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Web Resources

www.mathwarehouse.com/law-of-sines

 [ambiguous case](#) - video Tutorial and practice problems

 [Law of Sines](#) -video Tutorial and practice problems

[Pictures of Law of Sines](#) (problem diagrams and formula)

[Law of Sines and Cosines Worksheets](#)

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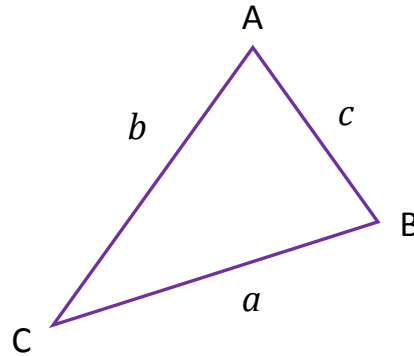
Law of Sines: Ambiguous Case

For any $\triangle ABC$:

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

or

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



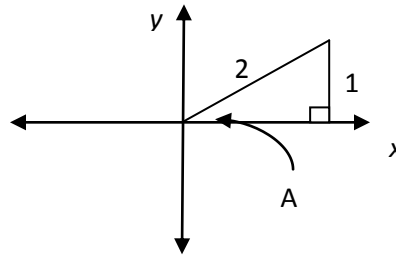
I. Model Problems

In the following example you will find the possible measures of an angle given the sine of the angle.

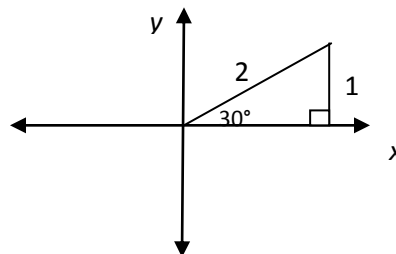
Example 1:

Find the $m\angle A$ if $\sin A = \frac{1}{2}$.

Shown in Quadrant I is angle A with a sine of $\frac{1}{2}$.



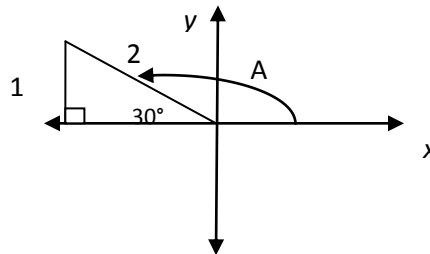
Finding the inverse,
 $m\angle A = 30^\circ$.



In Quadrant II is another angle A with a sine of $\frac{1}{2}$.

$$m\angle A = 180^\circ - 30^\circ$$

$$m\angle A = 150^\circ$$



Therefore if $\sin A = \frac{1}{2}$, then

$$m\angle A = 30^\circ \text{ or } 150^\circ.$$

In the following example you will find all the possible measures of an angle of a triangle using Law of Sines.

Example 2:

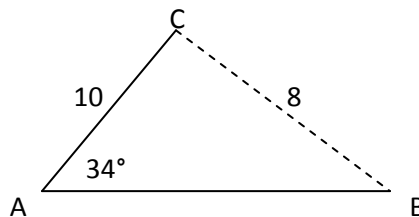
For $\triangle ABC$, $a = 8$, $b = 10$, and $m\angle A = 34^\circ$. Find all the possible $m\angle B$ to the nearest whole degree

Write down known.

$$a = 8, b = 10, m\angle A = 34^\circ$$

Draw and label a figure.

Drawn is one possible triangle (in this case an acute triangle). There may be more than one possible triangle.



Law of Sines

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

Substitute.

$$\frac{\sin B}{10} = \frac{\sin 34^\circ}{8}$$

Isolate $\sin B$.

$$\sin B = \left(\frac{\sin 34^\circ}{8}\right)(10)$$

Find the inverse.

$$\sin B = \frac{10}{8}(\sin 34^\circ)$$

Round to the nearest whole degree.

$$m\angle B \approx 44^\circ$$

Find $m\angle B$ in Quadrant II

$$m\angle B \approx 180^\circ - 44^\circ$$

$$m\angle B \approx 136^\circ$$

Check to see if 136° is a possible angle measurement for the triangle using the sum of the angles of a triangle.

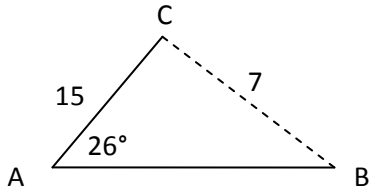
$$m\angle A + m\angle B < 180^\circ?$$

$$44^\circ + 136^\circ < 180^\circ?$$

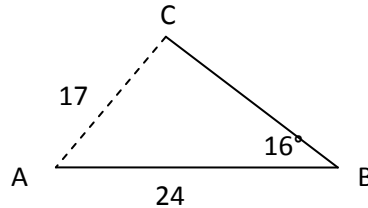
$$170^\circ < 180^\circ \quad \checkmark$$

II. Practice Problems

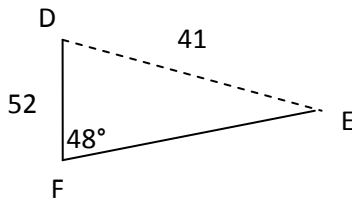
1. For $\triangle ABC$,
 $a = 7, b = 15$, and $m\angle A = 26^\circ$. Find all possible $m\angle B$ to the nearest degree.



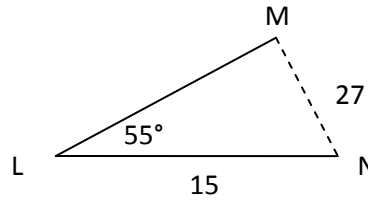
2. For $\triangle ABC$,
 $b = 17, c = 24$, and $m\angle B = 16^\circ$. Find all possible $m\angle C$ to the nearest degree.



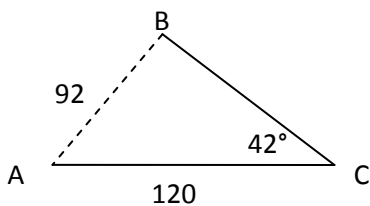
3. For $\triangle DEF$,
 $e = 52, f = 41$, and $m\angle F = 48^\circ$. Find all possible $m\angle E$ to the nearest degree.



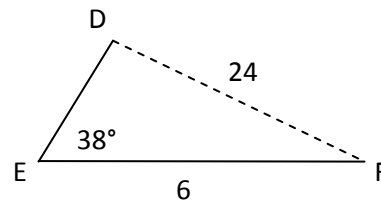
4. For $\triangle LMN$,
 $l = 27, m = 15$, and $m\angle L = 55^\circ$. Find all possible $m\angle M$ to the nearest degree.



5. For $\triangle ABC$,
 $b = 120, c = 92$, and $m\angle C = 42^\circ$. How many triangles can be formed?



6. For $\triangle DEF$,
 $d = 6, e = 24$, and $m\angle E = 38^\circ$. How many Triangles can be formed?

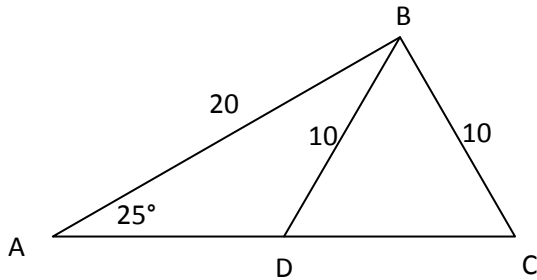


III. Practice (harder) & word problems

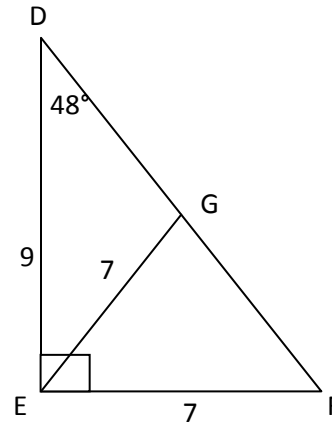
7. For $\triangle ABC$,
 $a = 62$, $b = 53$, and $m\angle A = 54^\circ$. Find all possible $m\angle A$ to the nearest degree.
8. For $\triangle LMN$,
 $m = 8$, $n = 11$, and $m\angle M = 6^\circ$. Find all possible $m\angle N$ to the nearest degree.
9. For $\triangle XYZ$, $y = 7$, $z = 5$, and $m\angle Y = 19^\circ$. Find all possible $m\angle Z$ to the nearest degree.
10. For $\triangle ABC$,
 $a = 40$, $c = 49$, and $m\angle C = 32^\circ$. Find all possible $m\angle A$ to the nearest degree.
11. For $\triangle DEF$,
 $e = 12$, $f = 21$, and $m\angle E = 25^\circ$. Find all possible $m\angle F$ to the nearest degree.
12. For $\triangle LMN$,
 $l = 30$, $m = 24$, and $m\angle M = 40^\circ$. Find all possible $m\angle L$ to the nearest degree.
13. A triangle has two sides with lengths of 20 and 15. The measure of the angle opposite the side with a length of 15 is 35° . Find all the possible measures of the angle opposite the side with a length of 20 to the nearest degree.
14. A triangle has two sides with lengths of 45 and 44. The measure of the angle opposite the side with a length of 44 is 62° . Find all the possible measures of the angle opposite the side with a length of 45 to the nearest degree.
15. A triangle has two sides with lengths of 63 and 75. The measure of the angle opposite the side with a length of 75 is 22° . Find all the possible measures of the angle opposite the side with a length of 63 to the nearest degree.
16. A triangle has two sides with lengths of 42 and 37. The measure of the angle opposite the latter is 20° . Find all the possible measures of the angle opposite the side with a length of 42 to the nearest degree.
17. A triangle has two sides with lengths of 15 and 9. The measure of the angle opposite the latter is 34° . How many triangles can be formed?
18. A triangle has two sides with lengths of 17 and 19. The measure of the angle opposite the latter is 5° . How many triangles can be formed?.

IV. Challenge Problems

19. For the figure below find $m\angle ADB$ and $m\angle C$ to the nearest whole degree, given $m\angle ADB > m\angle C$.



20. For the figure below find $m\angle DGE$ and $m\angle F$ to the nearest whole degree, given $m\angle DGE > m\angle F$.



21. Line segment AB has a length of 15 and $m\angle A = 35^\circ$. A segment with a length of 12 will form the third side of the triangle. What are the possible measures of the angle opposite side AB?
22. For $\triangle ABC$, $a = 6$, $b = 10$, and $m\angle A = 42^\circ$, how many triangles can be formed?
23. For $\triangle DEF$, $e = 27$, $f = 12$, and $m\angle F = 37^\circ$. Find all possible $m\angle E$ to the nearest degree.
24. For $\triangle ABC$, $a = 15$, $b = 11$, and $m\angle B = 36^\circ$. Find all possible $m\angle C$ to the nearest degree.
25. For $\triangle DEF$, $d = 25$, $e = 30$, and $m\angle D = 40^\circ$. Find all possible measurements of f to the nearest whole number.

V. Answer Key

1. $m\angle B \approx 70^\circ$ or 110°
2. $m\angle C \approx 22^\circ$ or 158°
3. $m\angle E \approx 70^\circ$ or 110°
4. $m\angle M \approx 27^\circ$
5. Two triangles ($m\angle B \approx 61^\circ$ or 119°)
6. One Triangle ($m\angle D \approx 9^\circ$)
7. $m\angle A \approx 71^\circ$ or 109°
8. $m\angle N \approx 8^\circ$ or 172°
9. $m\angle Z \approx 13^\circ$
10. $m\angle A \approx 26^\circ$
11. $m\angle F \approx 48^\circ$ or 132°
12. $m\angle L \approx 53^\circ$ or 127°
13. $\approx 50^\circ$ or 130°
14. $\approx 65^\circ$ or 115°
15. $\approx 18^\circ$
16. $\approx 23^\circ$ or 157°
17. Two triangles ($\approx 69^\circ$ or 111°)
18. One Triangle ($\approx 4^\circ$)
19. $m\angle ADB \approx 122^\circ$, $m\angle C \approx 58^\circ$
20. $m\angle DGE \approx 107^\circ$, $m\angle F \approx 73^\circ$
21. $\approx 134^\circ$
22. none, b is too short (if a is less than $b \sin A$ no triangle is formed- a is too short)
23. there is no possible $\angle E$ that will form a triangle with the given dimensions
24. $m\angle C \approx 17^\circ$ or 91°
25. $f \approx 7$ or 39