2.2 Equations with Variables on Both Sides

Lesson Objectives

2.2 Equations with Variables on Both Sides

Press the tabs to view details.
### Lesson Objectives

- **A.CED.3**: I will demonstrate how an equation with variables on both sides, both with and without distributing can have “no solution” or an “all reals” solution.
- **A.REI.1**: I will solve a proportion by using cross multiplication.
- **A.REI.1**: I will explain each step in solving an equation with variables on both sides.
- **A.REI.3**: I will solve an equation with variables on both sides with and without distribution.
- **A.REI.3**: I will explain each step in solving an equation with variables on both sides.

### Standards

- **A.CED.3**: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
- **A.REI.1**: Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- **A.REI.3**: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

### Press the tabs to view details.

### Multi-Step Equations

**(variables on BOTH sides)**

1. Distribute
2. Combine like terms
3. Move all variables to one side
4. Move constants to the other side
5. Divide by coefficient
6. Simplify

### Press the tabs to view details.

### ALL REALS

2x + 4 = 2x + 4

Left side = Right side

0 = 0

all variables
AND
all constants cancel out
**NO SOLUTION**

\[
\frac{2x + 4}{m} = \frac{2x - 4}{m}
\]

Left side ≠ Right side

0 = some other number

all variables cancel out BUT all constants do NOT cancel out

---

**Solve each equation by SHOWING ALL WORK.**

1) \(66 - 2x = 4x\)

\[
\begin{align*}
+4x & \quad +4x \\
66 & = 6x \\
6 & = 6
\end{align*}
\]

\(x = 11\)

2) \(4x + 7 = 2x - 15\)

\[
\begin{align*}
-2x & \quad -2x \\
2x + 7 & = -15 \\
\frac{2x}{2} & = \frac{-22}{2} \\
\frac{x}{1} & = -11
\end{align*}
\]

\(x = -11\)

3) \(3(-z + 12) \leq 4(z - 5)\)

\[
\begin{align*}
-3z + 36 & \leq 4z - 20 \\
+3z & \quad +3z \\
36 & = 7z - 20 \\
+20 & \quad +20 \\
56 & = 7z \\
\frac{56}{7} & = \frac{7z}{7} \\
8 & \leq z
\end{align*}
\]

\(z \geq 8\)

4) \(6y = 6(y + 4)\)

\[
\begin{align*}
-6y & = 6y + 24 \\
-6y & = 6y + 24 \\
-6y & = 24 \\
\frac{20}{-6} & = \frac{24}{-6} \\
\frac{y}{1} & = 4 \\
y & = 1.2
\end{align*}
\]
Solve each equation by SHOWING ALL WORK.

5. \( \frac{3x - 2}{8} = \frac{x + 4}{4} \)
   
6. \( \frac{6x}{x} = \frac{4}{4} \)

7. \( 6x + 72 < 15x \)

8. \( 5y = 3(y - 2) \)

Solve each equation by SHOWING ALL WORK.

5. \( 8(x + 4) = 4(3x - 2) \)
   \( x^2 = \sqrt{36} \)
   \( x = 6 \) or \( x = -6 \)

6. \( \frac{9x}{x - 4} \)
   \( x = \pm 6 \)

7. \( 6x + 72 < 15x \)
   \( x > 10 \)

8. \( 5y + 3y - 6 \)
   \( y = -3 \)
Solve each equation by SHOWING ALL WORK.

7. $6x + 72 \leq 15x$
   
   $-6x
   \frac{72}{-9x} = \frac{9}{x}$
   
   $8 \leq x$
   
   $x \geq 8$

8. $5y = 3(y - 2)$
   
   $5y = 3y - 6$
   
   $2y = -6$
   
   $y = -3$

9. $4x - 10 = 2(2x + 5)$
   
   $4x - 10 = 4x + 10$
   
   $-10 = 10$
   
   NO Solution

10. $4x + 5 = 4x + 5$

   All Reals

11. $2x - 3 = 3x - 2$
   
   $4
   -4x
   2x = 1$
   
   $x = \frac{1}{2}$

12. $2p - 8p = 4(2p + 5)$
   
   $-6p
   2p + 8 = 4
   p = 20$
On Your Whiteboards

11. \( \frac{2x + 3}{4} = \frac{3x - 4}{5} \)
12. \( \frac{p}{2p} + \frac{6}{5} = \frac{4}{0} \)

5(2x + 3) = 4(3x - 4)
10x + 15 = 12x - 16
-10x

\( 15 = 2x - 16 \)
\( x = 15 + 16 \)
\( x = 31 \)

\( \frac{p}{2p + 5} = 4 \)
\( q = \frac{2q + 5}{2q} \)
\( q = 8q + 20 \)
\( -6q = 20 \)
\( q = 20 \)

\( \frac{2x}{2} = \frac{10}{2} \)
\( x = 5 \cdot 5 \)

a) \( 3y + 6 > 2y - 4 \)
b) \( 3(7 + 2w) \geq \frac{1}{2} (\text{2w} - 10w) \)

c) \( \frac{n}{18} = \frac{n - 3}{16} \)
On the Worksheet

Homework

1. $10x = 143 - x$
2. $4x + 2x - 3 = 21$
3. $3x + 5 - 5x < 14$
4. $6x + 6 > -x + 55$
5. \( 5x + 20 = 3x \)  
6. \( n + 8 = -4n + 53 \)  
7. \( 12 - 7n = 2n + 30 \)  
8. \( -9(d + 2) = 4(15 + d) \)  
9. \( 13 = -2(x - 8) \)  
10. \( 3(x - 1) = 3(x + 4) \)  
11. \( 4x - 5 < 2x + 17 \)  
12. \( 6u + 11 \geq 7u - 28 \)
13. \(-9 + 8w > 3w - 24\)

14. \(2x + 6 = 2x + 3\)

15. \(5x - 8 = 5x + 8\)

16. \(4x + 1 = 4x + 1\)

17. \(6(4 - 2h) = 4(5 - 3h)\)

18. \(3(2x - 2) = 6(x - 1)\)

19. \(6(3x + 9) = 9(2x + 1)\)
Round answers to the nearest tenth if necessary.

20. \( \frac{x + 3}{4} = \frac{x - 1}{3} \)  
21. \( \frac{x}{8} = \frac{2}{x} \)  
22. \( \frac{x + 3}{4} = \frac{2x - 5}{6} \)  
23. \( \frac{x - 4}{2} = \frac{x + 1}{9} \)  
24. \( \frac{15}{8x - 3} = \frac{-1}{2 + 2x} \)  
25. \( \frac{x}{4} = \frac{2x + 3}{15} \)  
26. \( \begin{array}{c} 4 \hline 5 \end{array} \)  
27. \( \begin{array}{c} 20 \hline 12 \end{array} \)
2.2 solve equations variables both sides ink.notebook

September 18, 2017

Answers:

1) $x = 13$  
3) $x > -4.5$  
5) $x = -10$  
7) $n = 2$  
9) $x = 1.5$  
11) $x < 11$

13) $w > 3$  
15) no solution  
17) no solution  
19) no solution  
21) $x = 4$ and $x = -4$

23) $x = 5.4$  
25) $x = 1.7$  
27) 10 and 2  
29) 8 and 5  
31) 4 and 3  
33) 5 and 3