



<p><b>Objective</b></p>	<p><b>Interpretation of Objective</b></p>	<p><b>Connections</b></p>
<p><b>G.SRT. 11 (HONORS ONLY)</b></p> <p>Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).</p>	<p>Use the Law of Sines and Cosines to solve a variety of application based problems.</p>	<p>Apply these two laws to more real life situations.</p>

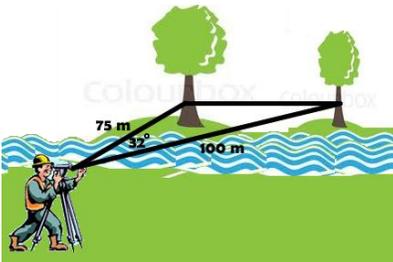
<p><b>Student Outcomes</b></p>	<p><b>Emphasis</b></p>	<p><b>Tips</b></p>
<p><b>(1)</b> The student will be able solve for the sides and angles of any triangle.</p>	<p>The purpose of this objective is to have student apply their new relationships to a variety of situations that have real life contexts.</p>	<p>1 – Vocabulary – Again this is always the issue with word problems about bearing, vectors or other situations that seem to appear when working with these two laws. Take time to breakdown the vocabulary and things will flow a little easier.</p>



**CONCEPT 1** – Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

The Law of Sines and Cosines are used in many different areas because of their wide reaching application to any and all triangles. Look at a few ‘real world’ problems that can be solved by these laws.

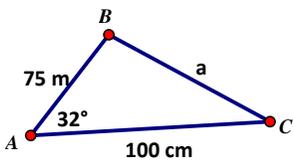
**Type #1 – Surveying Problem**



The surveyor is able to determine that the angle to the two trees is  $32^\circ$  from where he is standing and that the distance to the tall tree is 75 m and to the shorter tree is 100 m.

What is the distance between the two trees? (to the nearest meter)

**Draw a diagram**



$$a^2 = 75^2 + 100^2 - 2(75)(100)(\cos 32)$$

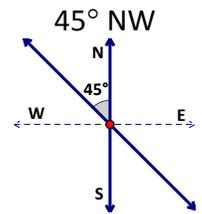
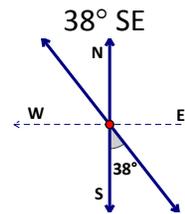
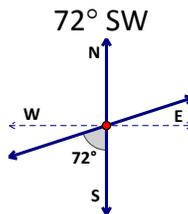
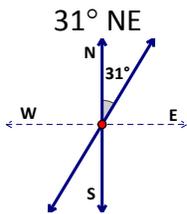
$$a^2 = 2904.28$$

$$a = \pm 53.89$$

**The two trees are approximately 54 m apart.**

**Type #2 – Navigation (Bearing)**

Navigation works of a bearing system – one of the ways bearings are determine is to reference them from the North/South line. Here are a few examples:

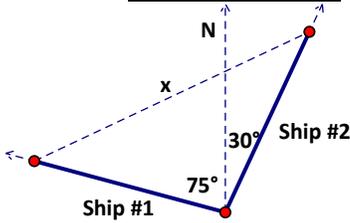


The direction and angle is referenced from either the north or the south.

Two storage ships leave from a harbor, Ship #1 leaves on a bearing of  $75^\circ$  NW and Ship #2 leaves on a bearing of  $30^\circ$  NE. If Ship #1 is travelling at 25 mph and Ship #2 is travelling at 30 mph, after 3 hours how far apart are they (to the nearest mile)?



**Draw a Diagram**



Distance = Rate  $\times$  Time

Ship #1  
Distance = (25)(3) = 75 miles

Ship #2  
Distance = (30)(3) = 90 miles

$$x^2 = 75^2 + 90^2 - 2(75)(90)(\cos 105)$$

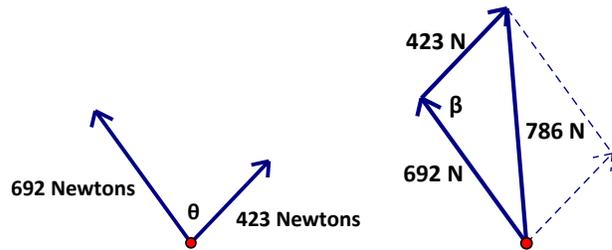
$$x^2 = 17219.06$$

$$x = \pm 131.22$$

**The two ships are 131 miles apart.**

**Type #3 – Vectors**

Two forces of 692 newtons and 423 newtons act on a point. The resultant force is 786 newtons. Find the angle between the forces.



Angle  $\theta$  represents the angle between the two forces but the data gives the resultant force. To diagram the resultant force put the vectors tip to tail and the resultant force or vector is from the original location to the end of the second vector. This means that after solving for angle  $\beta$ , subtract it from 180 to get angle  $\theta$ . Angle  $\beta$  and angle  $\theta$  are consecutive interior angles of the parallelogram so angle  $\theta = 180^\circ - \beta$ .

$$786^2 = 423^2 + 692^2 - 2(423)(692)(\cos \beta)$$

$$786^2 - 423^2 - 692^2 = -2(423)(692)(\cos \beta)$$

$$-39997 = -585432(\cos \beta)$$

$$\frac{-39997}{-585432} = \cos \beta$$

$$0.0683 = \cos \beta$$

$$\cos^{-1}(0.0683) \approx m\angle \beta$$

$$86.08^\circ \approx m\angle \beta$$

So then the angle between the two forces is

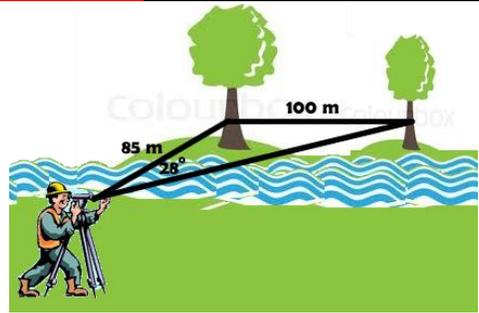
$$\theta = 180^\circ - \beta$$

$$\theta = 180^\circ - 86.08$$

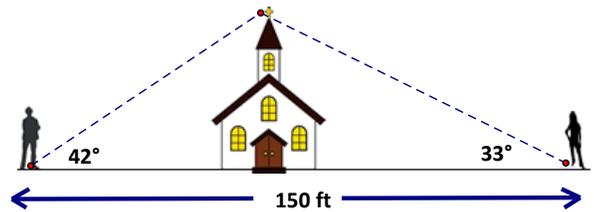
$$\theta = 93.32^\circ$$



1. A surveyor is trying to determine the distance from his current location to the smaller tree so that he can build a rope bridge for walking traffic. The angle from where he is located to the two trees that are 100 m apart is  $28^\circ$  and the distance across the river to the big tree from where he is 85 m. What is the distance from his location to the small tree (Round to the nearest meter)?



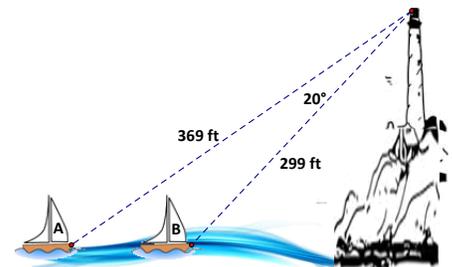
2. Two people are 150 ft apart and are on either sides of the church. Jeff sees the top of the steeple at  $42^\circ$  and Samantha sees it at  $33^\circ$ . How much closer is Jeff than Samantha to the steeple (Round to the nearest foot)?



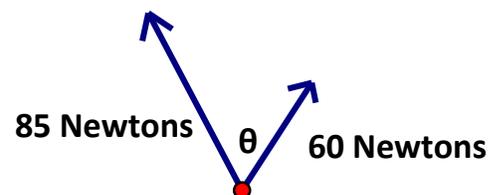
3. Some marine biologists are studying rare red belly salmon in the north portion of the lake. They have gathered some of the measurements of the area but still need to determine the width (from *A* to *B*) of the north portion of the lake. Determine the width of the north portion of the lake (from *A* to *B*) to the nearest foot.



4. From the lighthouse two boats are spotted. The line of sight to the two boats is 369 ft to boat *A* and 299 ft to boat *B*. If the line of sight angle between the two boats is  $20^\circ$ , how far apart are the boats from each other? (Round to the nearest foot)



5. Two forces act at a point. One force is 85 newtons and the other is 60 newtons. If the resultant force of both forces is 130 newtons, what is the angle between the two forces? (Round to the nearest degree)



**Answers:**

**1)** (Exactly one answer because  $AS_1S_2$  where  $S_2 > S_1$ )

$$\frac{\sin 28}{100} = \frac{\sin B}{85}$$

$$(\sin B)100 = 85(\sin 28)$$

$$\sin B = \frac{85(\sin 28)}{100}$$

$$\sin B = 0.39905$$

$$\sin^{-1}(0.39905) = m\angle B$$

$$23.52^\circ \approx m\angle B$$

**2)**

$$\frac{\sin 105}{150} = \frac{\sin 42}{c}$$

$$(\sin 105)c = 150(\sin 42)$$

$$c = \frac{150(\sin 42)}{(\sin 105)}$$

$$c = 103.91 \text{ ft}$$

**3)**

$$c^2 = 178^2 + 589^2 - 2(178)(589)(\cos 53)$$

$$c^2 = 252,414.02$$

$$c = \pm 502.41$$

**4)**

$$c^2 = 369^2 + 299^2 - 2(369)(299)(\cos 20)$$

$$c^2 = 18,207.55$$

$$c = \pm 134.93$$

$$180 - 28 - 23.52 = 128.48^\circ = m\angle C$$

$$\frac{\sin 28}{100} = \frac{\sin 128.48}{c}$$

$$(\sin 128.48)100 = c(\sin 28)$$

$$c = \frac{(\sin 128.48)100}{(\sin 28)}$$

$$c = 166.75 \text{ m}$$

**The rope bridge would need to be 167 m long.**

$$\frac{\sin 105}{150} = \frac{\sin 33}{b}$$

$$(\sin 105)b = 150(\sin 33)$$

$$b = \frac{150(\sin 33)}{(\sin 105)}$$

$$b = 84.58 \text{ ft}$$

$$103.91 - 84.58 = 19.33 \text{ ft}$$

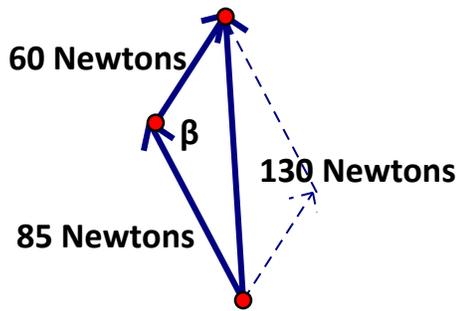
**Jeff is approximately 19 ft closer than Samantha to the steeple.**

**The north lake is approximately 502 ft wide.**

**The two boats are approximately 135 ft apart.**



5)



$$130^2 = 85^2 + 60^2 - 2(85)(60)(\cos B)$$

$$130^2 - 85^2 - 60^2 = -2(85)(60)(\cos B)$$

$$6075 = -10200(\cos B)$$

$$\frac{6075}{-10200} = \cos B$$

$$-0.59559 \approx \cos B$$

$$\cos^{-1}(-0.59559) \approx m\angle B$$

$$126.55^\circ \approx m\angle B$$

Because a parallelogram was formed: (consecutive angles are supplementary  $\rightarrow \theta$  &  $\beta$  are supplementary)

$$\theta = 180^\circ - \beta.$$

$$\theta \approx 180^\circ - 126.55$$

$$\theta \approx 53.45^\circ$$

**So the angle between the two forces is  $53^\circ$ .**