Natural numbers and Whole numbers

- The collection of all counting numbers is known as **natural numbers.**

  These are 1, 2, 3, 4 … and so on.

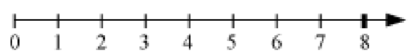
- All natural numbers along with zero are called **whole numbers**.

  These are 0, 1, 2, 3, 4 … and so on.

- All natural numbers are whole numbers, but all whole numbers are not natural numbers.
- We can write a natural number using 10 symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Each of such symbols is called a **digit** or a **figure**.

- **Number line:**

  To draw a number line, we take a line and mark a point on it, labelling it 0. Then, we mark the points to the right of zero at equal intervals and label them as 1, 2, 3 …, as follows:

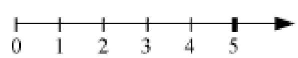


  On the number line, we can say that out of any two whole numbers, the number on the right of the other number is greater.

  Example: Place predecessor of 6 on the number line.

  Solution:

  The predecessor of 6 is 5. On the number line, we can show 5 as follows:



- According to fundamental theorem of arithmetic, a number can be represented as the product of primes having a unique factorisation.

  Example:

  Check whether 15^n in divisible by 10 or not for any natural number n. Justify your answer.

  Solution:

  A number is divisible by 10 if it is divisible by both 2 and 5.

  $15^n = (3 . 5)^n$

  3 and 5 are the only primes that occur in the factorisation of 15^n

  By uniqueness of fundamental theorem of arithmetic, there is no other prime except 3 and 5 in the factorisation of 15^n.

  2 does not occur in the factorisation of 15^n.

  Hence, 15^n is not divisible by 10.

- If we subtract 1 from a whole number, then we will get its **predecessor** and if we add 1 to a whole number, then we will find its **successor**.

  For example, the predecessor of 15 is 15 – 1 = 14 and its successor is 15 + 1 = 16.

- Each whole number has a successor. All whole numbers, except zero, has a predecessor.

- **Closure Property of whole numbers:**
  - Whole numbers are closed under addition. For example, the sum of whole numbers 3 and 8 is 11 (3 + 8 = 11), which is again a whole number.
  - Whole numbers are closed under multiplication. For example, the multiplication of whole numbers 4 and 7 is 28 (4 × 7 = 28), which is again a whole number.
  - Whole numbers are not closed under subtraction. For example, 5 – 2 = 3 is a whole number, but 1 – 2 = –1 is not a whole number.
  - Whole numbers are not closed under division. For example, 98 ÷ 4 = 2 is a whole number, but 2 ÷ 5 = $\frac{2}{5}$ is not a whole number.

  - **Properties of whole numbers:**

    We can add or multiply two whole numbers in any order, that is, 12 + 5 = 5 + 12 = 17 and 9 × 8 = 8 × 9 = 72.

    This property of addition and multiplication of whole numbers is known as **commutative**.

    Addition and multiplication of whole numbers are **associative**.

    For example: (17 + 19) + 25 = 17 + (19 + 25) = 61.

    Similarly, (6 × 13) × 19 = 6 × (13 × 19) = 1482.

    These properties help some mathematical calculations easier.

    Example: Find the value of 4 × 17 × 25.

    Solution:

    4 × 17 × 25 = 4 × 25 × 17 (commutative over multiplication)

    = (4 × 25) × 17

    = 100 × 17

    = 1700

- **Distributive property of whole numbers for multiplication over addition:**

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

  The property also holds true for multiplication over subtraction.

  This property also helps in making mathematical calculations easier.

  Example:

Simplify 38 × 68 + 32 × 38

Solution:

$$\begin{aligned}38\times 68+32\times 38 &= 38\times 68+38\times 32 \quad (\text{Commutative property})\\ &= 38\times(68+32) \quad (\text{Distributive } property)\\ &= 38\times 100\\ &= 3800\end{aligned}$$

- Addition of any whole number to zero gives the same whole number. Therefore, zero is the **additive identity** of whole numbers.

  For example, 5 + 0 = 5, 9 + 0 = 9.

- Multiplication of any whole number with 1 gives the same whole number. Therefore, 1 is the **multiplicative identity** of whole numbers.

  For example, 9 × 1 = 9.

- Multiplication of any whole number with zero, gives zero as the result.

  For example, 5 × 0 = 0