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(Affiliated to CBSE up to +2 Level)

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Arithmetic Progressions

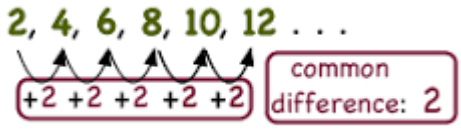
Sequences, Series and Progressions

- A **sequence** is a finite or infinite list of numbers following a certain pattern. For example: 1, 2, 3, 4, 5… is the sequence, which is infinite. Sequence of natural numbers.
- A **series** is the sum of the elements in the corresponding sequence. For example: 1+2+3+4+5….is the series of natural numbers. Each number in a sequence or a series is called a term.
- A **progression** is a sequence in which the general term can be can be expressed using a mathematical formula.

There are three types of **progression**

Arithmetic Progressions

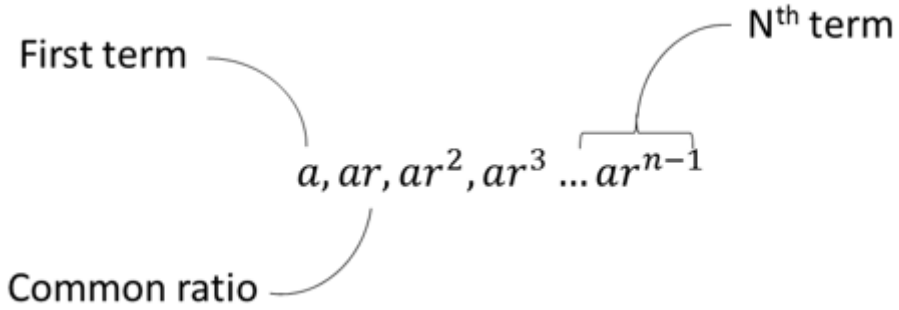
An **Arithmetic Progression** is a sequence of numbers in which we get each term by adding a particular number to the previous term, except the first term.



Geometric Progression

A **Geometric Progression** is a sequence of numbers in which we get each term by multiplying or dividing a particular number to the previous term, except the first term.

The ratio between every term to the next term is constant.



n^{th} term of the Geometric Sequence

Harmonic Progression

It is the reverse of Arithmetic Progression. If a, a + d, a + 2d …..is an Arithmetic Progression then the harmonic progression is

$$\frac{1}{a}, \frac{1}{a+d}, \frac{1}{a+2d}, \ldots.$$

n^{th} term of Harmonic Progression

Arithmetic Progression

An arithmetic progression (A.P) is a progression in which the **difference** between two **consecutive** terms is constant.
Example: 2, 5, 8, 11, 14…. is an arithmetic progression.

Common Difference

The difference between two consecutive terms in an AP, (*which is constant*) is the "**common difference**"**(d)** of an A.P. In the progression: *2, 5, 8, 11, 14* …the common difference is 3.
As it is the difference between any two consecutive terms, for any A.P, if the common difference is:

- **positive**, the AP is **increasing**.
- **zero**, the AP is **constant**.
- **negative**, the A.P is **decreasing.**

- Each number in the sequence is known as **term**.
- The fixed number i.e. the difference between each term with its preceding term is known as **common difference**. It can be positive, negative or zero. It is represented as '**d**'.

Some Examples of Arithmetic Progressions

Common difference	Value of d	Example
d > 0, positive	10	20, 30, 40, 50,…
d < 0, negative	-25	100, 75, 50, 25, 0
d = 0, zero	0	5, 5, 5, 5,..

General form of Arithmetic Progression

$$a, a+d, a+2d, a+3d, \ldots$$

Where the first term is **'a'** and the common difference is **'d'**.

Example

Given sequence is 2, 5, 8, 11, 14, …

Here, a = 2 and d = 3

d = 5 – 2 = 8 – 5 = 11 – 8 = 3

First term is a = 2

Second term is a + d = 2 + 3 = 5

Third term is a + 2d = 2 + 6 = 8 and so on.

Finite or Infinite Arithmetic Progressions

1. Finite Arithmetic Progression

If there are only a limited number of terms in the sequence then it is known as **finite** Arithmetic Progression.

229, 329, 429, 529, 629

2. Infinite Arithmetic Progression

If there are an infinite number of terms in the sequence then it is known as **infinite** Arithmetic Progression.

2, 4, 6, 8, 10, 12, 14, 16, 18 ……..

The n^{th} term of an Arithmetic Progression

If a_n is the nth term, a_1 is the first term, n is the number of terms in the sequence and d is a common difference then the nth term of an Arithmetic Progression will be

$$a_n = a_1 + (n - 1)d$$

a_n: n^{th} term in the sequence; a_1: 1st term in the sequence; n: number of terms in the sequence; d: common difference

Example

Find the 11th term of the AP: 24, 20, 16, …

Solution

Given a = 24, n = 11, d = 20 – 24 = – 4

$a_n = a + (n - 1)\, d$

$a_{11} = 24 + (11-1) – 4$

$= 24 + (10) – 4$

$=24 – 40$

$= -16$