2 Whole Numbers

In this chapter, you will learn:

- Whole numbers
- Representation of whole numbers on number line
- Successor and predecessor of a whole number
- Properties of addition
- Properties of multiplication
- Operation of division
- Division algorithm
- Properties of division
- Patterns in whole numbers.

WHOLE NUMBERS

In the previous chapter, we have learnt about counting numbers 1, 2, 3, 4, ... These numbers come naturally when we begin counting. Hence, we call the counting numbers as **natural numbers**. The ***smallest*** natural number is 1 and there is no ***largest*** natural number.

Number zero

The concept of the number zero came much later than that of the natural numbers.

Suppose, Ankita has five toffees and she has eaten up all the five, so she is left with no toffees. Another way of saying this is that Ankita is left with *zero* toffees. The number zero (which Indians call 'Shunya' and Arabs called 'Cipher') is denoted by the symbol '0'.

The number '0' together with natural numbers *i.e.* the numbers 0, 1, 2, 3, 4, 5, ... are called **whole numbers**.

Representation of whole number on number line

To represent whole numbers on a line, we proceed as under:

(1) Draw any straight line, mark point O on it and label it as 0 (zero).

(2) Mark another point A to the right of O on the line and label it as 1 (one), then the length of the segment OA = 1 unit.

(3) Mark points B, C, D, E, ... to the right of A at unit length intervals on the line and label these points as 2, 3, 4, 5, ... respectively.

Thus, the points O, A, B, C, D, E, ... on the line represent the whole numbers 0, 1, 2, 3, 4, 5, ...

Continuing the above process, we can represent every whole number by some point on the line.

The line drawn above is called the **number line**.

From the number line, we observe that:

1. *There is no whole number on the left of '0', and every whole number on its right is greater than 0.*

Thus, 0 is the smallest whole number.

As the above process of marking points to the right of 0 does not stop anywhere, there is no largest whole number.

2. *A whole number is greater than all those whole numbers that lie to its left on the number line.*

In other words, a whole number is greater than the other whole number if the first number lies on the right of the second number on the number line.

For example:

As 5 lies on the right of 2 on the number line, so $5 > 2$.

Similarly, $7 > 3$ and $11 > 10$.

3. *A whole number is less than all those whole numbers that lie to its right on the number line.*

In other words, a whole number is less than the other whole number if the first number lies on the left of the second number on the number line.

For example:

As 2 lies on the left of 5 on the number line, so $2 < 5$.

Similarly, $3 < 7$ and $10 < 11$.

4. *There is no whole number between any two consecutive whole numbers; and there is atleast one whole number between two non-consecutive whole numbers.*

Consecutive means that the numbers are next to one-another.

For example:

(*i*) There is no whole number between two consecutive whole numbers 5 and 6.

(*ii*) The whole number 5 lies between two non-consecutive whole numbers 4 and 6.

Obviously $4 < 5$ and $5 < 6$; we may write $4 < 5 < 6$.

(*iii*) The whole numbers 5 and 7 lie between two non-consecutive whole numbers 4 and 10.

Obviously $4 < 5 < 10$ and $4 < 7 < 10$.

Successor and Predecessor

One more than a given whole number is called its ***successor***.

Thus, 1 is the successor of 0, 2 is the successor of 1 and so on.

Note that each whole number has one and only one successor; and it is the successor of the whole number just on its left on the number line. Note that 0 is not the successor of any whole number.

One less than a given whole number (other than zero) is called its ***predecessor***.

Thus, 0 is the predecessor of 1, 1 is the predecessor of 2 and so on.

Note that each whole number (except 0) has one and only one predecessor; and it is the predecessor of the whole number just on its right on the number line.

Note that 0 has no predecessor in the whole number system.

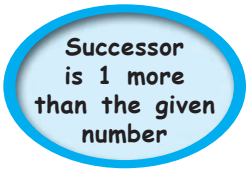
Remarks

- Successor of a whole number = (given whole number) + 1.
- Predecessor of a whole number = (given whole number) – 1.
- 0 is not the successor of any whole number.
- 0 has no predecessor in whole number system.
- 1 has no predecessor in natural number system.

Example 1. Write the successor of each of the following numbers:

(*i*) 3799 (*ii*) 531010

Solution. Successor is 1 more than the given number.



(*i*) The successor of 3799

= 3799 + 1 = 3800.

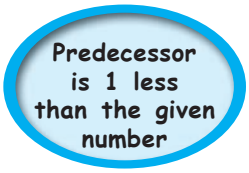
(*ii*) The successor of 531010

= 531010 + 1 = 531011.

Example 2. Write the predecessor of each of the following numbers:

(*i*) 3799 (*ii*) 531010

Solution. Predecessor is 1 less than the given number.



(*i*) The predecessor of 3799

= 3799 – 1 = 3798.

(*ii*) The predecessor of 531010

= 531010 – 1 = 531009.

Example 3. Write the whole number whose successor is 379600.

Solution. The required whole number = predecessor of 379600

= 379600 – 1 = 379599.

Example 4. Write the whole number whose predecessor is 74999.

Solution. The required whole number = successor of 74999

= 74999 + 1 = 75000.

Example 5. Write two whole numbers occurring just before 10001.

Solution. The whole numbers occurring just before 10001 are

10001 – 1 and 10001 – 2 *i.e.* 10000 and 9999.

Example 6. Write the next three consecutive whole numbers of the following numbers:

(*i*) 59 (*ii*) 37898

Solution.

(*i*) The next three consecutive whole numbers of 59 are:

60, 61, 62.

(*ii*) The next three consecutive whole numbers of 37898 are:

37899, 37900, 37901.

Example 7. How many whole numbers are there between 81 and 101?

Solution. The whole numbers between 81 and 101 are:

82, 83, 84, …, 100.

Number of these numbers = 100 – 81 = 19.

Note that in the above list, 100 is included and 81 is not included.

Example 8. How many 3-digit numbers are there between 94 and 607?

Solution. 3-digit numbers between 94 and 607 are:

100, 101, 102, ... 606.

Number of these numbers = 606 – 99 = 507.

Exercise 2.1

1. Write the smallest (*i*) natural number (*ii*) whole number. Can you write the largest whole number?

2. Write the successor of each of the following numbers:
(*i*) 3999 (*ii*) 378915 (*iii*) 5001299.

3. Write the predecessor of each of the following numbers:
(*i*) 500 (*ii*) 38794 (*iii*) 54789011.

4. Write the whole number (in each of the following) whose successor is:
(*i*) 50795 (*ii*) 720300 (*iii*) 8300000.

5. Write the whole number (in each of the following) whose predecessor is:
(*i*) 5347 (*ii*) 72399 (*iii*) 3012999.

6. Write next three consecutive whole numbers of the following numbers:
(*i*) 79 (*ii*) 598 (*iii*) 35669

7. Write three consecutive whole numbers occurring just before 320001.

8. In each of the following pairs of numbers, state which whole number is on the left of the other number on the number line. Also write them with appropriate sign (>, <) between them.
(*i*) 530, 503 (*ii*) 370, 307 (*iii*) 98765, 56789

9. (*i*) How many whole numbers are there between 32 and 53?
(*ii*) How many whole numbers are there between 99 and 300?

10. Write all whole numbers between 100 and 200 which do not change if the digits are written in reverse order.

11. How many 2-digit whole numbers are there between 5 and 92?

12. How many 3-digit whole numbers are there between 72 and 407?

FUNDAMENTAL OPERATIONS ON WHOLE NUMBERS

We are already familiar with the four fundamental operations of ***addition***, ***subtraction***, ***multiplication*** and ***division*** on the whole numbers. In this section, we shall learn some basic properties of the operations of addition and multiplication on the whole numbers. These properties help us to understand the numbers better and sometimes make calculations very simple. We shall also review the operations of subtraction and division on whole numbers.

Properties of Addition

• Closure property of addition

Let us add any two whole numbers and check whether the sum is a whole number.

Whole number	*Whole number*	*Sum*	*Is the sum a whole number?*
18	23	18 + 23 = 41	Yes
127	308	127 + 308 = 435	Yes
239	239	239 + 239 = 478	Yes

Thus, we find that the sum of any two whole numbers is a whole number. In other words:

If a and b are any two whole numbers, then a + b is also a whole number. This is called *closure property of addition*.

• Commutative property of addition

Let us add any two whole numbers in two different orders and check whether the sum is same.

For example:

(*i*) 39 + 28 = 67, 28 + 39 = 67.

Is 39 + 28 = 28 + 39? Yes.

(*ii*) 231 + 78 = 309, 78 + 231 = 309.

Is 231 + 78 = 78 + 231? Yes.

From the above examples, we find that in *whatever order* we add any two whole numbers, their sum remains the same.

In other words:

If a and b are any two whole numbers, then a + b = b + a. This is called *commutative property of addition*.

• Associative law of addition

Let us take any three whole numbers and find the sum of these numbers. We find the sum of any two of them and add their sum to the third number in two different ways of associating them and check whether the result is same.

For example:

(*i*) (8 + 13) + 6 = 21 + 6 = 27 and 8 + (13 + 6) = 8 + 19 = 27.

Is (8 + 13) + 6 = 8 + (13 + 6)? Yes.

(*ii*) (52 + 17) + 23 = 69 + 23 = 92 and 52 + (17 + 23) = 52 + 40 = 92.

Is (52 + 17) + 23 = 52 + (17 + 23)? Yes.

From the above examples, we find that the sum of any three whole numbers in whatever way we associate them remains the same.

In other words:

If a, b and c are any three whole numbers, then (*a* + *b*) + *c* = *a* + (*b* + *c*). This is called *associative law of addition.*

• Existence of additive identity

6	+	0	=	6
0	+	6	=	6
23	+	0	=	23
0	+	23	=	23

The number ‘0’ has a special role in addition.

Look at the adjoining table, we note that: If *a* is any whole number, then

a + 0 = *a* = 0 + *a*.

The number ‘0’ is called the **additive identity.**

• Cancellation law of addition

If *a*, *b* and *c* are any whole numbers, then

$a + c = b + c \Rightarrow a = b$.

For example:

If *x* is a whole number, then

$x + 5 = 3 + 5 \Rightarrow x = 3$.