Please get your notebook and clicker ready.

Get ready for the warm-up questions.

Simplify 7(t - 5)

A) 7t - 5

B) 7t - 35

C) 7t + 5

D) 75 + 35

True or false: The distributive property is used to solve for x in 2x + 3(x+2) = 16 by multiplying 3 by x, then multiplying 3 by 2, then combining like terms and solving for x.

(A) True

(B) False

Solve: -2(m - 12) = 18

(A) 3

(D) -6

(B) -3

(E) 2

(C) 6

(F) -2

Solve: 3(15 - m) = 12

(A) 33

(D) -11

(B) -33

(E) 45

(C) 11

(F) -45

True or False: When you multiply a factor by a sum (or difference), the product is the same as multiplying the factor by each term and then adding (or subtracting) the products.

(A) True

(B) False

Solve: 3(y + 0.2) = 9.6
What does y equal?

Text in your number answer

Solving Systems by Substitution

What You'll Learn

To solve a system of linear equations by substitution

🔊 **New Vocabulary** substitution method

8.EE.8b, 8.EE.8.c

Why Learn This?

You can use a system of equations to compare the costs of two phone plans. To solve a system, you can solve one of the equations for one of the variables. This is called the **substitution method**.

EXAMPLE **Using Substitution**

1 Solve the system by substitution. $y = 4x - 1$
$2x + 2y = 3$

Step 1 Because $y = 4x - 1$, substitute $4x - 1$ for y in $2x + 2y = 3$.

$2x + 2y = 3$	← Write the second equation.
$2x + 2(4x - 1) = 3$	← Substitute $4x - 1$ for y.
$2x + 8x - 2 = 3$	← Use the Distributive Property.
$10x - 2 = 3$	← Simplify.
$10x = 5$	← Add 2 to each side.
$x = \dfrac{1}{2}$	← Divide each side by 10.

Step 2 Substitute $\dfrac{1}{2}$ for x in either equation and solve for y.

$y = 4x - 1$	← Write either equation.
$y = 4\left(\dfrac{1}{2}\right) - 1$	← Substitute $\dfrac{1}{2}$ for x.
$y = 1$	← Simplify.

The solution of the system is $\left(\dfrac{1}{2}, 1\right)$.

Check Replace x with $\dfrac{1}{2}$ and y with 1 in each equation.

$y = 4x - 1$ $\qquad$ $2x + 2y = 3$
$1 \overset{?}{=} 4\left(\dfrac{1}{2}\right) - 1$ $\qquad$ $2\left(\dfrac{1}{2}\right) + 2(1) \overset{?}{=} 3$
$1 = 1$ ✓ $\qquad$ $3 = 3$ ✓

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1 **Using Substitution** Solve the system by substitution.

$y = 2x + 3$
$2x - 2y = 4$

Step 1 As y is isolated in the first equation, substitute [ ] in the other equation.

$2x - 2y = 4$
$2x - 2 \cdot$ [ ] $= 4$ $\qquad$ ← Substitute [ ] for y.
$2x -$ [ ] $-$ [ ] $= 4$ $\qquad$ ← Use the Distributive Property.
[ ] $= 4$ $\qquad$ ← Simplify.
$-2x =$ [ ] $\qquad$ ← Add [ ] to each side.
$x =$ [ ] $\qquad$ ← Divide each side by [ ].

Step 2 Substitute [ ] for x in either equation and solve for [ ].

$y = 2x + 3$
$y = 2 \cdot$ [ ] $+ 3$ ← Substitute [ ] for x.
$y =$ [ ] $\qquad$ ← Simplify.

Check Replace x with [ ] and y with [ ] in each equation.

$y = 2x + 3$ $\qquad\qquad$ $2x - 2y = 4$
[ ] $\overset{?}{=} 2 \cdot$ [ ] $+ 3$ $\qquad$ $2 \cdot$ [ ] $- 2 \cdot$ [ ] $\overset{?}{=} 4$
[ ] $=$ [ ] ✓ $\qquad\qquad$ [ ] $=$ [ ] ✓

The solution of the system is [ ].

✅ Quick Check

1. Solve the system by substitution.
   Check your answer.

$y = x + 1$

$2x + y = -2$

EXAMPLE **Solving for a Variable and Using Substitution**

2 Solve the system by substitution.
$-9x + 5y = -1$
$-3x + y = 4$

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

$-3x + y = 4$ ← Write the second equation.

$y = 3x + 4$ ← Add 3x to each side.

Step 2 Substitute $3x + 4$ for y in the other equation and solve for x.

$-9x + 5y = -1$ ← Write the first equation.

$-9x + 5(3x + 4) = -1$ ← Substitute 3x + 4 for y.

$-9x + 15x + 20 = -1$ ← Use the Distributive Property.

$6x = -21$ ← Simplify. Subtract 20 from each side.

$x = -3.5$ ← Divide each side by 6.

Step 3 Substitute -3.5 for x in either equation and solve for y.

$-3x + y = 4$ ← Write either equation.

$-3(-3.5) + y = 4$ ← Substitute −3.5 for x.

$10.5 + y = 4$ ← Simplify.

$y = -6.5$ ← Subtract 10.5 from each side.

The solution of the system is $(-3.5, -6.5)$.

❷ Solving for a Variable and Using Substitution Solve the system by substitution.

$$3x + 5y = -8$$
$$5x + y = 5$$

Step 1 Solve the second equation for y.

$$5x + y = 5$$

$y = \boxed{}$ ← **Subtract** $\boxed{}$ **from both sides.**

Step 2 Substitute $\boxed{}$ for y in the other equation and solve for $\boxed{}$.

$$3x + 5y = -8$$

$3x + 5 \cdot \boxed{} = -8$ ← **Substitute** $\boxed{}$ **for y.**

$3x - \boxed{} + \boxed{} = -8$ ← **Use the Distributive Property.**

$\boxed{} = -8$ ← **Simplify.**

$-22x = \boxed{}$ ← **Subtract** $\boxed{}$ **from both sides.**

$x = \boxed{}$ ← **Divide each side by** $\boxed{}$.

Step 3 Substitute $\boxed{}$ for x in either equation and solve for $\boxed{}$.

$$5x + y = 5$$

$5 \cdot \boxed{} + y = 5$ ← **Substitute** $\boxed{}$ **for x.**

$\boxed{} + y = 5$ ← **Simplify.**

$y = \boxed{}$ ← **Subtract** $\boxed{}$ **from both sides.**

Check Replace x with $\boxed{}$ and y with $\boxed{}$ in each equation.

$$3x + 5y = -8 \qquad\qquad 5x + y = 5$$

$3 \cdot \boxed{} + 5 \cdot \boxed{} \stackrel{?}{=} -8 \qquad 5 \cdot \boxed{} + \boxed{} \stackrel{?}{=} 5$

$\boxed{} = \boxed{} \checkmark \qquad\qquad \boxed{} = \boxed{} \checkmark$

The solution of the system is $\boxed{}$.

EXAMPLE **Application: Phone Plans**

❸ Nia's phone plan costs $42 per month plus $.20 per text. Rick's phone plan costs $45 per month plus $.10 per text. For what number of texts will their plans cost the same per month? What will the monthly cost be?

Step 1 Write a system of equations. Let $x = $ the number of texts and $y = $ the cost per month.

$y = 42 + 0.2x$ ← **Cost of Nia's plan**
$y = 45 + 0.1x$ ← **Cost of Rick's plan**

Step 2 $42 + 0.2x = 45 + 0.1x$ ← **Substitute $42 + 0.2x$ for y in the second equation.**

$0.1x = 3$ ← **Subtraction Property of Equality.**

$x = 30$ ← **Divide each side by 0.1.**

Step 3 $y = 42 + 0.2(30)$ ← **Substitute 30 for x in either equation.**

$y = 48$ ← **Simplify.**

For 30 texts per month, both plans will cost $48.

More Than One Way

Solve the linear system.

$$-x + y = 5$$
$$\tfrac{1}{2}x + y = 8$$

Jasmine's Method

I can solve the system by substitution. First, I can solve the equation $-x + y = 5$ for y to get $y = x + 5$.

$\tfrac{1}{2}x + y = 8$	← Write the second equation.
$\tfrac{1}{2}x + (x + 5) = 8$	← Substitute $x + 5$ for y.
$\tfrac{3}{2}x + 5 = 8$	← Simplify.
$\tfrac{3}{2}x = 3$	← Subtract 5 from each side.
$x = 2$	← Divide each side by $\tfrac{3}{2}$.

Now I can substitute 2 for x in either equation and solve for y.

$-x + y = 5$	← Write the first equation.
$-(2) + y = 5$	← Substitute 2 for x.
$y = 7$	← Add 2 to each side.

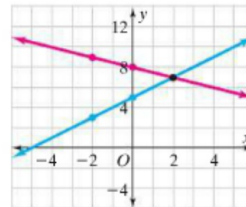The solution of the system is $(2, 7)$.
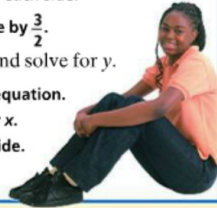
Kevin's Method

I can solve the system by graphing. I can make a table for each equation in the system. Then I can graph the lines.

$-x + y = 5$	
x	y
-5	0
0	5
5	10

$\tfrac{1}{2}x + y = 8$	
x	y
-2	9
0	8
2	7

The solution of the system is $(2, 7)$.

Power down your clickers and put them away.

You have a practice worksheet, due tomorrow.

Practice 5-2

Solving Systems by Substitution

Solve each system of equations using substitution. Check your answer.

1. $y = x - 2$
$-2x + 3y = -1$

_____

2. $3y - 2x = 0$
$y = 4x - 1$

_____

3. $x - 3y = -13$
$4x + 2y = 4$

_____

4. $2y - \frac{3}{4}x = -10$
$y + \frac{1}{4}x = 0$

_____

5. A gym charges a one-time registration fee as well as a monthly fee. The cost of joining the gym for 4 months is $370, and the cost of joining for 6 months is $530. Write and solve a system of equations to find the registration fee and monthly fee.

_____

_____

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