Unit 4, Lesson 4: More Balanced Moves

Let's rewrite some more equations while keeping the same solutions.

4.1: Different Equations?

Equation 1

$$x - 3 = 2 - 4x$$

Which of these have the same solution as Equation 1? Be prepared to explain your reasoning.

Equation A	Equation B	Equation C	Equation D
$2x - 6 = 4 - 8x$	$x - 5 = \text{-}4x$	$2(1 - 2x) = x - 3$	$\text{-}3 = 2 - 5x$

4.2: Step by Step by Step by Step

Here is an equation, and then all the steps Clare wrote to solve it:

$$14x - 2x + 3 = 3(5x + 9)$$
$$12x + 3 = 3(5x + 9)$$
$$3(4x + 1) = 3(5x + 9)$$
$$4x + 1 = 5x + 9$$
$$1 = x + 9$$
$$\text{-}8 = x$$

Here is the same equation, and the steps Lin wrote to solve it:

$$14x - 2x + 3 = 3(5x + 9)$$
$$12x + 3 = 3(5x + 9)$$
$$12x + 3 = 15x + 27$$
$$12x = 15x + 24$$
$$\text{-}3x = 24$$
$$x = \text{-}8$$

1. Are both of their *solutions* correct? Explain your reasoning.

2. Describe some ways the steps they took are alike and different.

3. Mai and Noah also solved the equation, but some of their steps have errors. Find the incorrect step in each solution and explain why it is incorrect.

Mai: Noah:

$$14x - 2x + 3 = 3(5x + 9)$$
$$12x + 3 = 3(5x + 9)$$
$$7x + 3 = 3(9)$$
$$7x + 3 = 27$$
$$7x = 24$$
$$x = \frac{24}{7}$$

$$14x - 2x + 3 = 3(5x + 9)$$
$$12x + 3 = 15x + 27$$
$$27x + 3 = 27$$
$$27x = 24$$
$$x = \frac{24}{27}$$

4.3: Make Your Own Steps

Solve these equations for x.

1. $\frac{12+6x}{3} = \frac{5-9}{2}$

2. $x - 4 = \frac{1}{3}(6x - 54)$

3. $-(3x - 12) = 9x - 4$

Are you ready for more?

I have 24 pencils and 3 cups. The second cup holds one more pencil than the first. The third holds one more than the second. How many pencils does each cup contain?

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Lesson 4 Summary

How do we make sure the solution we find for an equation is correct? Accidentally adding when we meant to subtract, missing a negative when we distribute, forgetting to write an x from one line to the next–there are many possible mistakes to watch out for!

Fortunately, each step we take solving an equation results in a new equation with the same solution as the original. This means we can check our work by substituting the value of the solution into the original equation. For example, say we solve the following equation:

$$2x = \text{-}3(x + 5)$$
$$2x = \text{-}3x + 15$$
$$5x = 15$$
$$x = 3$$

Substituting 3 in place of x into the original equation,

$$2(3) = \text{-}3(3 + 5)$$
$$6 = \text{-}3(8)$$
$$6 = \text{-}24$$

we get a statement that isn't true! This tells us we must have made a mistake somewhere. Checking our original steps carefully, we made a mistake when distributing -3. Fixing it, we now have

$$2x = \text{-}3(x + 5)$$
$$2x = \text{-}3x - 15$$
$$5x = \text{-}15$$
$$x = \text{-}3$$

Substituting -3 in place of x into the original equation to make sure we didn't make another mistake:

$$2(\text{-}3) = \text{-}3(\text{-}3 + 5)$$
$$\text{-}6 = \text{-}3(2)$$
$$\text{-}6 = \text{-}6$$

This equation is true, so $x = \text{-}3$ is the solution.

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1. Mai and Tyler work on the equation $\frac{2}{5}b + 1 = -11$ together. Mai's solution is $b = -25$ and Tyler's is $b = -28$. Here is their work:

Mai:

$\frac{2}{5}b + 1 = -11$

$\frac{2}{5}b = -10$

$b = -10 \cdot \frac{5}{2}$

$b = -25$

Tyler:

$\frac{2}{5}b + 1 = -11$

$2b + 1 = -55$

$2b = -56$

$b = -28$

Do you agree with their solutions? Explain or show your reasoning.

2. Solve $3(x - 4) = 12x$

3. Describe what is being done in each step while solving the equation.

    a. $2(-3x + 4) = 5x + 2$
    b. $-6x + 8 = 5x + 2$
    c. $8 = 11x + 2$
    d. $6 = 11x$
    e. $x = \frac{6}{11}$

4. Andre solved an equation, but when he checked his answer he saw his solution was incorrect. He knows he made a mistake, but he can't find it. Where is Andre's mistake and what is the solution to the equation?

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$$-2(3x - 5) = 4(x + 3) + 8$$
$$-6x + 10 = 4x + 12 + 8$$
$$-6x + 10 = 4x + 20$$
$$10 = -2x + 20$$
$$-10 = -2x$$
$$5 = x$$

5. Choose the equation that has solutions $(5, 7)$ and $(8, 13)$.

    A. $3x - y = 8$

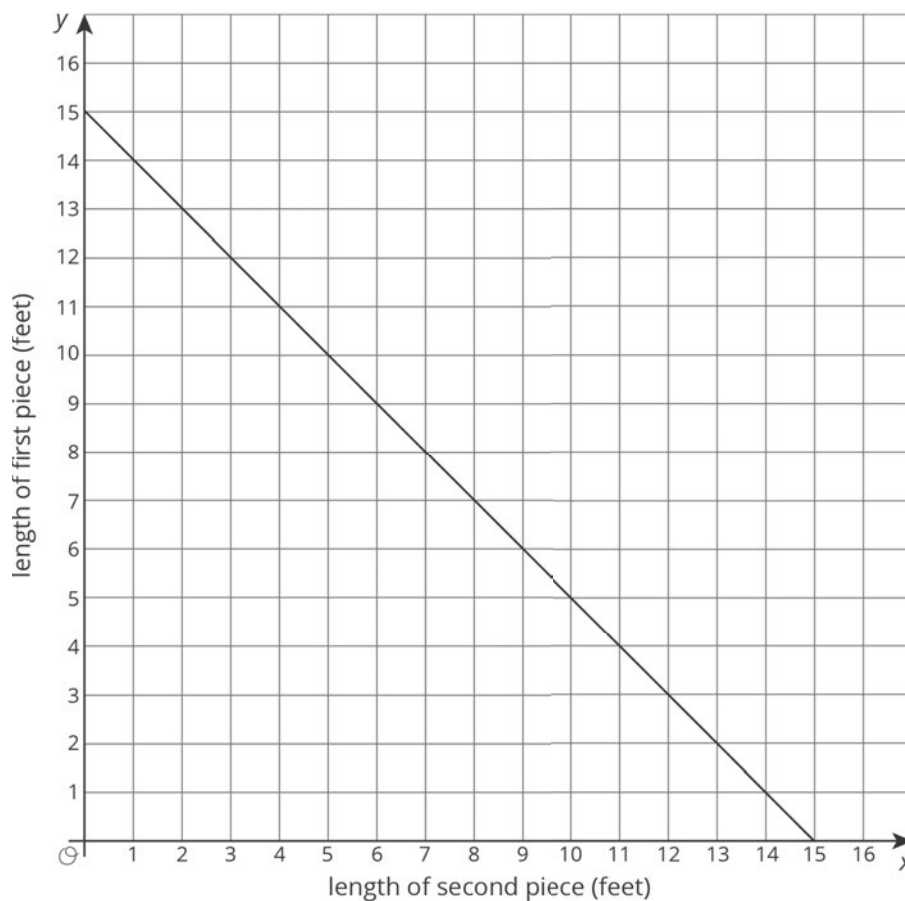   B. $y = x + 2$

    C. $y - x = 5$

    D. $y = 2x - 3$

    (from Unit 3, Lesson 12)

6. A length of ribbon is cut into two pieces to use in a craft project. The graph shows the length of the second piece, x, for each length of the first piece, y.

a. How long is the ribbon? Explain how you know.

b. What is the slope of the line?

c. Explain what the slope of the line represents and why it fits the story.

(from Unit 3, Lesson 9)