Number system (Basic Concepts & Formulas) for SSC & Railway Exams

Number system (Basic Concepts & Formulas)

Numbers

- A number is an arithmetic value used for representing the quantity and used in making calculations

TYPES OF NUMBERS

Natural Numbers

- Natural numbers are a part of the number system which includes all the positive integers from 1 till infinity. They are denoted by N.
  For example N= {1, 2, 3, 4…..}
- All natural numbers are positive
- Zero is not natural number
- 1 (one) is the smallest natural number

Whole number

- The **whole numbers** are the part of the number system in which it includes all the positive integers from 0 to infinity. They are denoted by W.
  For example W= {0, 1, 2, 3, 4…..}
- Whole numbers are also known as non-negative integers
- Zero (0) is the smallest natural number

Integers

- Integers include all whole numbers and their negative counterpart. They are denoted by I.
  For example I= {…-4,-3,-2,-1, 0, 1, 2, 3, 4…..}
- Two types of Integers are
  Positive Integers- Natural numbers are called as positive integers. They are denoted by I^+. For example I^+= {1, 2, 3, 4…..}
  Negative Integers- Negative of natural numbers are called as positive integers. They are denoted by I^-. For example I^- = {1, 2, 3, 4…..}
- Zero (0) is neither positive integers nor negative integer.

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Real Numbers

- Any number such as positive integers, negative integers, fractional numbers or decimal numbers without imaginary numbers are called the real numbers. Real numbers are denoted by R
  For example $\sqrt{2}$, $\sqrt{3}$,8/5,6/2,-0.65, π, 8
- Real numbers include both rational and irrational numbers

Rational Numbers

- A number that can be expressed as p/q is called a rational numbers. where p and q are integers and $q \neq 0$ (Note: The denominator cannot be 0, but the numerator can be)
  For example 1/2, 3/4, 7/2,3/5,7
- All the perfect squares are rational numbers. Example: $\sqrt{4}$, $\sqrt{9}$, $\sqrt{49}$
- All the terminating decimals are rational numbers. Example: 1.25, 2.34 and 6.94
- All the repeating decimals are the rational numbers. Example: 0.33333333, 0.222222 and 0.555555
- Zero(0) is a rational number
- Every integer is a rational number. Example:3,5,8
- All rational numbers are real numbers

Irrational Numbers

- The numbers that cannot be expressed in the form of p/q are called irrational numbers. where p and q are integers and $q \neq 0$
  For example $\sqrt{2}$, π, $\sqrt{3}$, $\sqrt{99}$, $\sqrt{11}$
- Non-periodic infinite decimal fractions are called as irrational numbers
  Example: 0.0435523, 0.3425452
- All irrational number are real number.

Prime Number

- A prime number is a natural number greater than 1 that can only be divided by itself and 1
  Example: 2, 3, 5,7,11…
- The number 2 is the only even prime number

How to test a given number is Prime or not?
Example: Let P=191
$14 > \sqrt{191}$
Take all the prime numbers less than 14
Prime numbers up to 14 are: 2, 3,5,7,11,13
(If none of these divides P exactly, then p is prime number otherwise is a non-prime number)
No one of these divides 191 exactly
Hence, 191 is a prime number

Composite numbers

- Composite numbers are the numbers which have factors other than 1 and the number itself
  Example: 4, 6, 8,9,10, etc.
- Composite numbers are non-prime natural numbers
- The number 1 is neither prime nor composite number.
- Composite numbers can be both odd and even numbers

Co-prime numbers

- Two numbers that have only one common factor are known as Co-prime numbers. All the prime numbers are Co-prime numbers
  Example: (35, 39), (25, 9), (7, 9)
- Co-prime numbers may or may not be prime

Twin Prime Numbers

- A twin prime is a prime number that is either 2 less or 2 more than another prime number

  Example: (3, 5), (5, 7), (11, 13), (17, 19), (29, 31)

Even number

- A number which is divisible by 2 and generates a remainder of 0 is called an even number
  Example: 2, 4, 8, 12, 18….

Odd Number

- Odd numbers are the numbers that cannot be divided by two
  Example: 3, 5, 7, 13, 17….

PLACE VALUE AND FACE VALUE

Face Value

- In numeral, the face value of a digit is the value of the digit itself irrespective of its place in the numeral

Example: Number = 581276

Face value of 6 is 6

Face value of 7 is 7

Face value of 8 is 8

Face value of 2 is 2

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Place Value

- Place value can be defined as the value represented by a digit in a number on the basis of its position in the number.
- Place Value of a digit in a number is the digit multiplied by thousand or hundred or whatever place it is situated

Example: Number = 581276

In 581276, the place value of 5 = 5*100000

=500000

In 581276, the place value of 8 = 8*10000

=80000

In 581276, the place value of 2 = 2*100

=200

DIVISIBILITY RULES

Divisibility by 1

- Every number is divisible by 1. Divisibility rule for 1 doesn't have any particular condition

Divisibility by 2

- When the last digit of a number is either zero even number, then the number is divisible by 2
  Example: 2, 12,20,36,48,64,1000, etc. are divisible by 2.

Divisibility by 3

- If the sum of the digits of the number is a multiple of 3, then the number is divisible by 3.

Example: (i) 2997 2+9+9+7=27, which is divisible by 3, so 2997 must be divisible by 3

(ii) 2997 2+9+9+7=27, which is divisible by 3, so 2997 must be divisible by 3

Divisibility by 4

- If the last two digits of a number are divisible by 4, then the number is divisible by 4.

Example: Let the number: 2512 consider the last two digits i.e. 12. As 12 is divisible by 4, the original number 2512 is also divisible by 4.

- The number having two or more zeroes at the end, is also divisible by 4
  Example: 47200, 4300

Divisibility by 5

- Number having 0 or 5 at the end are divisible by 5.
  Example: 250, 1555, 2650

Divisibility by 6

- When a number is divisible by both 3 and 2, then that particular number is divisible by 6 also
  Example: 18, 42, 90

Divisibility by 7

- A number is divisible by 7 when the difference between twice the digit at ones place and the number formed by the other digits is either zero or a multiple of 7
  Example: (i) 672 (Double 2 is 4, 67-4=63, and 63÷7=9), i.e 672 is divisible by 7
  (ii) 105 (Double 5 is 10, 10-10=0), i.e 105 is divisible by 7

Divisibility by 8

- When the number made by last three digits of a number is divisible by 8, then the number is also divisible by 8
- **Example**: Let the number: 5584 consider the last three digits i.e. 584. As 584 is divisible by 8, the original number 5584 is also divisible by 8.

Divisibility by 9

- If the sum of the digits of a number is divisible by 9, then the number itself is divisible by 9.
- **Example: 30555→ 3+0+5+5+5=18** which is divisible by 9, Therefore 30555 also divisible by 3

Divisibility by 10

- If a number has 0 in the one's place then it is divisible by 10.
- **Example:** Let the number:500 (500/10=50)

Divisibility by 11

- If the difference of the sum of alternative digits of a number is divisible by 11 then that number is divisible by 11
- Example:217382

Sum of digits at odd numbers (p) =2+7+8
Sum of digits at even numbers (q) =1+3+2
P-q=11
Clearly, 217382 is divisible by 11

UNITS DIGIT

- Unit's digit of a number is the digit in the one's place of the number
  Example: Units digit of 20197 is 7
  Units digit of 201 is 1

How to find unit digit?

- Find the unit digit in the product of 652*368*96*474
  Take the unit digit of every number and then multiplying them
  Product of unit digits=2*8*6*4
  Required digit=4

If the given number is index form

- To identify the unit digit of a number with some power, we must know about cyclicity

Cyclicity of Numbers

Number	Cyclicity of Numbers
1	1
2	4
3	4
4	2
5	1
6	1
7	4
8	4
9	2
0	1

Example:
Find the unit digit in the product: $(2567)^{143}$ x $(2513)^{85}$
In $(2567)^{143}$, unit digit is 7.
The cyclicity of 7 is 4. Dividing 143 by 4, we get 3 as remainder.
$7^3 = 3$
So, the unit digit of 7^{143} is 3
In $(2513)^{85}$, unit digit is 3.
The cyclicity of 3 is 4. Dividing 85 by 4, we get 1 as remainder.
$3^1 = 3$

So, the unit digit of 3^{85} is 3
By multiplying the unit digits, we get=3*3=9
The unit digit of the expression $(2567)^{143}$ x $(2513)^{85}$ is 9

- If unit's digit number is 0, 1, 5 and 6, then the resultant unit's digit remains same

Example:

(i) Unit digit of $(656)^{115}$ is?
Unit digit = 6

(ii) Unit digit of $(275)^{116}$ is?
Unit digit = 5

(iii) Unit digit of $(171)^{256}$ is?
Unit digit = 1

(iv) Unit digit of $(1700)^{25}$ is?
Unit digit = 0

- If unit digit is 4 and if the power of 4 is even, then the unit's digit will be 6 and if the power of 4 is odd, then units digit will be 4

Example:

(i) Unit digit of $(254)^{115}$ is?
Unit digit = 4

(ii) Unit digit of $(254)^{126}$ is?
Unit digit = 6

- If unit digit is 9 and if the power of 9 is even, then the unit's digit will be 1 and if the power of 9 is odd, then units digit will be 9

Example:

(iii) Unit digit of $(659)^{115}$ is?
Unit digit = 9

(iv) Unit digit of $(659)^{118}$ is?
Unit digit = 1

IMPORTANT FORMULAS

- Sum of first n natural numbers=n (n+1)/2
- Sum of square of first n natural numbers=n (n+1)(2n+1)/6
- Sum of square of first n natural numbers=$(n (n+1)/2)^2$
- Sum of first n even numbers=n (n+1)
- Sum of first n odd numbers=n^2
- The formula for finding the n-th term of an Arithmetic Progression (AP) is: $a_n=a+(n-1)d$
- Sum of n terms in Arithmetic Progression (AP)= n/2[2a + (n − 1) × d]