

MATHEMATICS • CLASS 10

CHAPTER 5

Arithmetic Progressions

CHAPTER NOTES



ARITHMETIC PROGRESSIONS: THE IDEA

- A sequence is an ordered list of numbers; each number is called a term.
- An arithmetic progression (AP) is a list in which each term after the first is obtained by adding the same fixed number to the preceding term.
- The fixed number is the common difference, d .

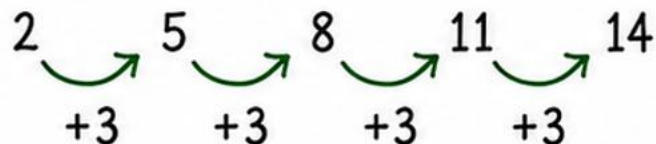
$$d = a_2 - a_1 = a_3 - a_2 = \dots = a_{k+1} - a_k.$$

- The common difference d may be positive, negative, or zero.

EXAMPLE - Recognising an AP

- 6, 9, 12, 15, ... $\Rightarrow$ differences: 3, 3, 3 $\Rightarrow a = 6, d = 3 \Rightarrow$ It is an AP.
- 1, 1, 2, 3, 5, ... $\Rightarrow$ differences: 0, 1, 1, 2 $\Rightarrow$ It is not an AP.

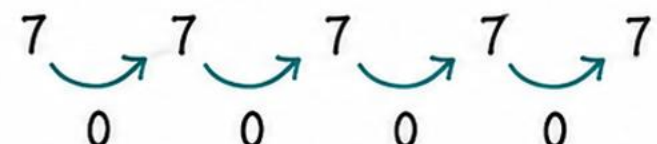
INCREASING ($d > 0$)



DECREASING ($d < 0$)



CONSTANT ($d = 0$)



GENERAL FORM & TYPES OF AN AP

GENERAL FORM OF AN AP

$$a, a + d, a + 2d, a + 3d, \dots, a + (n-1)d.$$

- a = first term
- d = common difference
- a_n = n th term = $a + (n-1)d$
- Knowing both a and d determines the entire AP.

EXAMPLE - Building APs

Given (a, d)	AP formed
$a = 6, d = 3$	6, 9, 12, 15, ...
$a = 6, d = -3$	6, 3, 0, -3, ...
$a = 2, d = 0$	2, 2, 2, 2, ...

TYPES OF AN AP

FINITE AP

- Has a limited number of terms.
- Has a last term l .
- Finite illustration:
 $7, 10, 13, 16, 19$
last term = $l = 19$

INFINITE AP

- Continues without end.
- Has no last term.
- Infinite illustration:
 $3, 8, 13, 18, 23, \dots$
(no last term)

IMPORTANT FACT

If a, b, c are consecutive terms of an AP, then
$$b - a = c - b.$$

Hence, $2b = a + c \Rightarrow b = \frac{a + c}{2}.$

Thus, b is the arithmetic mean of a and c .

THE n th TERM OF AN AP

BUILD THE PATTERN STEP BY STEP

$$a_1 = a$$

$$a_2 = a + d$$

$$a_3 = a + 2d$$

$$a_4 = a + 3d$$

$$\vdots$$

$$a_n = a + (n-1)d.$$

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

WHAT EACH SYMBOL MEANS

- a : first term of the AP
- d : common difference between successive terms
- n : term position (a positive integer, $n \geq 1$)
- a_n : n^{th} term of the AP

HOW TO USE THE FORMULA

- ① Identify a (first term) and d (common difference).
- ② Substitute the given value of n in $a_n = a + (n-1)d$.
- ③ Simplify carefully, keeping the signs of a and d .
- ④ Attach unit (if any) when the context has one.

IMPORTANT - KEEP IN MIND

- Use $(n-1)$, not n , in the formula.
- Calculate d as: later term - earlier term.

REVERSE POSITION (IN A FINITE AP)

If l is the last term of an AP, then the r^{th} term from the end is $l - (r-1)d$.

Here, $r = 1, 2, 3, \dots, n$.

USING THE n^{th} TERM FORMULA

EXAMPLE – Find a Required Term

- In the AP 5, 9, 13, 17, ..., find the 20th term.
- Here, first term $a = 5$, common difference $d = 4$, and $n = 20$.
- Use the n^{th} term formula: $a_n = a + (n-1)d$
- $a_{20} = a + (20-1)d$
 $= 5 + 19 \times 4$
 $= 81$
- Check pattern direction:
5, 9, 13, 17, ... (increasing by 4)

$$a_{20} = 81$$

EXAMPLE – Is a Number a Term?

- Is 117 a term of AP 9, 15, 21, ...?
- Here, $a = 9$, $d = 6$. Set $a_n = 117$.
- Use the n^{th} term formula: $a_n = a + (n-1)d$
$$117 = 9 + (n-1)6$$
$$108 = 6(n-1)$$
$$n-1 = 18$$
$$n = 19$$
- Therefore, 117 is the 19th term.

METHOD TO TEST MEMBERSHIP

To check whether a given number is a term of an AP, substitute it for a_n in $a_n = a + (n-1)d$ and solve for n . If n is a positive integer, the number is a term of the AP.





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