



# Aptitude - Number System

## Numbers

In Decimal number system, there are ten symbols namely 0,1,2,3,4,5,6,7,8 and 9 called digits. A number is denoted by group of these digits called as numerals.

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The screenshot shows a Microsoft Excel spreadsheet with a table of employee data. The table has columns for ID, Name, Department, Salary, Joining Date, and Performance Rating. The formula bar at the top shows the formula =TAKE(A2:F10, 10). A tooltip for the =TAKE function is open, providing the following information:

- Description:** Returns rows or columns from an array, starting at start\_col and [start\_row] through [end\_col] and [end\_row].
- Example:** =TAKE(A1:F10, 1)
- Args:**
  - array:** The array from which to take rows or columns.
  - rows:** The number of rows to take. A negative value will return rows from the bottom of the array.
  - [columns]:** The number of columns to take. A negative value takes from the end of the array.

## Face Value

Face value of a digit in a numeral is value of the digit itself. For example in 321, face value of 1 is 1, face value of 2 is 2 and face value of 3 is 3.

## Place Value

Place value of a digit in a numeral is value of the digit multiplied by  $10^n$  where n starts from 0. For example in 321:

- Place value of  $1 = 1 \times 10^0 = 1 \times 1 = 1$
- Place value of  $2 = 2 \times 10^1 = 2 \times 10 = 20$
- Place value of  $3 = 3 \times 10^2 = 3 \times 100 = 300$

*0<sup>th</sup> position digit is called unit digit and is the most commonly used topic in aptitude tests.*

## Types of Numbers

**Natural Numbers** -  $n > 0$  where n is counting number; [1,2,3...]

**Whole Numbers** -  $n \geq 0$  where n is counting number; [0,1,2,3...].

*0 is the only whole number which is not a natural number.*

*Every natural number is a whole number.*

**Integers** -  $n \geq 0$  or  $n \leq 0$  where n is counting number; ..., -3, -2, -1, 0, 1, 2, 3... are integers.

- **Positive Integers** -  $n > 0$ ; [1,2,3...]
- **Negative Integers** -  $n < 0$ ; [-1,-2,-3...]
- **Non-Positive Integers** -  $n \leq 0$ ; [0,-1,-2,-3...]
- **Non-Negative Integers** -  $n \geq 0$ ; [0,1,2,3...]

*0 is neither positive nor negative integer.*

**Even Numbers** -  $n / 2 = 0$  where n is counting number; [0,2,4,...]

**Odd Numbers** -  $n / 2 \neq 0$  where n is counting number; [1,3,5,...]

**Prime Numbers** - Numbers which is divisible by themselves only apart from 1.

*1 is not a prime number.*

*To test a number p to be prime, find a whole number k such that  $k > \sqrt{p}$ . Get all prime numbers less than or equal to k and divide p with each of these prime numbers. If no number divides p exactly then p is a prime number otherwise it is not a prime number.*

Example: 191 is prime number or not?

Solution:

Step 1 -  $14 > \sqrt{191}$

Step 2 - Prime numbers less than 14 are 2,3,5,7,11 and 13.

Step 3 - 191 is not divisible by any above prime number.

Result - 191 is a prime number.

Example: 187 is prime number or not?

Solution:

Step 1 -  $14 > \sqrt{187}$

Step 2 - Prime numbers less than 14 are 2,3,5,7,11 and 13.

Step 3 - 187 is divisible by 11.

Result - 187 is not a prime number.

**Composite Numbers** - Non-prime numbers  $> 1$ . For example, 4,6,8,9 etc.

*1 is neither a prime number nor a composite number.*

*2 is the only even prime number.*

**Co-Primes Numbers** - Two natural numbers are co-primes if their H.C.F. is 1. For example, (2,3), (4,5) are co-primes.

## Divisibility

Following are tips to check divisibility of numbers.

**Divisibility by 2** - A number is divisible by 2 if its unit digit is 0,2,4,6 or 8.

Example: 64578 is divisible by 2 or not?

Solution:

Step 1 - Unit digit is 8.

Result - 64578 is divisible by 2.

Example: 64575 is divisible by 2 or not?

Solution:

Step 1 - Unit digit is 5.

Result - 64575 is not divisible by 2.

**Divisibility by 3** - A number is divisible by 3 if sum of its digits is completely divisible by 3.

Example: 64578 is divisible by 3 or not?

Solution:

Step 1 - Sum of its digits is  $6 + 4 + 5 + 7 + 8 = 30$

which is divisible by 3.

Result - 64578 is divisible by 3.

Example: 64576 is divisible by 3 or not?

Solution:

Step 1 - Sum of its digits is  $6 + 4 + 5 + 7 + 6 = 28$

which is not divisible by 3.

Result - 64576 is not divisible by 3.

**Divisibility by 4** - A number is divisible by 4 if number formed using its last two digits is completely divisible by 4.

Example: 64578 is divisible by 4 or not?

Solution:

Step 1 - number formed using its last two digits is 78

which is not divisible by 4.

Result - 64578 is not divisible by 4.

Example: 64580 is divisible by 4 or not?

Solution:

Step 1 - number formed using its last two digits is 80

which is divisible by 4.

Result - 64580 is divisible by 4.

**Divisibility by 5** - A number is divisible by 5 if its unit digit is 0 or 5.

Example: 64578 is divisible by 5 or not?

Solution:

Step 1 - Unit digit is 8.

Result - 64578 is not divisible by 5.

Example: 64575 is divisible by 5 or not?

Solution:

Step 1 - Unit digit is 5.

Result - 64575 is divisible by 5.

**Divisibility by 6** - A number is divisible by 6 if the number is divisible by both 2 and 3.

Example: 64578 is divisible by 6 or not?

Solution:

Step 1 - Unit digit is 8. Number is divisible by 2.

Step 2 - Sum of its digits is  $6 + 4 + 5 + 7 + 8 = 30$

which is divisible by 3.

Result - 64578 is divisible by 6.

Example: 64576 is divisible by 6 or not?

Solution:

Step 1 - Unit digit is 8. Number is divisible by 2.

Step 2 - Sum of its digits is  $6 + 4 + 5 + 7 + 6 = 28$

which is not divisible by 3.

Result - 64576 is not divisible by 6.

**Divisibility by 8** - A number is divisible by 8 if number formed using its last three digits is completely divisible by 8.

Example: 64578 is divisible by 8 or not?

Solution:

Step 1 - number formed using its last three digits is 578

which is not divisible by 8.

Result - 64578 is not divisible by 8.

Example: 64576 is divisible by 8 or not?

Solution:

Step 1 - number formed using its last three digits is 576

which is divisible by 8.

Result - 64576 is divisible by 8.

**Divisibility by 9** - A number is divisible by 9 if sum of its digits is completely divisible by 9.

Example: 64579 is divisible by 9 or not?

Solution:

Step 1 - Sum of its digits is  $6 + 4 + 5 + 7 + 9 = 31$

which is not divisible by 9.

Result - 64579 is not divisible by 9.

Example: 64575 is divisible by 9 or not?

Solution:

Step 1 - Sum of its digits is  $6 + 4 + 5 + 7 + 5 = 27$

which is divisible by 9.

Result - 64575 is divisible by 9.

**Divisibility by 10** - A number is divisible by 10 if its unit digit is 0.

Example: 64575 is divisible by 10 or not?

Solution:

Step 1 - Unit digit is 5.

Result - 64578 is not divisible by 10.

Example: 64570 is divisible by 10 or not?

Solution:

Step 1 - Unit digit is 0.

Result - 64570 is divisible by 10.

**Divisibility by 11** - A number is divisible by 11 if difference between sum of digits at odd places and sum of digits at even places is either 0 or is divisible by 11.

Example: 64575 is divisible by 11 or not?

Solution:

Step 1 - difference between sum of digits at odd places and sum of digits at even places =  $(6+5+5) - (4+7) = 5$

which is not divisible by 11.

Result - 64575 is not divisible by 11.

Example: 64075 is divisible by 11 or not?

Solution:

Step 1 - difference between sum of digits at odd places and sum of digits at even places =  $(6+0+5) - (4+7) = 0$ .

Result - 64075 is divisible by 11.

## Tips on Division

If a number  $n$  is divisible by two co-primes numbers  $a, b$  then  $n$  is divisible by  $ab$ .

$(a-b)$  always divides  $(a^n - b^n)$  if  $n$  is a natural number.

$(a+b)$  always divides  $(a^n + b^n)$  if  $n$  is an even number.

$(a+b)$  always divides  $(a^n - b^n)$  if  $n$  is an odd number.

## Division Algorithm

When a number is divided by another number then

$$\text{Dividend} = (\text{Divisor} \times \text{Quotient}) + \text{Reminder}$$

## Series

Following are formulae for basic number series:

$$(1+2+3+\dots+n) = (1/2)n(n+1)$$

$$(1^2+2^2+3^2+\dots+n^2) = (1/6)n(n+1)(2n+1)$$

$$(1^3+2^3+3^3+\dots+n^3) = (1/4)n^2(n+1)^2$$

## Basic Formulae

These are the basic formulae:

$$(a + b)^2 = a^2 + b^2 + 2ab$$

$$(a - b)^2 = a^2 + b^2 - 2ab$$

$$(a + b)^2 - (a - b)^2 = 4ab$$

$$(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$$

$$(a^2 - b^2) = (a + b)(a - b)$$

$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$$

$$(a^3 + b^3) = (a + b)(a^2 - ab + b^2)$$

$$(a^3 - b^3) = (a - b)(a^2 + ab + b^2)$$

$$(a^3 + b^3 + c^3 - 3abc) = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$$

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