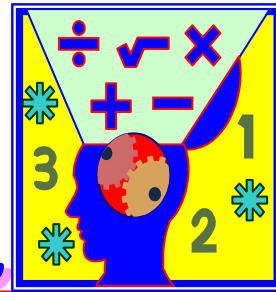


# Algebra Connections



Mr. Breitsprecher's Edition

January 24, 2005

FREE!



# Properties of Real Numbers

If you learn these properties, they will help you solve problems in algebra. Let's look at each property in detail, and apply it to an algebraic expression.

**Commutative Properties.** The commutative property of addition says that we can add numbers in any order. The commutative property of multiplication is very similar. It says that we can multiply numbers in any order we want without changing the result.

### Addition

$$5a + 4 = 4 + 5a$$

### Multiplication

$$3 \times 8 \times 5b = 5b \times 3 \times 8$$

**Associative Properties.** Both addition and multiplication can actually be done with two numbers at a time. So if there are more numbers in the expression, how do we decide which two to "associate" first? The associative property of addition tells us that we can group numbers in a sum in any way we want and still get the same answer. The associative property of multiplication tells us that we can group numbers in a product in any way we want and still get

the same answer.

### Addition

$$(4x + 2x) + 7x = 4x + (2x + 7x)$$

### Multiplication

$$2x2(3y) = 3y(2x2)$$

### Distributive Property.

The distributive property comes into play when an expression involves both addition and multiplication. A longer name for it is, "the distributive property of multiplication over addition." It tells us that if a term is multiplied by terms in parenthesis, we need to "distribute" the multiplication over all the terms inside.

$$2x(5 + y) = 10x + 2xy$$

Even though order of operations says that you must add the terms inside the parenthesis first, the distributive property allows you to simplify the expression by multiplying every term inside the parenthesis by the multiplier. This simplifies the expression.

**Identity Property.** The identity property for addition tells us that zero added to any number is the number itself. Zero is called the "additive identity." The identity property for multiplication tells us that the number 1 multiplied times any number gives the number itself. The number 1 is called the "multiplicative identity."

### Addition

$$5y + 0 = 5y$$

### Multiplication

$$2c \times 1 = 2c$$

**Inverses.** Two numbers that are the same distance from 0 on the number line but lie on opposites of zero are called "opposites" or "additive inverses." Also, for each real number, a, there exists another number, 1/a. The product of these number equals 1. (Note: the fraction a/a simplifies as 1.) Often, the term "reciprocal" is used.

### Addition

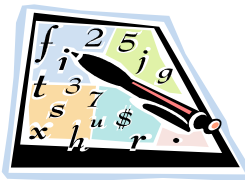
$$7 + -7 = 0$$

### Multiplication

$$3 * 1/3 = 1$$

Source: www.math.com

# Order of Operations



In algebra, we often work with expressions. Simplify expressions in the following order. If group symbols are present, simplify expressions within those first, starting with the innermost set. Also, simplify the numerator and the denominator of a fraction separately. Then:

1. Simplify exponential expressions.
2. Multiply or divide in order from left to right
3. Add or subtract in order from left to right.

### Try it - You'll Like It!

Here are some examples - I have kept the numbers "small," so we can just focus on the order of operations.

1.  $9 \div 3 + 4 * 7 - 20 \div 5 =$
2.  $23 - [(12 - 3) - 5] =$

3.  $25 - \{15 - [3(4 - 2) - 6]\} =$
4.  $(16 + 4) - (18 - 13) =$
5.  $(8 + 3)(14 - 6) =$
6.  $8 + 11 * 3 - 4 =$
7.  $2\{6[(5 - 2) - 2] + 4\} =$
8.  $27 - 14 \div 2 =$
9.  $5 + 3[4 + (8 - 5)] =$
10.  $5^2(4 - 3) * 2 + 1^6 =$
11.  $3(4 + 2) - \{7 - [4 - (6 + 5)]\} =$
12.  $10 - (8 + 2) + 3(6 - 4) =$
13.  $2\{6[(5 - 2) - 2] + 4\} =$
14.  $25 - \{15 - [3(4 - 2) - 6]\} =$
15.  $5 + [7 - (2 + 1)] =$
16.  $[11 - (9 - 5)] - 4 =$
17.  $2\{5 + 3\}[14 - (6 + 2)] =$
18.  $18 - \{5 + [14 - (6 + 2)]\} =$
19.  $-2 + 9 - (-9) * (-2) - 6 * (-2) =$
20.  $3[4 + (3 - 1)] + 5[12 - (8 + 2)] =$

# Mr. Breitsprecher's "Tech Connect"

## Properties of Real Numbers

### Does MS Excel Know the Order of Operations? YES!!!

Spreadsheets are powerful mathematical tools. Not only will it organize and keep track of data, but it can perform a variety of operations. Users may either "insert" a variety of preset functions or create their own formulas. To let Excel know you expect it to "do math" (create a formula) you need start your cell with an equal sign (=).

Addition, plus sign (+)	= 5+2	result 7
Subtraction, hyphen (-) (also used for negative)	= 5-2	result 3
Multiplication, asterisk (*)	= 5*2	result 10
Division, slash (/)	= 5/2	result 2.5
Power, chevron (^)	= 5^2	result 25

There are several operands to use for logic comparisons:

Greater than, greater than sign (>)	=5>2	result TRUE
Less than, less than sign (<)	=5<2	result FALSE
Equal to, equal sign (=)	=5=2	result FALSE
Not equal to, Greater & Less than signs (<>)	=5<>2	result TRUE

Microsoft Excel respects the Order of Operations and performs them in the following sequence:

Parenthesis  
 Powers  
 Multiplication and Division  
 Addition and Subtraction

This means with an equation such as  $=5+3*2$ , Excel will do the multiplication  $3*2$  before it does the addition. The result would be 11. If you wanted the addition to happen first, you would have to use parentheses such that  $=(5+3)*2$ , giving you a result of 16.

Unlike traditional math, you should not use the square brackets, such as  $[(5+3)*(4-2)]$  for separations, ONLY use parenthesis, such as  $=(5+3)*(4-2)$ , result 16.

Try it yourself! Using the information provided, can you create a formula that will "check" our results? Here are some examples of "formulas" using the Excel's syntax. If you follow these examples from the exercise we looked at earlier, you can use Excel to verify that you BOTH understand the Order of Operations!

### Order of Operations: Examples of Excel Formulas

- |                           |                                 |
|---------------------------|---------------------------------|
| 1. $=9/3+4*7-20/5$        | 11. $=3*(4+2)-(7-(4+(6+5)))$    |
| 2. $=23-((12-3)-5)$       | 12. $=10-(8+2)+3*(6-4)$         |
| 3. $=25-(15-(3*(4-2)-6))$ | 13. $=2*(6*((5-2)-2)+4)$        |
| 4. $=(16+4)-(18-13)$      | 14. $=25-(15-(3*(4-2)-6))$      |
| 5. $=(8+3)*(14-6)$        | 15. $=5+(7-(2+1))$              |
| 6. $=8+11*3-4$            | 16. $=(11-(9-5))-4$             |
| 7. $=2*(6*((5-2)-2)+4)$   | 17. $=2*(5+3*(14-(6+2)))$       |
| 8. $=2*(6*((5-2)-2)+4)$   | 18. $=18-(5+(4*(5-2)-7))$       |
| 9. $=5+3*(4+(8-5))$       | 19. $=-2+9--9*-2-6*-2--4$       |
| 10. $=5^2*(4-3)*2+1^6$    | 20. $=3*(4+(3-1))+5*(12-(8+2))$ |

### Symbols & Sets of Numbers

Beginning Algebra will be much easier if we start with an agreement of definitions and symbols as they relate to numbers. It won't be any fun to go back and review this as we move forward, so here are some concepts that will "pop-up" from time to time in our class.

**Set.** A collection of objects, called elements or members, enclosed in braces {a,b,c}

**Natural Numbers.** {1,2,3,4...}

**Whole Numbers.** {0,1,2,3,4...}

**Integers.** {...,-3,-2,-1,0,1,2,3...}

**Rational Numbers.** {real numbers that can be expressed as a quotient of integers}

**Irrational Numbers.** {real numbers that cannot be expressed as a quotient of integers}

**Real Numbers.** {all numbers that correspond to a point on the number line}

**Number Line.** A line used to picture numbers (please see test examples on page 23)

**Absolute Value.** The distance between a and 0 on the number line. Expressed as  $|a|$

All semester, we will work with the following symbols. They are presented here for the same reason; it will be much easier to get an agreement of them now.

= is equal to  
 $\neq$  is not equal to  
 > is greater than  
 < is less than  
 $\leq$  is less than or equal to  
 $\geq$  is greater than or equal to

**Order Property of Real Numbers.** For any 2 real numbers a and b, a is less than b if a is to the left of b on the number line.

### Examples

$-3 < 0$   
 $0 > -3$   
 $0 < 2.5$   
 $2.5 > 0$

I remember a teacher explaining these symbols to me as "the mouth of a whale." Because the whale is hungry, it always is about to eat the larger of the 2 numbers; the whale has already eaten the smaller number and is still hungry!

