



Law and Order

Number Properties of Algebra

Properties of EQUALITY



Properties of Equality

- ◆ Reflexive Property
- ◆ Symmetric Property
- ◆ Transitive Property
- ◆ Substitution Property

Reflexive Property

Any quantity is equal to itself!

Duh.....

$$3=3$$

$$x=x$$

$$2+3=2+3$$

$$5xy=5xy$$



Symmetric Property

The side of the equal sign doesn't matter!

Equal is Equal

$$a = b \text{ or } b = a$$

These are still equal.

$$\text{If } 60 = 30 + 30 \text{ then } 30 + 30 = 60$$

Transitive Property

If one quantity equals a second, and that second quantity equals a third, then the first also equals the third!

If $a = b$, and $b = c$,
then we can say $a = c$

Transitive

If

children = future

and

future = robots

then by the transitive property

children = robots

Transitive numerical example

$a = b$ and $b = c$ and $c = 6$

So $a = 6$

Substitution Property

A quantity can be “substituted” or “replaced” by its equal value in ANY expression.

If $2x+7 = y$ and $x=5$

You can replace x with 5

$$2(5)+7=y$$



Commutative Property

Order doesn't matter



Commutative Property of Addition

ORDER DOESN'T MATTER!

The order of addition does not change the answer.

$$1 + 2 + 4 = 4 + 1 + 2$$

$$a + b + c = c + a + b$$

Commutative Property of Multiplication

ORDER DOESN'T MATTER!

The order of multiplication does not change the answer.

$$1 \cdot 2 \cdot 4 = 4 \cdot 1 \cdot 2$$

$$a \cdot b \cdot c = c \cdot a \cdot b$$

$$xyz = zyx$$

WATCH OUT!!!

Do this work?

$$13 - 4 - 7 = 4 - 13 - 7$$

WATCH OUT!

SUBTRACTION DOESN'T WORK!

$$13 - 4 - 7 = 4 - 13 - 7$$

$$9 - 7 = -9 - 7$$

$$2 \neq -16$$



Associative Property

Grouping Doesn't Matter

Associative Property of Addition

You can regroup three or more terms when adding. The grouping (parenthesis) doesn't change the answer!

$$(3 + 4) + 5 = 3 + (4 + 5)$$

$$7 + 5 = 3 + 9$$

$$12 = 12$$

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

WATCH OUT

It doesn't work with subtraction or
division!

Associative Property of Multiplication

You can regroup three or more factors when multiplying. The grouping (parenthesis) doesn't change the answer!

$$(3 \cdot 4) \cdot 5 = 3 \cdot (4 \cdot 5)$$

$$12 \cdot 5 = 3 \cdot 20$$

$$60 = 60$$

$$a(b \cdot c) = (a \cdot b)c$$

Identity

ORGINIAL VALUE STAYS THE SAME!



STAYS THE SAME

Identity

ORGINIAL
VALUE STAYS
THE SAME!



An identity for a particular operation doesn't change the identity of the number when the operation is done.

Identity Property of Addition

You can ADD zero to any number and you will get the original number.

$$5 + 0 = 5$$

$$x + 0 = x$$

$$2x + 3y + 0 = 2x + 3y + 0$$

Identity Property of Multiplication

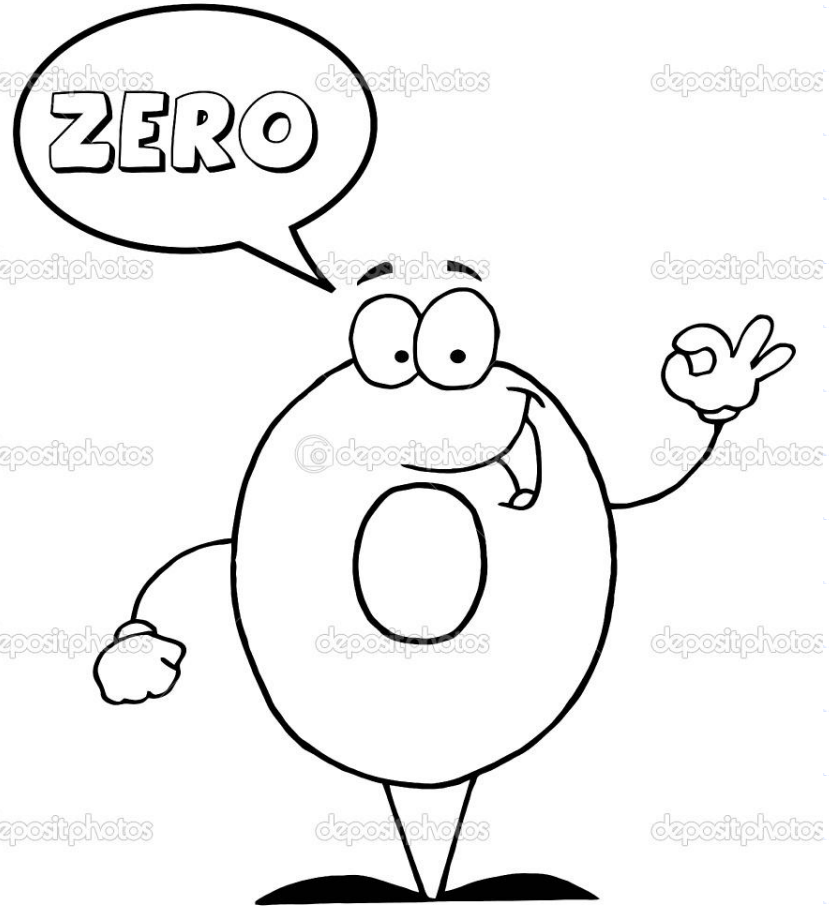
Any number multiplied by 1 will give you the original number.

$$12,357 \cdot 1 = 12,357$$

$$60(1) = 60$$

$$a(b \cdot c)(1) = a(b \cdot c)$$

ZERO PROPERTY

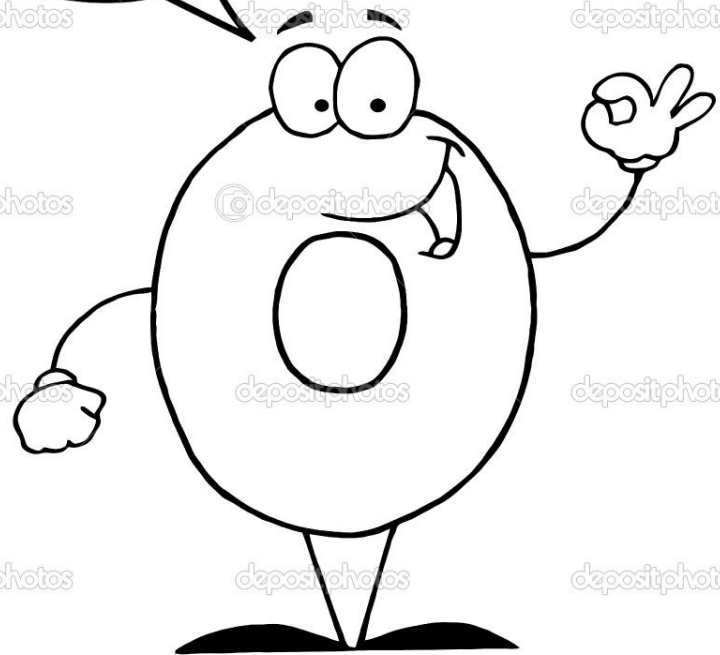


When any number is multiplied with zero, the answer is zero.

ZERO PROPERTY

$$(5x)(0) = 0$$

$$7652 \cdot 0 = 0$$



Additive Inverse

The number you add to get zero.

AKA: The Opposite

The answer to additive inverse is zero!

Ex: $6 + (-6) = 0$

Multiplicative Inverse

The number you multiply by to get 1

AKA: The Reciprocal

The answer to multiplicative inverse is 1!

$$6 \cdot \left(\frac{1}{6}\right) = 1$$

$$x \cdot \left(\frac{1}{x}\right) = 1$$



Distributive Property

Connecting Addition to
Multiplication



Distributive property

Multiplying a sum by some number is the same as multiplying each term by that same number.

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

$$8(7 + 2) = 8 \cdot 7 + 8 \cdot 2$$