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The Law of Sines and the Ambiguous Case - Part 1

Thus far in this course, when the given information for a triangle was two sides and an opposite angle (SSA), using the law of sines yielded the missing measures. However, such is not always the case because two sides and an angle do not geometrically define a single triangle as do combinations like SSS.

SSA information can define 0, 1, or even 2 triangles. Therefore, it is called the ambiguous case.

Figure 1 illustrates five possibilities when given an acute angle A , and sides a and b .

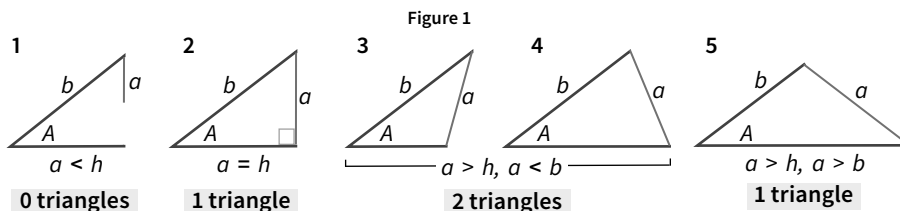
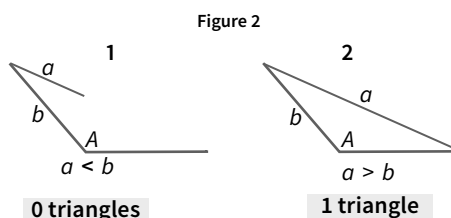


Figure 2 illustrates two possibilities when the given angle A is obtuse.



In each situation, the number of triangles possible for the SSA data depends on the relationship of side a to the height of the triangle and side b , as summarized in this chart.

To determine how many triangles are possible for a given set of SSA data, find the height of the triangle using $\sin A = \frac{h}{b}$ and compare the length of a to the lengths of h and b . (Note that finding the height is not necessary if $a > b$ or if angle A is obtuse.)

Acute angle A

$a > b$ 1 triangle
 $a < b, a < h$ 0 triangles
 $a > b, a = h$ 1 triangle
 $a < b, a > h$ 2 triangles

Obtuse angle A

$a < b$ 0 triangles
 $a > b$ 1 triangle

Example 1 Determine how many triangles exist for each set of data.

1. Angle $A = 45$, $b = 12$, $a = 14$

Because $a > b$, it is not necessary to calculate the height of the triangle. This data corresponds to triangle 5 in figure 1; one triangle is possible with this data.

2. Angle $A = 25$, $b = 15$, $a = 8$

Angle A is not obtuse, nor is $a > b$, so calculate the height of the triangle with $\sin A = \frac{h}{b}$.

$$\sin 25 = \frac{h}{15}$$

$$h \approx 6.3$$

Now compare the lengths of a , b , and h : $a > h$ and $a < b$ which corresponds to triangles 3 and 4 in figure 1; two triangles are possible with this data.

3. Angle $A = 130$, $b = 21$, $a = 20$

Angle A is obtuse, so calculating the height is unnecessary. Because $a < b$, no triangle can be formed (corresponds to triangle 1 in figure 2).

Today's Lesson

Use the given data to determine how many triangles exist.

1. $A = 58^\circ$, $b = 10$, $a = 9$

2. $A = 127^\circ$, $b = 32$, $a = 24$

3. $A = 145^\circ$, $b = 13$, $a = 27$

4. $A = 37^\circ$, $b = 14$, $a = 12.5$

5. $A = 112^\circ$, $b = 27$, $a = 25$

6. $A = 48^\circ$, $b = 8$, $a = 16$

REVIEW

Solve the equations. 9.14

7. $2^{2x} = 11$

8. $3^{x-2} = 4$

Find the answers. 9.13

9. When rolling two die at one time, what is the probability of rolling the following:

a. A: a sum which is an odd number, or B: a multiple of 3?

b. A: a 7, or B: a prime number?

c. A: a sum which is less than 7, or B: a prime number?

Solve the equations. 9.11

10. $27^x = 9^{x-1}$

11. $\left(\frac{1}{2}\right)^{x+1} = \left(\frac{1}{4}\right)^{2x}$

With the given vertex and focus, provide the p -value and write an equation for each horizontal parabola. 8.11

12. vertex = $(-3, 0)$ focus = $(-4, 0)$

13. vertex = $(5, 1)$ focus = $(2, 1)$

State whether the function is increasing or decreasing. Then graph. 8.6

14. $y = 2^{x-2} + 5$

Use the Gauss-Jordan method to solve the systems. 8.1

15.
$$\begin{cases} 2x - 3y = -4 \\ 4x + y = 6 \end{cases}$$

16.
$$\begin{cases} 2x - y = -14 \\ x + 4y = 2 \end{cases}$$

17.
$$\begin{cases} x + y + 5z = -2 \\ x + 2y + 7z = -4 \\ x + y + 4z = -1 \end{cases}$$

Find the answer. 7.6

18. During the month of July the Valley Electric Company charges an extra \$0.01 per kw/hr. more than their usual rate of \$0.08 per kw/hr. due to increased demand during this time. What would a customer's electric bill be if they used 363 kWh. during the month of July and were also charged a service fee of \$10.50?

Change the given equations for a circle to standard form. Then determine the center and radius of the circle. 6.12

19. $x^2 + 4x + y^2 = 4$

20. $x^2 - 2x - 4y + y^2 = 0$

Extra Practice

Use the given data to determine how many triangles exist.

21. $A = 30^\circ, b = 16, a = 8$

22. $A = 43^\circ, b = 10, a = 5$

23. $A = 25^\circ, b = 14, a = 8$