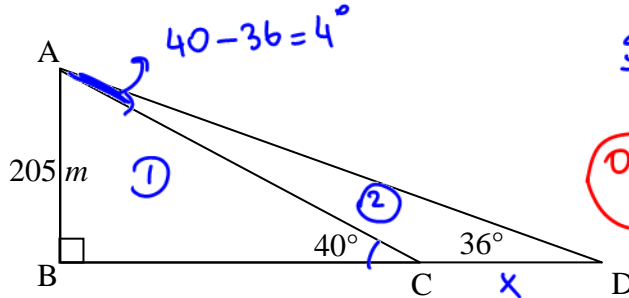


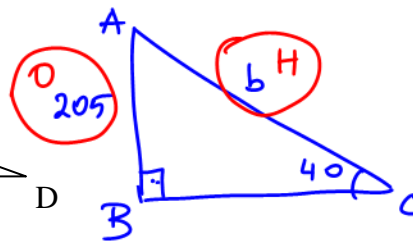
Trigonometry Applications

If diagrams are not included in any of the following questions it is advisable to sketch a diagram to aid in your solution to the problem. Round \angle 's to a whole degrees; length answers should be rounded to 1 decimal place and include units.

1. A smokestack, **AB**, is 205m high. From two points C and D on the **same side** of the smokestack's base B, the angles of elevation to the top of the smokestack are 40° and 36° respectively. Find the distance between C and D. (Diagram included.) (37.8 m)



Step 1: Separate the triangles, and solve for "b"



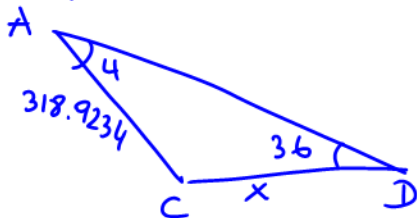
SOH

$$\sin 40^\circ = \frac{205}{b}$$

$$b = \frac{205}{\sin 40^\circ}$$

$$b = 318.9234$$

Step 2: AAS \rightarrow sine law



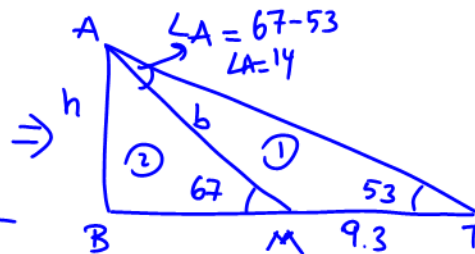
$$\frac{x}{\sin 4} = \frac{318.9234}{\sin 36}$$

$$x = \frac{318.9234 \sin 4}{\sin 36}$$

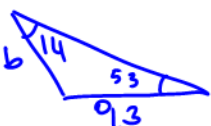
$$x = 37.8 \text{ m}$$

\therefore The distance between C and D is 37.8m.

2. Trina and Mazaheer are standing on the same side of a Red Maple tree. The angle of elevation from Mazaheer to the tree top is 67° and the angle of elevation from Trina to the tree top is 53° . If Mazaheer and Trina are 9.3 feet apart and Mazaheer is closer to the tree than Trina, how tall is the tree? The angles are from their feet. This is just like the one above it! (28.3 feet)



Step 1: Find b in triangle ① using sine law

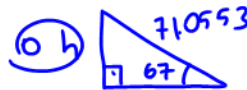


$$\frac{b}{\sin 53} = \frac{9.3}{\sin 14}$$

$$b = \frac{9.3 \sin 53}{\sin 14}$$

$$b = 30.7013$$

Step 2: Find h in triangle ② using SOH CATT TOA



$$\sin 67 = \frac{h}{30.7013}$$

$$h = 30.7013 \cdot \sin 67$$

$$h = 28.3 \text{ ft}$$

3. Two roads separate from a village at an angle of 37° . Two cyclists leave the village at the same time. One travels 7.5 km/h on one road and the other travels 10.0 km/h on the other road. How far apart are the cyclists after 2 hours? Start with the location of the village, and add in the two roads. Remember that you are given the SPEED, and they are cycling for 2 hours! (**12.1 km**)

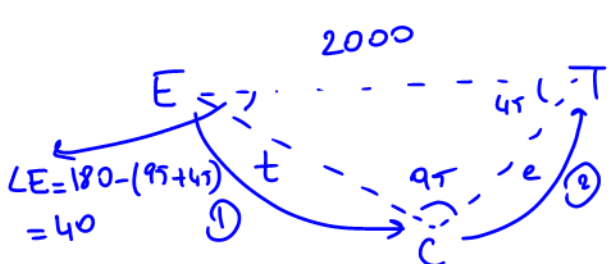
Cyclist 1 = $7.5 \times 2 = 15 \text{ km}$
 Cyclist 2 = $10 \times 2 = 20 \text{ km}$

$$c^2 = 15^2 + 20^2 - 2 \cdot 15 \cdot 20 \cdot \cos 37$$

$$c^2 = 145.8187$$

$c = 12.1 \text{ km}$

4. David wants to go to Toronto from Edmonton, but he took the wrong plane and ended up in Chicago instead. Upon realizing his mistake, David flew from Chicago to Toronto. If the angle at Toronto is 45° , the angle at Chicago is 95° , and the distance from Edmonton to Toronto is 2000 km , how much further did David travel than necessary? Start with the 3 locations and add in the straight line paths between each city. Add in the information. Note: read what the question is asking carefully. You will need to determine both of the other 2 sides! (**710.1 km**)



Step 1: find t , using sine law

$$\frac{t}{\sin 45} = \frac{2000}{\sin 95}$$

$$t = \frac{2000 \sin 45}{\sin 95}$$

$t = 1,419.6156 \text{ km}$

Step 2: Find e

$$\frac{e}{\sin 40} = \frac{2000}{\sin 95}$$

$$e = \frac{2000 \sin 40}{\sin 95}$$

$e = 1,290.4859$

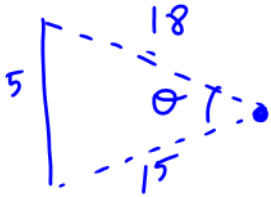
Step 3: $2000 - (e + t)$

$$= 2000 - (1,419.6156 + 1,290.4859)$$

$$= -710.10 \text{ km}$$

\therefore David flew extra 710.10 km .

5. Jill and her friends built an outdoor hockey rink. Their hockey goal line is 5 feet wide. Jill shoots a puck from a point where the puck is 5 yards from one goal post and 6 yards from the other goal post. Within what angle must Jill make her shot to hit the net? (14°)



$$\cos \theta = \frac{15^2 + 18^2 - 5^2}{2 \cdot 15 \cdot 18}$$

$$\cos \theta = \frac{524}{540}$$

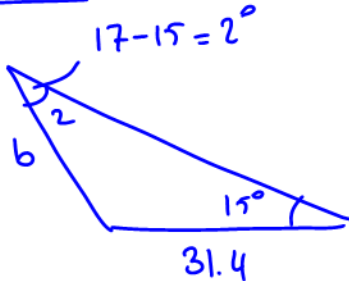
$$\cos^{-1}\left(\frac{524}{540}\right) = \theta$$

$$\theta = 14^\circ$$

5 yards = $5 \times 3 = 15$ ft
 6 yards = $6 \times 3 = 18$ ft

6. Jillian stood at a distance admiring a magnificent Douglas Fir. She is 5 feet tall. Jillian measured the angle of elevation to the top of the tree from eye level and found it to be 15° . Jillian then walked 31.4 feet closer to the tree. This time the angle of elevation to the top of the tree was 17° . Calculate the height of the tree to the nearest tenth of a metre. (73 feet)

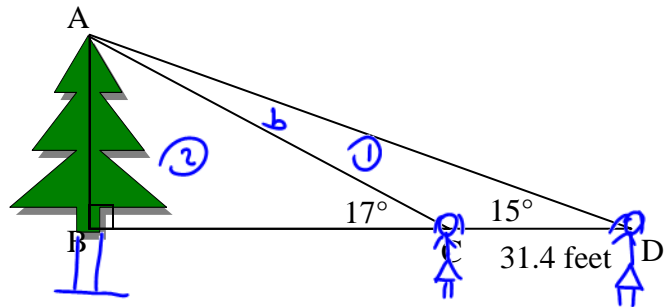
Step 1: find b using SINE law



$$\frac{b}{\sin 15} = \frac{31.4}{\sin 2}$$

$$b = \frac{31.4 \sin 15}{\sin 2}$$

$$b = 232.8663$$



Step 2: find the \overline{AB}



$$\sin 17 = \frac{c}{232.8663}$$

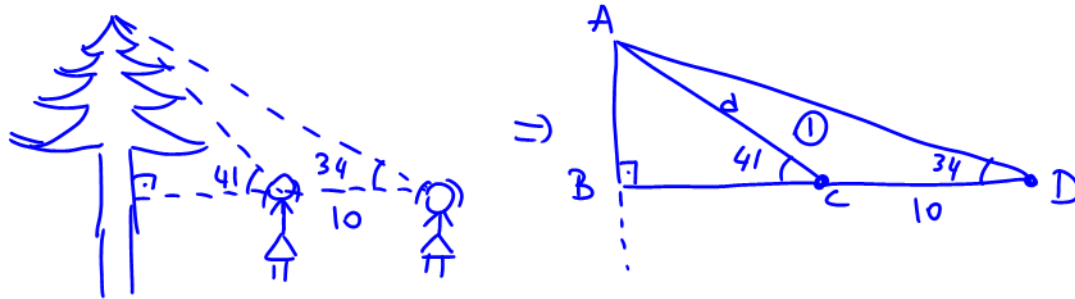
$$c = 68.1$$

Step 3: Add Jillian's height to AB

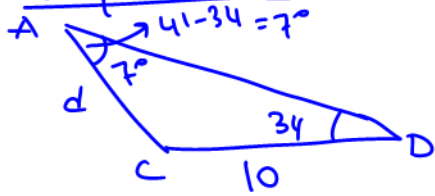
$$68.1 + 5 = 73.1$$

\therefore The tree's height is 73.1 feet

7. To calculate the height of a tree, Marie measures the angle of elevation from her eye level to be 34° . She then walks 10 feet directly toward the tree, and finds the angle of elevation from the new point to be 41° . Marie is 5.5 feet tall. What is the height of the tree? (35.6 feet)



Step 1: find d in triangle ①

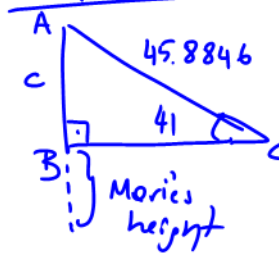


$$\frac{d}{\sin 34} = \frac{10}{\sin 7}$$

$$d = \frac{10 \cdot \sin 34}{\sin 7}$$

$$d = 45.8846$$

Step 2: find AB in $\Delta 1$



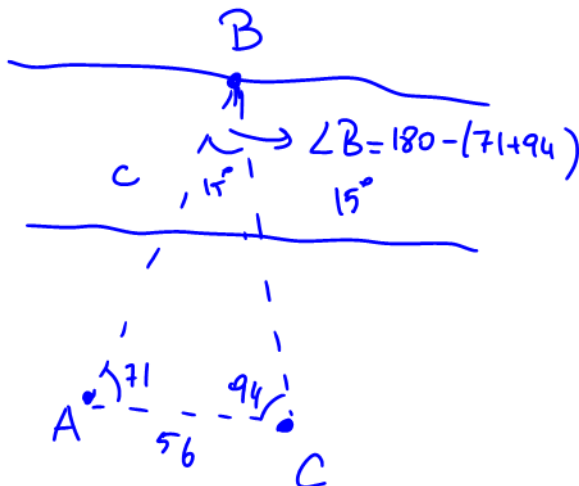
$$\sin 41 = \frac{c}{45.8846}$$

$$c = 45.8846 \cdot \sin 41$$

$$c = 30.1 \text{ ft}$$

$\therefore 30.1 + 5.5 = 35.6$ is the tree's height

8. To measure the distance from a point A to an inaccessible point B, a surveyor picks out a point C and measures $\angle BAC$ to be 71° . He moves to point C, a distance of 56 m from point A, and measures $\angle BCA$ to be 94° . How far is it from A to B? (215.8 m)

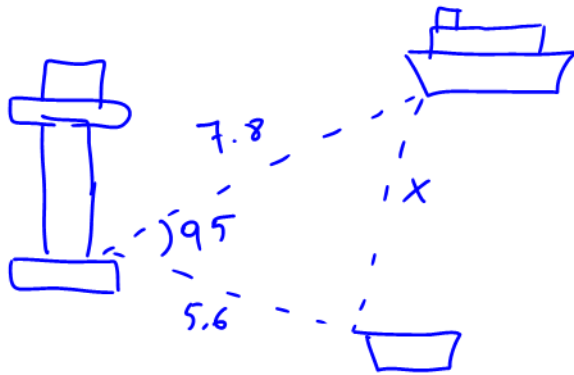


$$\frac{c}{\sin 94} = \frac{56}{\sin 15}$$

$$c = \frac{56 \sin 94}{\sin 15}$$

$$c = 215.8 \text{ m}$$

9. A radar tracking station locates an oil tanker at a distance of 7.8 km, and a sailboat at a distance of 5.6 km. At the station, the angle between the two ships is 95° . How far apart are the ships? (**10.0 km**)



$$x^2 = (7.8)^2 + (5.6)^2 - 2(7.8)(5.6)\cos 95^\circ$$

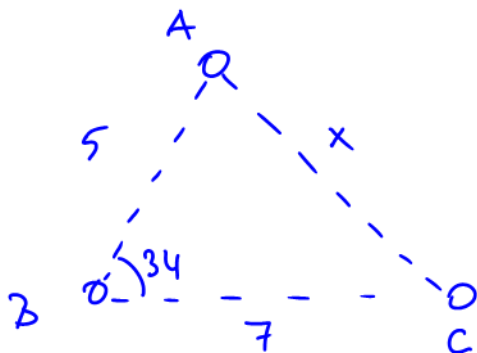
$$x^2 = 99.8139$$

$$x = 9.99$$

$$x \doteq 10 \text{ km}$$

\therefore The two ships are 10 km apart.

10. Two islands **A** and **B** are 5 km apart. A person took a vacation from island **B** and travelled 7 km to a third island **C**. At island **B** the angle separating island **A** and island **C** was 34° . While on this vacation the person decided to visit island **A**. Calculate how far the person will have to travel to get to island **A** from island **C**. (**4.0 km**)

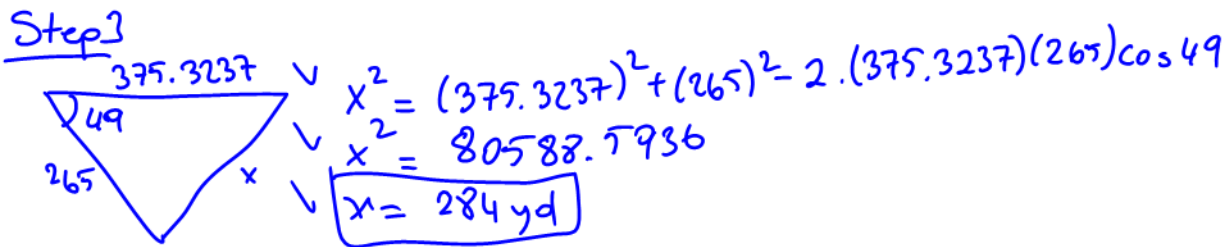
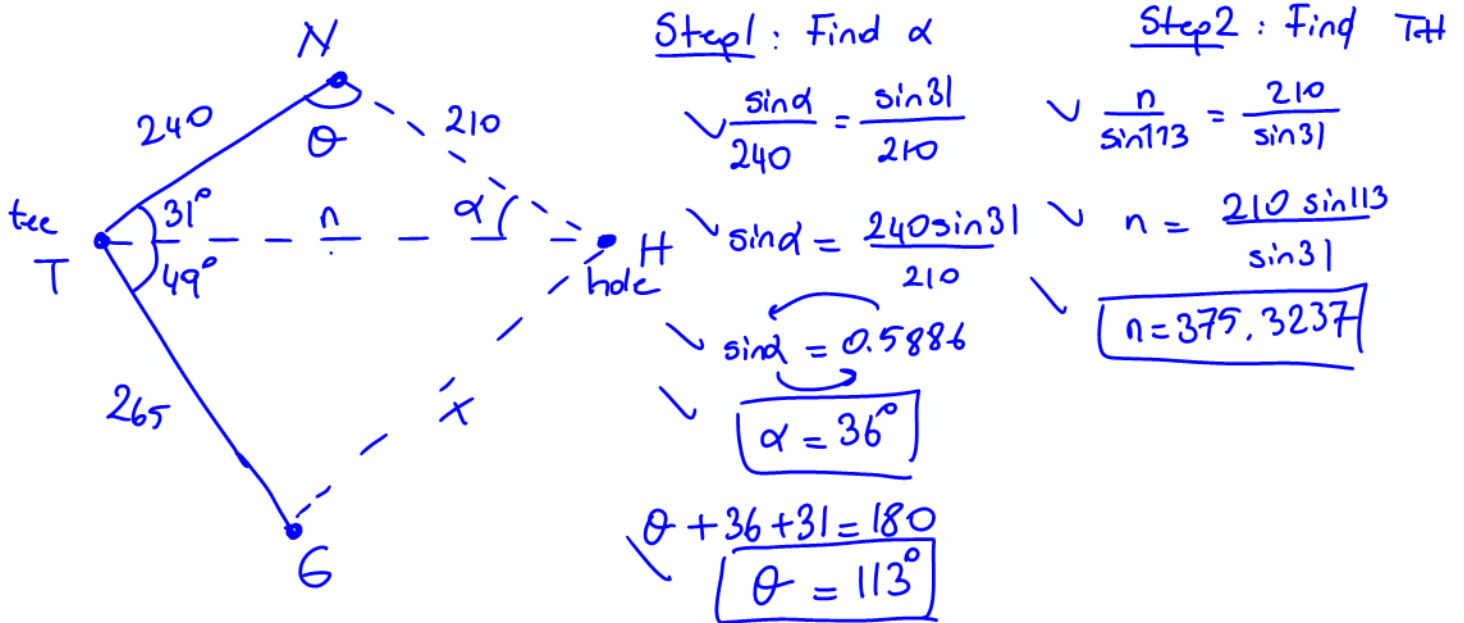


$$x^2 = 5^2 + 7^2 - 2 \cdot 5 \cdot 7 \cdot \cos 34^\circ$$

$$x \doteq 4 \text{ km}$$

\therefore The distance between island **A** and **C** is 4 km.

12. Nick is playing golf with Gerry, and both boys are trying to hit their golf ball from the tee to the hole, which is in a straight line with the tee. Nick drives the ball 240 yards, but at an angle 31° to the left of the hole. Gerry hits his ball 265 yards at an angle of 49° to the right of the hole. Nick calculates that his ball is still 210 yards from the hole. Whose ball is closer to the hole, and by what distance? Round the final answer to the nearest yard.



$$N = 210 \text{ yd}$$

$$G = 284 \text{ yd}$$

\therefore Nick's golf ball is closer to the hole by 74 yds.