

Math: Grade 8, Lesson 5, Expression & Equations

Lesson Objective: Students will write and solve linear equations with a focus on using relationships between angle measures.

Lesson Focus: Writing and Solving Linear Equations

Practice Focus: Writing and Solving Linear Equations connected to angle measures.

TN Standard: 8.EE.C.7

Key Vocabulary:

- Angle relationships & Triangle Definitions
 - Supplementary Angles (sum = 180°)
 - Complementary Angles (sum = 90°)
 - Alternate Interior Angles
 - Vertical Angles
 - Same Side Interior Angles
 - Right Triangle (one angle measures 90°)
 - Isosceles Triangle (two angles have congruent measures)
- Congruence
- Triangle Angle Sum Theorem which says that the sum of three angles in a triangle is equal to 180 degrees.

Teacher Video Materials:

- Whiteboard & Markers

Student Materials:

- Paper and writing utensil or other notetaking device
- Student packet for math, grade 8 lesson 5, which can be found at www.tn.gov/education
- No calculator required but could be used to double check calculations as you solve the equations.

Teacher Do	Student Do
<p><u>Opening</u> Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 8th graders out there, though all children are welcome to tune in. This lesson is the fifth in our series.</p> <p>My name is ____ and I'm an ____ grade teacher in Tennessee schools! I'm so excited to be your teacher for this lesson! Welcome to my virtual classroom!</p> <p>Today we will be continuing our learning about equations in our lesson today, you will need:</p> <ul style="list-style-type: none"> • Paper and a writing utensil or another notetaking device • Student packet for math, grade 8 lesson 5, which can be found at www.tn.gov/education • No calculator required today, but you could have one available to check on your arithmetic as you solve the equations. • <p>If you didn't see our previous lesson, you can find it on www.tn.gov/education. You can still tune in to today's lesson if you haven't seen any of our other, but it might be more fun</p>	<p>Student get materials ready for the lesson.</p>

<p>if you first go back and watch our other lessons since we'll be talking about things we learned previously.</p> <p>Ok, let's begin!</p>	
<p>Intro</p> <p>Today, we are going to start working on applying your knowledge of geometry to writing and solving linear equations. You might want to draw diagrams to help represent the situations presented the problems today.</p> <p>Here are some key things to remember from geometry:</p> <ul style="list-style-type: none"> • Angle relationships & Triangle Definitions <ul style="list-style-type: none"> ○ Supplementary Angles (sum = 180°) ○ Complementary Angles (sum = 90°) ○ Alternate Interior Angles ○ Vertical Angles ○ Same Side Interior Angles ○ Right Triangle (one angle measures 90°) ○ Isosceles Triangle (two angles have congruent measures) • Congruence • Triangle Angle Sum Theorem which says that the sum of three angles in a triangle is equal to 180 degrees. 	<p>Students think about and recall geometry relationships mentioned.</p>
<p>Teacher Model (5 examples)</p> <p>Let's solve the following problem together. (Example 1) Don't forget to draw diagrams to help represent the situations. (teacher write or show the example)</p> <p>Example 1</p> <p>One angle is five degrees less than three times the measure of another angle. Together, the angle measures have a sum of 143°. What is the measure of each angle?</p> <p>(Teacher should draw a diagram of two angles with one angle much larger than the other.)</p> <p>Now that we have our diagram, let's explore some questions.</p> <ul style="list-style-type: none"> • What do we need to do first to solve this problem? <ul style="list-style-type: none"> • <i>First, we need to define our variable (symbol). Let x be the measure of the first angle in degrees.</i> • If x is the measure of the first angle, how do you represent the measure of the second angle? <ul style="list-style-type: none"> • <i>The second angle is $3x - 5$.</i> • What is the equation that represents this situation? <ul style="list-style-type: none"> • <i>The equation is $x + 3x - 5 = 143$.</i> 	<p>Students follow along writing their ideas on their own paper or notetaking device during the examples.</p> <p>Students may copy or just watch and think about the responses.</p>

<p> <ul style="list-style-type: none"> The equation that represents this situation is $x + 3x - 5 = 143$. Solve for x, and then determine the measure of each angle. <p>There are some pathways to solving this linear equation, but this is one way: (Teacher writes each line of the solution pathway talking through the mathematics.)</p> <p> $x + 3x - 5 = 143$ (Equation that represents the situation.) $4x - 5 = 143$ (Combine like terms x and $3x$.) $4x - 5 + 5 = 143 + 5$ (Combine like terms across the equal sign by zero sum pairs.) $4x = 148$ (Arithmetic and then divide both sides by the coefficient of x.) $x = 37$ (Solution.) </p> <p>So, the measure of x (the first angle) is 37°. Then substitute in 37 for the measure of the second angle. The second angle is $3(37^\circ) - 5 = 111 - 5 = 106^\circ$.</p> <p>Let's look at a second example (Example 2): [Teacher writes or shows.]</p> <p>Example 2 Given a right triangle, find the degree measure of the angles if one angle is ten degrees more than four times the degree measure of the other angle and the third angle is a right angle.</p> <p>(Teacher should draw a diagram of a right triangle with one leg longer than the other.)</p> <p>Now that we have our diagram, let's explore some questions. What do we need to do first to solve this problem? (Pause.)</p> <ul style="list-style-type: none"> <i>First, we need to define our variable (symbol). Let x be the measure of the first angle in degrees.</i> <p>If x is the measure of the first angle, how do you represent the measure of the second angle? (Pause.)</p> <ul style="list-style-type: none"> <i>The second angle is $4x + 10$.</i> <p>What is the equation that represents this situation? Since we have a right triangle, we already know that one angle is 90 degrees, which means the sum of the other two angles is 90. (Pause.)</p> <ul style="list-style-type: none"> <i>The equation is $x + 4x + 10 = 90$</i> The equation that represents this situation is $x + 4x + 10 = 90$. Solve for x, and then determine the measure of each angle. <p>There are some pathways to solving this linear equation, but this is one way: (Teacher writes each line of the solution pathway, talking through the mathematics.)</p> <p>$x + 4x + 10 = 90$ (Equation that represents the situation.)</p> </p>	<p>Students answer.</p> <p>Students answer.</p> <p>Students answer.</p>
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<p> $5x + 10 = 90$ (Combine like terms x and $4x$.) $5x + 10 - 10 = 90 - 10$ (Combine like terms across the equal sign by zero sum pairs.) $5x = 80$ (arithmetic and then divide both sides by the coefficient of x) $x = 16$ (solution) </p> <p> The measure of the first angle is 16°. The measure of the second angle is $4(16) + 10 = 64 + 10 = 74$ degrees. The measure of the third angle is 90° because this is a right triangle. </p>	
<p><u>Guided Practice</u></p> <p>Now, you try these. Don't forget to define the variable first and to draw a diagram to help you visualize the situation! (Teacher writes or shows the problem.)</p> <p>Practice 1: A pair of congruent angles are described as follows: The degree measure of one angle is three more than twice a number, and the other angle's degree measure is 54.5 less than three times the number. Determine the measure of the angles in degrees.</p> <p>I'll give you some time to work. You can also pause the video. (Pause.)</p> <p>Are you ready to check? Let's see how you did. (Teacher writes or shows the solution.)</p> <p><u>Solution:</u> Let x be the number. The measure of one angle is $3 + 2x$, and the measure of the other angle is $3x - 54.5$. Because the angles are congruent, their measures are equal. This is one way to solve the linear equation.</p> <p> $3 + 2x = 3x - 54.5$ $3 + 2x - 2x = 3x - 2x - 54.5$ $3 = x - 54.5$ $3 + 54.5 = x - 54.5 + 54.5$ $57.5 = x$ </p> <p>So, the first angle is $3 + 2(57.5) = 3 + 115 = 118^\circ$ The second angle has the same measure because they are congruent angles.</p> <p>How did you do? Let's try another example. Pause the video while you work on it.</p> <p>Practice 2: A triangle has angles described as follows: The measure of the first angle is four more than seven times a number, the measure of the second angle is four less than the first, and the measure of the third angle is twice as large as the first. What is the measure of each angle in degrees?</p>	<p>Students should solve each practice problem and then check work against teacher responses.</p>

<p>I'll give you some time to work. You can also pause the video. (Pause.) Are you ready to check? Let's see how you did. (Teacher writes or shows the solution.)</p> <p>Solution: Draw a triangle and label each angle with its expression. Let x be the number. The measure of the first angle is $7x + 4$. The measure of the second angle is $7x + 4 - 4$ or $7x$. The measure of the third angle is $2(7x + 4)$ or $14x + 8$. The sum of the interior measures of a triangle is 180 degrees.</p> $7x + 4 + 7x + 14x + 8 = 180$ $28x + 12 = 180$ $28x + 12 - 12 = 180 - 12$ $28x = 168$ $x = 6$ <p>The measure of the first angle is $7(6) + 4 = 46^\circ$ The measure of the second angle is $7(6) = 42^\circ$ The measure of the third angle is $14(6) + 8 = 92^\circ$ (Pause.)</p> <p>How did you do? Great!</p>	<p>Students set up and solve the equation.</p> <p>Students should solve each practice problem and then check work against teacher responses.</p>
<p><u>Independent Practice</u> Now, let's recap some of the highlights from our lesson.</p> <ul style="list-style-type: none"> • We know that an algebraic method for solving equations is more efficient than guessing and checking. • We know how to write and solve equations that relate to angles, triangles, and geometry, in general. • We know that drawing a diagram can sometimes make it easier to understand a problem and that there is more than one way to solve an equation. <p>Try these two problems as your Exit Ticket for Today's Lesson. I'll give you some time to work or you can pause the video. (teacher write or show both problems and pause)</p> <p>For each of the following problems, write an equation and solve.</p> <ol style="list-style-type: none"> 1. Given a right triangle, find the measures of all the angles, in degrees, if one angle is a right angle and the measure of the second angle is six less than seven times the measure of the third angle. 	<p>Students write or listen to the closing points.</p> <p>Students complete Exit Ticket</p> <p>Students should solve each practice problem and then check work against teacher responses.</p>

<p>2. In a triangle, the measure of the first angle is six times a number. The measure of the second angle is nine less than the first angle. The measure of the third angle is three times the number more than the measure of the first angle. Determine the measure of each angle in degrees.</p> <p>(Pause.)</p> <p>Here are the answers! (Teacher writes or shows both.)</p> <p>Problem 1: Let x be the number. First angle measure = 90° Second angle measure = $7x - 6$ Third angle measure = x</p> $90 + 7x - 6 + x = 180$ $8x + 84 = 180$ $8x + 84 - 84 = 180 - 84$ $8x = 96$ $x = 12$ <p>First angle measure = 90° Second angle measure = $7(12) - 6 = 78^\circ$ Third angle measure = 12°</p> <p>Problem 2: Let x be the number. First angle measure = $6x$ Second angle measure = $6x - 9$ Third angle measure = $3x + 6x$</p> $6x + 6x - 9 + 3x + 6x = 180$ $21x - 9 = 180$ $21x - 9 + 9 = 180 + 9$ $21x = 189$ $x = 9$ <p>First angle measure = $6(9) = 54^\circ$ Second angle measure = $6(9) - 9 = 54 - 9 = 45^\circ$ Third angle measure = $3(9) + 6(9) = 27 + 54 = 81^\circ$</p> <p>You can now complete the Problem Set for Math: Grade 8 Lesson 5 if you want some additional practice.</p>	<p>Students should solve each practice problem and then check work against teacher responses.</p> <p>Students should solve each practice problem and then check work against teacher responses.</p>
<p><u>Closing:</u></p> <ul style="list-style-type: none"> • I enjoyed doing some mathematics with you today! Thank you for inviting me into your home. I look forward to seeing you in our next lesson in Tennessee's At Home Learning Series! • Bye! 	

PBS Lesson Series

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