

SOLVING EQUATIONS

(ONE-STEP, TWO-STEP, & MULTI-STEP)

Objectives

- To solve multi- step equations by performing the inverse operations to both sides.
- To identify what properties are being used to simplify and solve equations.



Equations

An equation states that each side of the equal sign is equivalent.

Ex:

$$3 = 3$$

$$6 + 2 = 8$$

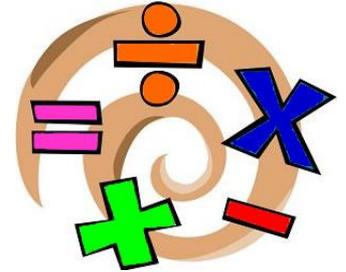
$$2.5 = \frac{5}{2}$$

$$x = 7$$



What happens to one side, , must happen to the other side.

Properties



- **Addition** Property of Equality

– If you add 5 to one side, you must add 5 to the other side:

$$3 = 3$$

$$3 + 5 = 3 + 5$$

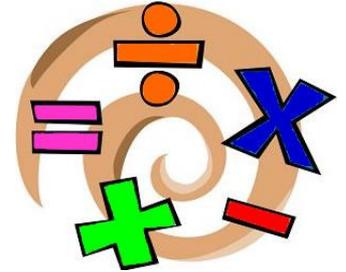
- **Subtraction** Property of Equality

– If you subtract 5 from one side, you must subtract 5 from the other side:

$$3 = 3$$

$$3 - 5 = 3 - 5$$

Properties



- **Multiplication Property of Equality**

– If you multiply by 5 to one side, you must multiply by 5 to the other side:

$$3 = 3$$

$$3 \cdot 5 = 3 \cdot 5$$

- **Division Property of Equality**

– If you divide by 5 from one side, you must divide by 5 from the other side:

$$3 = 3$$

$$\frac{3}{5} = \frac{3}{5}$$



Solving Equations



To solve an equation for an unknown variable, we use inverse operations.

We have to do the opposite!

- ***Addition*** and ***Subtraction*** are inverse operations.
- ***Multiplication*** and ***Division*** are inverse operations.



So remember...

**When you solve an
equation, you must
do the opposite
operation to
both sides!**

Why are we using inverse operations?

Your goal is *to isolate the variable*. This means you want to get the variable alone on one side of the equation.

Once the variable is isolated, you have your solution!



Examples of One-Step Equations

Solve each equation. State the property used.

1) $x + 15 = 18$

2) $-7 + w = -2$

3) $N - 6 = -9$

Property:

Property:

Property:

4) $2y = -10$

5) $\frac{2}{5}a = \frac{8}{15}$

6) $\frac{3}{10} = \frac{c}{5}$

Property:

Property:

Property:

Your Turn!

a) $m - 10 = 2$

b) $-9 = b - 5$

c) $\frac{2}{3}y = \frac{1}{4}$

Property:

Property:

Property:

Solving Two-Step Equations



1. Use the Addition or Subtraction Property of Equality to get the term with a variable alone on one side of the equation.
2. Use the Multiplication or Division Property of Equality to write an equivalent equation in which the variable has a coefficient of 1.

Examples

Solve each equation and state each property used.

1) $10 = \frac{m}{4} + 2$

2) $-b + 6 = -11$

You Try!



Solve each equation and state each property used.

a) $7 = 2y - 3$



b) $-x + 7 = 12$

You Try!

Solve each equation and state each property used.

c) $\frac{x}{9} - 15 = 12$

d) $6 - \frac{y}{3} = -2$



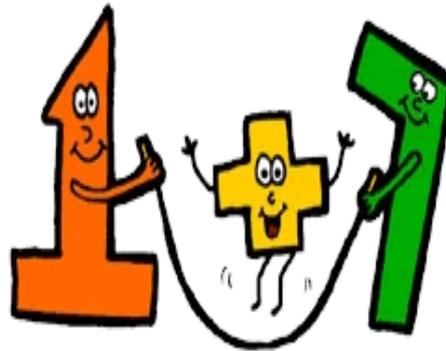
Solving Multi-Step Equations

1. Use the Distributive Property to eliminate parentheses
2. Clear the equation of fractions by multiplying by the denominator (optional step)
3. Combine like terms
4. “Undo” addition or subtraction
5. “Undo” multiplication or division

Examples: Solve each equation.

1. $2c + c + 12 = 78$

2. $2 - 2(b - 4) = 10$



You Try!

a. $-2y + 5 + 5y = 14$

b. $15 = 9 - 3(x - 1)$

Solving Equations with Variables on Both Sides

1. Clean up both sides of the equation individually (combine like terms and simplify).
2. Move all variables to one side of the equation.
3. Move everything else to the other side of the equation.
4. Solve for the variable!

Examples:

1. $n + 4n - 5 = 2n + 12 - 2n$

2. $38 - y = -3(4y + 2)$

You Try!

a. $2(c - 6) = 9c + 2$

b. $3(2x + 1) - x = 8 - 4x + 6$

State each property used to justify each step.

3. $4(n - 1) = 5n + 3 - 2n$

How was it used?

$$4n - 4 = 5n + 3 - 2n$$

.....

$$4n - 4 = 3n + 3$$

.....

$$\begin{array}{r} -3n \quad -3n \\ \hline \end{array}$$

$$n - 4 = 3$$

.....

$$\begin{array}{r} +4 \quad +4 \\ \hline \end{array}$$

$$n = 7$$

.....

c. Justify each step.

How was it used?

$$8 - 3(p - 4) = 2p$$

$$8 - 3p + 12 = 2p$$

$$20 - 3p = 12p$$

$$\begin{array}{r} +3p \quad +3p \\ \hline \end{array}$$

$$\frac{20}{15} = \frac{15p}{15}$$

$$\frac{4}{3} = p$$

.....

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Equivalent Expressions

You may be asked to provide an “equivalent expression” for any given expression. All steps while simplifying an expression are considered equivalent. Equivalent expressions are always equal in value same solution.

Take 10 minutes ...

- Make up a rap, song or funny quote about solving equations!
- Write down your rap, song or funny phrase then practice it with your group!
- Everyone has to present it!
- **BE CREATIVE**