**Topic C: Signed Numbers and Absolute Value**

**Signed Numbers**

**Signed number:** a positive number is written with a plus sign (or without sign) in front and a negative number is written with a minus sign in front.

**Example:** Positive number: +5 (or 5) , 7*x,* 4*y*2

Negative number: -3, -2 , -9*x*

**Positive and negative numbers in real life:**

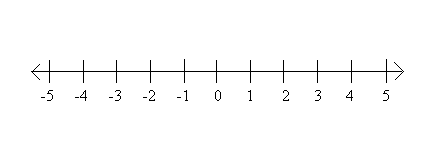
|  |  |
| --- | --- |
|  | **Meaning Example** |
| Temperature | + 0C: above 0 degree +200C  - 0C: below 0 degree -50C |
| Money | + $: gain or own Own: +$10000  - $: loss or owe Owe: -$500 |
| Sports | + points: gain Gain 3 points: +3  - points: loss Lost 2 points: -2 |

**Positive and negative numbers:** positive numbers are greater than zero; negative numbers are less than zero.

**The real number line:** a straight line on which every point corresponds to a real number.

**Example:** Put the following numbers on the real number line.

, , -0.67, , π ≈ 3.1416



π ≈ 3.1416

**The number on the right is greater than the number on the left on the number line.**

**Example: -**5 < - 3 , -1 < 4 , 0 > -2 , 2 > , <

big > small, small < big

**Example:** Arrange the following numbers from the smallest to the largest number.

**a)** -17, 3, -3, -6, 11, 0

- 17 < -6 < -3 < 0 < 3 < 11

**b)**  , , ,

, , , = 2.67

< < < 2.67

< < <

**Absolute Value**

**Absolute value:** geometrically, it is the distance of a number *x* from zero on the number line. It is symbolized “”.

**Example**: is 5 units away from 0.

is 18 units away from 0.

**No negatives for absolute value:**  the distance is always positive, and absolute value is distance, so the absolute value is never negative.

**Example:** is 2 units away from 0. 2 units

-2 0 2

is also 2 units away from 0. 2 units

-2 0 2

**Example**: **a)** = 8

**b)** 10

**c)** 0.2

**d)** = (5 -5

**e)** = (36= 36

**Order of operations:**

|  |  |
| --- | --- |
| **Order of operations** | |
| Clear the brackets or parentheses and absolute values (innermost first). | ( ) , [ ] , { } and |
| Calculator exponents (power) and radicals. | *a****n*** and |
| Perform multiplication or division (from left-to-right). | **×**  and  **÷** |
| Perform addition or subtraction (from left-to-right). | **+** and- |

**Example**:  **1)** 3 [7 4 (10 2)] = 3 [7 4 8] Parentheses

= 3 [3 8] Brackets / subtraction

= 3 11 Brackets /addition

= 33 Multiplication

**2)**  Parentheses and absolute value

= Exponent

Division

1 Subtraction

**Topic D: Operations with Signed Numbers**

**Adding and Subtracting Signed Numbers**

**Adding signed numbers**

* Add two numbers with the same sign: add their values and keep their common sign.

**Example**: **1)**  5 + 4 = 9Add and keep the () sign.

**2)**  (-6) + (-2) = -8 Add and keep the () sign.

**3)**  ) = ) = = -2Add and keep the () sign.

* Add two numbers with different signs: subtract their values and keep the sign of the larger absolute value.

**Example**: **1)** 2 + (-5) = -3Subtract and keep the sign of -5, since > .

**2)**  (-3) + 7 = 4Subtract and keep the sign of 7, since > .

**3)**  3.2 + (-0.2) =3Subtract and keep the sign of 3.2, since > .

**Subtracting signed numbers**

* Subtract a number by adding its opposite (additive inverse), i.e. *a* – *b* = *a* + (-*b*)

(Change the sign of *b* and then follow the rules for adding signed numbers.)

**Example**: **1)**  (-3) – (-4) = (-3) **+** (4) = 1Change the sign of the (-4), then add (-3) and 4.

**2**) (-7) – 2 = (-7) **+** (-2) = -9Change the sign of the 2, then add (-7) and (-2).

– (+2)

**3)**  = = = -1

)

**4)**  | |

* Opposite (or additive inverse): the opposite of a number (two numbers whose sum is 0).

**Example**:  **1)**  The additive inverse of 7 is -7 7 + (-7) = 0

**2)** The additive inverse of is - + = 0

**Multiplying Signed Numbers**

**Multiplying two numbers with the same sign:** the product is positive.

*a ∙ b = c*

**Example**: 4 ∙ 5 = 20

(-3) (-5) =15

**Multiplying two numbers with different signs:** the product is negative.

**Example**: (-5) (6) = -30

(0.3) (-3) = - 0.9

(-4)2 = (-4) (-4) = 16

**Multiplying by -1**: -1 ∙ *a* = - *a*

**Example**: - 1 (6 *x*)= - 6*x*

-42 = - 1 ∙ 42 = -16

**Signs of multiplication:**

|  |  |  |
| --- | --- | --- |
| **Multiplication Example** | | |
| Positive Positive = Positive | (+) (+) = (+) | 4 ∙ 3 = 12 |
| Negative Positive = Negative | (–) (+) = (–) | (-4) (3) = –12 |
| Positive Negative = Negative | (+) (–) = (–) | (4) (–3) = –12 |
| Negative Negative = Positive | (–) (–) = (+) | (–4) (–3) = 12 |

**Multiplying two or more numbers:**

**Multiplying Example**

* If the two signs are the same, the result is positive. (-3) (-4) = 12
* If the two signs are different, the result is negative. (-0.5) (0.6) = -0.3
* The product of an ***even*** number of negative numbers (-4) (-2) (-5) (-1) = 40

is always ***positive***. (-1)4 = 1

* The product of an ***odd*** number of negative numbers (-)(-)(- ) = -

is always ***negative***. (-1)7 = -1

**Evaluating expressions:**

**Example:** Evaluate *a*4 – *b* + *c* if *a* = -1 , *b* = -2, *c* = 4 .

*a*4 – *b* + *c* = (-1)4 – (-2) + 4 Substitute a for -1, b for -2 (add parentheses), and c for 4.

= 1 + 2 + 4 = 7

**Dividing Signed Numbers**

**Dividing signed numbers**

* Dividing two numbers with the same sign: the quotient is positive.

**Example**: **1)** -9 (-3) = 3 *a b = c*

**2)** 0.9

**3)** 8

* Dividing two numbers with different signs: the quotient is negative.

**Example**: **1)** 8 (-2) = -4

**2)** -7

1 1

**3)**

3 2

**Signs of division:**

|  |  |  |
| --- | --- | --- |
| **Division** | **Sign** | **Example** |
| Positive Positive = Positive |  |  |
| Negative Positive = Negative |  |  |
| Positive Negative = Negative |  |  |
| Negative Negative = Positive |  |  |

**Properties of zero:**

**Property**  **Example**

* The number 0 divided by any nonzero number is zero. = 0
* A number divided by 0 is undefined (not allowed). is undefined.

**Evaluating expressions:**

**Example:** Evaluate *a*2 – if *a* = -2, *b* = 1, c = (-1), and *d* = 0.

*a*2 – + = (-2)2 – + Substitute *a* for -2, *b* for 1, c for -1 and d for 0.

= 4 0

= 5

**Unit 5: Summary**

**The Real Number System**

**The real number system:**

Real Numbers

Rational Numbers: , -4.27

Integers: … -2, -1, 0, 1, 2, … Irrational Numbers

Whole Numbers: 0. 1, 2, 3 … , π , …

Natural Numbers: 1,2, 3 …

**Properties of addition and multiplication:**

|  |  |  |
| --- | --- | --- |
| **Name Additive properties** | | **Multiplicative properties** |
| **Commutative property** | ***a*** + *b* = *b +* ***a*** | ***a*** *b* = *b* ***a*** |
| **Associative property** | **(***a* + *b***)** *+ c* = *a +* **(***b* ***+ c*)** | **(***a* *b***)** *c* = *a* **(***b c***)** |
| **Identity property** | ***a*** + 0 = ***a*** | ***a*** ∙ 1 = ***a*** |
| **Closure property** | If *a* and *b* are real numbers,  then *a* + *b* is a real number. | If *a* and *b* are real numbers,  then *a* ∙ *b* is a real number. |
| **Inverse property** | -*a* + *a* = 0 |  |
| **Distributive property** |  | ***a*** (*b + c*) = ***a****b* **+ *a****c*  ***a*** (*b c*) = ***a****b* ***a****c* |
| **Property of zero** |  | ***a*** ∙ 0 = **0** |

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**Absolute value:** geometrically, it is the distance of a number *x* from zero on the number line. It is symbolized “”.

**No negatives for absolute value:**  the distance is always positive, and absolute value is distance, so the absolute value is never negative.

**Order of operations with absolute value:**

|  |  |
| --- | --- |
| **Order of operations** | |
| Clear the brackets or parentheses and absolute values (innermost first). | ( ) , [ ] , { } or |
| Calculator exponents (power) and absolute value. | *an*and |
| Perform multiplication or division (from left-to-right). | **×**  and  **÷** |
| Perform addition or subtraction (from left-to-right). | **+** and |

**Signed numbers summary:**

|  |  |
| --- | --- |
| **Operation Method** | |
| **Adding signed numbers** | * Add two numbers with the *same* sign:   Add their values, and keep their common sign.   * Add two numbers with *different* signs:   Subtract their values, and keep the sign of the larger number. |
| **Subtracting signed numbers** | Subtract a number by adding its opposite. |
| **Multiplying signed numbers** | (+)(+) = (+), ()() = (+), ()(+) = (), (+)() = () |
| **Dividing signed numbers** | , |

**Multiplying two or more numbers:**

* If the two signs are the same, the result is positive.
* If the two signs are different, the result is negative.
* The product of an ***even*** number of negative numbers is always ***positive***.
* The product of an ***odd*** number of negative numbers is always ***negative***.

**Opposite (or additive inverse):** the opposite of a number.

**Properties of zero**

* The number 0 divided by any nonzero number is zero. = 0
* A number divided by 0 is undefined (not allowed). is undefined.

**Unit 5: Self-Test**

**The Real Number System**

**Topic A**

1. Give two examples of rational numbers that are not integers.
2. Given the set of numbers:

-3, 4.7, 0, 8, , , 5.4259….,

Determine which of the numbers above are

1. natural numbers?
2. integers?
3. rational numbers?
4. irrational numbers?

**Topic B**

1. Name the properties.
2. 12 *a* + 0 = 12*a*
3. (3*x* + 11*y*) + 7 = 7 + (3*x* + 11*y*)
4. (4 + *x*) + 11 = 4 + (*x* + 11)
5. (6*a* + 5) + [-(6*a* + 5)] = 0
6. 7(3 *y +* 4) = 7 ∙ 3 *y* + 7 ∙ 4

= 21 *y* + 28

1. (0.5*a*) *b* = 0.5 (*a b*)
2. (4*x*) (7*y*) = (4 ∙ 7) (*x* *y*)
3. -(
4. (4 – 7*y*) 3 = 12 – 21*y*
5. *∙* 0 = 0
6. (199 + 36) + 1 = (199 + 1) + 36
7. (1000 8) 9 = 1000 (8 9)
8. Regroup and simplify the calculations using properties.
9. 12 + (45 + 88)
10. 9 (1000 )
11. 3 + (2997 + 56)
12. Use the distributive property to write an equivalent expression without parentheses.
13. 4*y* (*y* + 0.3)
14. (2 – 3*y*2) 5
15. ( *–* )

**Topic C**

1. Compare these numbers using either < or > .
2. 6 8
3. 0 -6
4. **-**4 - 2
6. 6 -0.8
8. Arrange the following numbers from the smallest to the largest number (using < to order them).
9. 8, -9, -4, 23, 0, -17
10. 0.05 , -8 , , , -3.24
11. , , ,
12. Preform the indicated operation.



17. | |
18. Preform the indicated operation.
19. 4 [7 3 (30 5)]

**Topic D**

1. Preform the indicated operation.
2. 13 + 24
3. (-7) + (-8)
4. )
5. 9 + (-4)
6. (-25) + 12
7. 8.4 + (-0.9)
8. (-7) – (6)
9. (-5) – (-7)
11. | |
12. -45 (-9)

15. -72 9

18. Write the additive inverse (opposite) of each number.
19. – 45
21. -1
22. If *x* = -2 , *y* = 5, *z* = 4 and *w* = 0, evaluate each of the following.
23. *zy + x*3
24. *x*2 *–* 2*xy* + *y*2 +
25. (*x + y*) (*x – y*) *–* 5*z*
26. 4()