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Unit 4, Lesson 5: Solving Any Linear Equation

Let's solve linear equations.

5.1: Equation Talk

1. $5 - x = 8$

2. $-1 = x - 2$

3. $-3x = 9$

4. $-10 = -5x$

5.2: Trading Moves

Your teacher will give you 4 cards, each with an equation.

1. With your partner, select a card and choose who will take the first turn.

2. During your turn, decide what the next move to solve the equation should be, explain your choice to your partner, and then write it down once you both agree. Switch roles for the next move. This continues until the equation is solved.

3. Choose a second equation to solve in the same way, trading the card back and forth after each move.

4. For the last two equations, choose one each to solve and then trade with your partner when you finish to check one another's work.

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5.3: A Puzzling Puzzle

Tyler says he invented a number puzzle. He asks Clare to pick a number, and then asks her to do the following:

- Triple the number
- Subtract 7
- Double the result
- Subtract 22
- Divide by 6

Clare says she now has a -3. Tyler says her original number must have been a 3. How did Tyler know that? Explain or show your reasoning. Be prepared to share your reasoning with the class.

Lesson 5 Summary

When we have an equation in one variable, there are many different ways to solve it. We generally want to make moves that get us closer to an equation like

variable = some number

For example, $x = 5$ or $t = \frac{7}{3}$. Since there are many ways to do this, it helps to choose moves that leave fewer terms or factors. If we have an equation like

$$3t + 5 = 7,$$

adding -5 to each side will leave us with fewer terms. The equation then becomes

$$3t = 2.$$

Dividing each side of this equation by 3 will leave us with t by itself on the left and that

$$t = \frac{2}{3}.$$

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Or, if we have an equation like

$$4(5 - a) = 12,$$

dividing each side by 4 will leave us with fewer factors on the left,

$$5 - a = 3.$$

Some people use the following steps to solve a linear equation in one variable:

1. Use the distributive property so that all the expressions no longer have parentheses.
2. Collect like terms on each side of the equation.
3. Add or subtract an expression so that there is a variable on just one side.
4. Add or subtract an expression so that there is just a number on the other side.
5. Multiply or divide by a number so that you have an equation that looks like *variable = some number*.

For example, suppose we want to solve $9 - 2b + 6 = -3(b + 5) + 4b$.

$9 - 2b + 6 = -3b - 15 + 4b$	Use the distributive property
$15 - 2b = b - 15$	Gather like terms
$15 = 3b - 15$	Add $2b$ to each side
$30 = 3b$	Add 15 to each side
$10 = b$	Divide each side by 3

Following these steps will always work, although it may not be the most efficient method. From lots of experience, we learn when to use different approaches.

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1. Solve each of these equations. Explain or show your reasoning.

$2(x + 5) = 3x + 1$ $3y - 4 = 6 - 2y$ $3(n + 2) = 9(6 - n)$

2. Clare was solving an equation, but when she checked her answer she saw her solution was incorrect. She knows she made a mistake, but she can't find it. Where is Clare's mistake and what is the solution to the equation?

$$\begin{aligned} 12(5 + 2y) &= 4y - (5 - 9y) \\ 72 + 24y &= 4y - 5 - 9y \\ 72 + 24y &= -5y - 5 \\ 24y &= -5y - 77 \\ 29y &= -77 \\ y &= \frac{-77}{29} \end{aligned}$$

3. Solve each equation, and check your solution.

$\frac{1}{9}(2m - 16) = \frac{1}{3}(2m + 4)$ $-4(r + 2) = 4(2 - 2r)$ $12(5 + 2y) = 4y - (6 - 9y)$

4. Here is the graph of a linear equation.

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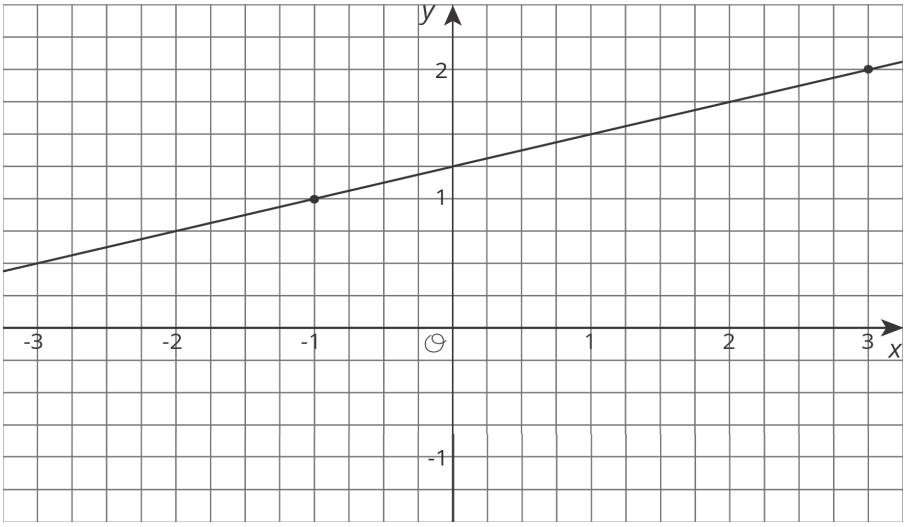

Select **all** true statements about the line and its equation.

A. One solution of the equation is $(3, 2)$.
B. One solution of the equation is $(-1, 1)$.
C. One solution of the equation is $\left(1, \frac{3}{2}\right)$.
D. There are 2 solutions.
E. There are infinitely many solutions.
F. The equation of the line is $y = \frac{1}{4}x + \frac{5}{4}$.
G. The equation of the line is $y = \frac{5}{4}x + \frac{1}{4}$.

(from Unit 3, Lesson 13)

5. A participant in a 21-mile walkathon walks at a steady rate of 3 miles per hour. He thinks, "The relationship between the number of miles left to walk and the number of hours I already walked can be represented by a line with slope -3." Do you agree with his claim? Explain your reasoning.

(from Unit 3, Lesson 9)