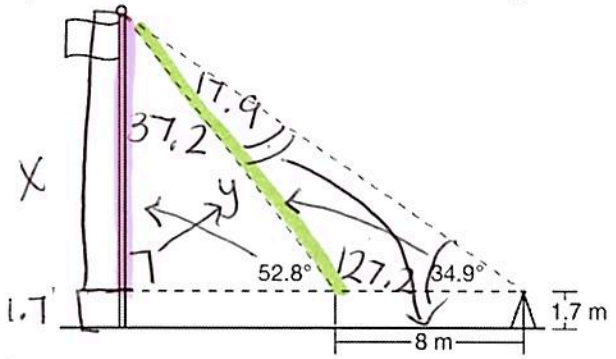
$$\frac{\sin 5}{x} = \frac{\sin 90}{1049.7334}$$

$$\frac{1049.7334 \sin 5}{\sin 90} = \frac{\sin 90 \, x}{\sin 90}$$

$$x = 91.4902$$

$$\boxed{x = 91.5 \text{ ft}}$$

Example 3: Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be 34.9°. She walks 8 meters closer and determines the new measure of the angle of elevation to be 52.8°. At each measurement, the survey instrument is 1.7 meters above the ground.



Determine and state, to the nearest tenth of a meter, the height of the flagpole. ★add 1.7 to ans.★

① Find shared side (y)

$$\frac{\sin 17.9}{8} = \frac{\sin 34.9}{y}$$

$$\frac{y \sin 17.9}{\sin 17.9} = \frac{8 \sin 34.9}{\sin 17.9}$$

$$y = 14.8920$$

② Find x

$$\frac{\sin 52.8}{x} = \frac{\sin 90}{14.8920}$$

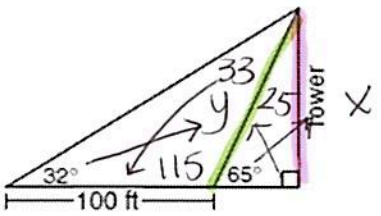
$$\frac{x \sin 90}{\sin 90} = \frac{14.8920 \sin 52.8}{\sin 90}$$

$$x = 11.8619$$

$$x = 11.9 + 1.7 = 13.6$$

NOW YOU TRY ONE!

The accompanying diagram shows the plans for a cell-phone tower that is to be built near a busy highway. Find the height of the tower, to the nearest foot.



① Find shared side (y)

$$\frac{\sin 32}{y} = \frac{\sin 33}{100}$$

$$\frac{y \sin 33}{\sin 33} = \frac{100 \sin 32}{\sin 33}$$

$$y = 97.2973$$

② Find x

$$\frac{\sin 90}{97.2973} = \frac{\sin 65}{x}$$

$$\frac{97.2973 \sin 65}{\sin 90} = \frac{x \sin 90}{\sin 90}$$

$$x = 88.1813$$

$$x = 88 \text{ ft}$$

Name: Key

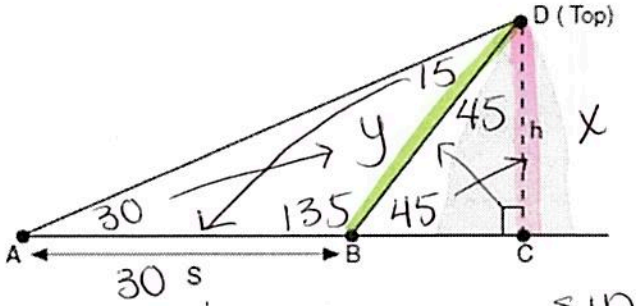
Date:

UNIT 6

LESSON 6

HOMEWORK

1. A ship at sea heads directly toward a cliff on the shoreline. The accompanying diagram shows the top of the cliff, *D*, sighted from two locations, *A* and *B*, separated by distance *S*. If $m\angle DAC = 30$, $m\angle DBC = 45$, and $S = 30$ feet, what is the height of the cliff, to the *nearest foot*?



$$\frac{\sin 30}{y} = \frac{\sin 15}{30}$$

$$\frac{y \sin 15}{\sin 15} = \frac{30 \sin 30}{\sin 15}$$

$$y = 57.9555$$

$$\frac{\sin 90}{57.9555} = \frac{\sin 45}{x}$$

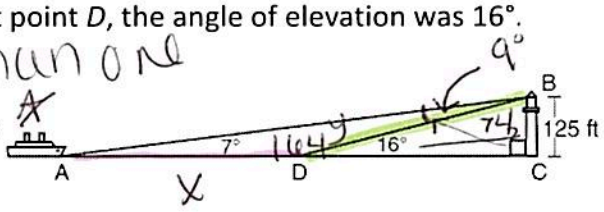
$$\frac{x \sin 90}{\sin 90} = \frac{57.9555 \sin 45}{\sin 90}$$

$$x = 40.9807$$

$$\boxed{x \approx 41 \text{ ft}}$$

2. As shown in the diagram below, a ship is heading directly toward a lighthouse whose beacon is 125 feet above sea level. At the first sighting, point *A*, the angle of elevation from the ship to the light was 7°. A short time later, at point *D*, the angle of elevation was 16°.

* there is more than one way to do this!



* still start by finding shared side but this time start with $\triangle BDC$ b/c it has the given side measure*

To the *nearest foot*, determine and state how far the ship traveled from point *A* to point *D*.

$$\frac{\sin 90}{y} = \frac{\sin 16}{125}$$

$$\frac{125 \sin 90}{\sin 16} = \frac{y \sin 16}{\sin 16}$$

$$y = 453.4944$$

$$\frac{\sin 9}{x} = \frac{\sin 7}{453.4944}$$

$$\frac{x \sin 7}{\sin 7} = \frac{453.4944 \sin 9}{\sin 7}$$

$$x = 582.1164$$

$$\boxed{x \approx 582 \text{ ft}}$$

3. As modeled below, a movie is projected onto a large outdoor screen. The bottom of the 40-foot-tall screen is 10 feet off the ground. The projector sits on the ground at a horizontal distance of 25 feet from the screen. Determine and state, to the *nearest tenth of a degree*, the measure of θ, the projection angle.
(Hint: Find the big angle of elevation, small angle of elevation and subtract!)

★ BIG triang ★

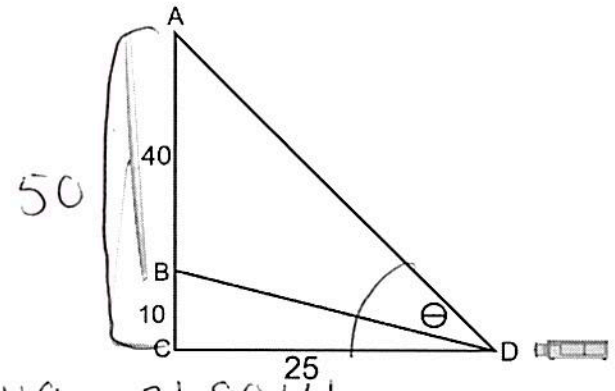
$\tan^{-1}(\tan x) = \left(\frac{50}{25}\right)\tan^{-1}$

$x = 63.4349$

★ small Δ ★

$\tan^{-1}(\tan y) = \left(\frac{10}{25}\right)\tan^{-1}$

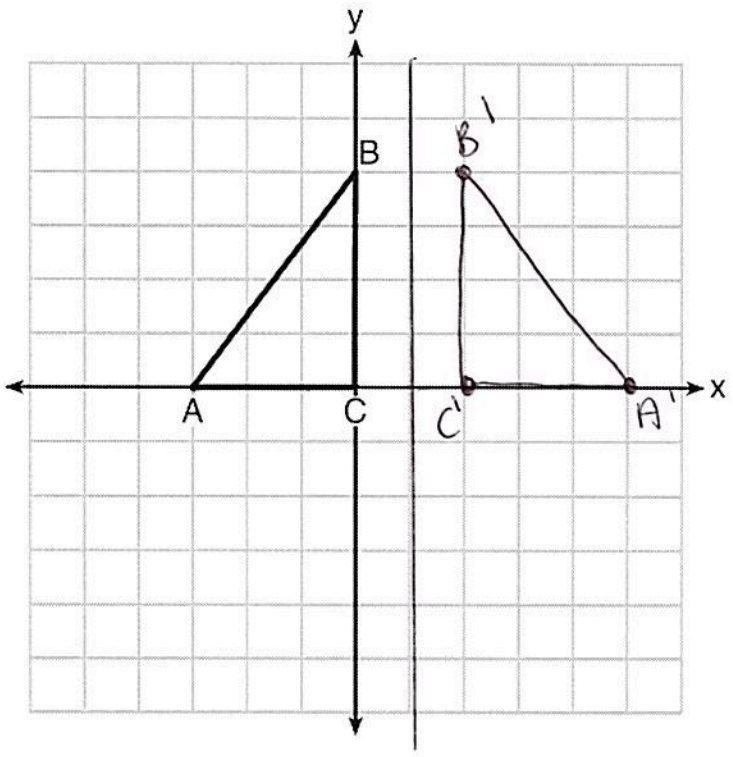
$y = 21.8014$



$\theta = 63.4349 - 21.8014$

$\theta = 41.6335 \approx \boxed{41.6^\circ}$

4. Triangle *ABC* is graphed on the set of axes below. Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$ after a reflection over the line $x = 1$.



$\triangle ABC \cong \triangle A'B'C'$ b/c a reflection is a rigid motion which preserves distance & ∠ measure