Chapter 1 Expressions, Equations, and Inequalities

Order of Operations
1. Perform any operation(s) inside grouping symbols.
2. Simplify any terms with exponents.
3. Multiply and divide in order from left to right.
4. Add and subtract in order from left to right.

[Also known as PEMDAS]

Closure
For all real numbers a and b, $a + b$ and $a \cdot b$ are real numbers.

The Associative Properties
For all real numbers a, b, and c:

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

The Commutative Properties
For all real numbers a and b:

$a + b = b + a$ and $a \cdot b = b \cdot a$

The Identity Properties
For every real number a:

$a + 0 = a$ and $0 + a = a$ $a \cdot 1 = a$ and $1 \cdot a = a$
0 is the additive identity.   1 is the multiplicative identity.

The Inverse Properties
For every real number a:

$a + (-a) = 0$ and $a \cdot \frac{1}{a} = 1$ $(a \neq 0)$

The Distributive Properties
For all real numbers a, b, and c:

$a(b + c) = ab + ac$ $(b + c)a = ba + ca$
$a(b - c) = ab - ac$ $(b - c)a = ba - ca$

Multiplication

Let a represent a real number.
Multiplication by 0: $0 \cdot a = 0$.
Multiplication by -1: $-1 \cdot a = -a$

Opposites

Let a and b represent real numbers.
Opposite of a Sum: $-(a + b) = -a + (-b) = -a - b$
Opposite of a Difference: $-(a - b) = -a + b = b - a$
Opposite of a Product: $-(ab) = -a \cdot b = a \cdot (-b)$
Opposite of an Opposite: $-(-a) = a$

Properties of Equality

Assume a, b, and c represent real numbers.

Reflexive: $a = a$
Symmetric: If $a = b$, then $b = a$.
Transitive: If $a = b$ and $b = c$, then $a = c$.
Substitution: If $a = b$, then you can replace a with b and
                 vice versa.
Addition: If $a = b$, then $a + c = b + c$.
Subtraction: If $a = b$, then $a - c = b - c$.
Multiplication: If $a = b$, then $ac = bc$.
Division: If $a = b$ and $c \neq 0$, then $\frac{a}{c} = \frac{b}{c}$.

Properties of Inequality

Let a, b, and c represent real numbers.

Transitive: If $a > b$ and $b > c$, then $a > c$.
Addition: If $a > b$, then $a + c > b + c$.
Subtraction: If $a > b$, then $a - c > b - c$.
Multiplication: If $a > b$ and $c > 0$, then $ac > bc$.
                  If $a > b$ and $c < 0$, then $ac < bc$.
Division: If $a > b$ and $c > 0$, then $\frac{a}{c} > \frac{b}{c}$.
                  If $a > b$ and $c < 0$, then $\frac{a}{c} < \frac{b}{c}$.