

# Properties



What are the mathematical laws?

$$A + B = B + A$$

Ex.  $3 + 4 = 4 + 3$

(“commute = move to new place”)

$$3 - 4 = 4 - 3$$

$$-1 \neq 1$$

----- Commutative ----- property of addition

$$AB = BA$$

Ex.  $3(4) = 4(3)$

----- Commutative ----- property of multiplication

("regroup – elements do not move, they group with a new friend")

$$A + (B + C) = (A + B) + C$$

Ex.  $2 + (3 + 4) = (2 + 3) + 4$

$$A + (B+C) = (B+C) + A$$

----- Associative ----- property of addition

$$A(B \cdot C) = (A \cdot B) \cdot C$$

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

----- Associative ----- property of multiplication

(“multiplication distributes over addition/subtraction”)

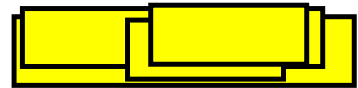
$$A(B + C) = AB + AC$$

Ex.  $2(3 + 4) = 2(3) + 2(4)$

-----Distributive----- property



An \_\_\_\_\_ identity \_\_\_\_\_ is something that is done to a number so the number stays the \_\_\_\_\_ same \_\_\_\_\_.



Ex.  $5 + 0 = 5$

The additive identity element is ZERO because if you add it to any number, the number stays the same.

Ex.  $5 (1) = 5$

The multiplicative identity element is ONE because if you multiply it to any number, the number stays the same.

An INVERSE of a number is something that is combined with that number so the result is the identity.

$$\text{Ex. } 5 + (-5) = 0$$

The additive inverse of the number is the OPPOSITE of the number.

$$\text{Ex. } 4\left(\frac{1}{4}\right) = 1 \quad \frac{4}{1} \cdot \frac{1}{4} = 1$$

The multiplicative inverse of a number is the reciprocal of the number.

$$\frac{5}{1} \cdot \frac{1}{5} = 1 \quad \frac{3}{4} \cdot \frac{4}{3} = 1$$



("zero times any element is 0")

$$a \cdot 0 = 0$$

$$4 \cdot 0 = 0$$



**Multiplicative Property of Zero**

Directions: Simplify each expression by showing and/or justifying each step.

EXAMPLE: Simplify and justify steps:  $20 + 4(x + 3y) - 4x - 8y - 12 + x$

(This is one possible solution.)

$$\begin{aligned}
 & *20 + 4(x + 3y) - 4x - 8y - 12 + x \\
 & 20 + 4x + 12y - 4x - 8y - 12 + x \\
 & 20 - 12 + 4x - 4x + x + 12y - 8y \\
 & (20 - 12) + (4x - 4x + x) + (12y - 8y) \\
 & (8) + (4x - 4x + x) + (12y - 8y) \\
 & 8 + x + y(12 - 8) \\
 & 8 + x + y(4) \\
 & 8 + x + 4y
 \end{aligned}$$

Given  
 Distributive Property  
 Commutative Property of Addition to align terms  
 Associative Property of Addition to group terms  
 Addition of Signed Numbers  
 Distributive Property in reverse  
 Addition of Signed Numbers  
 Commutative Property of Multiplication

1.  $3(x + 4) - 5(x - 2)$

$$3x + 12 - 5x + 10$$

$$3x - 5x + 12 + 10$$

$$x(3 - 5) + 12 + 10$$

$$x(-2) + 12 + 10$$

$$-2x + 12 + 10$$

$$-2x + 22$$

Given

Distributive Property \_\_\_\_\_

Commutative Property of Addition \_\_\_\_\_

Distributive Property in reverse \_\_\_\_\_

Addition of signed numbers \_\_\_\_\_

Commutative Property of Multiplication \_\_\_\_\_

Numerical addition \_\_\_\_\_



$$\begin{aligned}
 2. \quad & 4(a + 2b) - 3(2a - b) + 6a - 7b \\
 & 4a + 8b - 6a + 3b + 6a - 7b \\
 & 4a - 6a + 6a + 8b + 3b - 7b \\
 & a(4 - 6 + 6) + b(8 + 3 - 7) \\
 & a(4) + b(4) \\
 & 4a + 4b
 \end{aligned}$$

Given

Distributive Property \_\_\_\_\_

Commutative Property of Addition \_\_\_\_\_

Distributive Property in reverse \_\_\_\_\_

Addition of Signed Numbers \_\_\_\_\_

Commutative Property of Multiplication \_\_\_\_\_

$$\begin{aligned}
 3. \quad & 3a^2(2a^2 + 3) - 2(a^4 + 8) \\
 & 6a^4 + 9a^2 - 2a^4 - 16 \\
 & 6a^4 - 2a^4 + 9a^2 - 16 \\
 & a^4(6 - 2) + 9a^2 - 16 \\
 & a^4(4) + 9a^2 - 16 \\
 & 4a^4 + 9a^2 - 16
 \end{aligned}$$

Given

Distributive Property \_\_\_\_\_

Commutative Property of Addition \_\_\_\_\_

Distributive Property in reverse \_\_\_\_\_

Addition of Signed Numbers \_\_\_\_\_

Commutative Property of Multiplication \_\_\_\_\_

