Properties of Numbers

Question: Does 6 + 4 = 4 + 6? How about 9 (5) = 5 (9)?

Can you always change the order of multiplication or addition without affecting the outcome?

YES!

Key Concepts Commutative Properties of Addition and Multiplication

Changing the order of the values you are adding or multiplying does not change the sum or product.

Arithmetic	Algebra
$6 + 4 = 4 + 6$	$a + b = b + a$
$9 \cdot 5 = 5 \cdot 9$	$a \cdot b = b \cdot a$

Properties of Numbers

Question: Does (2 + 7) + 3 = 2 + (7 + 3)?
How about (9 * 4) 5 = 9 (4 * 5)?

Can you always change the grouping of multiplication or addition without affecting the outcome?

YES!

Key Concepts Associative Properties of Addition and Multiplication

Changing the grouping of the values you are adding or multiplying does not change the sum or product.

Arithmetic	Algebra
$(2 + 7) + 3 = 2 + (7 + 3)$	$(a + b) + c = a + (b + c)$
$(9 \cdot 4)5 = 9(4 \cdot 5)$	$(ab)c = a(bc)$

Riddle me this Batman:

What is the one number that when you add it to any other number it doesn't change a thing?

What is the one number that when you multiply it by any other number it doesn't change a thing?

These are called identities:

additive identity- 0, when you add a number and zero, the sum equals the original number

multiplicative identity - 1, when you multiply a number and 1, the product equals the original number

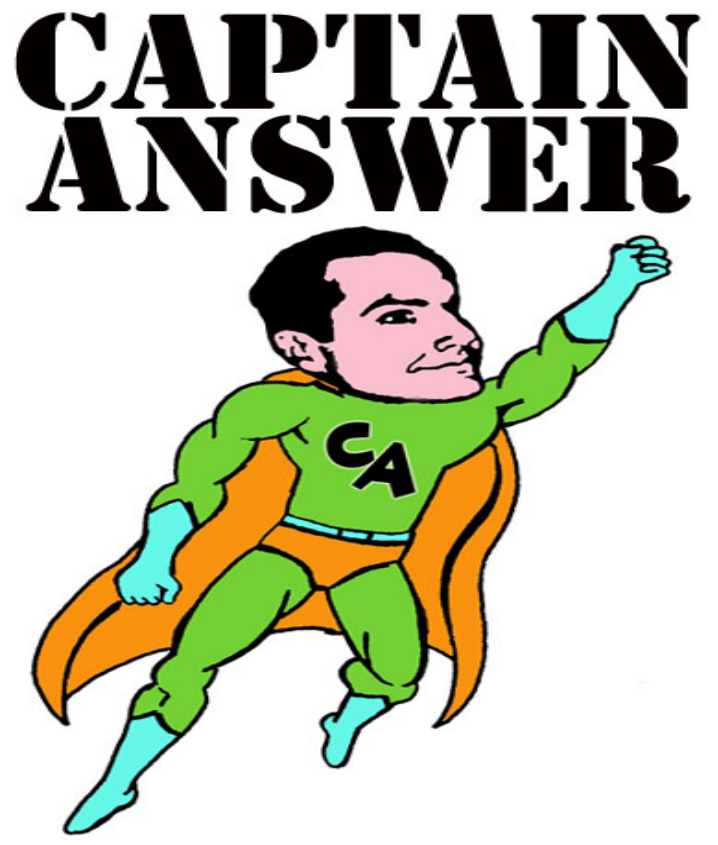
Can you identify the property?

a. $5 \cdot 7 = 7 \cdot 5$

b. $c \cdot 1 = c$

c. $7 + a = a + 7$

d. $5(xy) = (5x)y$



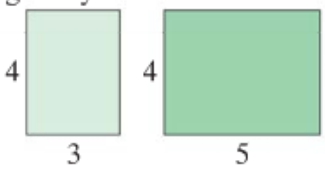
Give this a try with your partner...

Activity

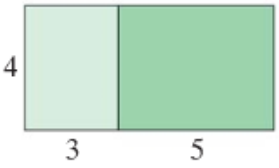
Exploring the Distributive Property

You can find the total area of two rectangles by two methods.

1. **Method 1:** Find the area of each rectangle. Then find the sum of the areas.



2. **Method 2:** Combine the two rectangles into one large rectangle. Find its length. Find its width. Then find its area.



3. On a piece of paper, draw two rectangles with the same width,and lengths different from those above. Label the dimensions. Repeat Method 1 and Method 2 with your pair of rectangles. What do you notice about your results?

Now for the Big Daddy of all properties...

THE DISTRIBUTIVE PROPERTY

Key Concepts Distributive Property

To multiply a sum or difference, multiply each number within the parentheses by the number outside the parentheses.

Arithmetic	Algebra
$3(2 + 6) = 3(2) + 3(6)$	$a(b + c) = ab + ac$
$(2 + 6)3 = 2(3) + 6(3)$	$(b + c)a = ba + ca$
$6(7 - 4) = 6(7) - 6(4)$	$a(b - c) = ab - ac$
$(7 - 4)6 = 7(6) - 4(6)$	$(b - c)a = ba - ca$

Simplifying Variable Expressions

Vocabulary:

term - a number of the product of a number and a variable; always seperated by a + or -

constant - a term that has no variable

like terms - have identical variables and must be combined to simplify

coefficient - a number that is multiplied with a variable

simplifying a variable expression - combine all like terms

deductive reasoning - the process of reasoning logically through a problem using what you know to reach a solution

Want an example?

there are 4 terms total

the constants are +6 and +7

$-2x + 6 - x + 7$

the coefficients are -2 and -1

the like terms are -2x and -x, +6 and +7, because they are like, they can be combined

$3x + 2 - 4r + 8x$

How many terms are there?

How many constants are there?

Are there any like terms? What are they?

Are there any coefficients?

Can this expression be simplified?

More on like terms...

Remember!

- Any terms, like or unlike can be MULTIPLIED and DIVIDED !
- Only like terms can be ADDED or SUBTRACTED !

For example:

$a + 2a = 3a$ ← terms can be combined because they are like

terms cannot be combined because they are unlike → $a + 2b = a + 2b$

$a(2a) = 3a$ ← like terms can be multiplied

unlike terms can be multiplied too → $a(2b) = 2ab$

Variables and Equations

Vocabulary:

equation - a mathematical sentence with an equal sign

solution of an equation - a value for a variable that makes an equation true

open sentence - an equation with one or more variables

Objectives:

1. *Classifying equations - true, false, or open sentence*
2. *Writing equations from word problems*
3. *Checking equations using substitution*

Classifying Equations

Tell if the following equations are true, false, or open sentence :

$22 + 10 = 34$

ANSWER!

$139 = 2x - 15$

ANSWER!

$-36 - 6 = -42$

ANSWER!

Writing equations from word problems

Nine times the opposite of five is forty-five.

Twenty minus x is three.

Checking equations using substitution

Is 30 a solution of the equation $170 + x = 200$?

Is the given number a solution of the equation?

$8 + t = 2t; 1$

$9 - m = 3; 6$

Solving Equations by Adding or Subtracting

Vocabulary:
inverse operations - performing the opposite operation to a number to "zero" or "cancel" it out

When solving equations, your goal is to ISOLATE THE VARIABLE to find out its value.

For example...

$$x + 7 = 10$$

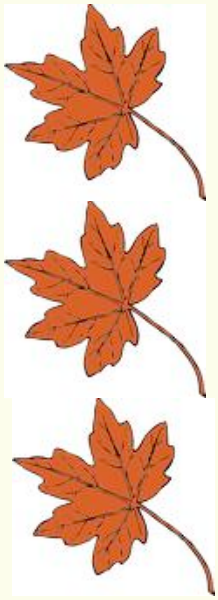
If your goal is to isolate the variable, in this case x, what number needs to go away?

How would you get rid of it, or undo it, or cancel it out?

Think of equations as a scale...
you have to keep it balanced for the two sides to remain equal!

Solve the equation:

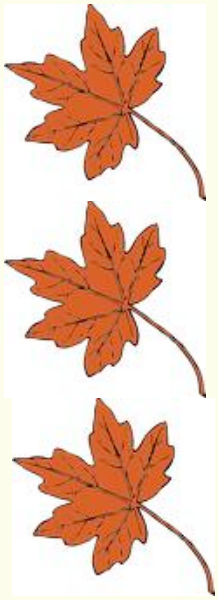
$6 + t = 28$



Pull Me!

Solve the equation:

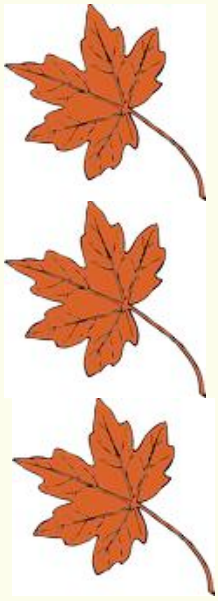
$$m - 8 = -14$$



Pull Me!

Solve the equation:

$p - (-13) = -10$



Pull Me!

Solving Equations by Multiplying or Dividing

Remember!

In this lesson we are still working on solving equations. We still have the same goal--to ISOLATE THE VARIABLE to solve for its value. We still have to perform INVERSE OPERATIONS to do that.

So what's the opposite of multiplication?

DIVISION

What's the opposite of division?

MULTIPLICATION

Therefore, if an equation has multiplication in it, we want to divide to solve. If an equation has division in it, we multiply to solve!

Let's work some examples...

$4x = 84$

What is happening in this equation?

How do we "undo" that operation?

So what do we want to do?

Pull for the work to this problem!

$5r = -20$

What is happening in this equation?

How do we "undo" that operation?

So what do we want to do?

Pull for the work to this problem!

$\frac{x}{-9} = -3$

What is happening in this equation?

How do we "undo" that operation?

So what do we want to do?

Pull for the work to this problem!

$$-30 = \frac{x}{20}$$

What is happening in this equation?

How do we "undo" that operation?

So what do we want to do?

Pull for the work to this problem!

Properties Revisited:

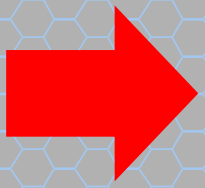
Now that you've learned how to solve equations using addition, subtraction, multiplication and division, you have added four new properties to your list!

Previous properties:

1. Commutative Property of Addition & Multiplication
2. Associative Property of Addition & Multiplication
3. Identity Property of Addition & Multiplication
4. Distributive Property

New properties:

5. Subtraction Property of Equality
6. Addition Property of Equality
7. Multiplication Property of Equality
8. Division Property of Equality



Need more info on these? It's coming on the next page!

ALL OF THESE PROPERTIES WILL BE ON YOUR TEST!!!

New Properties:

Addition Property of Equality

- If you add the same number to each side of an equation, the two sides will remain equal.

Subtraction Property of Equality

- If you subtract the same number from each side of an equation, the two sides will remain equal.

Multiplication Property of Equality

- If you multiply each side of an equation by the same number, the two sides will remain equal.

Division Property of Equality

- If you divide both sides of an equation by the same number, the two sides will remain equal.