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# Chapter 1: Number System

**Introduction**

Number systems have been in vogue since times immemorial. The Arabic and Roman number systems are also very old, just like the Indian number system.Let us study various number systems in this chapter.

**Definition**

Arithmetic is a science which deals with relationships of numbers with one another. It includes those methods that are applicable to numbers. One number can be represented in two ways.

**Notation**

It is the art of representing a number by means of figure, such as 492.

**Numeration**

It is the art of representing a number in words, such as 'four hundred and ninety-two' (492).

**Digits**

In the Indian number system, numbers are expressed by means of numerals. These numerals are—1, 2, 3, 4, 5, 6, 7, 8, 9 and 0. They are called 'digits.' This is the decimal system in which we use numbers from 0 to 9. The number 0 is called 'insignificant digit' whereas numbers 1, 2, 3, 4, 5, 6, 7, 8 and 9 are called 'significant digits.'

**Absolute and Local Values of Digits**

The unchanged value of a digit is known as its 'absolute value.' If the value of any digit is not absolute, this value is called 'local value' of the digit. In the number 5492, the absolute value of 5 'five' and the absolute value of 9 is 'nine.' The local value of 5 is 5000, the local value of 9 is 90. Further, the local value of 2 is 2 in the number 5492 and the absolute value of 2 in this number is also 2. Absolute value is also called 'face value.'

**Note:** In any complete number, the value of the unit's digit is equal to its absolute value. The figure in the second place from the right has ten times its absolute value and the figure in the third place from the right has one hundred times its absolute value.

**SOLVED EXAMPLES**

**Example**: Find the difference of the local value and absolute value of 9 in 29735.

**Solution:** Local value of 9 = 9000

Absolute value of 9 = 9

Difference = 8991

**Example:** What is the difference between the local value of 8 and 9 in the number 78931?

**Solution:** Local value of 8 = 8000

Local value 9 = 900

Difference = 8000 – 7100

= 7100

**INDIAN NUMERATION TABLE**

| | | |
|---|---|---|
| Unit | = | $1 = 10^0$ |
| Tens | = | 10 |
| | = | $10^1$ |
| Hunderd | = | 100 |
| | = | $10^2$ |
| Thousand | = | 1,000 |
| | = | $10^3$ |
| Ten thousand | = | 10,000 |
| | = | $10^4$ |
| Lakh | = | 100,000 |
| | = | $10^5$ |
| Ten lakh | = | 1,000,000 |
| | = | $10^6$ |
| Crore | = | 10,000,000 |
| | = | $10^7$ |
| Ten crore | = | 100,000,000 |
| | = | $10^8$ |
| Arab | = | 1,000,000,000 |
| | = | $10^9$ |
| Ten Arab | = | 10,000,000,000 |
| | = | $10^{10}$ |
| Kharab | = | 1,00,000,000,000 |
| | = | $10^{11}$ |
| Ten Kharab | = | 1,000,000,000,000 |
| | = | $10^{12}$ |

After Kharab, we have Neel, Ten Neel, Padam,

Ten Padam, Sankh and Ten Sankh.

**ENGLISH SYSTEM OF NUMERATION**

| | | |
|---|---|---|
| Unit | = | 1 |
| | = | $10^0$ |
| Tens | = | 10 |
| | = | $10^1$ |
| Hunderd | = | 100 |
| | = | $10^2$ |
| Thousand | = | 1,000 |
| | = | $10^3$ |
| Ten thousand | = | 10,000 |
| | = | $10^4$ |
| Hundred thousand | = | 100,000 |
| | = | $10^5$ |
| Million | = | 1,000,000 |
| | = | $10^6$ |
| Ten Million | = | 10,000,000 |
| | = | $10^7$ |
| Hundred million | = | 100,000,000 |
| | = | $10^8$ |
| Thousand million | = | 1,000,000,000 |
| | = | $10^9$ |
| Ten thousand million | = | 10,000,000,000 |
| | = | $10^{10}$ etc. |

**Numbers**

All numbers are written by using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. The number 0 is called 'insignificant digit' whereas the rest are called 'significant digits.'

**Natural Numbers (or counting numbers)Numbers**

1, 2, 3, 4, ... etc. are called 'natural numbers.' There is no largest number whereas the smallest number is 1. If N is the set of natural numbers, then we write N = {1, 2, 3, 4, ...}.

2. Whole Numbers: Set of whole numbers is written as W = {0, 1, 2, 3, 4, ...}.

3. Integers: Set of integers is written as I = {0, ± 1, ± 2, ± 3, ...}.

**Rules of Natural Numbers**

A. Sum of the first n natural numbers is:

$$1 + 2 + 3 + 4 + .... + n = \frac{n \times (n+1)}{2}$$

Symbolically, we write $\sum n = \frac{n \times (n+1)}{2}$.

B. Sum of the first n odd natural numbers is:

$1 + 3 + 5 + 7 + ..... + n^{th}$ odd number = n2.

C. Sum of the first n even natural numbers is:

$2 + 4 + 6 + 8 + .... \ n^{th}$ even number

$= n \times (n + 1)$.

**Example:** Rohit saved Re. 1 on the first day of the year, Rs. 2 on the second day of the year, Rs. 3 on the third day of the year and so on. How much money will he save by the end of the non-leap year?

**Solution:** There are 365 days in a non-leap year. So, add the first 365 natural numbers.

$\therefore$ Money Rohit will have by the end of the year

$= \text{Rs.}\ (1 + 2 + 3 + .... + 365)$

$$= \text{Rs.}\ 365 \times \frac{(365+1)}{2} = \text{Rs.}\ 66795.$$

**Example:** A rickshaw puller saves one coin of Rs. 5 on first day of the week, three coins of Rs. 5 on the second day of the week, five coins of Rs. 5 on third day and so on. How much money will he have at the end of the week?

**Solution**: Number of Rs. 5 coins by the end of the week = sum of first seven odd numbers

$= 7^2 = 49.$

Sum of money with him = Rs. 5 x 49 = Rs. 245

**Example:** Find the sum of first 20 multiples of 12.

**Solution:** It is required to find the value of

$12 \times 1 + 12 \times 2 + 12 \times 3 + .... + 12 \times 19 + 12 \times 20$

$= 12\,(1 + 2 + 3 + .... + 20)$

$$= 12 \times \left(\frac{20 \times 21}{2}\right) = 2520$$

**Important Results**

**1.** Sum of the first m multiples of n

$= n \times$ (sum of the first m natural numbers)

$$= n \times \frac{m(m+1)}{2} = \frac{nm(m+1)}{2}$$

**2.** Let there be first n counting numbers.

**Case 1.** If n is even, then there are $\frac{n}{2}$ odd numbers