Chapter 3

Whole Numbers

3.1 We count several things daily, like you have 3 friends, 6 cows are grazing in the field, 25 students in the class etc.

Man has started counting thousands years ago. We always start counting by number 1. We can count up to how much?

Ramesh said: up to 100.

Seema - why, we have the number 101 after 100.
(Ramesh was counting himself and thought that there are 200, 300…) after 100.
Then he said up to 1000.

Seema - but we have 2000, 3000,4000……after 1000.
(Ramesh starts thinking again about the greatest number but then gets puzzled)

Ramesh - Ok. Please you tell us up to which number can we count.

Seema - Yes , I am also thinking but even I don't know the last greatest number.We start counting from the number 1. Hence 1 is the first natural number. Next natural number is 2 which we get as a result of adding 1 to 1, 3 when we add 1 to 2.This is the third natural number. Actually by adding 1 we get the next natural number, which is called successor of the previous number. Thus 99+1=100 is the successor of 99.Hence the group of natural numbers is a group which is increased by 1 by 1.

If someone asks you that how many natural numbers are there? Can you tell us by counting? Perhaps no.

If we count 1,2,3….100, 101….999…1001. Then where will it end? No…Natural numbers are infinite, which is represented by …Group of natural numbers is denoted by N.

Therefore N={1,2,3…..}

3.1.1 Properties of natural numbers

1. The smallest natural number is 1
2. We get next natural number by adding 1 to the natural number. Such as 18+1=19
3. Except 1, Subtracting 1 from each natural number we get its predecessor. Such as 18-1=17
4. Natural numbers are infinite. Therefore we cannot write the largest natural number.

5. Subtracting 1 from the smallest natural number 1, we get zero (0), which is not a natural number.

3.2 Whole numbers

Fill in the blanks with suitable numbers :-

Predecessor natural number	Natural Number	Successor (Next natural number)
13−1= 12	13	13 + 1 = 14
—	55	—
99	100	101
—	200	—
—	10	11
—	1	—

Table 3.1

Which number does not have any natural Predecessor natural number?

There is no natural predecessor of number 1.We take zero as the predecessor of 1.when we add it to the group of natural numbers, it becomes a new group.

(0,1,2,3…)

This is called a group of Whole numbers. It is denoted by W. Hence

W={0,1,2,3…}

Your Father brought 6 bananas. There are six members in the family. Everyone ate 1 banana each. Now how many bananas are left?

you will say none.

Five birds were sitting on a tree. All birds flew one by one. So now how many are left.

You will say none.

Think about it:

6-6=.... or 5-5=..... or 10-10=...........

What is the answer?

3.2.1 Representing whole numbers on the number line.

To represent whole numbers on the number line draw a straight line which has many marks on equal distances.

Show the initial point by 0. Write 1,2,3 etc on the right side of 0. Looking at the number line can you tell which number is bigger? For this think whether a number on the left side of another number will be greater or smaller?

3.2.2 Properties of whole numbers

1.All the properties of natural numbers are true for whole numbers as well.

2. The smallest whole number is zero.

3.On the number line numbers are written in ascending order from zero towards right. i.e

0+1=1, 1+1=2……101+1=102, 102+1=103….103+1=104 etc.

Looking at the following table find out true or false.

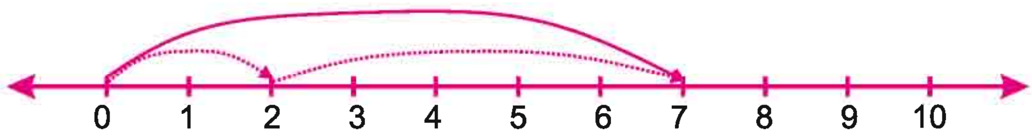
S.N.	Numbers	Position on number line	Relation between numbers	True/ false
1	12,8	12 is on the right side of 8	12>8	
2	3,10	3 is on the left side of 10	10<3	
3	66,45	66 is on the right side of 45	66>45	
4	236,190	190 is on the left side of 236	190<236	
5	1001,1010	1010 is on the right side of 1001	1010>1001	

Table 3.2

3.2.3 Operations of whole numbers on the number line.

Practise the operations of simple addition, subtraction, multiplication and division on the number line.

Addition on the number line - Let us add 2 and 5.

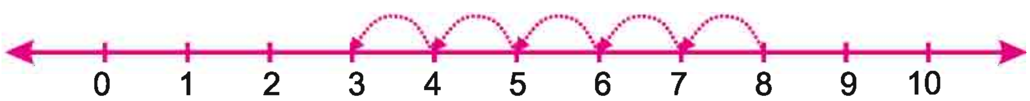


Starting from 2 on the number line we move 5 steps to the right and reach 7. Hence 2+5=7 (Do practice with different numbers.)

When two numbers are added on the number line, we start with one number and move the number of steps equal to the other number. This gives us the desired sum.

Subtraction on the number line

This operation will be done in the opposite direction to the addition operation. If 5 is to be subtracted from 8. then –

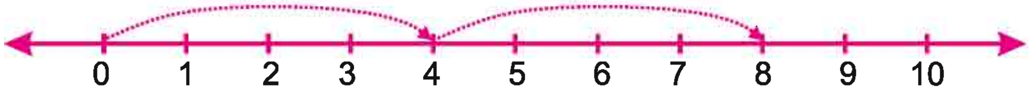


8 - 5 = 3. Practise with different numbers.

Multiplication on the number line.

Now we will multiply whole numbers on the number line .

Find out 2×4. We can write it as (2 times 4)



Starting from 0 on the number line we reach till 4 once. Moving 4 steps again we reach 8 the second time. i.e 2×4 = 8

Exercise 3.1

1. Fill in the blanks
   - (i) Predecessor of 55 is....
   - (ii) Predecessor of 100 is........
   - (iii) Predecessor of 305 is ....and its successor is ....
   - (iv) Whole numbers are formed by including .....in natural numbers.
   - (v) Predecessor of 1 is..............

2. Write the predecessors of the following numbers

   (i) 1203 (ii) 2406 (iii) 3555 (iv) 4444

3. Write the successors of the following numbers

   (i) 2304 (ii) 3611 (iii) 4000 (iv) 5060

4. Write the successors and predecessors of the following numbers

   (i) 189 (ii) 199 (iii) 209 (iv) 300

5. Which is the smallest whole number?

6. Mark right or wrong in front of the following statements :
   - (i) All natural numbers are whole numbers.
   - (ii) 1 is the smallest whole number.
   - (iii) The sum of two whole numbers is always a whole number.

iv. $245 + 450 = 450 + 245$

v. $1124 + 0 = 0$

vi. The operation of subtraction is reciprocal to the operation of addition.

vii. $4 - 4 = 0$ (is a whole number)

viii. $7 - 7 \neq 0$

ix. The product of any two whole numbers is a whole number.

x. When we multiply a whole number by 0 the product is the number itself.

xi. When we multiply a whole number by 1 the product is the number itself.

3.3 Properties of whole numbers

3.3.1 Closure property

Look at the following numbers carefully and think

$6 + 2 = 8$, a whole number

$2 + 8 = 10$, a whole number

$0 + 5 = 5$, a whole number

$12 + 0 = 12$, a whole number

$7 + 6 = 13$, a whole number

We can see from the above examples that the sum of two whole numbers is a whole number. Take some more pairs of whole numbers.

Are their sums also a whole number?

Did you find any pair whose sum is not a whole number? You will find that sum of whole numbers is always a whole number.

Therefore whole numbers are closed under addition.

Are the whole numbers closed for subtraction?

Consider the following

$8 - 5 = 3$ is whole number $\quad$ $10 - 9 = 1$ is a whole number

$0 - 5 = (-5)$ is not a whole number $\quad$ $6 - 0 = 6$ is a whole number

$13 - 17 = (-4)$ is not a whole number

Subtraction of any two whole number may or may not be a whole number.

Thus whole number are not closed under subtraction.

Look at the following :

$6 \times 2 = 12$ a whole number

$4 \times 5 = 20$ a whole number

$10 \times 0 = 0$ a whole number

$0 \times 8 = 0$ a whole number

Therefore the product of two whole numbers is also a whole number.

Therefore whole numbers are closed under multiplication.

Think about the operation of division.

$12 \div 4 = 3$, a whole number

$7 \div 8 = \frac{7}{8}$, not a whole number

$0 \div 5 = 0$, a whole number

$20 \div 25 = \frac{4}{5}$, not a whole number

The quotient of two whole numbers may or may not be a whole number.

Therefore whole numbers are not closed under Division.

Do and learn **Closure property**

Whole numbers	Operations	Result	Conclusion
6 and 2	Addition		
0 and 5	Addition		
8 and 5	Subtraction		
13 and 17	Subtraction		
6 and 2	Multiplication		
0 and 8	Multiplication		
8 and 2	Division		
7 and 9	Division		

Table 3.3

3.3.2 Division by zero

Meaning of dividing a number by any number is subtracting that number again and again from the first number.

After subtracting 5 three times from the number 15 we will get 0.

Hence $15 \div 5 = 3$

Let's try to find out the solution of $4 \div 0$

(i) Every time after subtraction of zero we are getting the number 4 only.

(ii) Will this procedure ever end or not?

Hence $4 \div 0$ is not explained in mathematical language. Therefore we will say that this is undefined.

Conclusion: Division of whole numbers by 0 is not defined.

3.3.3 Commutative property

Think about the following

$8 + 7 = 15$,

$7 + 8 = 15$

Likewise

$19 + 15 = 34$,

$15 + 19 = 34$

Hence adding two numbers in any order we get the same number as answer.

Now take five more pairs of numbers and test the above fact.

Does sum of any pair changed after changing their order? no.

Therefore we can say that whole numbers follow the property of commutativity for addition operation.

$8 \times 5 = 40$

$5 \times 8 = 40$

$25 \times 10 = 250$

$10 \times 25 = 250$

Hence multiplying two numbers by exchanging orders we get the same product.

$8 - 3 = 5$ $\quad$ $10 - 7 = 3$

$3 - 8 = ?$ $\quad$ $7 - 10 = ?$

We do not get same answer while subtraction on interchanging the place of numbers.

So as:

$8 \div 2 = 4$ $\quad$ $25 \div 5 = 5$

$2 \div 8 = ...?$ $\quad$ $5 \div 25 = ...?$

We also do not get the same answer after interchanging the numbers of a division.

Conclusion Hence we can say

Whole numbers have a property of commutativity for addition and multiplication.

For subtraction and division whole numbers, property of commutativity is not applicable.

Whole numbers	Operations	Result	Conclusion
7 and 8	7 + 8 = 15	We get same sum after changing the order of numbers.	Is commutative is there
8 and 7	8 + 7 = 15		
9 and 6	9 - 6 = 3	We do not get same difference after changing the order of numbers.	Not commutative.
6 and 9	6 - 9 = ?.		
5 and 4	5 × 4 = 20	Product is always same after changing the order of numbers.	Is commutative.
4 and 5	4 × 5 = 20		
10 and 2	10 ÷ 2 = 5	When we interchange the numbers we do not get the same quotient.	Not commutative.
2 and 10	2 ÷ 10 = ?		

3.3.4 Property of associativity

$(5+2)+4 \quad = \quad 7+4=11$

$5+(2+4) \quad = \quad 5+6=11$

$(7+9)+1 \quad = \quad 16+1=17$

$7+(9+1) \quad = \quad 7+10=17$

$(5+8)+7 \quad = \quad 13+7=20$

$5+(8+7) \quad = \quad 5+15=20$

Look at the above operations of addition. This property of whole numbers is known as associativity.

Will property of associativity also apply on subtraction?

One other example:

$(6\times3)\times2=18\times2=36$

$6\times(3\times2)=6\times6=36$

Hence we see in the operation of multiplication as well there is no difference in the answer when we multiply first two numbers and then the third number. Let's see the rule of the associativity for division

$(24\div6)\ \div2=\ 2$

$24\div(6\div2)=\ 8$

Hence we get different results on division of three whole numbers.

Conclusion (I) Property of associativity is applied on the operation of addition and multiplication.

(ii) Property of associativity is not applied on operations of subtraction and division.

Do and learn

Now take set of 3-3 numbers and test properties of associativity on the operations of addition and multiplication respectively.

3.3.5 Distribution of multiplication on addition

$4 \times 6 = 24$ can also be written as

$4 \times (4 + 2) = 24$

$(4 \times 4) + (4 \times 2) = 24$ or $4 \times (4 + 2) = 24$

Look at the following numbers carefully:

$8 \times (3 + 9) = (8 \times 3) + (8 \times 9)$

This is called distributive property of multiplication on addition.

3.3.6 Identity element

For addition and multiplication

Look at the following table

8	+	0	=	8
4	+	0	=	4
0	+	5	=	5
0	+	24	=	24
0	+	....	=	...

Hence it is clear from the table above that when we add 0 to any whole number , the answer is whole number itself. Therefore 0 is known as an identity element for whole numbers. Zero is an additive identity for whole numbers.

7	x	1	=	7
8	x	1	=	8
15	x	1	=	15
18	x	1	=	18
.....	x	1	=	....

Hence it is clear from the table above that when we multiply any number by 1 then we get the number itself. Therefore 1 is the identity element for multiplication of whole numbers. 1 is known as the multiplicative identity of whole numbers.

Exercise 3.2

1. Add the following by arranging in proper order.

   (i) 85 + 186 + 15 (ii) 175 + 96 + 25 (iii) 65 + 75 + 35 (iv) 55 +8 6 + 45

2. Find out the multiplication by proper order.

   (i) 4×1225×25 (ii) 4×158×125 (iii) 4×85×25 (iv) 8×20×125

3. Find out the value of each of the following by distributive property.

   (i) 185 × 25 + 185 × 75 (ii) 4 × 18 + 4 × 12

   (iii) 54279 × 92 + 8 × 54279 (iv) 12 × 8 + 12 × 2

4. Find out the multiplication by using proper property.

   (i) 185 × 106 (ii) 208 × 185

   (iii) 54 × 102 (iv) 158 × 1008

5. Match the following

(i) 2+8 = 8+2	(a) commutativity of multiplication
(ii) 8×90 = 90×8	(b) commutativity of addition
(iii) 885×(100+45) = 885×100+885×45	(c) Associative property of multiplication
(iv) 5×(4×28) = (5×4)×28	(d) Multiplicative distribution on addition

6. If the multiplication of any two whole numbers is zero, can we say that one or both of the numbers must be zero? Give an example to prove it.

7. If the multiplication of two whole numbers is 1, then can we say that one or both of the numbers are equal to 1? Prove your answer with example.

8. Find out the following by distributive method.

   (i)138 × 101 (ii) 125 × 400 (iii) 608 × 35

9. Which of the following will not result in zero.

   (i) 1 + 0 (ii) 0 × 0 (iii) $\frac{0}{2}$ (iv) $10 - \frac{10}{2}$

10. Choose a, b, c… and write in the bracket.

(i) Which of the following has the commutative property of addition?

(a) $5\times8=8\times5$ (b) $(2\times3)\times5=2\times(3\times5)$

(c) $(12+8)+10=(2+8)+10$ (d) $15+8=8+15$ ( )

(ii) Which of the following has commutative property of multiplication.

(a) $10\times20=20\times10$ (b) $10\times10=20\times20$

(c) $(10\times20)=10\times1$ (d) $10+20=10\times20$ ( )

We learnt

1. Natural numbers are used for counting such as 1,2,3…
2. If we add 1 to natural number we get the successive natural number. If we subtract 1 from any natural number, we get its predecessor.
3. Every natural number has its successor.
4. Except 1 every natural number has its predecessor again a natural number.
5. If we include 0 in the group of natural numbers 1,2,3…, then we get a group of whole numbers.
6. Every whole number has a predecessor except 0. Every whole number has a predecessor which is again a whole number.
7. All whole numbers are not natural numbers but all the natural numbers are whole numbers.
8. Take a line and mark a zero on it. On the right side mark more points on equal distances. Now write 1,2,3 …on these marks. This line is called number line. Operations like addition, subtraction, multiplication can be easily performed on the number line.
9. Moving towards right side of number line we get addition and towards left subtraction. Beginning from 0 and moving on equal distance on number line gives the multiplication.
10. Whole numbers are closed under addition and multiplication.
11. Division by 0 is not defined.
12. For addition of whole numbers identity element or identity is zero and whole number 1 is the identity element for multiplication.
13. Addition and multiplication are commutative for whole numbers.
14. Addition and multiplication are associative for whole numbers.