

CH 2-4 Variables on both sides

Objective: to model real world situations that require an equation with variables on both sides

Warm - up
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Solving an Equation with Variables on Both Sides

What is the solution of $5x + 2 = 2x + 14$?

$$\begin{aligned} 5x + 2 &= 2x + 14 \\ 5x + 2 - 2x &= 2x + 14 - 2x && \text{Subtract } 2x \text{ from each side} \\ 3x + 2 &= 14 && \text{Simplify.} \\ 3x + 2 - 2 &= 14 - 2 && \text{Subtract 2 from each side.} \\ 3x &= 12 && \text{Simplify.} \\ \frac{3x}{3} &= \frac{12}{3} && \text{Divide each side by 3.} \\ x &= 4 && \text{Simplify.} \end{aligned}$$

Check $5x + 2 = 2x + 14$
 $5(4) + 2 \stackrel{?}{=} 2(4) + 14$ Substitute 4 for x .
 $22 = 22$ ✓ Simplify. The solution checks.

2-4 Solving Equations with the Variable on Each Side

Solve an equation with the variable on each side.

Isolate the variable

$$-2 + 10p = 8p - 1$$

Your Turn! Solve with your group

$$8 + 5s = 7s - 2$$

Solve by yourself
Show all your work and check

$$7k + 2 = 4k - 10$$

Got It?
1. a. -4

Solving an Equation with Grouping Symbols

What is the solution of $2(5x - 1) = 3(x + 11)$?

$2(5x - 1) = 3(x + 11)$	
$10x - 2 = 3x + 33$	Distributive Property
$10x - 2 - 3x = 3x + 33 - 3x$	Subtract $3x$ from each side.
$7x - 2 = 33$	Simplify.
$7x - 2 + 2 = 33 + 2$	Add 2 to each side.
$7x = 35$	Simplify.
$\frac{7x}{7} = \frac{35}{7}$	Divide each side by 7.
$x = 5$	Simplify.

Solve and
equation with
grouping
symbols.

$$\begin{array}{r|l}
 4(2r - 8) & = \frac{1}{7}(49r + 70) \\
 \hline
 8r - 32 & = 7r + 10 \\
 -7r & -7r \\
 \hline
 r - 32 & = 10 \\
 + 32 & + 32 \\
 \hline
 r & = 42
 \end{array}$$

Solve with your group

a) $4(2y + 1) = 2(y - 13)$

a. -5
b. 4

b) $7(4 - a) = 3(a - 4)$

Your turn!

$$\begin{array}{r|l} \frac{1}{3}(18 + 12q) & = 6(2q - 7) \\ \hline 6 + 4q & = 12q - 42 \\ \hline -4q & -4q \\ \hline 6 & = 8q - 42 \\ \hline +42 & +42 \\ \hline 48 & = 8q \\ \hline \underline{\quad} & \underline{\quad} \\ 8 & = 8 \\ \hline \underline{\quad} & \underline{\quad} \\ 6 & = q \end{array}$$

Identity Equation

An equation that is true for every possible value of the variable.

The two sides of the equal sign must be the same

$$3 = 3$$

No Solution Equation

An equation has no solution if there is no value of the variable that makes the equation true.

The two sides of the equal sign are not the same

$$3 = 4$$

no solution equation

$$\begin{array}{r|l} 2m + 5 & = 5(m - 7) - 3m \\ \hline 2m + 5 & = 5m - 35 - 3m \\ \hline 2m + 5 & = 2m - 35 \\ \hline -2m & -2m \\ \hline 5 & = -35 \end{array}$$

False statement
No solution

Your turn!


$$\begin{array}{r|l} 8(5c - 2) & = 10(32 + 4c) \\ \hline 40c - 16 & = 320 + 40c \\ \hline -40c & -40c \\ \hline -16 & = 320 \end{array}$$

no solution

Infinite solution

An Identity


An equation that is true for every value of the variable.

$$\begin{array}{l} 3(r + 1) - 5 = 3r - 2 \\ \text{Distributive Property} \quad 3r + 3 - 5 = 3r - 2 \\ \text{Reflexive Property of Equality} \quad 3r - 2 = 3r - 2 \end{array}$$


Your turn!

$$\begin{array}{l} 4(t + 20) = \frac{1}{5}(20t + 400) \\ 4t + 80 = 4t + 80 \end{array}$$

All real numbers
Infinite solutions



Concept Summary Solving Equations

Step 1 Use the Distributive Property to remove any grouping symbols. Use properties of equality to clear decimals and fractions.

Step 2 Combine like terms on each side of the equation.

Step 3 Use the properties of equality to get the variable terms on one side of the equation and the constants on the other.

Step 4 Use the properties of equality to solve for the variable.

Step 5 Check your solution in the original equation.

Problem 2 Using an Equation With Variables on Both Sides

Graphic Design It takes a graphic designer 1.5 h to make one page of a Web site. Using new software, the designer could complete each page in 1.25 h, but it takes 8 h to learn the software. How many Web pages would the designer have to make in order to save time using the new software?

Know
 • Current design time: 1.5 h per page
 • Time with new software: 1.25 h per page
 • Time to learn software: 8 h

Need
The number of pages the designer needs to make for the new software to save time

Plan
Write and solve an equation that models the situation.

Relate $\text{current design time} = \text{design time with new software} + \text{time to learn software}$

Define Let p = the number of pages the designer needs to make.

Write $1.5p = 1.25p + 8$

$$\begin{array}{l} 1.5p = 1.25p + 8 \\ 1.5p - 1.25p = 1.25p + 8 - 1.25p \quad \text{Subtract } 1.25p \text{ from each side.} \\ 0.25p = 8 \quad \text{Simplify.} \\ \frac{0.25p}{0.25} = \frac{8}{0.25} \quad \text{Divide each side by } 0.25. \\ p = 32 \quad \text{Simplify.} \end{array}$$

It will take the designer the same amount of time to make 32 Web pages using either software. The designer must make 33 pages or more in order to save time using the new software.

Get It?

