

Real Numbers

Properties: For any real numbers, a, b, c,

	Addition	Multiplication
Closure	$a + b$ is a real number	ab is a real number
Commutative	$a + b = b + a$	$ab = ba$
Associative	$(a + b) + c = a + (b + c)$	$(ab)c = a(bc)$
Identity	$a + 0 = 0 + a = a$	$a \cdot 1 = 1 \cdot a = a$
Inverse	$a + (-a) = (-a) + a = 0$	$a \cdot \frac{1}{a} = \frac{1}{a} \cdot a = 1, a \neq 0$
Distributive	$a(b + c) = ab + ac$ $a(b - c) = ab - ac$	

Operations:

Absolute value

$|a| = a$ if a is zero or a positive number

$|a| = -a$ if a is a negative number

$|a|$ is the distance of a from 0 on the number line.

e.g., $|-3| = -(-3) = 3$

$|5| = 5$

$|0| = 0$

Addition

(1) Same signs: Add the absolute values; the sign of the answer is the same as that of the original numbers

e.g., $2 + 3 = 5$

$-2 + (-3) = -5$

(2) Different signs: Subtract the absolute values, larger minus smaller; the sign of the answer is the same as the number with the larger absolute value.

e.g., $7 + (-3) = 4$

$(-7) + 3 = -4$

Subtraction

$a - b = a + (-b)$

e.g., $7 - 3 = 7 + (-3) = 4$

$7 - (-3) = 7 + 3 = 10$

$-7 - 3 = -7 + (-3) = -10$

$-7 - (-3) = -7 + 3 = -4$

Multiplication

- (1) Same signs: the product is positive.
- (2) Different signs: the product is negative
e.g., $5 \cdot 3 = 15$
 $(-5)(-3) = 15$
 $(-5)(3) = -15$
 $(5)(-3) = -15$

Division (denominator not equal to zero)

- (1) Same signs: the quotient is positive
- (2) Different signs; the quotient is negative
e.g., $15/3 = 5$
 $-15/-3 = 5$
 $-15/3 = -5$
 $15/-3 = -5$

Double negative

- $-(-a) = a$
e.g., $-(-4) = 4$

Order of Operations

- (1) Grouping symbols (), [], { }
 - (a) Start from innermost and work outward
 - (b) Work numerator and denominator of a fraction separately; there are invisible parenthesis around each.
- (2) Exponents and Roots: simplify working from left to right.
- (3) Multiplication and division in order, working from left to right.
- (4) Addition and subtraction in order from left to right.