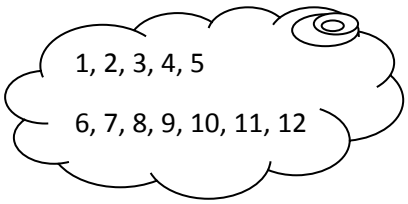
Number System

In Introduction



Numbers can be called as the base of mathematics as mathematics starts with numbers. Therefore, understanding of numbers is essential in order to study mathematics. In this chapter we will study about the numbers, number systems and their properties.

Numbers

Numbers are mathematical objects by which we express date, time, distance, position, quantity, etc. for example,
I reached in the party at 10 o clock - time
My birthday is on 6th march — date.
Distance between the earth and the sun is 15 crore km –distance 3rd planet from the sun is the earth — position.
There are 45 tones corn in this go down - quantity.
We use ten symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) to write any number.
Like 654544544, 34541540044,
35445154154454, etc.

Number System

Number system is a pattern or set of numbers in which one number is related to other number by one or more algebraic operations. There are various number system. In this chapter we will study about the following three types of number systems:
(a) Natural number
(b) Whole number
(c) Integers

Natural Number

Counting starts with 1 and continue till infinite. Counting numbers are called natural numbers. For example:
1, 2, 3, 4, 5, 6, 7..... etc.
Note: Natural number starts from 1 and goes to infinty. Therefore, smallest natural number is 1 but largest natural number cannot be found.

Whole Number

When 0 is included with natural numbers, it is called whole numbers zero are called whole numbers.
0, 1, 2, 3, 4, 5, 6, 7 .....etc. In other words ''Natural numbers together with zero are called whole numbers.''
Note: Whole numbers starts with 0 and goes to infinity. Therefore smallest natural numbers is 0 but largest whole numbers cannot be found.

Integers

To make the natural numbers more informative and efficient so that more complicated problems can be solved, a new number system was invented in which natural numbers are written with symbols "-(minus)". This type of number is known as negative numbers.
Integers are the collection of whole numbers and negative numbers.
..... -5, -4, -3, -2, -1, 0, +1, +2, +3, +4, +5, +6, + 7 ..... etc.

Note: Integers goes to infinity in either direction. Therefore, neither smallest integer nor greatest integer can be found.

System of Numeration

Mathematical notation of numbers is called numeration. We are aware of the symbols which are used to write any numbers. In this chapter we will study about the following two system of numeration:
(a) Indian system of numeration
(b) International system of numeration

Indian System of Numeration

Indian system of numeration is also called Hindu-Arabic number system. It is a positional decimal number system. Look at the following place value chart:

Period	Kharab		Arab		Crores		Lakhs		Thousands		Ones		
Places	Ten Kharab (T-kh) 1000000000000	Kharab (kh) 100000000000	Ten Arab (T-A) 10000000000	Arab (a) 1000000000	Ten Crores (T-C) 100000000	Crores (c) 10000000	Ten Lakhs (T-L) 1000000	Lakhs (L) 100000	Ten thousands (T-TH) 10000	Hundred (H) 1000	Hundred (H) 100	Tens (T) 10	Ones (0) 0

This system is based on periods and places. Units, thousands, lakhs, crores, arabs etc. are periods. Each period has been divided into places. The first period, units, has been divided into three places ones, tens, and hundreds. Other periods have been divided into two places. Like thousands has been divided into two places thousands and ten-thousands.

Illustrative EXAMPLE

Sixty five thousand six hundred and eighty nine is written as:
Six in place of "Ten thousands"
Five in place of "Thousands"
Six in place of "Hundreds"
Eight in place of "Tens" and
Nine in place of "units"
Now the expanded form of the number = 6 x
$=6\times10000+5\times1000+6\times100+8\times10+9=65689$

Illustrative EXAMPLE

Forty two crores seventy two lakhs ninety six thousand two hundred and fifteen is written as:
Four in place of "ten crores"
Two in place of "crores"
Seven in place of "Ten lakhs"

Two in place of "lakhs"
Nine in place of "Ten thousands"
Six in place of "Thousands"
Two in place of "Hundred-s"
One in place of "Tens"
Five in place of "Units or ones"
Now expanded form of the number

$$=4\times100000000+2\times10000000+7\times1000000+2\times100000+9\times10000+6\times1000+2\times100+5\times10+5=427296215$$

Illustrative EXAMPLE

Two lakhs Eight thousand and four is written as:
Two in place of "Lakhs"
Zero in place of "Ten thousands"
Eight in place of "Thousands"
Zero in place of "Hundreds"
Zero in place of "Tens"
Four in place of "units or ones"
Now expanded form of the number

$$=2\times100000+0\times10000+8\times1000+0\times100$$
$$+0\times10+4=208004$$

Illustrative EXAMPLE

Name the number indicated in the place value chart.

Period	Kharab		Arab		Crores		Lakhs		Thousands		Ones		
Places	Ten Kharab (T-kh) 1000000000000	Kharab (kh) 100000000000	Ten Arab (T-A) 10000000000	Arab (a) 1000000000	Ten Crores (T-C) 100000000	Crores (c) 10000000	Ten Lakhs (T-L) 1000000	Lakhs (L) 100000	Ten thousands (T-TH) 10000	Hundred (H) 1000	Hundred (H) 100	Tens (T) 10	Ones (0) 0

Solution:
Fourteen kharab seventy two arab ninety six crore eighty three, lakh fifty thousand eight hundred sixty two

Relation Between Different Periods

10 ones = 1 tens
10 tens =1 hundreds
10 hundreds = 1 thousands
100 thousands = 1 laks
100 lakshs =1 crores
100 crores = 1 arabs
100 arabs = 1kharabs

International System of Numeration

This system is applied in whole world. The following place value chart shows the international system of numeration:

International Place Value Chart

Period	Trillions		Billions		Millions			Thousands			Ones		
Places	Hundred Trillions	Ten Trillions	Hundred billions	Ten billions	Hundred millions	Ten millions	Millions	Hundred thousandth	The thousand	Thousands	Hundred	Tens	Ones

This system is also based on periods and places. Ones, thousands millions, billions etc. are periods. In this system each period have been divided into three places.
Like thousands has been divided into three places, thousands, ten-thousands, and hundred-thousands.

Name the number indicated in the place value chart

Period	Trillions		Billions		Millions			Thousands			Ones		
Places	Hundred Trillions	Ten Trillions	Hundred billions	Ten billions	Hundred millions	Ten millions	Millions	Hundred thousandth	The thousand	Thousands	Hundred	Tens	Ones

Solution:
Six hundred eight trillions one hundred sixty four billions eight hundred seventy millions nine hundred twenty nine thousand six hundred thirty five.

Illustrative EXAMPLE

Punctuate the following as per international system.

(a) 24365968 (b) 115632865
(c) 56268708005 (d) 52012

Solution:
(a) 24365968
Twenty four million three hundred sixty five thousand nine hundred sixty eight.
(b) 115632865
One hundred fifteen million six hundred thirty two thousand and eight hundred sixty five.
(c) 56268708005
Fifty six billion two hundred sixty eight million seven hundred eight thousand and five.
(d) 52012
Fifty two thousand and twelve.

Relation Between Indian and International Number System

International place value chart	Indian place value chart	1.
Ones	Ones	2.
Tens (10)	Tens (10)	3.
Hundreds (100)	Hundreds (100)	4.
Thousands (1000)	Thousands (1000)	5.
10 Thousands (10000)	10 housands (10000)	10
100 Thousands (100000)	1 Lakhs (100000)	100
1 Millions (1000000)	1akhs (1000000)	1
10 Millions (10000000)	1 Crores (10000000)	10
100 Millions (100000000)	10 rores (100000000)	100
1 Billions (1000000000)	1 Arabs (1000000000)	1
10 Millions (10000000000)	10 rabs (10000000000)	10
100 Millions (100000000000)	1 Kharabs (100000000000)	100
1 Trillions (1000000000000)	10 Kharabs (1000000000000)	101

Place Value

Place value of a digit in a number is the position it occupies according to the place value chart.

Illustrative EXAMPLE

Find place value of each of the digit given in number 86495.

Place value of $8 = 8\times$ Ten thousand $= 8\times10000 =$ 80000 Place value of $6 = 6\times$ Thousand $= 6\times1000 = 6000$

Place value of $4 = 4\times$ hundred $= 4\times100 = 400$

Place value of $9 = 9\times ten = 9\times10 = 90$

Place value of $5 = 5\times one = 5\times1 = 5$

Face Value

Face value of a number is the number itself.

Illustrative EXAMPLE

In the number 874.

Face value of 8 is 8 itself.

Face value of 7 is 7 itself.

Face value of 4 is 4 itself.

Successor

Successor of a number comes just after the number. In other words when we add a number by 1, the resulting number is the successor of that number. Like P is a whole number, then P + 1 is successor of P.

Illustrative EXAMPLE

Find the successor of 523604

Solution:

523604 + 1 = 523605
Thus 523605 is the successor of 523604

Predecessor

Predecessor of a number comes just before the number. In other words when we reduce a number by 1, the resulting number is the predecessor of that number. For example, P is a whole number then P - 1 is the predecessor of P.

Illustrative EXAMPLE

Find the predecessor of 986546

Solution:

986546 - 1= 986545
Thus 986545 is the predecessor of 986546.

You Must KNOW

- was invented by Aryabhata.
- Number system is based on the place value system. If places of the digits in a number are changed, the number will change.
- Predecessor of the smallest natural number is the smallest whole number.
- Successor of the smallest whole number is the smallest natural number.
- First digit of every numeral is always at unit place but first digit from left has net a fixed place.

SUMMARY

- Numbers are mathematical objects by which we express date, time, distance, position, quantity, etc.
- Number system is a set of numbers where numbers are related with each ether by one or more algebraic operations.
- Lakhs, creres, arabs, etc. are the periods which are used in the Indian system of numeration.
- Millions, billions, trillions, etc. are the periods which are used in international system of numeration.
- Successor of a number is greater than the number by
- Predecessor of a number is smaller than the number by 1.

Commonly Asked QUESTIONS

Which one of the following numbers is a whole number as well as a natural number?

(a) 3 (b) 8
(c) 100 (d) All of these
(e) None of these

Answer (d)

Explanation

All the whole numbers are also natural numbers except 0.

Which one of the following is not true?
(a) Greatest natural number cannot be found
(b) Smallest natural number is 1
(c) 35 is not an integer
(d) 0 is the smallest whole number
(d) None of these

Answer: (c)
Explanation
All the whole numbers are also integers. Therefore, 35 is also an integer.

Jack has prepared some sets of numbers which has been given below.
Which one of the following sets is the set of integers?
(a) {0, 1, 2, 4, 8, 16, 32}
(b) {3, 6, 9, 12, 15}
(c) {-4, -3, -2, -1, 0, 1, 2, 3, 4}
(d) {9, 4, 8, 3, 2}
(e) All of these

Answer (e)

Make a set of the numbers which comes between 20 to 58. First member of the set belongs to____.
(a) Natural number
(b) Whole number
(c) Integer
(d) All of these
(e) None of these

Answer (d)

P is an integer. Choose the correct option about P.
(a) P is only a negative whole number
(b) P is only a negative natural numbers
(c) P+(-P) is a whole number
(d) P-P is a natural number
(e) None of these

Answer: (c)

If the place value of 8 in a number is 80000, what place does 8 occupies in the number?
(a) Thousands
(b) Ten thousands
(c) Lakhs
(d) Crores
(e) None of these
Answer: (b)
Explanation
From the right 8 is at the fifth position and in the place value chart fifth position from the right is the position of ten thousands.

If X million is equal to 50 lakh then X =?

(a) 10 (b) 5
(c) 50 (d) 500
(e) None of these

Answer: (b)
Explanation
10 akh = 1 million, 50 lakh =5 million

You have to place a digit in a number such that place value and face value of the digit in the number is equal. At which one of the following places will you place the digit?

(a) Thousands (b) Tens
(c) Hundreds (d) Ones
(e) None of these

Answer: (d)

Jack: If we find the place value of each digit of a number and add them then result will be equal to the number.
Codi: If there is 0 in the middle of the number then you will be wrong.
Who is correct?

(a) Jack (b) Codi
(c) Both are correct (d) Both are partially incorrect
(e) None of these

Answer: (b)

Find the sum of the place value of X and Y in the number 1X0078Y5. If X = Y=2

(a) 2000020 (b) 20020000
(c) 2000002 (d) 2200000
(e) None of these

Answer: (a)

P is a natural number which represents 5 digit greatest number. Which one of the following is the successor of P?

(a) 99999 (b) 10000
(c) 100000 (d) 100001
(e) None of these

Answer: (c)
Explanation
5 digits greatest number = 99999
Successor of 99999 = 99999 + 1 = 100000

Predecessor of a number, lies ..... to the number on the line.

(a) Left (b) Right
(c) Either side (d) Centre
(e) None of these

Answer: (a)

Explanation

Predecessor of a number is smaller than the number. Therefore, it lies left to the number on the number line.

"Predecessor of n-digit smallest number is (n - 1). The above statement is:

(a) Correct (b) Incorrect
(c) Partially correct (d) All of these
(e) None of these

Answer: (a)

Q is a natural number. Find the difference between successor and predecessor of Q

(a) 0 (b) 1
(c) 2 (d) 3
(e) None of these

Answer: (c)

Which one of the following is not true?

(a) Sum of successor and predecessor of a number is twice of that number
(b) Successor of a number is always greater than the number
(c) Predecessor of the smallest natural number is the smallest whole number
(d) Predecessor of a number is either smaller or equal to the number
(e) None of these

Answer: (d)

Self Evaluation TEST

Duration 10 Minutes

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1. Name the number, indicated in the Indian place value chart, as per the international system of numeration

Period	Kharab		Arab		Crores		Lakhs		Thousands		Ones		
Places	Ten Kharab (T-kh) 1000000000000	Kharab (kh) 100000000000	Ten Arab (T-A) 10000000000	Arab (a) 1000000000	Ten Crores (T-C) 100000000	Crores (c) 10000000	Ten Lakhs (T-L) 10000000	Lakhs (L) 1000000	Ten thousands (T-TH) 10000	Hundred (H) 1000	Hundred (H) 100	Tens (T) 10	Ones (0) 0

(a) Seventy eight trillion fifty six billion two forty five million forty thousand two hundred thirty five
(b) Seven hundred eighty trillion five hundred sixty two billion four hundred fifty four million two thirty five
(c) Seven hundred eighty billion five hundred sixty two million four hundred fifty four thousand thousand two hundred thirty five (d) Seven trillion eight hundred five billion six hundred twenty four million five hundred forty thousand two hundred thirty five
(e) None of these

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2. Name the number, indicated in the International place value chart, as per the Indian system of numeration.

Period	Trillions			Billions			Millions			**Thousands**			Ones		
Places	Hundred Trillions	Ten Trillions	Ten Trillions	Hundred billions	Ten billions	Billions	Hundred millions	Ten millions	Millions	Hundred thousands	Ten thousands	Thousands	Hundred	Tens	Ones
	0	0	4	5	0	2	3	4	47	5	4	5	6	8	0

(a) Four kharab fifty arab twenty three crore forty four lakh forty five thousand six hundred eighty
(b) Forty five kharab two arab thirty four crore forty five lakh forty five thousand six hundred eighty
(c) Forty five kharab twenty arab thirty four crore forty five lakh forty five thousand six hundred eighty
(d) Forty five kharab two arab forty four crore forty five lakh forty five thousand six hundred eighty
(e) None of these

3. **Find the sum of place value and face value of 6 in the numeral 1869523.**

(a) 66000 (b) 60600
(c) 60060 (d) 60006
(e) None of these

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4. **Write Six hundred twenty three million four hundred fifty six thousands and twelve in numbers as per Indian system of numeration.**

(a) 623456012 (b) 623456012
(c) 68865496 (d) 623456012
(e) None of these

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5. **Which one of the following is the successor of seventeen crore fifteen lakh thirteen thousand?**

(a) 171513001 (b) 170151301
(c) 107151301 (d) 171501301
(e) None of these

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6. **Steve has 3 million and 4 hundred thousand rupees. What is the worth of his money as per Indian system of numeration?**

(a) 30 lakhs (b) 31 lakhs
(c) 32 lakhs (d) 34 lakhs
(e) None of these

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7. **Write 805000002600 in words as per international system of numeration?**

(a) Eight hundred five billion two thousand and six hundred
(b) Eight hundred five billion twenty thousand and six hundred
(c) Eight hundred five billion and twenty six thousand
(d) Eight hundred five billion and six hundred
(e) None of these

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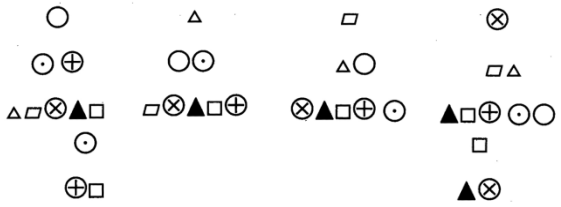
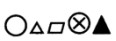
8. **Look at the following pattern carefully and choose the correct option to complete the pattern:**



(a) 

(b) 

(c) 

(d) 

(e) None of these

9. **Which one of the following is the short form of the number 600000 + 6000 + 40 + 2 ?**

(a) 6642 (b) 66042
(c) 66402 (d) 606042
(e) All of these

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10. **What least number should be added to 6456533 such that place value of 1 in the resulting numeral becomes 10000000?**

(a) 50000000 (b) 3543466
(c) 3516144 (d) 3543467
(e) None of these

Answers – Self Evaluation Test																			
1.	D	**2.**	B	**3.**	D	**4.**	D	**5.**	A	**6.**	D	**7.**	A	**8.**	D	**9.**	D	**10.**	D

Self Evaluation Test
SOLUTIONS

1. 7805624540235 = Seven trillion eight hundred five billion six hundred twenty four million five hundred forty thousand two hundred thirty five.

2. 4502344545680 = Forty five kharab two arab thirty four crore forty five lakh forty five thousand six hundred eighty.

3. Place value of 6 in the numeral = 60000
Face value of 6 = 6
Sum =60000+6= 60006

4. 62, 34, 56, 012 is in Indian system.

5. Seventeen crore fifteen lakh thirteen thousand = 171513000 Successor of 171513000 = 171513000+1 = 171513001

6. 3 million = 30 lakhs and 4 hundred thousand = 4 lakhs = 30 + 4 = 34 lakhs.

7. Eight hundred five billion, two thousand and six hundred is correct.

8. In the pattern, symbols are moving in this way. The symbol at the top comes down in the second row at the first position from left then it moves in right direction, then it comes in third row at the first position from right and moves in left direction.

9. 600000 + 6000 + 40 + 2 = 606042

10. 10000000 – 6456533 = 3543467
Thus 3543467 should be added to 6456533.