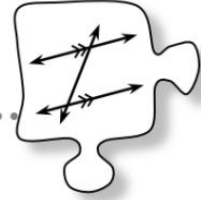


# 9.1.2 How can I find a missing angle?



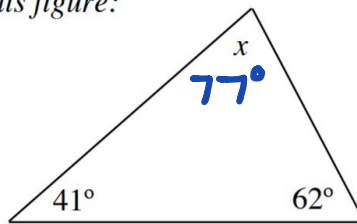
## Finding Unknown Angles in Triangles

In today's lesson, you will be challenged again to use what you do know to determine information that you did not previously know, in order to solve problems with variables. You will do an investigation to learn a new geometric relationship for triangles.

**9-14.** Quigley was excited about what he had learned about angles. He went home, grabbed his older brother's math book, and tried to find some problems that he could do with angles. He came across the following problem that he wanted to solve.

*Solve for  $x$  in this figure:*

$$\begin{array}{r}
 41 + 62 + x = 180 \\
 103 + x = 180 \\
 \underline{-103 \quad -103} \\
 x = 77
 \end{array}$$



a. Using what you have learned about angles, can you find the measure of the angle? Why or why not?

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b. Estimate the measure of the angle. \_\_\_\_\_

**9-15. TANGLED TRIANGLES** Your teacher will give your team a copy of the Lesson 9.1.2 Resource Page. Cut out the three copies of the triangle. Your Task: Determine the measure of the missing angle without using a protractor. As you work with your team, the following questions might help guide your discussion.

*What do we know about angles?*

*Can we combine the unknown angle with any other angles to create a new angle that we do know?*

**9-16.** Be prepared to contribute what your team has discovered to a whole-class discussion. Your teacher will use a technology tool to show what each team has discovered for their triangle. Keep track of what each team has found to see if you can find a relationship that would allow you to find a missing angle in any triangle.



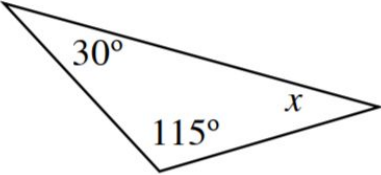
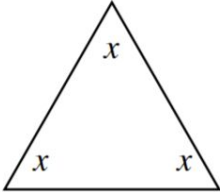

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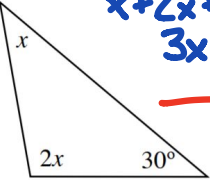
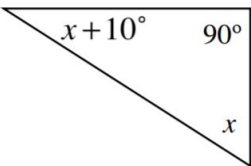
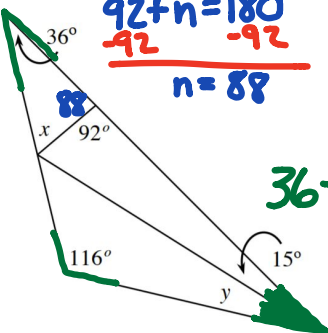
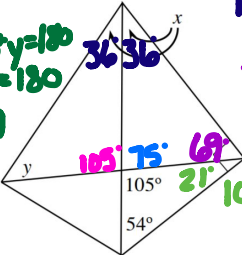
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9-17. Now use what you have discovered about the angles in a triangle to find the answer to the problem that Quigley was trying to solve in problem 9-14. How close was your estimate?

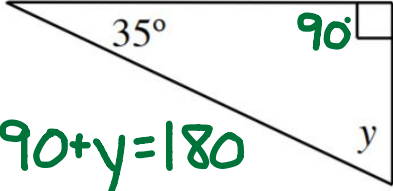
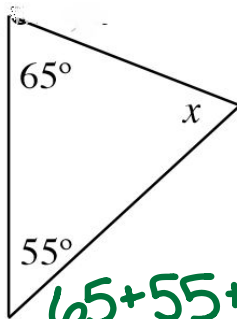
9-18. Use what you have learned about triangles and angles to write an equation that represents each situation. Then find each of the missing angle(s) in the triangles below.

<p>a.</p>  $145 + x = 180$ <p>Equation: <u><math>30 + 115 + x = 180</math></u></p> <p>Solution: <u>35</u></p>	<p>b.</p>  $3x = 180$ <p>Equation: <u><math>x + x + x = 180</math></u></p> <p>Solution: <u>60</u></p>
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9-19. **Additional Challenge:** Use what you know about triangles and angle relationships to find the missing angles in the triangles below.

<p>a.</p>  $\begin{aligned} x + 2x + 30 &= 180 \\ 3x + 30 &= 180 \\ -30 &-30 \\ \hline 3x &= 150 \\ \frac{3x}{3} &= \frac{150}{3} \\ x &= 50 \end{aligned}$ <p>x = <u>50</u></p>	<p>b.</p>  $\begin{aligned} x + x + 10 + 90 &= 180 \\ 2x + 100 &= 180 \\ -100 &-100 \\ \hline 2x &= 80 \\ \frac{2x}{2} &= \frac{80}{2} \\ x &= 40 \end{aligned}$ <p>x = <u>40</u></p>
<p>c.</p>  $\begin{aligned} 92 + n &= 180 \\ -92 &-92 \\ \hline n &= 88 \end{aligned}$ $\begin{aligned} 88 + 36 + x &= 180 \\ 124 + x &= 180 \\ -124 &-124 \\ \hline x &= 56 \end{aligned}$ $\begin{aligned} 36 + 116 + 15 + y &= 180 \\ 167 + y &= 180 \\ -167 &-167 \\ \hline y &= 13 \end{aligned}$ <p>x = <u>56</u></p> <p>y = <u>13</u></p>	<p>d.</p>  $\begin{aligned} 75 + 69 + x &= 180 \\ 144 + x &= 180 \\ x &= 36 \end{aligned}$ $\begin{aligned} 105 + 36 + y &= 180 \\ 141 + y &= 180 \\ -141 &-141 \\ \hline y &= 39 \end{aligned}$ $\begin{aligned} 21 + n &= 90 \\ n &= 69 \end{aligned}$ $\begin{aligned} 105 + 54 + m &= 180 \\ 159 + m &= 180 \\ m &= 21 \end{aligned}$ $\begin{aligned} 105 + r &= 180 \\ r &= 75 \end{aligned}$ <p>x = <u>36</u></p> <p>y = <u>39</u></p>

9-21. Find the measure of the missing angle in each triangle below and then classify the triangle as acute, right, or obtuse.

<p>a.</p>  <p> <math>35 + 90 + y = 180</math>  <math>125 + y = 180</math>  <math>y = 55</math> </p> <p>y = <u>55°</u></p> <p>Type of Triangle: <u>right</u></p>	<p>b.</p>  <p> <math>65 + 55 + x = 180</math>  <math>120 + x = 180</math>  <math>x = 60</math> </p> <p>x = <u>60°</u></p> <p>Type of Triangle: <u>acute</u></p>
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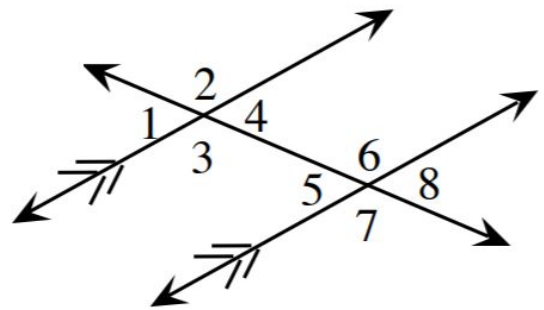
9-22. Find the measures of the angles requested and explain how you found them. Each part is a separate problem.

a. If  $m\angle 4 = 61^\circ$ , find  $m\angle 6$ .

$61 + x = 180$   
 $x = 119^\circ$

b. If  $m\angle 1 = 48^\circ$ , find  $m\angle 8$ .

$48^\circ$



c. If  $m\angle 2 = 137^\circ$ , find  $m\angle 8$ .

$137 + x = 180$   
 $x = 43^\circ$

## LESSON SUMMARY



### MATH NOTES

## METHODS AND MEANINGS

### Angle Sum Theorem for Triangles

The measures of the angles in a triangle add up to  $180^\circ$ . For example, in  $\triangle ABC$  at right,  $m\angle A + m\angle B + m\angle C = 180^\circ$ .

You can verify this statement by carefully drawing a triangle with a ruler, tearing off two of the angles ( $\angle A$  and  $\angle B$ ), and placing them side by side with the third angle ( $\angle C$ ) on a straight line. The sum of the three angles is the same as the straight angle (line), that is,  $180^\circ$ .

