

Order of Operations and Properties of Numeric Operations

Order of Operations

Please Excuse My Dear Aunt Sally

1. Parentheses
2. Exponents
3. Multiplication/Division (left to right)
4. Addition/Subtraction (left to right)

Example:

$$\begin{aligned} & \mathbf{(6 + 3)^2 - 7 \times 2 + 8} \\ & = \mathbf{9^2 - 7 \times 2 + 8} && \mathbf{1. parentheses} \\ & = \mathbf{81 - 7 \times 2 + 8} && \mathbf{2. exponents} \\ & = \mathbf{81 - 14 + 8} && \mathbf{3. multiplication and division} \\ & = \mathbf{67 + 8} && \mathbf{4. addition and subtraction} \\ & = \mathbf{75} \end{aligned}$$

Example:

$$\begin{aligned} & 3 + 3^2 - (3 + 2 \times 4) \times 2 + 20 / 2 \\ & 3 + 3^2 - (3 + 8) \times 2 + 20 / 2 \\ & 3 + 3^2 - (11) \times 2 + 20 / 2 \\ & 3 + 9 - (11) \times 2 + 20 / 2 \\ & 3 + 9 - 22 + 20 / 2 \\ & 3 + 9 - 22 + 10 \\ & 22 - 22 = 0 \end{aligned}$$

Associative and Commutative Properties

Just like you associate with your friends, the **associative property** is about who hangs out with whom. Look for a **change in the grouping**, not the order. Parentheses will give the clue!

$$(a + b) + c = a + (b + c)$$

$$(ab)c = a(bc)$$

Examples:

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

$$1 + 5 = 3 + 3$$

$$6 = 6$$

$$(2 \cdot 3)4 = 2(3 \cdot 4)$$

$$6 \cdot 4 = 2 \cdot 12$$

$$24 = 24$$

Think about your commute back and forth to school to remember the **commutative property**. This is a **change in the order** of the numbers.

$$a + b = b + a$$

$$ab = ba$$

Examples:

$$2 + 3 = 3 + 2$$

$$5 = 5$$

$$2 \cdot 3 = 3 \cdot 2$$

$$6 = 6$$

Both associative and commutative properties are true only for addition and multiplication.

Distributive Property

$$a(b+c) = ab+ac$$

This property allows us to get rid of parentheses by distributing the multiplier outside the parentheses evenly to every term inside the parentheses.

Example:

$$3(2+5) = 3 \cdot 2 + 3 \cdot 5$$

3 times 2 3 times 5

$$3 \cdot (4+1) = 3 \cdot 4 + 3 \cdot 1$$

12 + 3

15

$$-5(x+9) = -5$$
$$-5x - 45 = -5$$