

Properties of Addition and Multiplication

For real numbers a , b , and c , the following properties hold.

Closure $a + b$ and ab are real numbers.

(when you add or multiply 2 real numbers, you always get a real number)

Commutative $a + b = b + a$ and $ab = ba$.

(you can add or multiply 2 real numbers in any order you want)

Associative $(a + b) + c = a + (b + c)$
 $(ab)c = a(bc)$

(when you add or multiply 3 numbers, you can group any 2 together then include the 3rd and get the same answer)

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Identity There is a real number 0 such that

$$a + 0 = a \text{ and } 0 + a = a.$$

There is a real number 1 such that

$$a \cdot 1 = a \text{ and } 1 \cdot a = a.$$

Think of the identity as looking in a mirror – you see your own reflection (identity). You get the same thing back at you!

0 is the **identity element** for addition.

1 is the **identity element** for multiplication.

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Inverse For each real number a , there is a single real number $-a$ such that $(-a) + a = a + (-a) = 0$.

Using the Inverse property gets you to the Identity element, which is zero for add/subtract and is 1 for multiply/divide.

For each nonzero real number a , there is a single real number $\frac{1}{a}$ such that $a \cdot \frac{1}{a} = \frac{1}{a} \cdot a = 1$.

$-a$ is the **additive inverse** (or *opposite*) of a .

$\frac{1}{a}$ is the **multiplicative inverse** (or *reciprocal*) of a .

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**Distributive Property
of Multiplication with
Respect to Addition**

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

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