WHOLE NUMBERS

NATURAL NUMBERS

When we count a set of objects, we start counting from one then go on to two, three, four, etc. This is the natural way of counting any set of objects.

Hence, 1, 2, 3, 4,... are called counting numbers or natural numbers. The number of students in a class, the number of days in a week, and the number of trees in a garden are all examples of natural numbers.

ZERO

Let us consider an example to understand the concept of zero. If we want to divide 7 sweets equally among 3 children, 1 sweet will be left. But if we were to divide 6 sweets equally among 3 children, we are left with no sweets.

Zero means absence of the item (or no item)

WHOLE NUMBERS

The numbers 1, 2, 3,...., are called natural number or counting numbers. Let us add one more number, i.e., zero (0), to the collection of natural numbers. Now the numbers are 0, 1, 2, 3,.... . These numbers are called whole numbers.

PROPERTIES OF ADDITION

• **Closure Property :** If 'a' and 'b' are two whole numbers and their sum is c, i.e., a + b = c, then c will always be a whole number. This property of a addition is called the closure property of addition.

For ex. : 3 + 4 = 7

2 + 8 = 10 i.e., whole number + whole number = whole number

• **Commutative Property :** If a and b are two whole numbers a + b = a. This property of addition, where the order of addition does not alter the sum, is called the commutative property of addition.

For ex. : 3 + 4 = 7

Also, 4 + 3 = 7

i.e., 3 + 4 = 4 + 3

• **Associative Property :** If a, b and c three whole numbers then, then a + (b + c) = (a + b) + c. In other words, in the addition of whole numbers, the sum does not change even if the grouping is changed. This property is called the associative property of addition.

For ex. : 2 + (3 + 4) = (2 + 3) + 4

2 + 7 = 5 + 4

9 = 9

• **Additive Identity :** If a is a whole number, then a + 0 = 0 + a = a.

Hence, zero is called the additive identity of the whole numbers because it maintains (or does not change) the identity (value) of the numbers during the operation of addition.

For ex. : 7 + 0 = 7 = 0 + 7

PROPERTIES OF SUBTRACTION

• **Closure Property :** If a and b are two whole numbers, then a – b will be a whole number only if a is greater than b or a is equal to b. If a is smaller than b, than the answer will not be a whole number. Hence subtraction is not closed under whole numbers.

For ex. : 7 – 2 = 5 is whole number

but 3 – 8 is not a whole number

• **Commutative Property :** If a and b are two distinct whole numbers, then a – b is not equal to b – a. Hence, the commutative property is not true for subtraction of whole numbers.

For ex. : $a - b \neq b - a$

$7 - 2 \neq 2 - 7$

• **Associative Property :** If a, b and c are whole numbers, then (a – b) – c is not equal to a – (b – c). So, the associative property also not hold true for subtraction of whole numbers

For ex. $(12 - 4) - 3 = 8 - 3 = 5$

$12 - (4 - 3) = 12 - 1 = 11$

$\therefore$ $(12 - 4) - 3 \neq 12 - (4 - 3)$

• **Property of Zero :** If zero is subtracted from any whole number, then the result is the number itself. a – 0 = a, for any whole number a.

For ex. : $3 - 0 = 3$.

PROPERTIES OF MULTIPLICATION

• **Closure Property :** If a and b are whole numbers, then their product $a \times b = c$ will always be a whole number. That is whole numbers are closed under multiplication.

For ex. : $7 \times 3 = 21$, $6 \times 8 = 48$, $3 \times 0 = 0$

• **Commutative Property :** In general $a \times b = b \times a$ for all whole numbers a and b.

Consider the following example

$2 \times 3 = 3 \times 2 = 6$

$8 \times 9 = 9 \times 8 = 72$

• **Associative Property :** If a, b and c are whole numbers, then

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

That is, whole numbers have the associative property of multiplication.

For ex. : $(3 \times 4) \times 2 = 3 \times (4 \times 2)$

$12 \times 2 = 3 \times 8$

$24 = 24$

• **Multiplicative Identity :** $1 \times a = a \times 1 = a$. Hence, 1 is called the multiplicative identity for whole numbers.

For ex. : $10 \times 1 = 1 \times 10 = 10$

$3 \times 1 = 1 \times 3 = 3$

$672 \times 1 = 1 \times 672 = 672$

$0 \times 1 = 1 \times 0 = 0$

• **Property of Zero :** When any whole number a is multiplied by zero, the product is zero. That is, $a \times 0 = 0 \times a = 0$

For ex. : $27 \times 0 = 0 \times 27 = 0$

PROPERTIES OF DIVISION

• **Closure Property :** If a and b are whole number, then the quotient a + b need not always be a whole number. So, division in whole numbers is not closed.

For ex. : $6 \div 3 = 2$, $6 \div 4 = 1\frac{1}{2}$, $6 \div 7 = \frac{6}{7}$

$1\frac{1}{2}$ and $\frac{6}{7}$ are not whole numbers.

• **Commutative Property :** If a and b are whole numbers, then $a \div b$ is not equal to $b \div a$. So, the commutative property does not hold true for whole numbers.

For ex. : $6 \div 3 = 2$ is not the same as $3 \div 6 = \frac{1}{2}$

• **Associative Property :** If a, b and c are whole numbers, then $(a \div b) \div c$ is not equal to $a \div (b \div c)$.
$(a \div b) \div c \neq a \div (b \div c)$

For ex. : $(81 \div 9) \div 3 = 3$ and $81 \div (9 \div 3) = 27$

So, $(81 \div 9) \div 3$ is not equal to $81 \div (9 \div 3)$

Hence, the associative property does not apply to the division of whole numbers.

SPECIAL PROPERTIES

1. Whenever a whole number is divided by 1, we get the same whole number as the answer.

For ex. : $6 \div 1 = 6$, $8 \div 1 = 8$

If 6 sweets are divided between 2 children, we have $6 \div 2 = 3$. Each child gets 3 sweets. If 6 sweets are divided among 3 children, then $6 \div 3 = 2$. Each child gets 2 sweets in this case. If 6 sweets are given to one child, then $6 \div 1 = 6$. The child gets 6 sweets. So, when we divide by taking 1 as the divisor, the quotient (answer) is the same as the dividend.

Hence, $a \div 1 = a$

2. If zero is divided by any whole number, the result will always be zero.

For ex. : $0 \div 3 = 0$

If there are zero chocolates or no chocolate in a packet and we divide into equal parts, each part will still have only zero chocolates.

So, $0 \div a = 0$

3. Division of a whole number by zero is meaningless and is not allowed.

For example, to speak of dividing 12 oranges between zero students is meaningless.

DISTRIBUTIVE PROPERTY

If a, b, c are whole numbers, then $a \times (b + c) = a \times b + a \times c$

This property is called the distributive property of multiplication over addition.

For ex. : $7 \times (8 + 3) = 7 \times 8 + 7 \times 3$

$7 \times 11 = 56 + 21$

$77 = 77$

If a, b, c are whole numbers ($b > c$), then $a \times (b - c) = a \times b - a \times c$

This property is called the distributive property of multiplication over subtraction.

For ex. : $5 \times (7 - 3) = 5 \times 7 - 5 \times 3$

$5 \times 4 = 35 - 15$

$20 = 20$

Ex. Solve using distributive property.

(i) 8×107 (ii) 18×95

Sol. (i) $8 \times 107 = 8 \times (100 + 7)$

$= 8 \times 100 + 8 \times 7$ $= 800 + 56$ $= 856$

(ii) $18 \times 95 = 18 \times (100 - 5)$

$= 18 \times 100 - 18 \times 5$ $= 1800 - 90$ $= 1710$

Ex. Using suitable arrangment, find the product of :

(i) 8, 9, 25, 3 (ii) 4, 897, 25 (iii) 250, 2986, 4

(iv) 4000, 625, 32 (v) 125, 40, 8, 25

Sol. Since the number may be grouped in any order we group those numbers which make the calculations most conveneint.

(i)

$8 \times 9 \times 25 \times 3$

200×27

5400

(ii) $4 \times 897 \times 25 = (4 \times 25) \times 897 = 100 \times 897 = 89700$

(iii) $250 \times 4 \times 2986 = 250 \times 4 \times 2986$

$= (250 \times 4) \times 2986 = 1000 \times 2986$

$= 2986000.$

(iv) $4000 \times 625 \times 32$

$= 4000 \times 625 \times 16 \times 2$

$= (4000 \times 2) \times (625 \times 16)$

$= 8000 \times 10000 = 8,00,00,000.$

(v) $125 \times 40 \times 8 \times 25$

$= (125 \times 40) \times (8 \times 25) = 5000 \times 200 = 10,00,000$

Ex. Find the value of the following using properties of multiplication.

$37 \times 865 + 18 \times 865 - 49 \times 865 - 6 \times 865$

Sol. $37 \times 865 + 18 \times 865 - 49 \times 865 - 6 \times 865$

$= 865 \times (37 + 18 - 49 - 6)$

$= 865 \times (55 - 55) = 865 \times 0 = 0.$

Ex. 25 sets containing a pencil and a ruler are made. The cost of each pencil is Rs. 2 and that of a ruler is Rs. 8. What is the total cost of 25 sets?

Sol. Cost of 25 pencils = $25 \times$ Rs. 2 = Rs. 50

Cost of 25 rulers = $25 \times$ Rs. 8 = Rs. 200

$\therefore$ Total cost = $25 \times 25 + 25 \times 8$

Alternatively,

Total cost = $25 \times$ Total cost of pencil and ruler

= $25 \times$ Rs. $(2 + 8) = 25 \times$ Rs. 10 = Rs. 250

Thus, we can see here,

$25 \times (2 + 8) = 25 \times 2 + 25 \times 8 = 250$, i.e.,

we have used distributive property.