**Appendix D: Properties of Operations, Equality and Inequality** 

## **Properties of Operations**

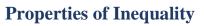
The table below illustrates the properties of operations. For each property, the variables a, b and c stand for arbitrary numbers in a given number system. The properties of operations apply to the rational number system, the real number system and the complex number system.

Property of Operation	Example
Associative property of addition	(a+b) + c = a + (b+c)
Commutative property of addition	a + b = b + a
Additive identity property of zero	a + 0 = a 0 + a = a
Existence of additive inverses	For every <i>a</i> there exists $-a$ so that $a + (-a) = 0$ and $(-a) + a = 0$ .
Associative property of multiplication	$(a \times b) \times c = a \times (b \times c)$
Commutative property of multiplication	$a \times b = b \times a$
Multiplicative identity property of one	$a \times 1 = a$ $1 \times a = a$
Existence of multiplicative inverses	For every $a \neq 0$ there exists $\frac{1}{a}$ so that $a \times \frac{1}{a} = 1$ and $\frac{1}{a} \times a = 1$ .
Distributive property of multiplication over addition	$a \times (b + c) = (a \times b) + (a \times c)$

## **Properties of Equality**

The table below illustrates the properties of equality. For each property, the variables a, b and c stand for arbitrary numbers in a given number system. The properties of equality apply to the rational number system, the real number system and the complex number system.

Property of Equality	Example
Reflexive property of equality	a = a
Symmetric property of equality	If $a = b$ , then $b = a$ .
Transitive property of equality	If $a = b$ and $b = c$ , then $a = c$ .
Addition property of equality	If $a = b$ , then $a + c = b + c$ .
Subtraction property of equality	If $a = b$ , then $a - c = b - c$ .
Multiplication property of equality	If $a = b$ , then $a \times c = b \times c$ .
Division property of equality	If $a = b$ and $c \neq 0$ , then $a \div c = b \div c$ .
Substitution property of equality	If $a = b$ , then b may be substituted for a in any expression containing a.



The table below illustrates the properties of inequality. For each property, the variables a, b and c stand for arbitrary numbers in a given number system. In addition, exactly one of the following is true: a < b, a = b or a > b. The properties of inequality apply to the rational number system and the real number system.

Property of Inequality	Example
Asymmetric property of inequality	If $a > b$ , then $b < a$ .
Transitive property of inequality	If $a > b$ and $b > c$ , then $a > c$ .
Addition property of inequality	If $a > b$ , then $a + c > b + c$ .
Subtraction property of inequality	If $a > b$ , then $a - c > b - c$ .
Multiplication property of inequality	If $a > b$ and $c > 0$ , then $a \times c > b \times c$ . If $a > b$ and $c < 0$ , then $a \times c < b \times c$ .
Division property of inequality	If $a > b$ and $c > 0$ , then $a \div c > b \div c$ . If $a > b$ and $c < 0$ , then $a \div c < b \div c$ .