Math-2

Lesson 1-2

Solving Single-Unknown Linear Equations

Linear Equation: an equation where all of the letters (either variables or unknown values) have NO EXPONENTS.

$4x - 2 = 6$ $2x + 3y = 6$

Previous Vocabulary

Solution to an equation: the value of the variables or unknown value that makes the equation "true".

Equivalent equation:

has the same solution as the original equation

$4x + 2 = 10$ $4x = 8$

The solution to both equations is $x = 2$.

They are equivalent equations.

Property of Equality

Only apply to equations!!!

"+, -, x, ÷" by the same number on both sides of the equal sign and you are guaranteed that the next equation is an equivalent equation.

"Math"	Justification why the math results in an equivalent equation
$x+3=7$	
$-3 \quad -3$	
$x + 0 = 4$	(1) Subtraction Property of Equality and (2) Inverse Property of Addition.
$x = 4$	(3) Identity Property of Addition.

One operation → rewrite and give your justification.

Your turn: solve the following equations using "one step—rewrite—justify"

$$-5 + x = 13$$
$$+5 \qquad +5$$

(1) Addition Property of Equality and (2) Inverse Property of Addition.

$$0 + x = 18$$

(3) Identity Property of Addition.

$$x = 18$$

$$-9 = x + 4$$
$$-4 \qquad -4$$

(1) Subtraction Property of Equality and (2) Inverse Property of Addition.

$$-13 = x + 0$$

(3) Identity Property of Addition.

$$-13 = x$$

Solve the following equations using "one step—rewrite—justify" Hint: gather x's to one side of the equal sign.

$$2x = x + 5$$

-x | -x

x = 0 + 5

x = 5

(1) Addition Property of Equality and (2) Inverse Property of Addition.

(3) Identity Property of Addition.

$$2x - 6 = x + 4$$

-x | -x

x – 6 = 0 + 4

x – 6 = 4

+6 | +6

x = 10

(1) Subtraction Property of Equality and (2) Inverse Property of Addition.

(3) Identity Property of Addition.

(5) Addition Property of Equality and (6) Inverse Property of Addition.

(7) Identity Property of Addition.

$2x = 12$ What property would we use here?

Inverse property of multiplication: turn the 2 into a one but we must also obey the properties of equality.

$$2x = 6$$
$$\div 2 \quad \div 2$$
$$1x = 3$$
$$x = 3$$

Are the two equations equivalent?

Are the two equations equivalent?

What property says that: 1x = x ?

Identity Property of Multiplication.

Your turn: solve the following equations using "one step—rewrite—justify"

$$
\begin{array}{rcl}
5x + 2 & = & 17 \\
-2 & & -2 \\
\hline
5x & = & 15 \\
\div 5 & & \div 5 \\
\hline
x & = & 3
\end{array}
$$

(1) Subtraction Property of Equality
(2) inverse property of addition,
(3) Identity property of addition

(4) Division property of equality
(5) Inverse Property of Multiplication
(6) Identity Property of Multiplication.

Turn coefficients into ones and addends into zeroes so that they disappear!

Could we have used the division property of equality first?

YES…but….

Your turn: solve the following equations using "one step—rewrite—justify"

$$\frac{5x+2}{5} = 17 \div 5$$

(1) division Property of Equality
(2) inverse property of multiplication,

$$1x + \frac{2}{5} = \frac{17}{5}$$

(3) Identity property of multiplication

$$x + \frac{2}{5} = \frac{17}{5}$$

$$-\frac{2}{5} \quad -\frac{2}{5}$$

(4) Subtraction Property of equality
(5) Inverse Property of addition
(6) Identity Property of addition.

$$x = \frac{15}{5}$$

(7) Equivalent values of the "3"

$$x = 3$$

Your turn: solve using “1 step—rewrite—justify” (identify the properties that you used)

1. $2 = 3 + x$

2. $12 – x = 3x$

3. $-27 = 2x – 3 + 2x$

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

5. $\frac{2x}{5} - 4 = -8$

6. $3x - 8 = 1$

The Distributive Property (of multiplication over addition)

When multiplying a factor and the sum of two or more addends, the factor can be distributed to each of the addends.

$2(x + 4) \rightarrow 2x + 2(4) \rightarrow 2x + 8$

Factor Addends

Your Turn: Use the distributive property to simplify the expression

$4(x + 5)$

$-3(x - 4)$

$5(3x - 2)$

Order of Operations!!

$5 + 2(x + 4) \rightarrow$ ______

$\rightarrow 5 + 2x + 8$

$\rightarrow 2x + 13$

$2x - 3(x - 1) \rightarrow$ ______

$\rightarrow 2x - 3x + 3$

$\rightarrow -x + 3$

$3 - 2(x + 5) \rightarrow$ ______

$\rightarrow 3 - 2x - 10$

$\rightarrow -2x - 7$

$4 - 3x - (-5x - 2) \rightarrow$ ______

$\rightarrow 4 - 3x + 5x + 2$

$\rightarrow 2x + 6$

Solving Equations using the Distributive Property

$$3(5x - 6) = 12$$

Can we use the addition property of equality to add '6' (left/right)?

$$3(5x - 6) = 12$$
$$+6 \quad +6$$
$$3(5x) = 18$$

Why not?

PEMDAS: you must multiply (to remove the parentheses) before you can subtract from the parentheses.

$$\rightarrow 15x - 18 = 12$$
$$+18 \quad +18$$
$$15x = 30$$
$$\div 15 \quad \div 15$$
$$x = 2$$

Another example

$$3(x-2)=4(-x+1)$$

→ $3x-6=4(-x+1)$

→ $3x-6=-4x+4$

+ 4x + 4x

7x – 6 = 4

+6 +6

7x = 10

7x = 10

÷ 7 ÷ 7

$$x=\frac{10}{7}$$

Solve

$$2(x+3)=2(2x-1)$$

$$-5(x+2)=(2x-7)$$

$$(x+3)-3(3x-2)=1$$

Solve the following equations

$$2x - 3 = 4 - 3(1 + 2x)$$

$$2(2x + 4) = 5 - (2x - 5)$$

$$3x - (2x - 3) = 5(2x - 3) - 3x$$

Solve for 'x'

$$4 + 2x + 4y = 6$$
$$-4 \qquad -4$$

$$2x + 4y = 2$$
$$-4y \qquad -4y$$

$$2x = 2 - 4y$$
$$\div 2 \qquad \div 2$$

$$x = \frac{2-4y}{2}$$

$$x = \frac{2}{2} - \frac{4y}{2}$$

$$x = 1 - 2y$$

Solve for the specified variable: Use properties of equality to rewrite the equation as an equivalent equation with the specified variable on one side of the equal sign and all other terms on the other side.

Another way to Solve for ‘x’

$$4 + 2x + 4y = 6$$

$\div 2 \quad \div 2$

$$2 + x + 2y = 3$$

$-2y \quad -2y$

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

$-2 \quad -2$

$$x = 1 - 2y$$

‘2’ is a <u>common factor</u> of each term

Solve for “x”

$$yx - 2 = 4$$

$+2 \quad +2$

$$yx = 6$$

$\div y \quad \div y$

$$x = \frac{6}{y}$$

<u>Solve for the variable</u>: Use properties of equality to rewrite the equation as an <u>equivalent</u> equation with the <u>specified</u> variable on one side of the equal sign and all other terms on the other side.

Your turn: Solve for ‘k’

$$2k-3m=5$$

$$\frac{7k-3y}{2}=4x$$

$$4m-3ky=7$$