Section 1 – 1B: Properties of the Real Numbers

The Additive Identity

The **Additive Identity** is the number you **add** to any given number you get that same identical number you started with.

**The Additive Identity is Zero**

If you add zero to a number the answer you get is that **same identical number** you started with.

\[
5 + 0 = 5 \quad 8 + 0 = 8 \quad -3 + 0 = -3 \quad -7 + 0 = -7
\]

The Additive Inverse

The **Additive Inverse** is the number you **add** to any given number you get zero.

**The Additive Inverse of a number is the same number with the opposite sign**

**Example 1**

What is the additive inverse of 5?

you add \(-5\) to 5 to get 0

\[
5 + (-5) = 0
\]

\(-5\) is the additive inverse of 5?

**Example 2**

What is the additive inverse of \(-8\)?

you add 8 to \(-8\) to get 0

\[
-8 + 8 = 0
\]

8 is the additive inverse of \(-8\)?

**Example 3**

What is the additive inverse of \(\frac{3}{5}\)?

you add \(-\frac{3}{5}\) to \(\frac{3}{5}\) to get 0

\[
\frac{3}{5} + (-\frac{3}{5}) = 0
\]

\(-\frac{3}{5}\) is the additive inverse of \(\frac{3}{5}\)?

**Example 4**

What is the additive inverse of \(-\frac{2}{3}\)?

you add \(\frac{2}{3}\) to \(-\frac{2}{3}\) to get 0

\[
\frac{-2}{3} + \frac{2}{3} = 0
\]

\(\frac{2}{3}\) is the additive inverse of \(-\frac{2}{3}\)?
The Identity for Multiplication

The **Identity for Multiplication** is the number you **multiply** with a given number you get that same identical number you started with. The number is also called the **Multiplicative Identity**.

**The multiplicative Identity is 1**

If you multiply  a number by 1 the answer you get is that **same identical number** you started with.

\[
5 \cdot 1 = 5 \quad 8 \cdot 1 = 8 \quad -3 \cdot 1 = -3 \quad -7 \cdot 1 = -7
\]

**The Multiplicative Inverse**

The **Multiplicative Inverse** is the number you multiply with any given number you get 1.

**The Multiplicative Inverse of a number is the reciprocal (flip) of that number**

**Example 1**

What is the multiplicative inverse of 5?

you multiply 5 by \( \frac{1}{5} \) to get 1

\[
5 \cdot \frac{1}{5} = 1
\]

\( \frac{1}{5} \) is the multiplicative inverse of 5?

**Example 2**

What is the multiplicative inverse of \( -4 \)?

you multiply \( -4 \) by \( -\frac{1}{4} \) to get 1

\[
-4 \cdot -\frac{1}{4} = 1
\]

\( -\frac{1}{4} \) is the multiplicative inverse of \( -4 \)?

**Example 3**

What is the multiplicative inverse of \( \frac{2}{3} \)?

you multiply \( \frac{2}{3} \) by \( \frac{3}{2} \) to get 1

\[
\frac{2}{3} \cdot \frac{3}{2} = 1
\]

\( \frac{3}{2} \) is the multiplicative inverse of \( \frac{2}{3} \)?

**Example 4**

What is the multiplicative inverse of \( \frac{-5}{2} \)?

you multiply \( \frac{-5}{2} \) by \( \frac{-2}{5} \) to get 1

\[
\frac{-5}{2} \cdot \frac{-2}{5} = 1
\]

\( \frac{-2}{5} \) is the multiplicative inverse of \( \frac{-5}{2} \)?
The Commutative Property states that the order of the operation DOES NOT MATTER.

**Addition is Commutative**

**Example 1**

\[ 5 + 3 = 3 + 5 \]

The signs are the same so you add.
The order of addition does not matter.

**Example 2**

\[ -1 - 6 = -6 - 1 \]

The signs are the same so you add.
The order of addition does not matter.

**Multiplication is Commutative**

**Example 1**

\[ 5 \cdot 3 = 3 \cdot 5 \]

The order of multiplication does not matter.

**Example 2**

\[ 6 \cdot -3 = -3 \cdot 6 \]

The order of multiplication does not matter.

**Subtraction IS NOT Commutative**

**Example 1**

\[ 5 - 3 \neq 3 - 5 \]

The order of subtraction does matter.

**Example 2**

\[ 9 - 4 \neq 4 - 9 \]

The order of subtraction does matter.

**Division IS NOT Commutative**

**Example 1**

\[ 15 \div 5 = \frac{15}{3} = 5 \]

\[ 3 \div 15 = \frac{3}{15} = \frac{1}{5} \]

\[ 15 \div 5 \neq 3 \div 15 \]

The order of division does matter.

**Example 2**

\[ 8 \div 4 = \frac{8}{4} = 2 \]

\[ 4 \div 8 = \frac{4}{8} = \frac{1}{2} \]

\[ 8 \div 4 \neq 4 \div 8 \]

The order of division does matter.
The Distributive Property

\[ a(bx^2 + cx + d) = (a \cdot b)x^2 + (a \cdot c)x + a \cdot d \]

The **distributive property** is used to find what the product of a constant times a polynomial is.

The Distributive Property describes the distributive process as taking the **constant outside** the parenthesis and **multiplying** it into **each term inside the parenthesis** one product at a time.

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**Example 1**

A constant times a Binomial

\[-4(2x - 5) \text{ means } -4(2x) \text{ and } -4(5) = -8x + 20\]

**Example 2**

A constant times a Binomial

\[\frac{5}{2}(6x - 10) \text{ means } \frac{3}{2}(6x) \text{ and } \frac{3}{2}(-10) = \frac{18}{2} - \frac{30}{2} = 9x - 15\]

**Example 3**

A constant times a Trinomial

\[-2(3x^2 - 4x + 6) = -6x^2 + 8x - 12\]

**Example 4**

A constant times a Polynomial

\[2(5x^3 + 3x^2 - 1x - 4) = 10x^3 + 6x^2 - 2x - 8\]