

## MAC 1114

### Trigonometry Applications : Law of Sines and Cosines Worksheet

#### Law of Sines (ratio)

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

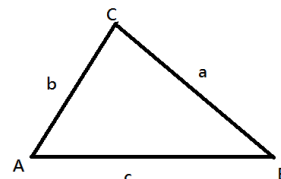
**When to Use:**  
ASA and SAA is given

#### Case 1: given ASA

A = 50°, B = 68°, c = 230.

*Hint: angles are usually given in Capital letters and sides in small letters.*

1. You can find C. (hint: sum of all angles in a triangle = 180)
2. Set up the ratio using the side given and one of the other angles.  
\_\_\_\_\_ = \_\_\_\_\_ and solve for the missing side.



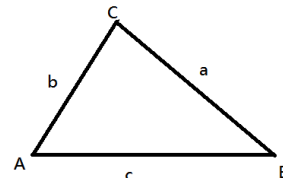
3. You can repeat this if you need to know all of the sides.

#### Case 2: given SAA

B = 10°, C = 100°, c = 115

You have enough information to set up a ratio.

\_\_\_\_\_ = \_\_\_\_\_ (solving for b); continue if you need to find the other side.



*Keep in mind you can find A by using the fact that the sum of all angles in a triangle = 180°.*

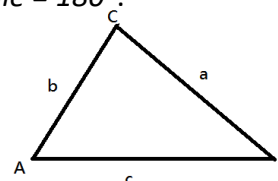
#### Case 3: SSA (no solution)

a = 20, c = 45, A = 125°

Set up the ratio to solve for C

\_\_\_\_\_ = \_\_\_\_\_

;when you do this you get  $\sin C = 1.84 > 1$  so outside of the range for sine values! Therefore, this problem has no solution.



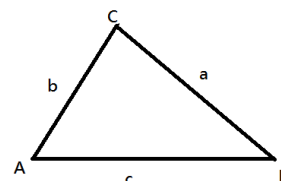
#### Case 4: given SSA (one solution)

A = 110°, c = 15, a = 28

Set up the ratio for this one using the appropriate ratio.

\_\_\_\_\_ = \_\_\_\_\_

; this will give you  $\sin C = .503$  or C = 30° or 150°



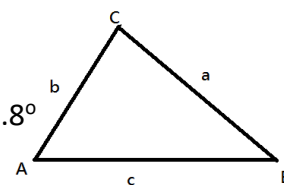
Let's try 30°: B = 180 - (110 + 30) = 40° ✓ Let's try 150°: B = 180 - (110 + 150) = -80° ✗ (can't draw a triangle with a negative angle) so we reject this one. Thus, there is only one solution to this problem.

### Case 5: SSA (2 solutions)

$$a = 26, c = 15, C = 29^\circ$$

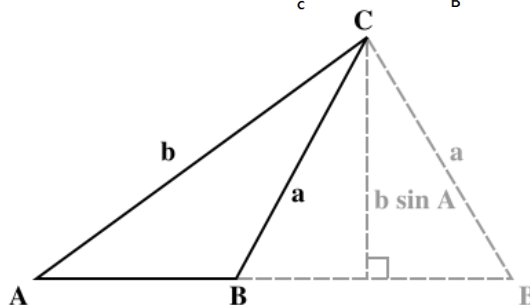
$$\frac{a}{\sin A} = \frac{c}{\sin C}$$

; solve for A, this will give you  $57.2^\circ$  or  $122.8^\circ$



$$\text{Let's try } 75.2^\circ: B = 180 - (57.2 + 29) = 93.8^\circ \quad \checkmark$$

$$\text{Let's try } 150^\circ: B = 180 - (122.8 + 29) = 28.2^\circ \quad \checkmark$$



Since there are two legitimate values for B, we will have two triangles. Use each B to find the rest of the missing pieces for the two triangles.

### Law of Cosines

$$a^2 = b^2 + c^2 - 2bc \cos(A)$$

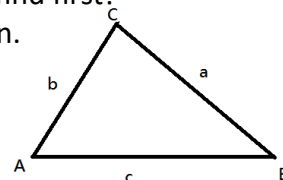
$$b^2 = a^2 + c^2 - 2ac \cos(B)$$

$$c^2 = a^2 + b^2 - 2ab \cos(C)$$

**When to Use:** when you know 2 sides and the angle between them or if you know all 3 sides.

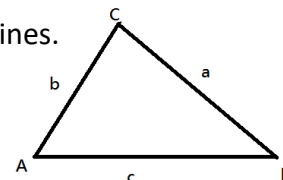
### Case 1: SSS

$a = 21.2$  ft.,  $b = 24.6$  ft. and  $c = 12$  ft. since you don't know any angle just pick 1 to find first! After you find one angle, you can switch back to law of sines or use the cosine again.



### Case 2: SAS

$C = 134^\circ$ ,  $a = 20$  and  $b = 8$ . Hint: find c first and then you can switch back to law of sines.



### Applications

1. A car travels east 1 hour at 40 mi/hr. the turns northeast and travels for 30 minutes longer. How far is it from its starting point?
2. A cell phone tower is supported by two guy wires (165 ft. and 180 ft.) on opposite sides. Each wire is attached to the top of the tower and anchored to the ground. The shorter wire makes an angle of  $67^\circ$  with the ground. How far apart are the anchor points?

Answers 1. 56 miles, 2. 55.5 ft