Module 5: Solving Linear Equations
Topic 2 Content: Solving Multi-Step Equations – Part 2

Introduction

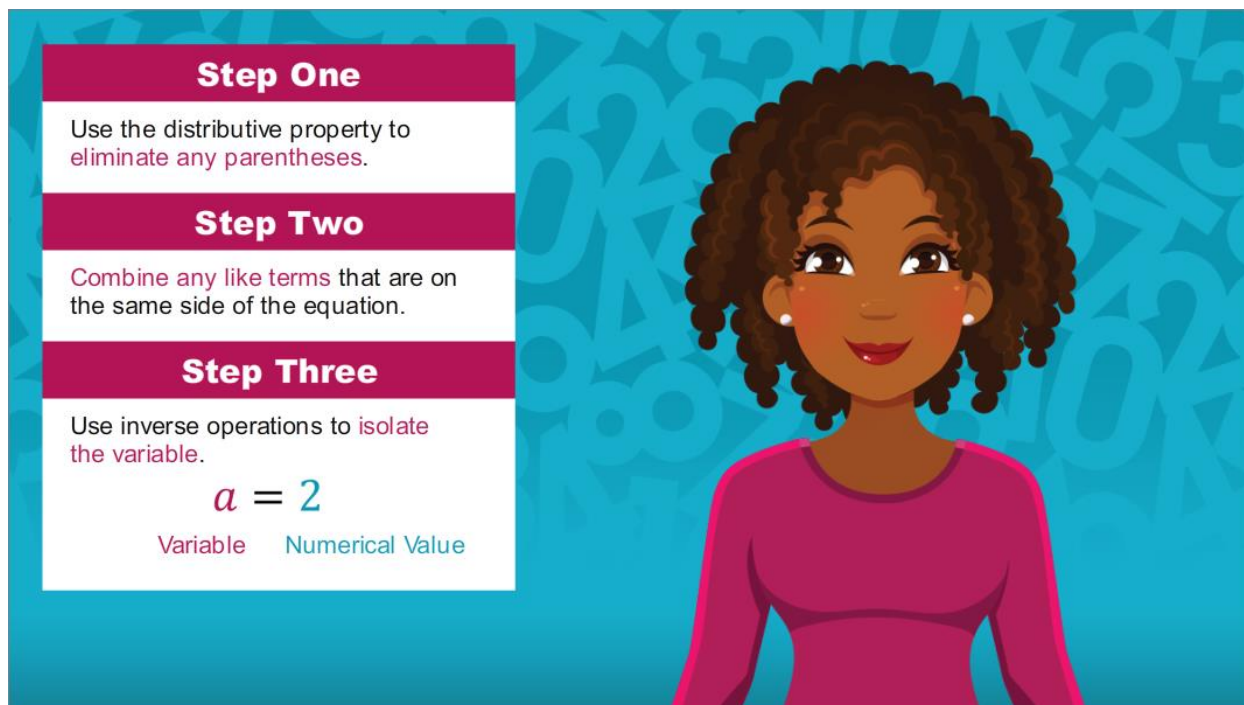Hi there! I'm so glad to have you here for this lesson in Algebra I, where you will continue to solve multi-step linear equations. In this lesson, you will focus on solving multi-step linear equations that include variables on both sides.

Steps

When solving equations with variables on both sides, continue to use these three steps:

Step 1: Are there any *parentheses?*

If so, use the distributive property to eliminate them.

Step 2: Are there any *like terms to combine?*

Remember to only combine like terms that are on the same side of the equation.

Step 3: Now, it's time to *isolate the variable.*

When solving an equation, the goal is typically to end with the variable on the left side of the equation and the numerical value on the right side.

Solving Multi-Step Equations – Part 2

Click the examples below to learn more.

- Example One
- Example Two
- Self-Check

Example 1

What is the solution to the equation below?

$$-4 + 7x + 28 = 11x$$

$-4 + 7x + 28 = 11x$ Step 1: Are there any _**parentheses?**_

$24 + 7x = 11x$ This equation does not have any parentheses, so you will not need to use the distributive property. You can move on to Step 2.

Step 2: Do you have any _**like terms to combine?**_

In this case, you do have like terms to combine. Remember to only combine like terms that are on the same side of the equation.

$$-4 + 28 = 24$$

Bring down the addition sign and $7x$, along with the equals sign and $11x$.

$24 + 7x = 11x$ **Step 3:** Now, it's time to _**isolate the variable.**_

$- 7x \quad - 7x$ You can begin using inverse operations to isolate the variable.

$24 = 4x$ Recall that the Subtraction Property of Equality states that you can subtract the same value from each side of an equation and the equation will remain true. So, begin isolating the variable by subtracting $7x$ from each side of the equation.

Bring down 24.

$7x - 7x = 0$. So these terms are canceled out. Now bring down the equals sign.

$11x - 7x = 4x$.

Example 1 (continued)

What is the solution to the equation below?

$$-4 + 7x + 28 = 11x$$

$$24 = 4x$$
$$4 \quad\quad 4$$
$$6 = x$$
$$x = 6$$

There is one more step to isolating the variable. Recall that the Division Property of Equality states that you can divide each side of an equation by the same value and the equation will remain true. To isolate the variable, divide each side of the equation by 4.

The solution is $6 = x$. Or if you prefer, apply the Symmetric Property of Equality to state the result as $x = 6$.

Example 2

Solve the equation below for x.

$$\frac{3x - 4}{5} = x + 2$$

Which of the following operations will eliminate the fraction from the equation?

A) multiplying each side by 2
B) multiplying each side by 4
C) multiplying each side by 5

Step 1: Are there any **_parentheses?_**

This equation does not have any parentheses, so you will not need to use the distributive property. You can move on to Step 2.

Step 2: Do you have any **_like terms to combine?_**

In this case, you have no like terms to combine. So, move on to Step 3.

Step 3: Now, it's time to **_isolate the variable._**

You can begin using inverse operations to isolate the variable. Apply the Multiplication Property of Equality to eliminate the fraction.

Example 2 (continued)

Example 2

Solve the following equation for x: $\dfrac{3x-4}{5} = x + 2$

Multiplying each side of the equation by 5 will eliminate the fraction.

$5 \cdot \dfrac{3x-4}{5} = 5(x+2)$

multiplying each side by 5

Next

Solve the equation below for x.

$$\frac{3x-4}{5} = x + 2$$

Multiplying each side of the equation by 5 will eliminate that fraction.

$$5 \cdot \frac{3x-4}{5} = 5(x+2)$$

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Example 2 (continued)

Solve the equation below for x.

$$\frac{3x - 4}{5} = x + 2$$

Multiplying the left side of the equation by 5 eliminates the fraction. To multiply the right side of the equation by 5, you must apply the Distributive Property.

$$5 \cdot \frac{3x - 4}{5} = 5(x + 2)$$

$$3x - 4 = 5x + 10$$

$5 \cdot x = 5x$
$5 \cdot 2 = 10$

The resulting equation is $3x - 4 = 5x + 10$. Continue using inverse operations to isolate the variable.

How can you apply the Subtraction Property of Equality to isolate the variable?

A) subtract $5x$ from each side
B) subtract 4 from each side
C) subtract 3 from each side

Example 2 (continued)

Solve the equation below for x.

$$\frac{3x - 4}{5} = x + 2$$

Apply the Subtraction Property of Equality by subtracting $5x$ from each side.

$$5 \cdot \frac{3x - 4}{5} = 5(x + 2)$$

$$3x - 4 = 5x + 10$$

$$-5x \qquad -5x$$

Example 2 (continued)

Solve the equation below for x.

$$\frac{3x - 4}{5} = x + 2$$

After $5x$ is subtracted from each side of the equation, the result is $-2x - 4 = 10$.

$$5 \cdot \frac{3x - 4}{5} = 5(x + 2)$$

$$3x - 4 = 5x + 10$$

How can you apply the Addition Property of Equality to isolate the variable?

$$\underline{ -5x \qquad -5x}$$

$$-2x - 4 = 10$$

A) add 10 to each side
B) add $2x$ to each side
C) add 4 to each side

Example 2 (continued)

Solve the equation below for x.

$$\frac{3x - 4}{5} = x + 2$$

Apply the Addition Property of Equality by adding 4 to each side.

$$5 \cdot \frac{3x - 4}{5} = 5(x + 2)$$

$$3x - 4 = 5x + 10$$

$$-5x \qquad -5x$$

$$-2x - 4 = 10$$

$$+4 \quad +4$$

Example 2 (continued)

Example 2

Solve the following equation for x: $\dfrac{3x - 4}{5} = x + 2$

The final step is to apply the Division Property of Equality by…

dividing each side by 14

dividing each side by 2

dividing each side by –2

$-2x - 4 = 10$

$\underline{ +4 \quad +4}$

$-2x = 14$

Solve the equation below for x.

$$\frac{3x - 4}{5} = x + 2$$

After 4 is added to each side of equation, the result is $-2x = 14$.

$$5 \cdot \frac{3x - 4}{5} = 5(x + 2)$$

$$3x - 4 = 5x + 10$$

$$\underline{-5x \qquad\quad -5x}$$

The final step is to apply the Division Property of Equality by…

$$-2x - 4 = 10$$

$$\underline{ +4 \quad +4}$$

A) dividing each side by 14
B) dividing each side by 2
C) dividing each side by -2

$$-2x = 14$$

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Example 2 (continued)

Example 2

Solve the following equation for x: $\dfrac{3x - 4}{5} = x + 2$

Apply the Division Property of Equality by dividing each side by –2.

$$-2x - 4 = 10$$
$$\underline{+4 \quad +4}$$
$$-2x = 14$$
$$\overline{-2} \quad \overline{-2}$$

dividing each side by –2

Next

Solve the equation below for x.

$$\frac{3x - 4}{5} = x + 2$$

Apply the Division Property of Equality by dividing each side by -2.

$$5 \cdot \frac{3x - 4}{5} = 5(x + 2)$$

$$3x - 4 = 5x + 10$$
$$\underline{-5x \qquad\quad -5x}$$
$$-2x - 4 = 10$$
$$\underline{\qquad\quad +4 \qquad +4}$$
$$-2x = 14$$
$$\overline{-2} \quad\; \overline{-2}$$

Example 2 (continued)

Example 2

Solve the following equation for x: $\dfrac{3x - 4}{5} = x + 2$

$$-2x - 4 = 10$$
$$\underline{+4 \quad +4}$$
$$-2x = 14$$
$$\underline{-2 \quad -2}$$
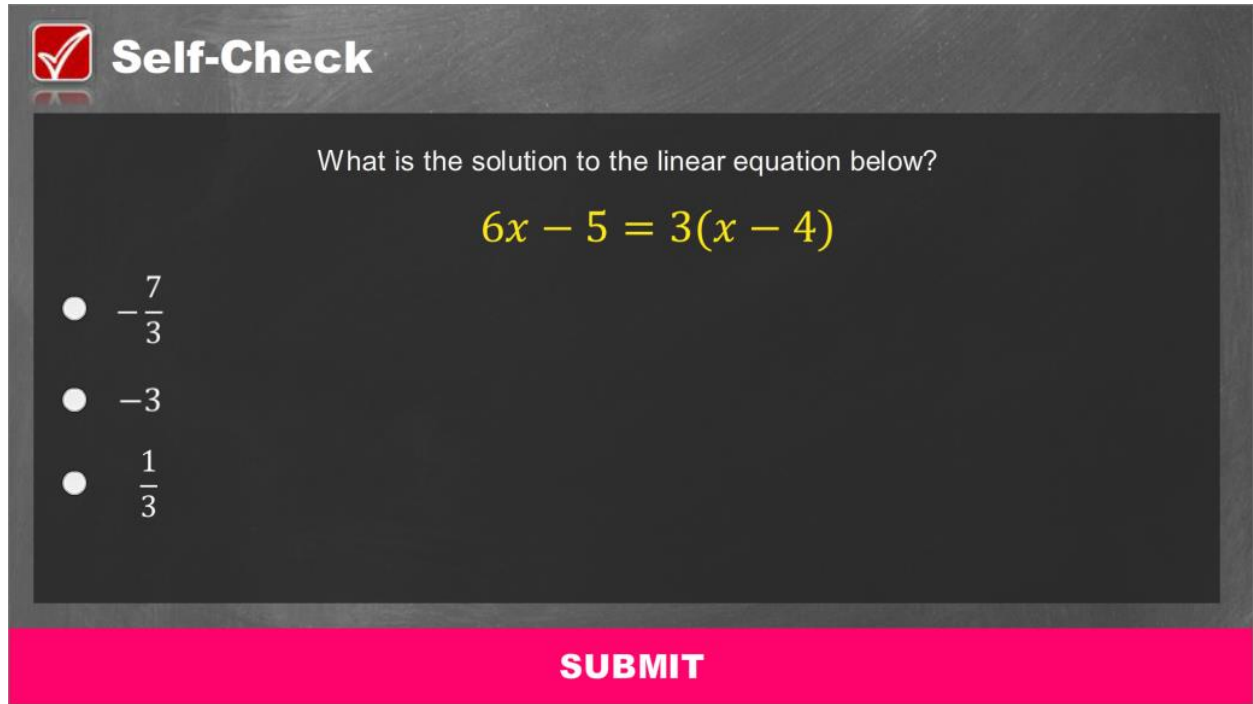$$\boxed{x = -7}$$

Menu

Solve the equation below for x.

$$\frac{3x - 4}{5} = x + 2$$

After dividing each side of the equation by -2, the result is $x = -7$.

$$\cancel{5} \cdot \frac{3x - 4}{\cancel{5}} = 5(x + 2)$$

$$3x - 4 = 5x + 10$$
$$\underline{-5x \qquad\quad -5x}$$
$$-2x - 4 = 10$$
$$\underline{\qquad\quad +4 \quad +4}$$
$$-2x = 14$$
$$\underline{-2 \quad\; -2}$$
$$x = -7$$

Self-Check 1

Solve the problem in the image above to check your understanding of the content.

Self-Check 1: Answer

Self Check

Correct

That's correct! This equation includes parentheses, so begin by applying the Distributive Property.

There are no like terms to combine, so begin using inverse operations to isolate the variable. Subtract 3 from each side of the equation.

Now add 5 to each side of the equation.

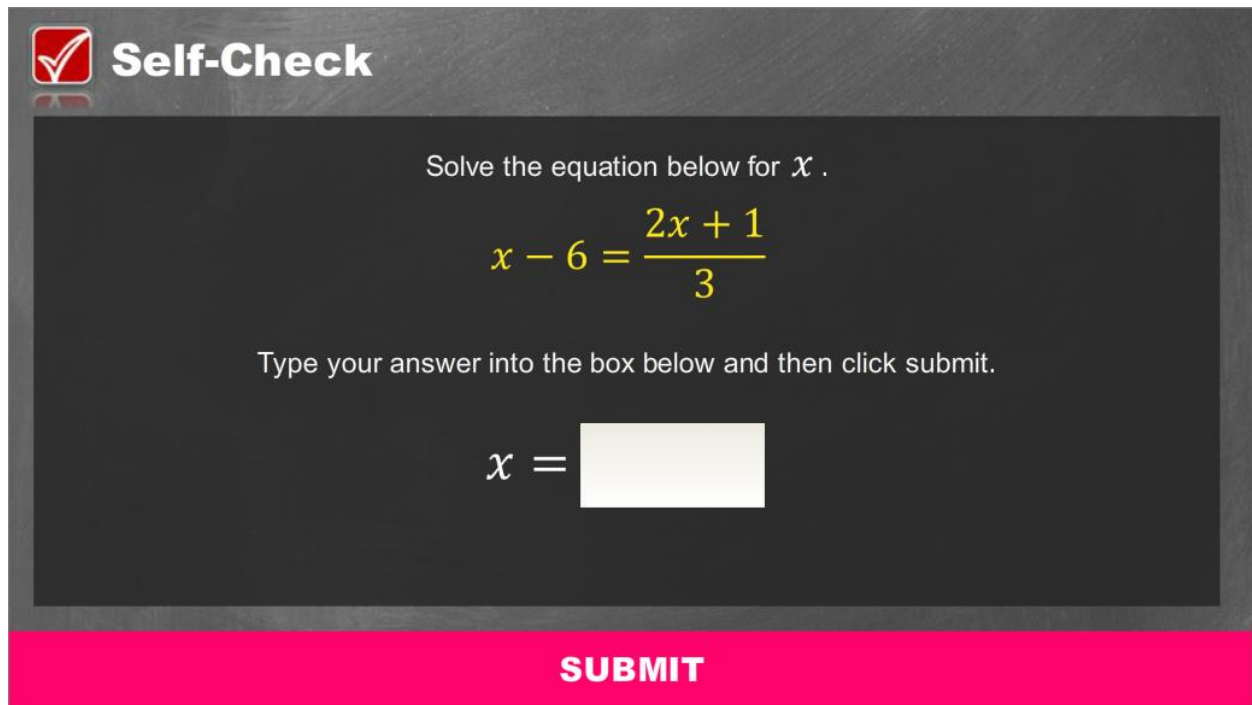The last step is divide each side by 3.

Continue

$$6x - 5 = 3(x - 4)$$
$$6x - 5 = 3x - 12$$
$$-3x \qquad -3x$$

$$3x - 5 = -12$$
$$+5 \qquad +5$$

$$\frac{3x}{3} = \frac{-7}{3}$$

$$x = -\frac{7}{3}$$

SUBMIT

For your reference, the image above shows the correct solution to the self-check problem.

Self-Check 2

Self-Check

Solve the equation below for x.

$$x - 6 = \frac{2x + 1}{3}$$

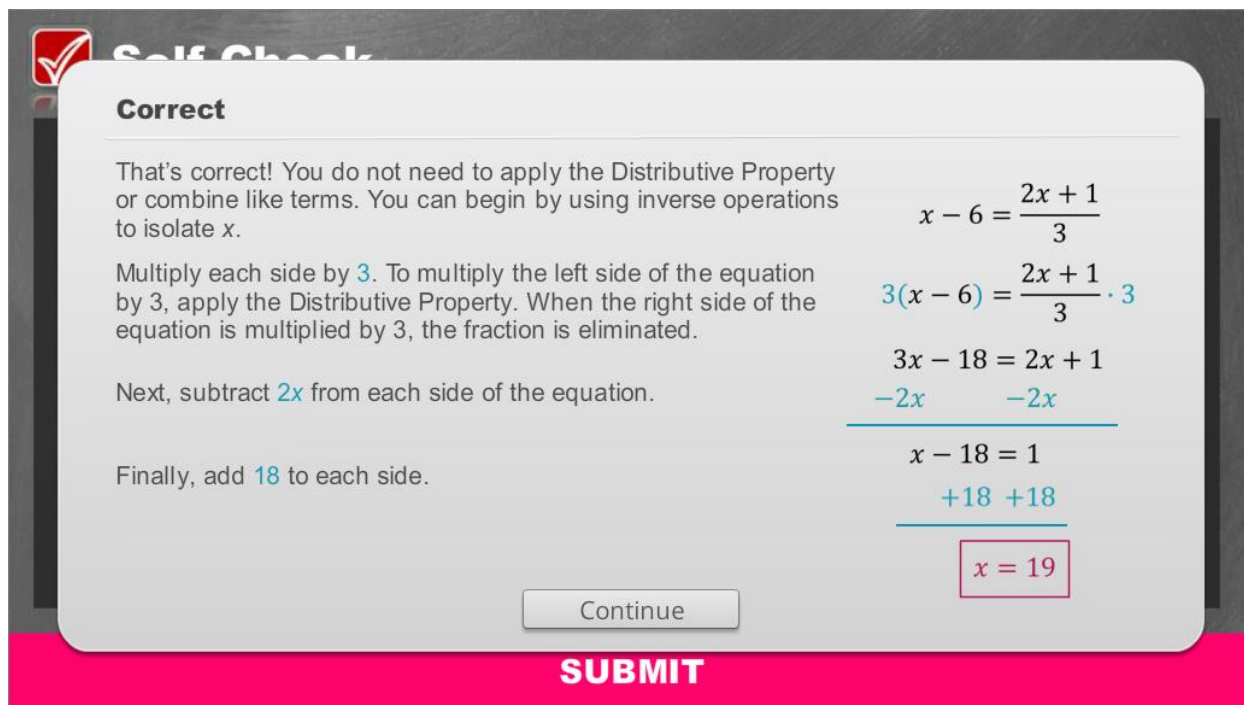Type your answer into the box below and then click submit.

$$x = \boxed{}$$

SUBMIT

Solve the problem in the image above to check your understanding of the content.

Self-Check 2: Answer

Correct

That's correct! You do not need to apply the Distributive Property or combine like terms. You can begin by using inverse operations to isolate x.

Multiply each side by 3. To multiply the left side of the equation by 3, apply the Distributive Property. When the right side of the equation is multiplied by 3, the fraction is eliminated.

Next, subtract $2x$ from each side of the equation.

Finally, add 18 to each side.

$$x - 6 = \frac{2x + 1}{3}$$

$$3(x - 6) = \frac{2x + 1}{3} \cdot 3$$

$$3x - 18 = 2x + 1$$
$$-2x \qquad -2x$$
$$x - 18 = 1$$
$$+18 \quad +18$$
$$x = 19$$

Continue

SUBMIT

For your reference, the image above shows the correct solution to the self-check problem.

Conclusion

You have reached the conclusion of this lesson where you solved multi-step linear equations that included variables on both sides.