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Lesson 7: Solve Lineal Equations with One Variable

OBJECTIVES: SWBA to

Solve linear equations with rational numbers coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. **(8. EE.7)**

INTRODUCTION

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We use lineal equations frequently in our lives. We observe and look for patterns in nature, school, work patterns and make generalizations to explain certain behaviors. For instance,

1. In Chemistry--when combining elements and find prices (of the mixture) or percentages (of, say, acid or salt).
2. In manufacturing when involving two or more people or things working together to complete a task, and finding how long they took
3. In computer programming to write computer codes
4. Entertainment and social events—to determine how of a product you can buy with certain amount of money
5. Forensic scientists use expressions to estimate length of bones, time of death, etc.

MINI-LESSON + Vocabulary (I DO):

Variable (description): A *variable* is a symbol (such as a letter) that represents a number, i.e., it is a placeholder for a number.

Equivalent Expressions: Two expressions are *equivalent* if both expressions evaluate to the same number for every substitution of

Term (description): Each summand of an expression in expanded form is called a *term.* For example, the expression $2x + 3x + 5$ consists of 3 terms: $2x$, $3x$, and 5.

Coefficient of the Term (description): The number found by multiplying just the numbers in a term together. For example, given the product $2 \cdot x \cdot 4$, its equivalent term is $8x$. The number 8 is called the coefficient of the term $8x$.

"To solve" an equation means to find the value of the variable that makes the equation true.

For the next two weeks, I am going to use the properties of operations (commutative, associative, and distributive properties) and regrouping of like terms to solve algebraic equations.

How do I solve an Equation that involves the distributive property?

Follow these steps:

1. Start with the given equation and determine whether you have to use the distributive property.

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2. If applicable, apply the distributive property. If the equation looks like ***a(x + b) = c***, where **a**, ***b***, and ***c*** are integers and ***x*** is a variable, you use the distributive property.

3. If applicable, combine like-terms. That is terms that have the same variable and exponent. For instance, 2x and x and $3x^2$ and x^2 are like terms. Constants are also like terms. For instance, 3 and 5 are like terms. If the equation looks like ***a(x + b) + c = d***, where **a**, ***b***, ***c***, and **d** are integers and ***x*** is a variable, you use the distributive property and must combine like-terms. You also combine like terms if the equation looks like this: **ax +b + c =d**.

4. Decide whether the equation is a one-step or a two-step equation. A one-step equation requires that you use inverse operation **once** because the equation involves one single operation (one-step). A two-step equation requires that you use inverse operations **twice** because the equation involves two operations (two-steps).

5. Use inverse operations to isolate the variable. In math isolating the variable means to remove all constants and signs from the side of the **equal sign** (=) that the variable is on. To accomplish this, moving from left to right, you **subtract** to undo addition or you **add** to undo subtraction. Next, if necessary, you **divide** to undo multiplication or you **multiply** to undo division.
6. Check your answer by substituting the value of the variable into the original equation. The equation should be true.

Let me model these steps for you!

Solve ***4(s + 5) + 10 = 70***.

Step	***What***	***why***
1	4(s + 5) +10= 70	**Original equation**. This equation involves the **distributive property** because of the parentheses.
2	4•s + 4•5 + 10= 70 4s + 20 + 10 = 70	***Apply the distributive property***. Distribute 4 over (s+5).
3	4s + 30 = 70	**Combine like-terms**. 20 and 10 are like-terms. Therefore, they can be added together to get 30.
4	4s + 30 = 70	This is a **two-step equation** because the equation involves multiplication, 4•s, and addition--plus 30.
3	4s +30 = 70 -30 -30 4s = 40	Use inverse operations to isolate the variable. In this example, subtract 30 from both sides of the equation to undo the addition of 30.
4	$\frac{4s}{4} = \frac{40}{4}$	Use inverse operations again to solve for s. This time, divide both sides of the equation by the coefficient of the variable, 4.
5	s = 10	*Solution*

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Check your answer:

4(s + 5) + 10 = 70 is the original equation.

4(10 +5) + 10 =70; Now that we know the value of the variable, we can use order of operations to simplify the equation. We don't to use the distributive property.

4(15) + 10 =70

60 + 10 = 70

70 =70

Initial Summary:

First check if you need to use the distributive property. Usually the presence of () indicates that the distributive property has to be applied. Second, combine line terms if they are on the same side of the equation. Third, regroup like terms if they are on different sides of the equation by using inverse operations; the general the idea is to isolate the variable on one side of the equation and get everything else to the other side of the equation by getting all terms with the variable together on one side of the equation and all non-variable terms on the other side. Fourth, once we have the equation written in a single variable term on one side and a constant on the other, use inverse operation to either divide or multiply both sides of the equation by the coefficient of the variable.

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Guide Practice (We do):

Solve $2x+13=5x-(x+4)$

Steps	What	Why
1	$2x+13=5x-(x+4)$	Original equation.
2	$2x+13=5x-1(x+4)$ $2x+13=5x-x-4$	Used the distributive property to "break open" the grouping symbols or ( ), so that we can get at the terms inside. Notice that we need to distribute the – sign or -1 outside the ( ).
3	$2x+13=4x-4$	Combine like terms on the right side of the equation after applying the distributive property.
4	$2x+13=4x-4$ +4 +4 2x + 17 = 4x	Since we have like terms in opposite sides of the equation, we need to regroup these like terms. To accomplish this we use inverse operations. First let's regroup the constants or numbers. To decide which number/constant we have to "move" identify which of the constants has the smallest value and "move" that one to the other side. In this case, -4 is smaller than +13, so we move -4. The inverse of -4 is +4. We add +4 on both sides of the equation and combine the terms. Ensure to vertically align like terms.
5	2x + 17 = 4x -2x -2x 17 = 2x	Now, regroup the terms with variable. We want the 9 to be by itself, so we use inverse operations again to move the 2x. The inverse of +2x is -2x. Therefore, we subtract -2x on both sides of the equation and combine the like terms.
6	$17=2x$ $\frac{17}{2}=\frac{2x}{2}$	We want the value of 1x not 2x. Therefore, we, again, use inverse operations to find the value of 1x or x. 2x means 2 times x. The inverse operation of multiplication is division. Thus, to find the value of 1x we divide both sides of the equation by 2.
7	$\frac{17}{2}=x$ Or $x=\frac{17}{2}$	Solution

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Independent Practice (You Do):

Problem 1:

Solve for n: $2(n+9)=6n.$

Use the what-why table below to help guide your work. You might not need 7 steps.

Steps	***What***	***why***
1		
2		
3		
4		
5		
6		
7		

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Problem 2:

Solve for x:

$2(5x + 9) = 78.$

Use the what-why table below to help guide your work. You might not need 7 steps.

Steps	***What***	***why***
1		
2		
3		
4		
5		
6		
7		

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Problem 3:

Solve for d.

$3(d + 15) - 18d = 0.$

Problem 4:

Solve for x.

$3(2x + 5) + 2x = 7.$

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Problem 5:

Solve for x in the equation below.

$$4(x+2) + 2x = 3x + 3 + 11$$

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Final Summary

In a U-Shape:

1. Re-state the objective to assess if students learn it
2. Elicit from students what they have learned and what they want to learn more about.
3. Tie what they learn to the lesson, and upcoming lessons **(continue with solving equations)**