Math Virtual Learning

Grade 8
Solving Equations: Variables on Both Sides
May 11, 2020
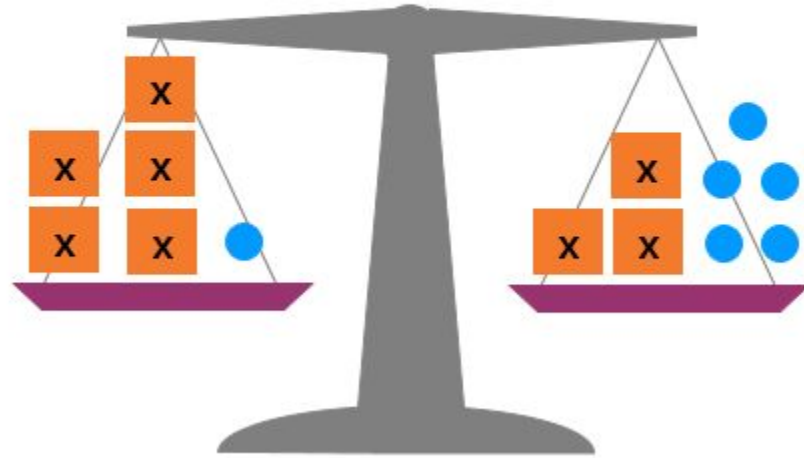
Math 8
Lesson: May 11, 2020

Objective/Learning Target:
I can solve equations with variables on both sides (including combining like terms and distributive property & number of solutions).

Warm-Up:

The picture below can represent an equation. If the right side is equal to 3x + 5, write the left side and solve for x.
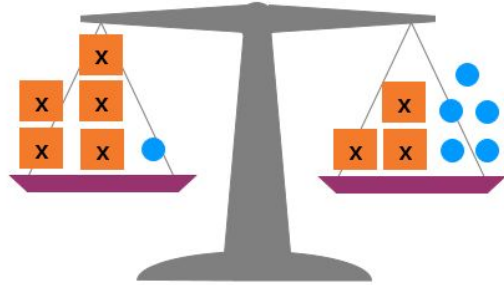

?   **=**   **3x + 5**

5x + 1   =   3x + 5

-3x   -3x
_____

2x + 1   =   5

      -1   -1
_____

2x   =   4
___   ___
2   2
_____

        x   =   2

Check Step:

5(2) + 1 = 3(2) + 5
10   + 1 =   6   + 5
    11   =   11
          ⭐

Video:

Take notes on a piece of paper as you watch this video.

$$5(y - 4) = 7(2y + 1)$$

Review: Multi-Step Equations

$$5(p - 4) + 5p = -100$$

5p − 20 + 5p = − 100

10p − 20 = − 100
    +20   + 20

10p = − 80

10 / 10

p = − 8

① **Distribute**. (Multiply the outside term to each term inside the parentheses.)
5 multiplied by p and 5 multiplied by − 4

② **Combine Like Terms**. (Number terms can be combined with other number terms on the <u>same side of the equal sign</u>. Variable terms can be combined with other variable terms on the <u>same side of the equal sign</u>.)
5p can be combined with 5p on the left side

③ **Add or Subtract** on <u>both sides</u> of the equal sign. (Use the correct <u>inverse</u> <u>operation</u> to isolate the variable.)
The inverse of − 20 is + 20, so add 20 to both sides

④ **Multiply or Divide** on <u>both sides</u> of the equal sign. (Use the correct <u>inverse operation</u> to solve.)
10p means 10 x p,   so divide by 10 on both sides

⑤ Plug your answer back in to **check**.   *(See next slide)*

Review: Check Step

$$5(p - 4) + 5p = -100$$

5(**−8** −4) + 5(**−8**) = −100

5(−12) + 5(−8) = −100

− 60   + −40 = −100

−100   = −100

① **Plug in your answer** for each variable.
Where there is a p, we will instead put − 8

② **Solve using Order of Operations**. (PEMDAS)
Parentheses: combine − 8 and − 4.

Multiply: 5 times − 12   and   5 times − 8

Add/Subtract: − 60 + − 40   is equal to − 100

③ **If your <u>answers</u> <u>match</u> at the end, your solution is correct. If your answers do not match at the end, you have made a mistake somewhere.**
− 100   is equal to − 100

How To: Variables on Both Sides
Use basically the same steps, and always make sure to <u>keep</u> <u>the</u> <u>equation</u> <u>balanced</u>!

$$2x - 36 = -2 + 6(x - 7)$$

2x −36 = −2 +6x −42

2x −36 =   +6x −44
−2x   −2x
_____
−36 =   4x −44

① <mark>**Distribute**</mark>. **(Multiply the outside term to each inside term.)**
 6 times x   <u>and</u>   6 times −7

② <mark>**Combine Like Terms**</mark>. **(Number terms can be combined with other number terms on the <u>same side of the equal sign</u>. Variable terms can be combined with other variable terms on the <u>same side of the equal sign</u>.)**
 Right side: Combine −2 and −42

③ <mark>**Isolate the Variable**</mark>. **(Use the correct <u>inverse</u> <u>operation</u> to isolate the variable to only <u>one</u> side of the equal sign. You will need to add or subtract a variable term.)**
(You can subtract 2x or 6x from each side. Suggestion: subtract the smaller variable term.)
 Subtract 2x from <u>both sides</u>

How To: Variables on Both Sides   *cont'd*

$$2x - 36 = -2 + 6(x - 7)$$

2x   −36 = −2   +6x   −42

2x −36   =   +6x   −44

−2x   −2x
_____

   −36   =   4x   −44

  +44   +44
_____

   $\dfrac{8}{4}$ = $\dfrac{4x}{4}$

_____

   2 =   x

④ **Add or Subtract** on <u>both sides</u> of the equal sign. (Use the correct <u>inverse</u> <u>operation</u> to isolate the variable. You will need to add or subtract a number term.)
(Because the variable term is on the right side, we want to eliminate the number term from the right side.)
The inverse of negative 44 is positive 44.

Add 44 to both sides.

⑤**Multiply or Divide** on <u>both sides</u> of the equal sign. (Use the correct <u>inverse operation</u> to solve.)
4x means 4 times x,   so divide by 4 on both sides

⑥ **Plug your answer back in to check.**
2(2) − 36   = −2 + 6(2 −7)
4 − 36   = −2 + 6(−5)
− 32   = −2   −30
− 32   =   −32

Example 1: Equations with <u>One</u> Solution

7 + 2(x + 1) = -4x – 15

7 + 2x + 2 = -4x - 15

2x + 9 = - 4x - 15

- 2x   = -2x
_____

9 = -6x - 15

+15   +15
_____

24 = -6x

-6   -6
_____

-4 = x

<u>Steps</u>

1) **Distribute**
2) **Combine Like Terms**
3) **Isolate the Variable to One Side**
4) **Add/Subtract Number Term**
5) **Multiply/Divide to Solve**

6. *Don't forget to <u>check</u> your answer!*

Example 2: Equations with <u>Infinite</u> Solutions

$$-7(p-4)+7=35-7p$$

$$-7p+28+7=35-7p$$

$$-7p+35=35-7p$$

$$+7p \qquad\qquad +7p$$

$$\overline{\hphantom{xxxxx}}$$

$$35=35$$

When you get a true statement, it means every value of x will work in the problem. There are INFINITE SOLUTIONS.

<u>Steps</u>

1) **Distribute**
2) **Combine Like Terms**
3) **Isolate the Variable to One Side**
4) ~~Add/Subtract Number Term~~
5) ~~Multiply/Divide to Solve~~

Example 3: Equations with <u>No</u> Solution

$$-14 - 8p = -1(8p + 5) - 4$$

$$-14 - 8p = -8p \quad -5 \quad -4$$

$$-14 - 8p = -8p \qquad -9$$

$$\quad +8p \qquad +8p$$

$$-14 \quad = \quad -9$$

When you get an untrue statement, there is no value of x that will work in the problem. There is NO SOLUTION.

Steps

1) **Distribute**
2) **Combine Like Terms**
3) **Isolate the Variable to One Side**
4) ~~Add/Subtract Number Term~~
5) ~~Multiply/Divide to Solve~~

Practice 1:

Solve each equation, then identify the number of solutions.

① $13 - 8x = -(6x + 1)$

② $-(-7 - 2r) = 2r + 7$

③ $30 - n = 6(n + 5)$

④ $-2(6 - 6z) = 3z - 39$

⑤ $7v - 27 = 7(v - 4)$

⑥ $-3n + 10 = -3(n - 4)$

Practice 1:

① $13 - 8x = -(6x + 1)$

x = 7
One Solution

② $-(-7 - 2r) = 2r + 7$

2r = 2r
Infinite Solutions

③ $30 - n = 6(n + 5)$

n = 0
One Solution

④ $-2(6 - 6z) = 3z - 39$

z = −3
One Solution

⑤ $7v - 27 = 7(v - 4)$

−27 = −28
No Solution

⑥ $-3n + 10 = -3(n - 4)$

10 = 12
No Solution

Practice 2: Challenge Problems

Solve each equation, then identify the number of solutions.

① $2(8x + 7) = 7(6 + 2x)$

<u>Double</u> Distributive Property!

② $6 + 3(m + 5) = 3(m + 7)$

① $2(8x + 7) = 7(6 + 2x)$

x = 14
One Solution

② $6 + 3(m + 5) = 3(m + 7)$

3m = 3m
Infinite Solutions

Additional Resources:

Khan Academy Practice

IXL

Khan Academy fractions and decimals

Practice Distributive Property