

CHAPTER 1 SECTION 3

PROPERTIES OF REAL NUMBERS

AND THE USE OF EXPONENTS

A. CLOSURE PROPERTY

1. **ADDITION** - If A and B are real numbers, then $A + B$ is a unique real number
2. **MULTIPLICATION** - If A and B are real numbers, then AB is a unique real number.

These properties states that for every two real numbers that you add or multiply, you should get a different answer. In other words, $2 + 3 = 5$ every time that you add 2 and 3. The same thing applies when two real numbers are multiplied, $2 * 3 = 6$ always.

B. COMMUTATIVE PROPERTY

1. **ADDITION** - If A and B are real numbers, then $A + B = B + A$
2. **MULTIPLICATION** - If A and B are real numbers, then $AB = BA$

These properties state that if A and B are real numbers, then the order that you add or multiply these two numbers does not matter, their solution will be the same.

$$\begin{array}{lcl} 2 + 3 = 5 & \text{and} & 3 + 2 = 5 \\ 2 * 3 = 6 & \text{and} & 3 * 2 = 6 \end{array}$$

C. ASSOCIATIVE PROPERTY

1. **ADDITION** - If A, B, and C are real numbers, then $(A + B) + C = A + (B + C)$
2. **MULTIPLICATION** - If A, B, and C are real numbers, then $(AB) C = A (BC)$

These properties should not be confused with the commutative properties, even though the same principles apply. The associative property involves more than two values. The grouping signs indicate which values were combined first.

$$\begin{array}{l} (2 + 3) + 5 = 2 + (3 + 5) = (2 + 5) + 3 \\ (2 * 3) * 4 = 2 * (3 * 4) = (2 * 4) * 3 \end{array}$$

D. IDENTITY PROPERTY

1. **ADDITION** - If A is a real number, then $A + 0 = A$
2. **MULTIPLICATION** - If A is a real number, then
 $A * 1 = 1 * A = A$

These properties discuss the manner in which a value that you start with, A, can be part of a problem and be an answer at the same time. For addition, this is done by adding the value to zero. For multiplication, this is done by multiplying the value by one.

$$5 + 0 = 0 + 5 = 5$$

$$5 * 1 = 1 * 5 = 5$$

E. INVERSE PROPERTY

1. **ADDITIVE** - For every real number A, there exists a unique real number such that $A + (-A) = -A + A = 0$
2. **MULTIPLICATIVE** - For every non-zero real number A, there exists a unique number $\frac{1}{A}$ such that $A \left(\frac{1}{A}\right) = \left(\frac{1}{A}\right) A = 1$

The additive property states that if you add a number, A, to its opposite, -A, you get zero as a solution. The multiplicative property states that if you multiply a number, A, by its inverse (reciprocal), $\left(\frac{1}{A}\right)$, you will get one as a product.

F. MULTIPLICATION PROPERTY OF ZERO

If A is a real number, then $A * 0 = 0 * A$.

This property states that if you multiply a value by zero, the answer is always zero.

G. MULTIPLICATION PROPERTY OF NEGATIVE ONE

If A is any real number, then $A (-1) = -1 (A) = -A$.

This property states that if you multiply a number by -1 that you get its opposite for a result.

$$5 (-1) = -5 \qquad -7 (-1) = 7$$

H. DISTRIBUTIVE PROPERTY

If A, B, and C are real numbers, then $A(B \pm C) = AB \pm AC$.

This property states that if you multiply a quantity times a quantity of a sum or difference, the multiplication operation distributes over the operator.

$$\begin{aligned}2(3 + 5) &= (2)(3) + (2)(5) = 6 + 10 = 16 \\2(8) &= 16\end{aligned}$$

$$\begin{aligned}2(5 - 3) &= (2)(5) - (2)(3) = 10 - 6 = 4 \\2(2) &= 4\end{aligned}$$

I. EXPONENTS

Exponents are used to indicate repeated multiplication. Written in the format B^x , B stands for the *base* that is being multiplied by itself the amount of times equal to x , the *exponent*.

$$5^3 = 5 * 5 * 5 = 125 \text{ (A base of 5 multiplied by itself 3 times.)}$$

$$2^5 = 2 * 2 * 2 * 2 * 2 = 32 \text{ (A base of 2 multiplied by itself 5 times.)}$$