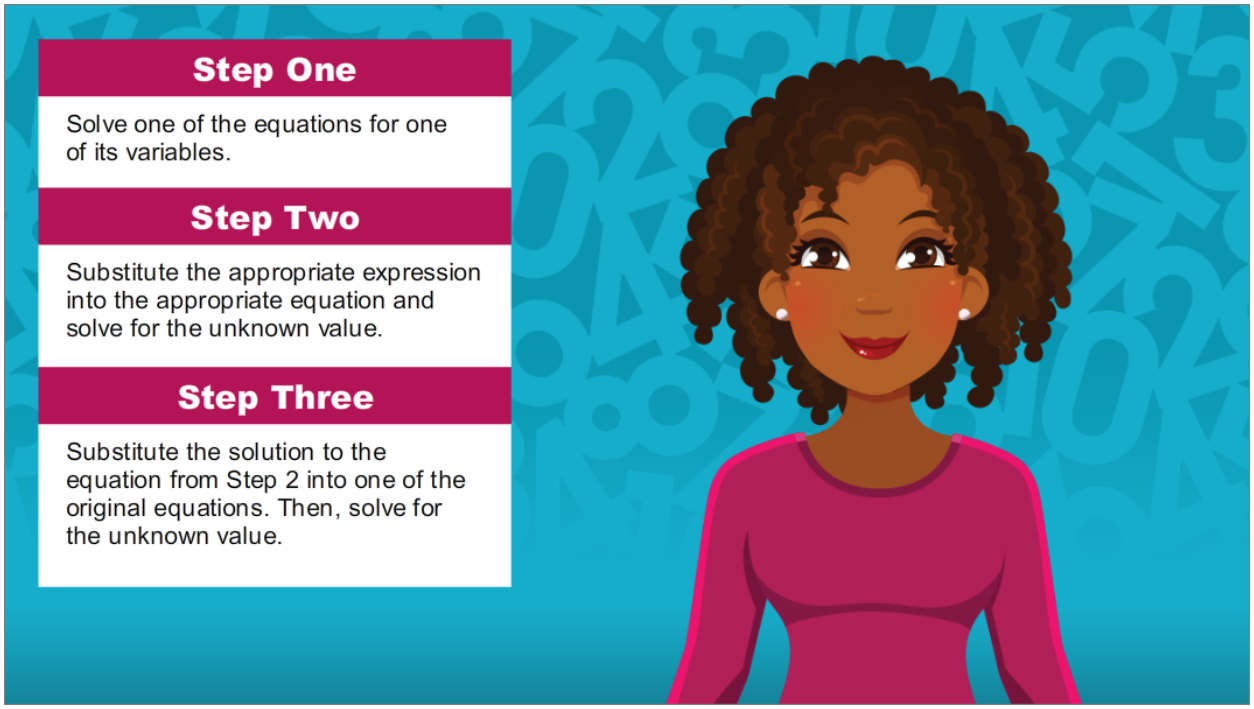
Module 5: Solving Linear Equations

Topic 3 Content: Using the Substitution Method to Solve Systems of Linear Equations

Introduction

Hi there! In this lesson, you will learn how to use the substitution method to solve a system of linear equations.

Anticipatory Set



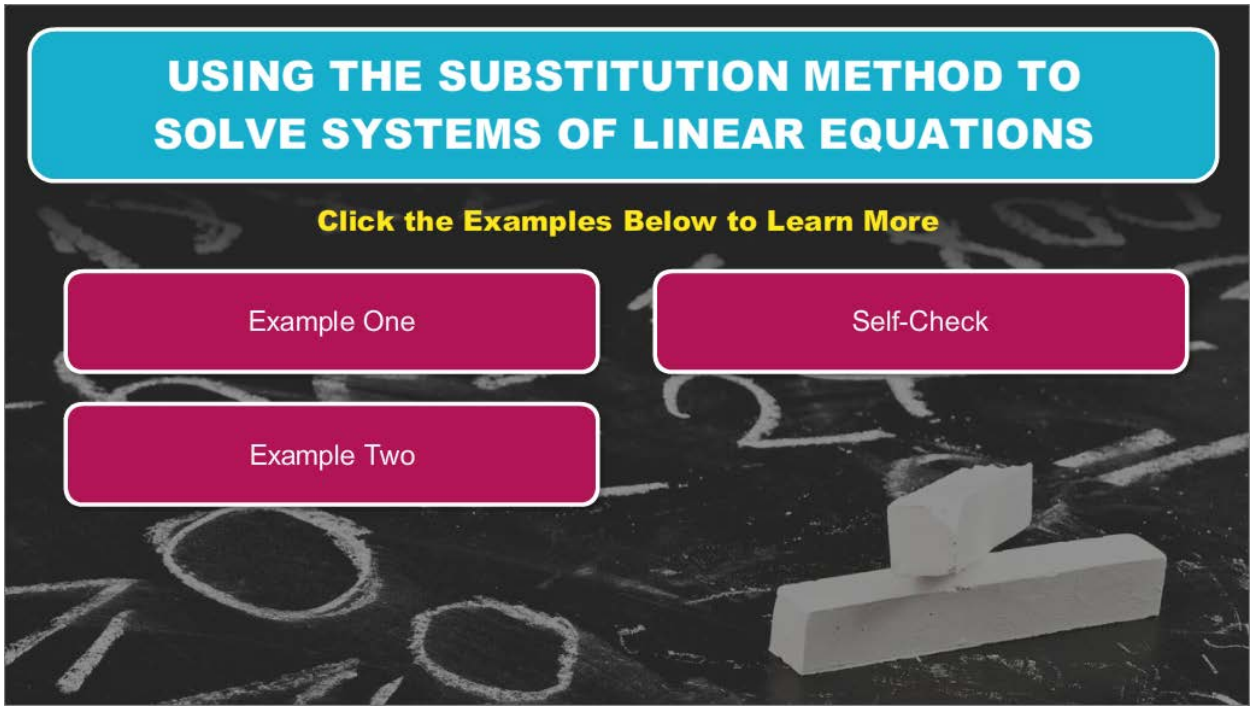
Use the following steps to guide you in the process of using the substitution method to solve a system of linear equations.

Step 1: Solve one of the equations for one of its variables.

Step 2: Substitute the appropriate expression into the appropriate equation and solve for the unknown value.

Step 3: Substitute the solution to the equation from Step 2 into one of the original equations. Then, solve for the unknown value.

Using the Substitution Method to Solve Systems of Linear Equations



Click the examples below to learn more.

- Example One
- Example Two
- Self-Check

Example 1

Use the substitution method to solve the system of equations.

$$\begin{cases} 5x - y = 7 \\ 4x - 2y = -4 \end{cases}$$

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Step 1: Solve one of the equations for one of its variables.

$$\begin{cases} 5x - y = 7 \\ 4x - 2y = -4 \end{cases}$$

When using the substitution method to solve a system of linear equations, begin by solving one of the equations for one of its variables. If possible, choose the equation in which one of the coefficients of one of its variables is 1 or -1. This will eliminate a few steps to solving the system.

In the given system, the coefficient of y in the first equation is -1. So solve this equation for y.

$$\begin{array}{rrr} 5x & - & y = 7 \\ -5x & & -5x \\ \hline -y & = & -5x + 7 \end{array}$$

Subtract $5x$ from each side of the equation.

The result is $-y = -5x + 7$.

$$\begin{array}{rcrcr} \dfrac{-y}{-1} & = & \dfrac{-5x}{-1} & + & \dfrac{7}{-1} \\ y & = & 5x & - & 7 \end{array}$$

Then, divide each term by -1.

The result is $y = 5x - 7$.

Example 1 (continued)

Use the substitution method to solve the system of equations.

$$\begin{cases} 5x - y = 7 \\ 4x - 2y = -4 \end{cases}$$

$\begin{cases} 5x - y = 7 \\ 4x - 2y = -4 \end{cases}$

Step 2: Substitute the appropriate expression into the appropriate equation and solve for the unknown value.

$y = 5x - 7$

Now that you know that $y = 5x - 7$, you can substitute the expression $5x - 7$ for y in the other equation. Solve the resulting equation for x.

$4x - 2y = -4$

$4x - 2(5x - 7) = -4$

$4x - 2(5x - 7) = -4$

Begin by applying the distributive property on the left side of the equation.

$4x - 2(5x - 7) = -4$

Bring down $4x$.

$4x - 10x + 14 = -4$

$-2 \cdot 5x = -10x$
$-2 \cdot -7 = 14$

Bring down the equals sign and -4.

$4x - 10x + 14 = -4$

Now combine like terms.

$-6x + 14 = -4$

$4x - 10x = -6x$

Bring down the addition sign and 14, as well as the equals sign and -4.

Example 1 (continued)

Use the substitution method to solve the system of equations.

$$\begin{cases} 5x - y = 7 \\ 4x - 2y = -4 \end{cases}$$

$-6x + 14 = -4$ — Next, subtract 14 from each side of the equation.

$\quad -14 \quad -14$

$-6x = -18$ — Bring down $-6x$.

$14 - 14 = 0$. So, these terms are canceled out. Bring down the equals sign.

$-4 - 14 = -18$.

$\frac{-6x}{-6} = \frac{-18}{-6}$ — Now divide each term by -6. The result is $x = 3$.

$x = 3$

$x = 3$ — **Step 3:** Substitute the solution to the equation from Step 2 into one of the original equations. Solve for the unknown value.

$5x - y = 7$

$5(3) - y = 7$ — Now that you know that $x = 3$, substitute 3 for x in one of the original equations. Then, solve for y.

$5(3) - y = 7$ — $5 \cdot 3 = 15$

$15 - y = 7$ — Bring down the subtraction sign and y, as well as the equals sign and 7.

Example 1 (continued)

Use the substitution method to solve the system of equations.

$$\begin{cases} 5x - y = 7 \\ 4x - 2y = -4 \end{cases}$$

$15 - y = 7$

$-15 \qquad -15$

$-y = -8$

Subtract 15 from each side of the equation.

$15 - 15 = 0$. So these terms are canceled out.

Bring down the subtraction sign and y, as well as the equals sign and -8.

$\frac{-y}{-1} = \frac{-8}{-1}$

$y = 8$

Divide each term by -1. The result is $y = 8$.

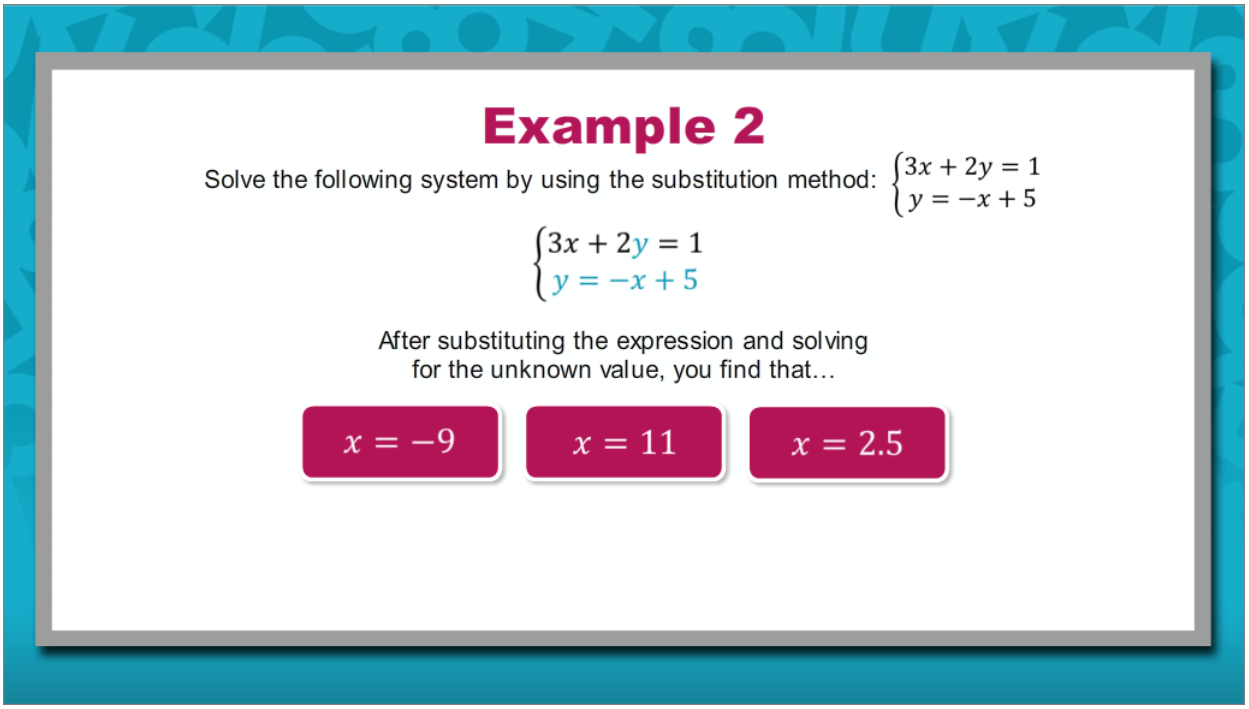
$\begin{cases} 5x - y = 7 \\ 4x - 2y = -4 \end{cases}$

$x = 3$ and $y = 8$

$(3, 8)$

Now that you know that $x = 3$ and $y = 8$, you can conclude that the solution to the system can be represented by the ordered pair $(3, 8)$.

Example 2



Solve the system below by using the substitution method.

$$\begin{cases}3x+2y=1\\y=-x+5\end{cases}$$

Step 1: Solve one of the equations for one of its variables.

In the given system of equations, the second equation is already solved for y. So you can move on to Step 2.

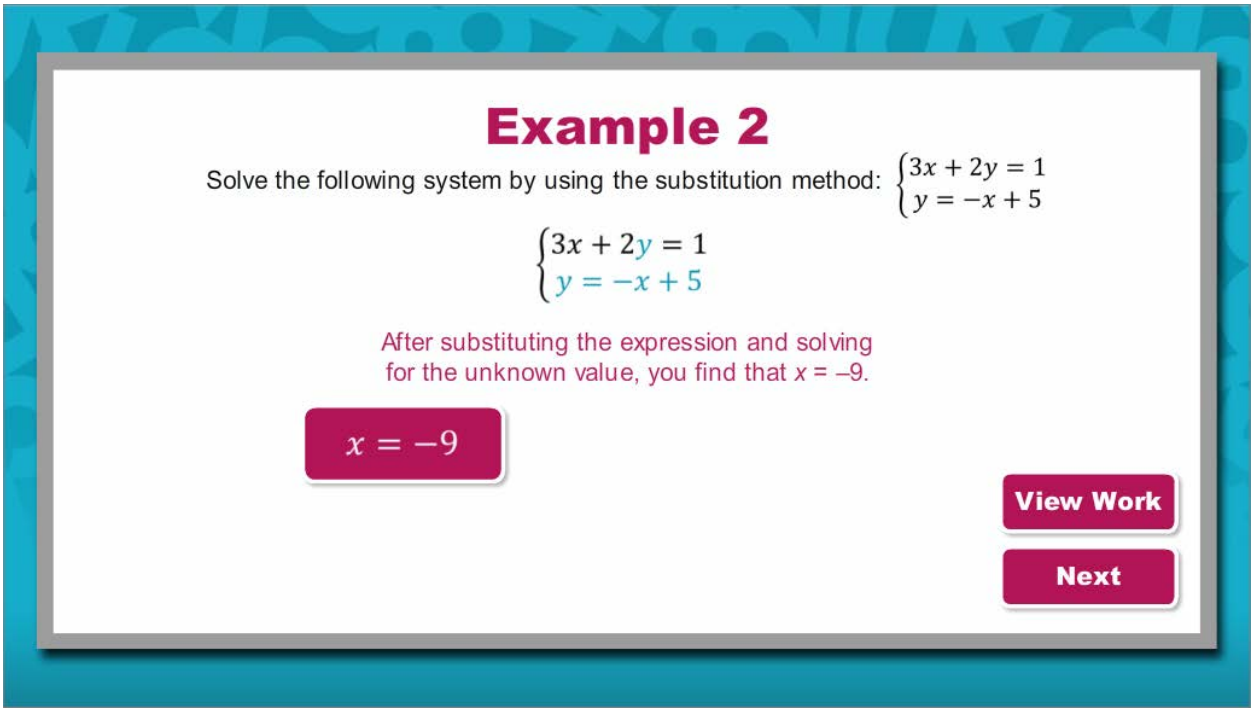
Step 2: Substitute the appropriate expression into the appropriate equation and solve for the unknown value.

Since you know that $y=-x+5$ you can substitute the expression, $-x+5$ for y in the first equation, and then solve for the unknown value.

After substituting the expression and solving for the unknown value, you find that…

A) $x=-9$
B) $x=11$
C) $x=2.5$

Example 2 (continued)



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$$\begin{cases}3x+2y=1\\y=-x+5\end{cases}$$

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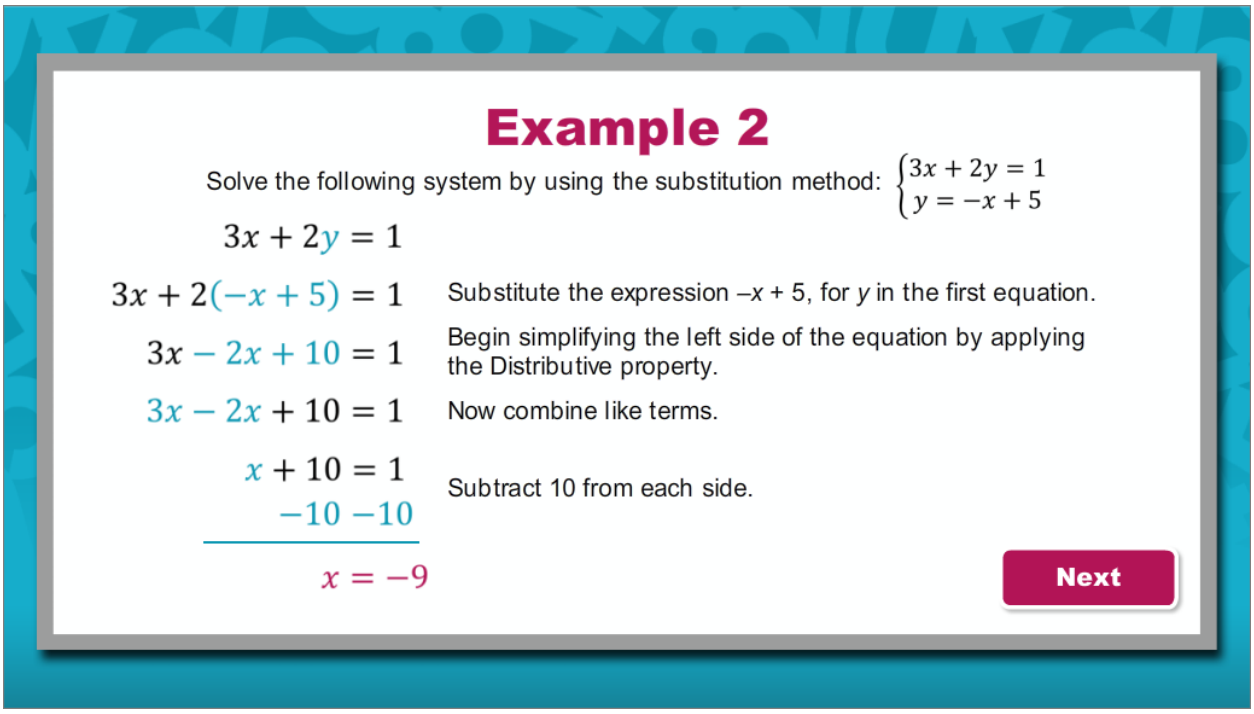
After substituting the expression and solving for the unknown value, you find that $x=-9$.

Example 2 (continued)



Solve the system below by using the substitution method.

$$\begin{cases}3x+2y=1\\y=-x+5\end{cases}$$

$3x + 2y = 1$ Substitute the expression, $-x + 5$, for y in the first equation.

$3x + 2(-x + 5) = 1$

$3x + 2(-x + 5) = 1$ Begin simplifying the left side of the equation by applying the Distributive Property.

$3x - 2x + 10 = 1$

$3x - 2x + 10 = 1$ Now combine like terms.

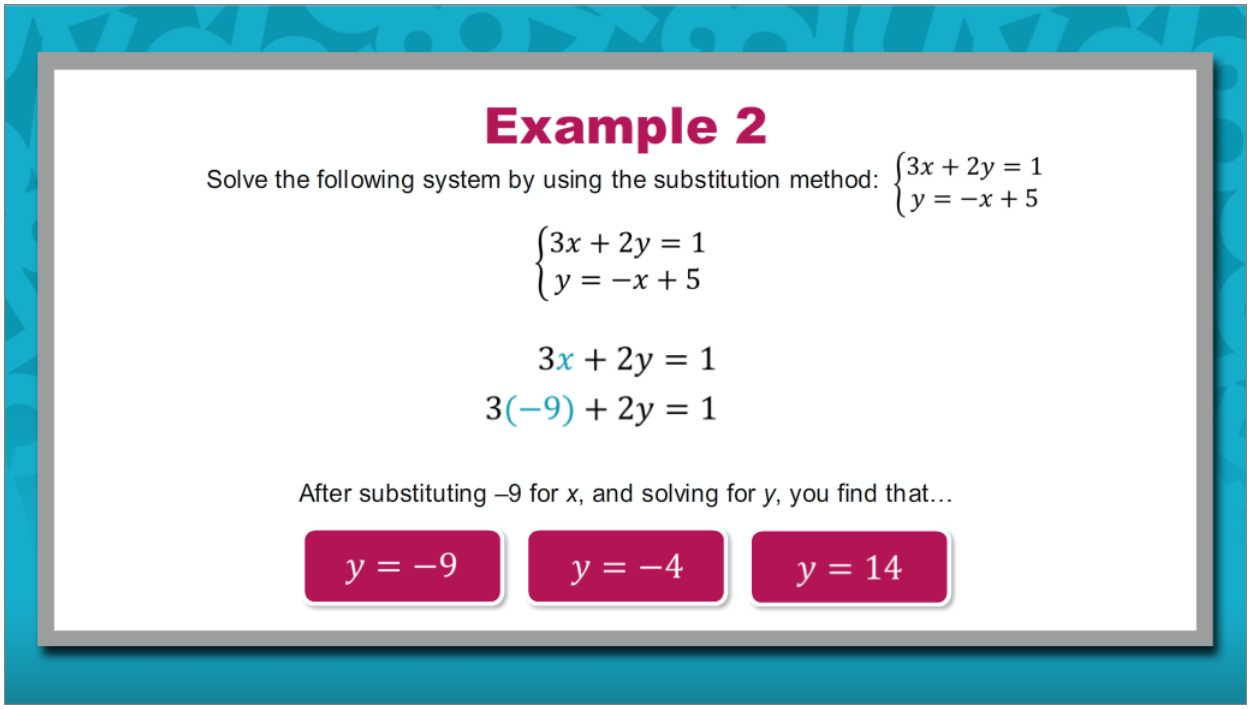
$x + 10 = 1$

$x + 10 = 1$ Subtract 10 from each side.

$-10 \quad -10$

$x = -9$

Example 2 (continued)



Solve the system below by using the substitution method.

$$\begin{cases} 3x + 2y = 1 \\ y = -x + 5 \end{cases}$$

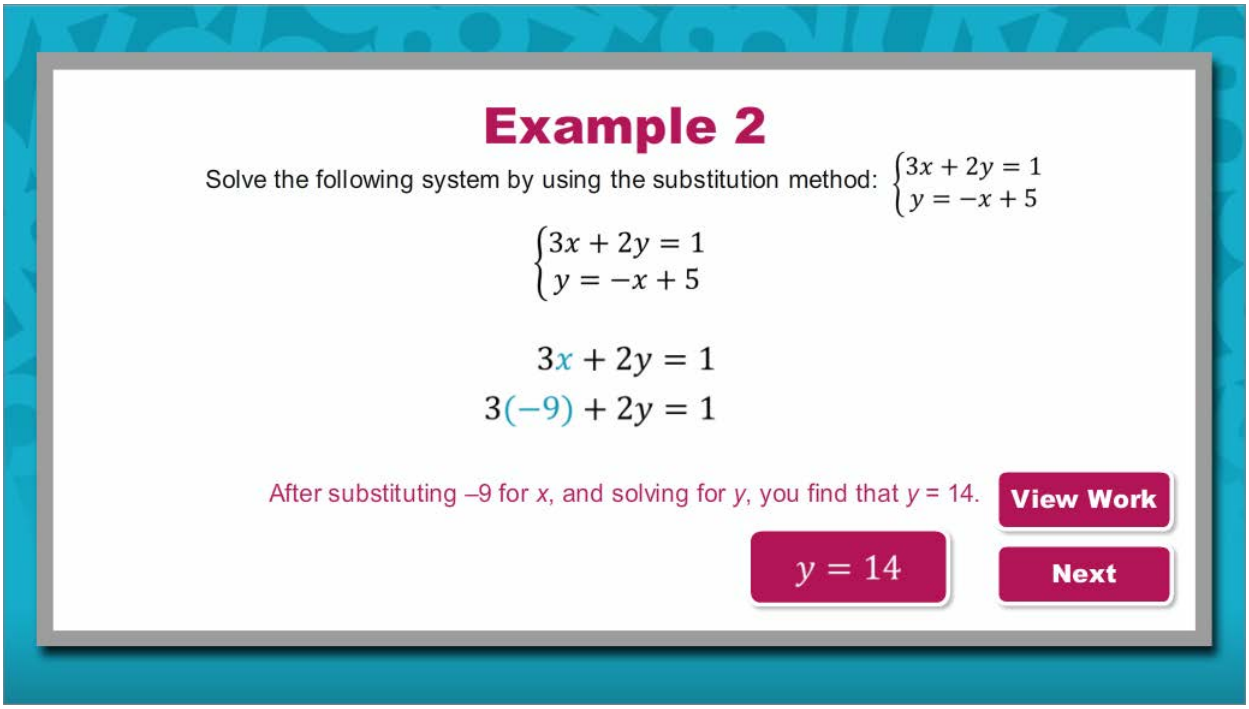
Step 3: Substitute the solution to the equation from Step 2 into one of the original equations. Then, solve for the unknown variable.

Now that you know that $x = -9$, substitute the value into one of the original equations, for example, $3x + 2y = 1$.

After substituting -9 for x, and solving for y you find that…

A) $y = -9$
B) $y = -4$
C) $y = 14$

Example 2 (continued)



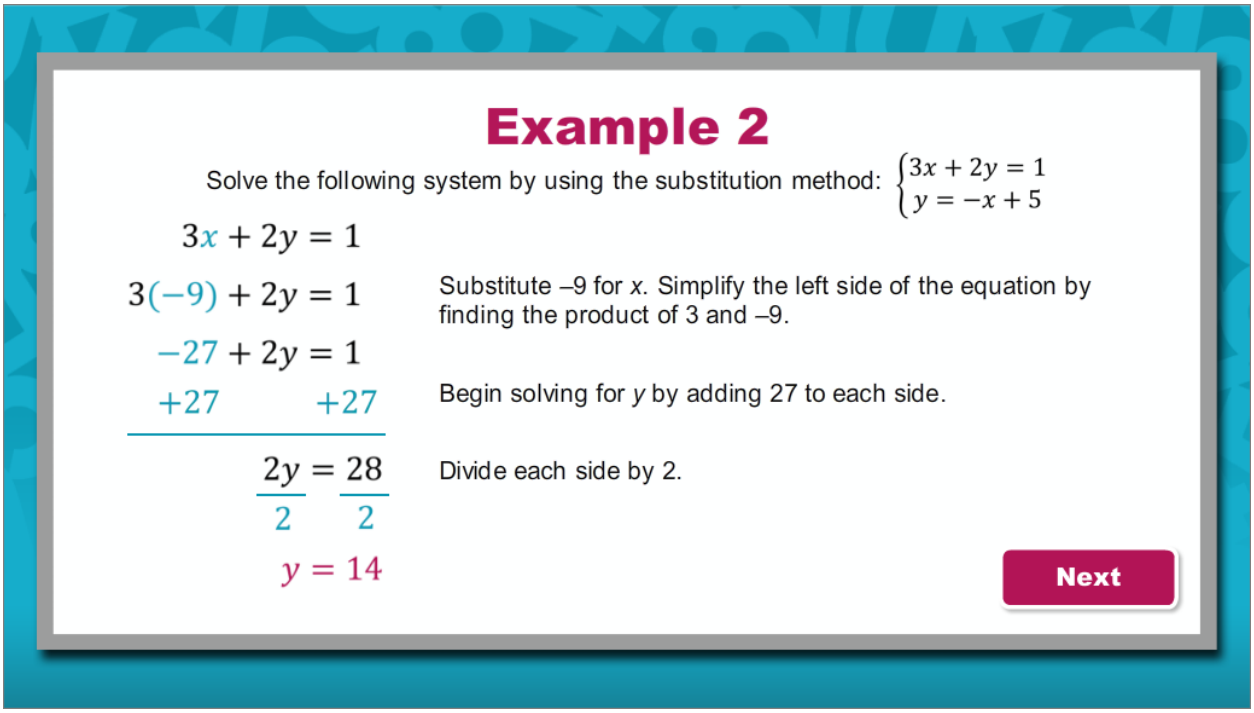
Solve the system below by using the substitution method.

$$\begin{cases} 3x + 2y = 1 \\ y = -x + 5 \end{cases}$$

$3x + 2y = 1$
$3(-9) + 2y = 1$

After substituting -9 for x, and solving for y, you find that $y = 14$.

Example 2 (continued)



Solve the system below by using the substitution method.

$$\begin{cases} 3x + 2y = 1 \\ y = -x + 5 \end{cases}$$

$3x + 2y = 1$ Substitute -9 for x. Simplify the left side of the equation by finding the product of 3 and -9.

$3(-9) + 2y = 1$

$-27 + 2y = 1$

$-27 + 2y = 1$ Begin solving for y by adding 27 to each side.

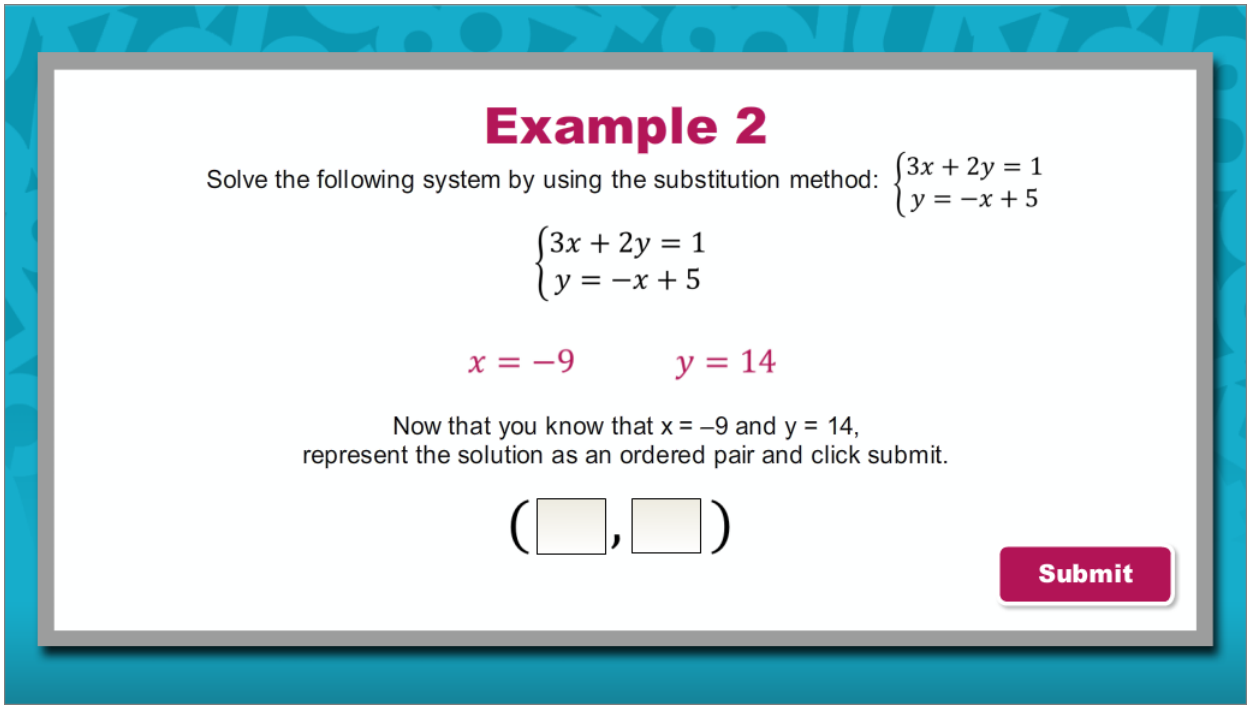
$+27 \quad +27$

$2y = 28$

$\frac{2y}{2} = \frac{28}{2}$ Divide each side by 2.

$y = 14$

Example 2 (continued)



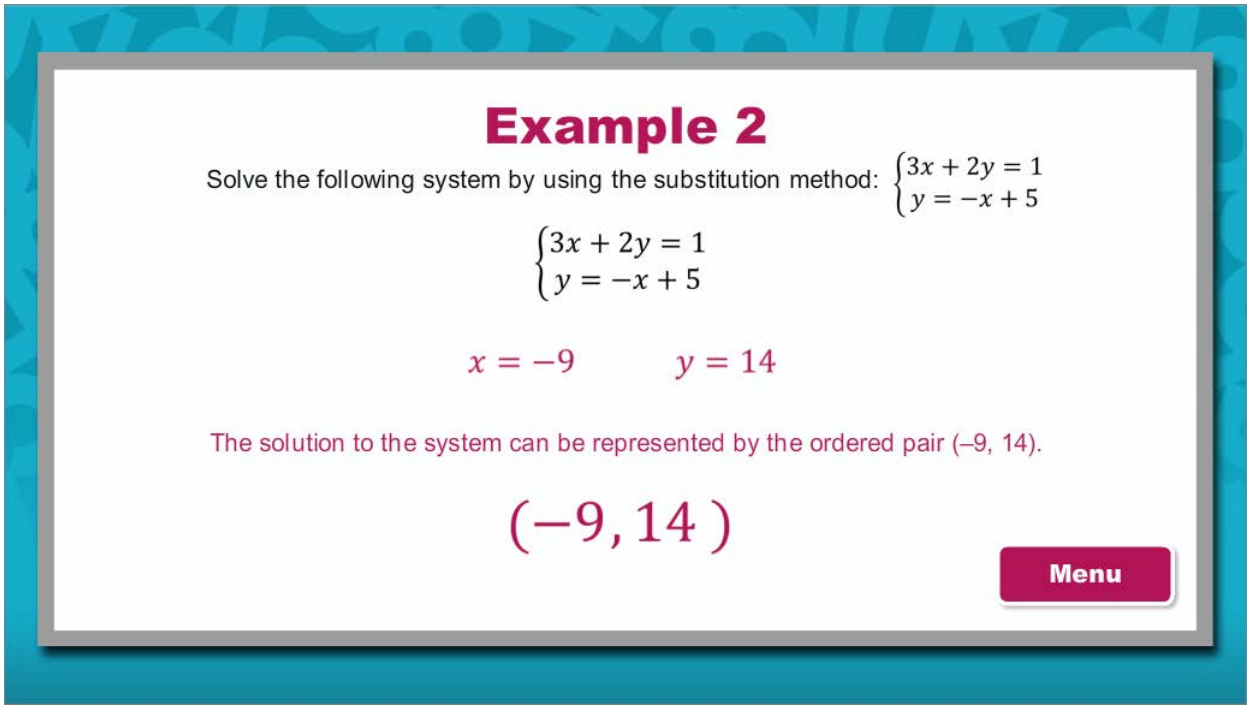
Solve the system below by using the substitution method.

$$\begin{cases} 3x + 2y = 1 \\ y = -x + 5 \end{cases}$$

Now that you know that $x = -9$ and $y = 14$, represent the solution as an ordered pair and click submit.

(? , ?)

Example 2 (continued)

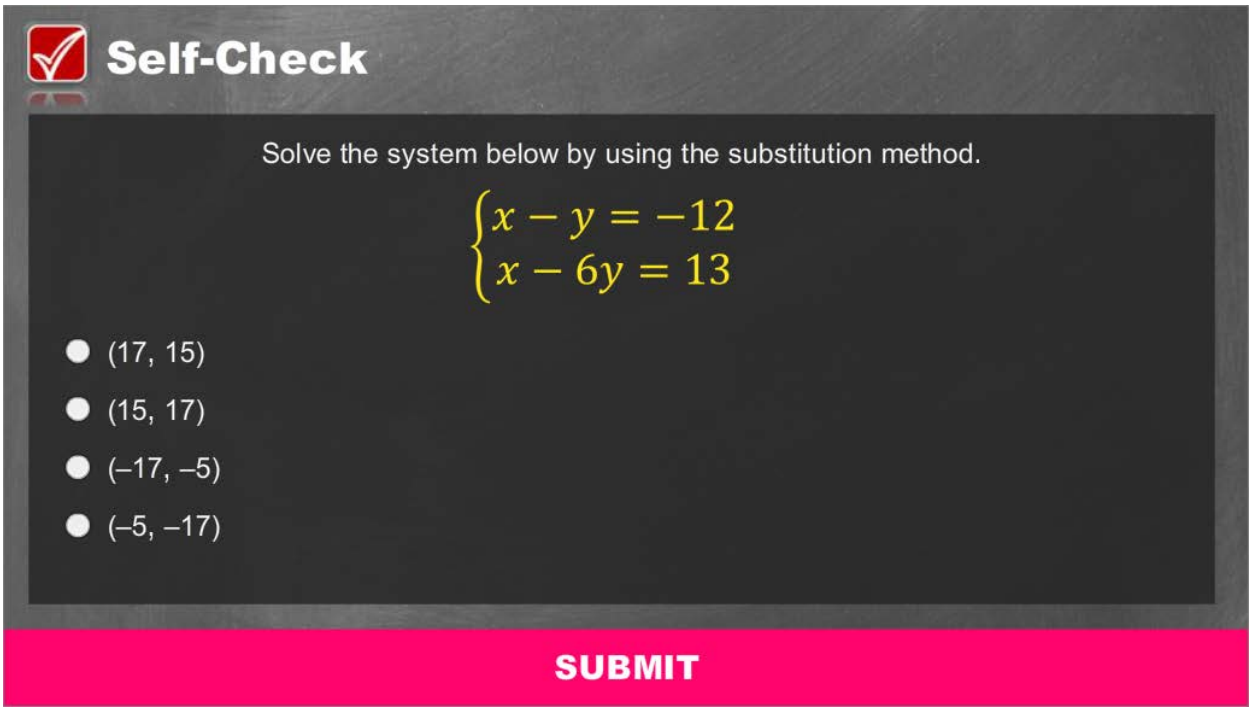


Solve the system below by using the substitution method.

$$\begin{cases} 3x + 2y = 1 \\ y = -x + 5 \end{cases}$$

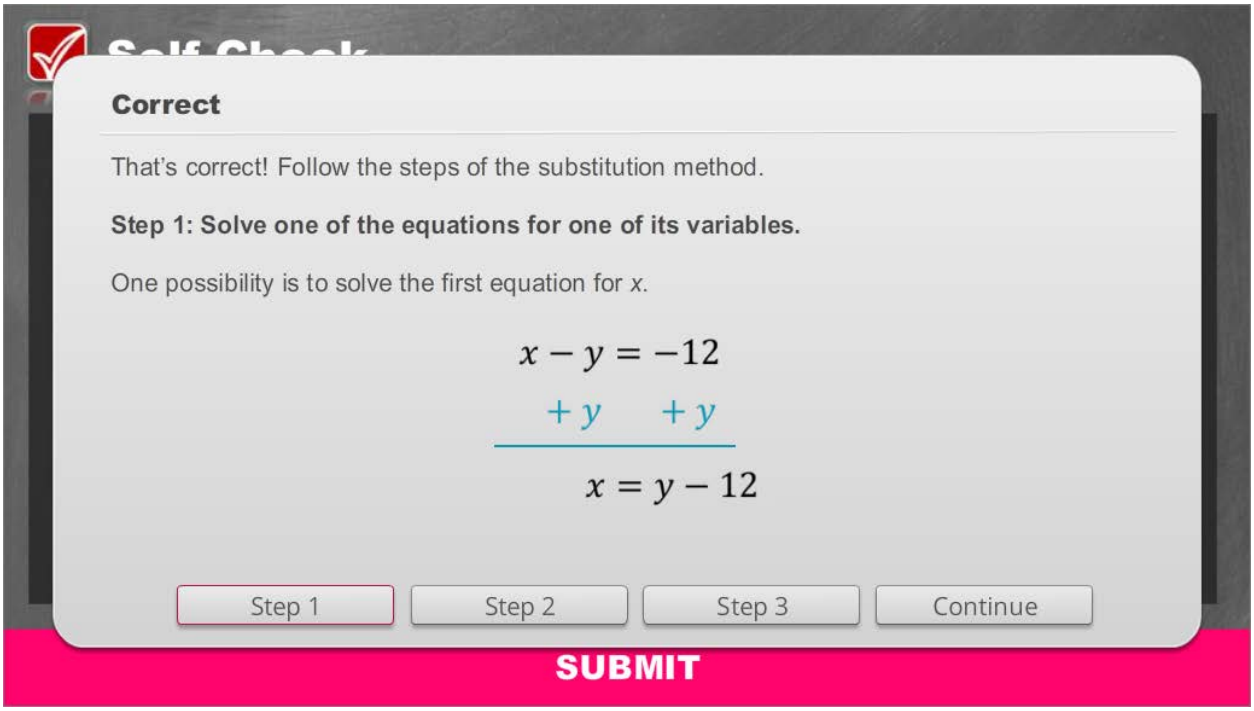
The solution to the system can be represented by the ordered pair $(-9, 14)$.

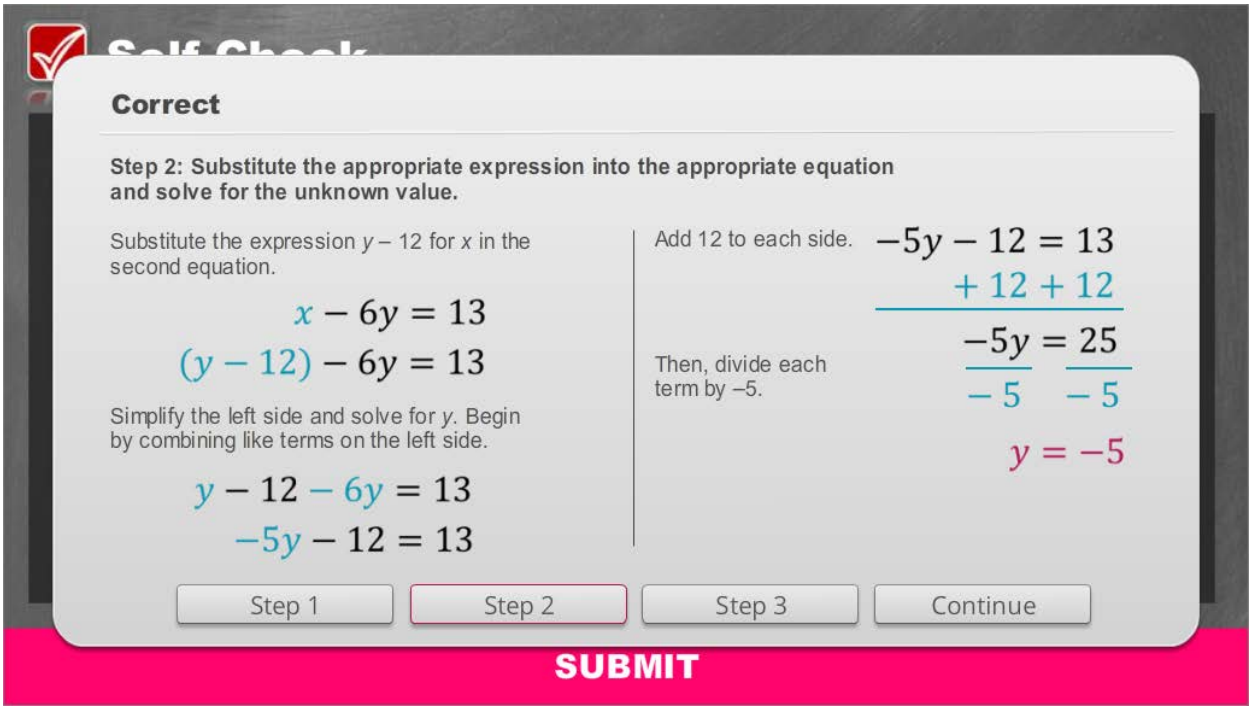
Self-Check



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

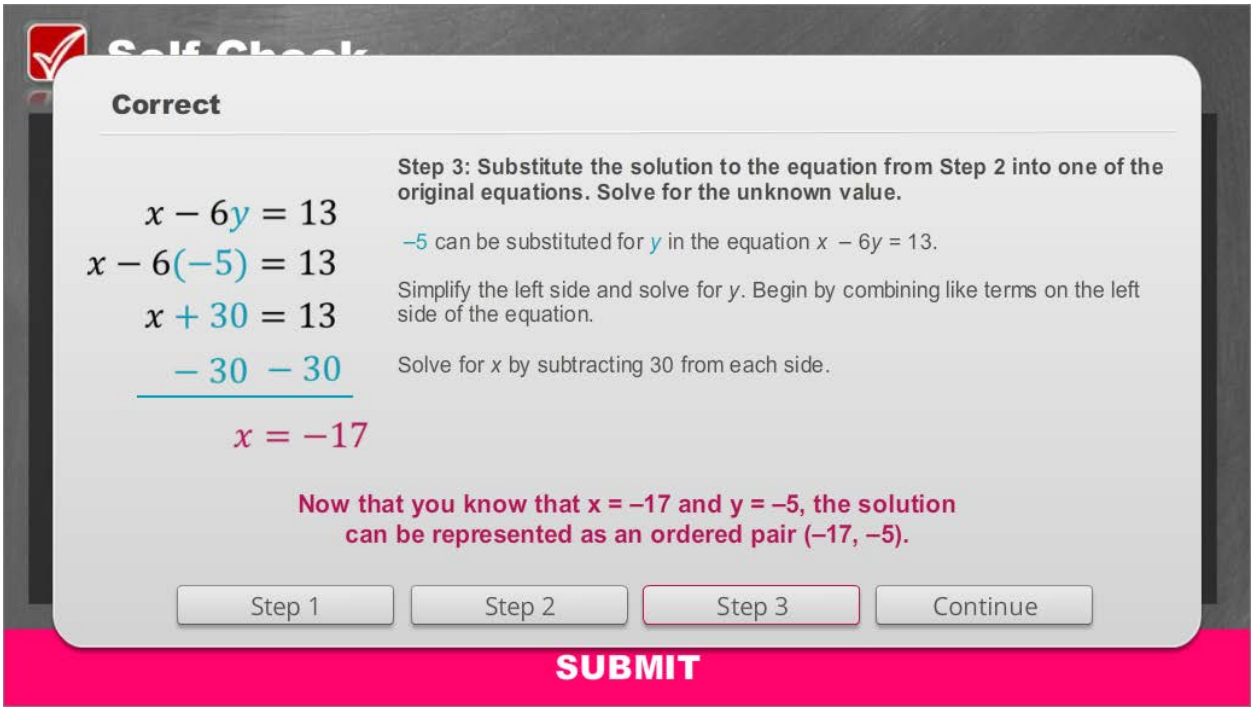
Self-Check: Answer





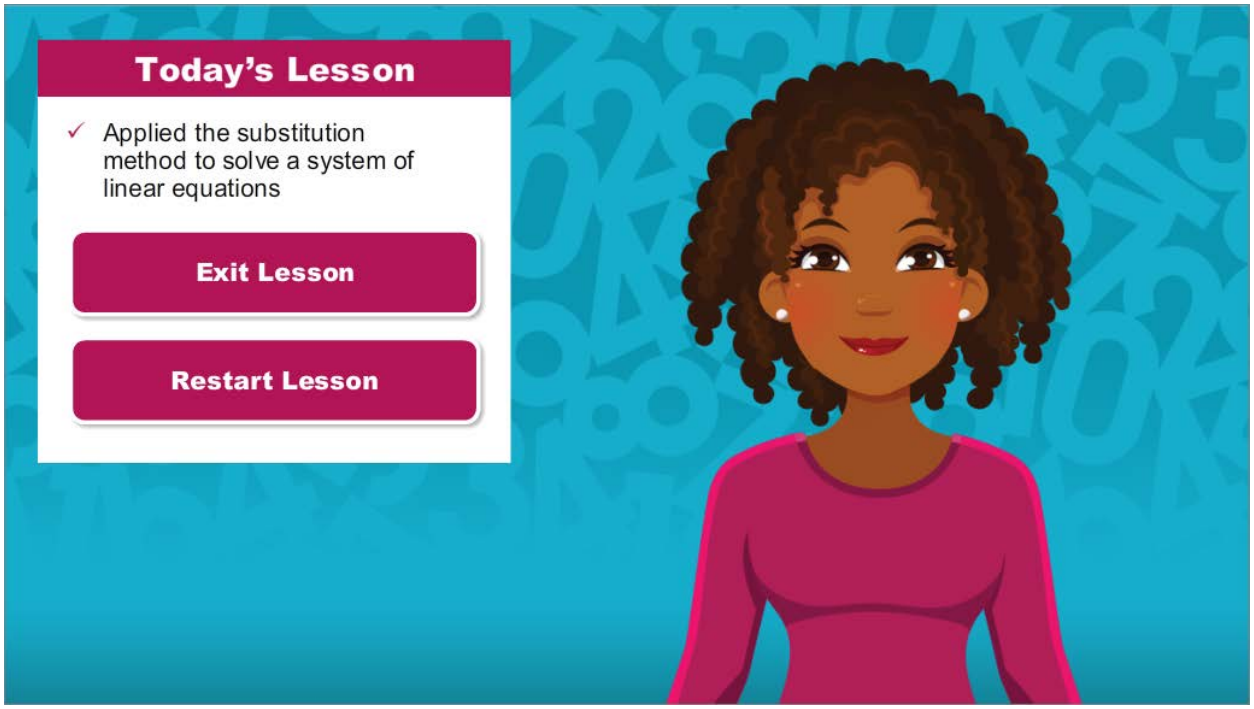
For your reference, the images above shows the correct solution to the self-check problem.

Self-Check: Answer (continued)



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 learned how to use the substitution method to solve a system of linear equations.