

## Algebraic Properties [Axioms]

### 2009 Mathematics Standards of Learning

The algebraic properties listed apply given  $a$ ,  $b$ , and  $c$  are real numbers. This is not an exhaustive list of algebraic properties.

#### Field Properties

Property	Addition	Multiplication
<b>Associative</b>	$(a + b) + c = a + (b + c)$	$(ab)c = a(bc)$
<b>Commutative</b>	$a + b = b + a$	$ab = ba$
<b>Identity</b>	$a + 0 = a = 0 + a$	$a \cdot 1 = a = 1 \cdot a$
<b>Inverse</b>	$a + (-a) = 0 = (-a) + a$	$a \cdot \frac{1}{a} = 1 = \frac{1}{a} \cdot a$ , if $a \neq 0$
<b>Distributive</b>	$a(b + c) = ab + ac$ and $ab + ac = a(b + c)$	

#### Properties of Equality and Inequality

Property	Equality	Inequality
<b>Multiplicative Property of Zero</b>	$a \cdot 0 = 0 = 0 \cdot a$	
<b>Zero Product</b>	If $ab = 0$ , then $a = 0$ or $b = 0$ .	
<b>Reflexive</b>	$a = a$	
<b>Symmetric</b>	If $a = b$ , then $b = a$ .	
<b>Transitive</b>	If $a = b$ and $b = c$ , then $a = c$ .	If $a > b$ and $b > c$ , then $a > c$ . If $a < b$ and $b < c$ , then $a < c$ .
<b>Addition</b>	If $a = b$ , then $a + c = b + c$ .	If $a < b$ , then $a + c < b + c$ . If $a > b$ , then $a + c > b + c$ .
<b>Subtraction</b>	If $a = b$ , then $a - c = b - c$ .	If $a < b$ , then $a - c < b - c$ . If $a > b$ , then $a - c > b - c$ .
<b>Multiplication</b>	If $a = b$ , then $ac = bc$ .	If $a < b$ and $c > 0$ , then $ac < bc$ . If $a < b$ and $c < 0$ , then $ac > bc$ . If $a > b$ and $c > 0$ , then $ac > bc$ . If $a > b$ and $c < 0$ , then $ac < bc$ .
<b>Division</b>	If $a = b$ and $c \neq 0$ , then $\frac{a}{c} = \frac{b}{c}$ .	If $a < b$ and $c > 0$ , then $\frac{a}{c} < \frac{b}{c}$ . If $a < b$ and $c < 0$ , then $\frac{a}{c} > \frac{b}{c}$ . If $a > b$ and $c > 0$ , then $\frac{a}{c} > \frac{b}{c}$ . If $a > b$ and $c < 0$ , then $\frac{a}{c} < \frac{b}{c}$ .
<b>Substitution</b>	If $a = b$ , then $b$ can be substituted for $a$ in any equation or inequality.	