CBSE Class 10 Mathematics — Chapter 5: Arithmetic Progressions PYQs

Dedicated Chapter Question Bank (2020–2026)

Bifurcated by Standard (041) & Basic (241) Curriculums | Complete Step-by-Step Solutions & Marking Schemes

Quick Formula Checklist (Chapter 5: Arithmetic Progressions)

- General Form of an AP: a, a + d, a + 2d, a + 3d, ... (where a = first term, d = common difference = $a_2 - a_1$)
- nth Term from the beginning: $a_n = a + (n - 1)d$ | nth Term from the end: $l - (n - 1)d$
- Sum of first n terms: $S_n = (n/2)[2a + (n - 1)d]$ OR $S_n = (n/2)(a + l)$
- Relation between S_n and a_n: $a_n = S_n - S_{n-1}$ | Three terms in AP: (a - d), a, (a + d)

Part A: Standard Mathematics (041) Question Bank

Question 1 [2025 Exam] (1 Mark - MCQ)

If the sum of first n terms of an AP is given by $S_n = 3n^2 + 2n$, then its nth term (a_n) is:

(A) 6n - 1 (B) 6n + 1 (C) 3n + 2 (D) 6n - 5

[Marking Scheme] *Applying $a_n = S_n - S_{n-1}$ correctly: 0.5 Mark | Simplifying to obtain correct nth term: 0.5 Mark.*

Answer: Given, $S_n = 3n^2 + 2n$

Replace n with (n - 1):

$S_{n-1} = 3(n - 1)^2 + 2(n - 1)$

$S_{n-1} = 3(n^2 - 2n + 1) + 2n - 2 = 3n^2 - 6n + 3 + 2n - 2 = 3n^2 - 4n + 1$

We know that nth term, $a_n = S_n - S_{n-1}$

$a_n = (3n^2 + 2n) - (3n^2 - 4n + 1) = 3n^2 + 2n - 3n^2 + 4n - 1 = 6n - 1$

Hence, the correct option is (A).

Question 2 [2024 Exam] (3 Marks - Short Answer)

If the mth term of an AP is 1/n and the nth term is 1/m, then show that its (mn)th term is 1.

[Marking Scheme] *Forming two linear equations for a_m and a_n: 1 Mark | Solving for a and d: 1 Mark | Substituting to prove $a_{mn} = 1$: 1 Mark.*

Answer: Let 'a' be the first term and 'd' be the common difference of the AP.

Given:

- The m^{th} term of an Arithmetic Progression (A.P.) is $a_m = \frac{1}{n}$:

$$a + (m - 1)d = \frac{1}{n} \quad \text{--- (Equation 1)}$$

- The n^{th} term of the A.P. is $a_n = \frac{1}{m}$:

$$a + (n - 1)d = \frac{1}{m} \quad \text{--- (Equation 2)}$$

Step 1: Find the common difference (d)

Subtracting Equation 2 from Equation 1 ($a_m - a_n$):

$$\frac{1}{n} - \frac{1}{m} = [a + (m-1)d] - [a + (n-1)d]$$
$$\frac{m-n}{mn} = (a-a) + [(m-1) - (n-1)]d$$
$$\frac{m-n}{mn} = (m-n)d$$
$$\therefore \ d = \frac{1}{mn}$$

Step 2: Find the first term (a)

Substitute $d = \frac{1}{mn}$ into Equation 1:

$$\frac{1}{n} = a + (m-1)\left(\frac{1}{mn}\right)$$
$$\frac{1}{n} = a + \frac{m}{mn} - \frac{1}{mn}$$
$$\frac{1}{n} = a + \frac{1}{n} - \frac{1}{mn}$$
$$\therefore \ a = \frac{1}{mn}$$

Step 3: Find the $(mn)^{\text{th}}$ term (a_{mn})

Using the n^{th} term formula $a_{mn} = a + (mn-1)d$:

$$a_{mn} = \frac{1}{mn} + (mn-1)\left(\frac{1}{mn}\right)$$
$$a_{mn} = \frac{1 + mn - 1}{mn}$$
$$a_{mn} = \frac{mn}{mn}$$
$$\therefore \ a_{mn} = 1$$

Hence Proved.

Question 3 [2024 Exam] (5 Marks - Long Answer)

The sum of the first 7 terms of an AP is 63 and the sum of its next 7 terms is 161. Find the 28th term of this AP.

[Marking Scheme] Setting up equation for $S_7 = 63$: 1.5 Marks | Setting up $S_{14} = 63 + 161 = 224$: 1.5 Marks | Finding a and d: 1 Mark | Calculating a_{28}: 1 Mark.

Answer: Let a be the first term and d be the common difference of the Arithmetic Progression (A.P.).

Step 1: Form Equation 1 using S_7

Given that the sum of the first 7 terms is $S_7 = 63$. Using the sum formula $S_n = \frac{n}{2}[2a + (n-1)d]$:

$$\frac{7}{2}[2a + (7-1)d] = 63$$
$$\frac{7}{2}(2a + 6d) = 63$$
$$7(a + 3d) = 63$$
$$a + 3d = 9 \qquad \text{--- (Equation 1)}$$

Step 2: Form Equation 2 using S_{14}

The sum of the next 7 terms (from the 8^{th} to the 14^{th} term) is given as 161.

Therefore, the sum of the first 14 terms (S_{14}) is:

$$S_{14} = S_7 + (\text{Sum of next 7 terms}) = 63 + 161 = 224$$

Using the formula for S_{14}:

$$\frac{14}{2}[2a + (14-1)d] = 224$$
$$7(2a + 13d) = 224$$
$$2a + 13d = 32 \quad \text{--- (Equation 2)}$$

Step 3: Solve for a and d

Multiply Equation 1 by 2:

$$2a + 6d = 18 \quad \text{--- (Equation 3)}$$

Subtract Equation 3 from Equation 2:

$$(2a + 13d) - (2a + 6d) = 32 - 18$$
$$7d = 14$$
$$\therefore \ d = 2$$

Substitute $d = 2$ into Equation 1:

$$a + 3(2) = 9$$
$$a + 6 = 9$$
$$\therefore \ a = 3$$

Step 4: Find the 28^{th} term (a_{28})

Using the n^{th} term formula $a_n = a + (n-1)d$:

$$a_{28} = a + (28-1)d$$
$$a_{28} = 3 + 27(2)$$
$$a_{28} = 3 + 54$$
$$\therefore \ a_{28} = 57$$

Hence, the 28^{th} term of the A.P. is 57.

Question 4 [2023 Exam] (3 Marks - Short Answer)

Which term of the Arithmetic Progression 65, 61, 57, 53, ... is its first negative term?

[Marking Scheme] *Identifying a and d: 1 Mark | Setting inequality $a_n < 0$: 1 Mark | Solving for n and concluding integer value: 1 Mark.*

Answer: Given AP is 65, 61, 57, 53, ...

Here, first term (a) = 65, common difference (d) = 61 - 65 = -4.

Let the nth term (a_n) be the first negative term, so $a_n < 0$.

$a + (n - 1)d < 0$

$65 + (n - 1)(-4) < 0$

$65 - 4n + 4 < 0 \Rightarrow 69 - 4n < 0 \Rightarrow 4n > 69$

$n > 69/4 \Rightarrow n > 17.25$

Since n must be a positive integer, the smallest integer greater than 17.25 is 18.

Hence, the 18th term is the first negative term of the given AP.

Question 5 [2023 Exam] (5 Marks - Long Answer)

If the ratio of the sum of the first n terms of two APs is (7n + 1) : (4n + 27), find the ratio of their 9th terms.

[Marking Scheme] Writing ratio of sums S_n / S'_n: 1 Mark | Substituting n = 2m - 1 (i.e., n = 17) to match 9th term ratio: 2 Marks | Evaluating final ratio: 2 Marks.

AnswerLet a_1, d_1 and a_2, d_2 be the first terms and common differences of the two Arithmetic Progressions (A.P.s) respectively.

Step 1: Set up the given ratio of the sums

Given that the ratio of the sum of the first n terms of the two A.P.s is:

$$\frac{S_n}{S'_n} = \frac{7n+1}{4n+27}$$

$$\frac{S_n}{S'_n} = \frac{7n+1}{4n+27}$$

Using the sum formula $S_n = \frac{n}{2}[2a + (n-1)d]$ for both A.P.s:

$$\frac{\frac{n}{2}[2a_1 + (n-1)d_1]}{\frac{n}{2}[2a_2 + (n-1)d_2]} = \frac{7n+1}{4n+27}$$

$$\frac{a_1 + \left(\frac{n-1}{2}\right)d_1}{a_2 + \left(\frac{n-1}{2}\right)d_2} = \frac{7n+1}{4n+27} \quad \text{— (Equation 1)}$$

$$\frac{\frac{n}{2}[2a_1 + (n-1)d_1]}{\frac{n}{2}[2a_2 + (n-1)d_2]} = \frac{7n+1}{4n+27}$$

$$\frac{a_1 + \left(\frac{n-1}{2}\right)d_1}{a_2 + \left(\frac{n-1}{2}\right)d_2} = \frac{7n+1}{4n+27} \quad \text{--- (Equation 1)}$$

Step 2: Relate to the ratio of the 9^{th} terms

We need to find the ratio of their 9^{th} terms, which is given by:

$$\frac{a_9}{a'_9} = \frac{a_1 + 8d_1}{a_2 + 8d_2}$$

$$\frac{a_9}{a'_9} = \frac{a_1 + 8d_1}{a_2 + 8d_2}$$

Comparing the coefficients of d_1 and d_2 in Equation 1 with the 9^{th} term formula:

$$\frac{n-1}{2} = 8$$

$$\frac{n-1}{2} = 8$$

$$n - 1 = 16$$

$$n - 1 = 16$$

$$\therefore n = 17$$

$$\therefore \ n = 17$$

Step 3: Substitute $n = 17$into Equation 1

$$\frac{a_1 + 8d_1}{a_2 + 8d_2} = \frac{7(17) + 1}{4(17) + 27}$$
$$= \frac{119 + 1}{68 + 27}$$
$$= \frac{120}{95}$$

$$\frac{a_1 + 8d_1}{a_2 + 8d_2} = \frac{7(17) + 1}{4(17) + 27}$$
$$= \frac{119 + 1}{68 + 27}$$
$$= \frac{120}{95}$$

Dividing both the numerator and the denominator by 5:

$$\frac{120 \div 5}{95 \div 5} = \frac{24}{19}$$

$$\frac{120 \div 5}{95 \div 5} = \frac{24}{19}$$

Hence, the ratio of their 9^{th}terms is $24 : 19$.

Question 6 [2022 Exam] (3 Marks - Short Answer)

How many terms of the AP: 24, 21, 18, ... must be taken so that their sum is 78? Explain the double answer.

[Marking Scheme] Forming quadratic equation in n: 1 Mark | Solving for two values of n: 1 Mark | Explaining why both values are valid: 1 Mark.

Answer: Given Arithmetic Progression (A.P.):

$$24, 21, 18, \ldots$$

From the given series, we have:

- **First term (a) = 24**
- **Common difference (d) = $21 - 24 = -3$**
- **Sum of $n$terms (S_n) = 78**

Step 1: Set up the equation using the sum formula

Using the sum formula $S_n = \frac{n}{2}[2a + (n-1)d]$:

$$78 = \frac{n}{2}[2(24) + (n-1)(-3)]$$
$$78 = \frac{n}{2}[48 - 3n + 3]$$
$$78 = \frac{n}{2}[51 - 3n]$$

$$156 = n(51 - 3n)$$
$$156 = 51n - 3n^2$$
$$3n^2 - 51n + 156 = 0$$

Dividing the entire equation by 3:

$$n^2 - 17n + 52 = 0$$

$$n^2 - 4n - 13n + 52 = 0$$
$$n(n-4) - 13(n-4) = 0$$
$$(n-4)(n-13) = 0$$
$$\therefore n = 4 \text{ or } n = 13$$

Explanation of the Double Answer:

n=4 ; a=24, d =-3

$$S_n = \frac{n}{2}[2a + (n-1)d]$$

$$78 = \frac{4}{2}[2(24) + (4-1)(-3)]$$

78 =78

For n=13 , a= 24, d= -3

$$S_n = \frac{n}{2}[2a + (n-1)d]$$

$$78 = \frac{13}{2}[2(24) + (13 - 1) - 3]$$

78 =78

Hence, both $n = 4$and $n = 13$yield the exact same sum of 78.

Question 7 [2025 Exam] (2 Marks - Short Answer)

Find the 11th term from the last term (towards the first term) of the AP: 10, 7, 4, ..., -62.

[Marking Scheme] *Identifying last term l and common difference d: 1 Mark | Applying l - (n - 1)d to find 11th term from end: 1 Mark.*

> **Answer:** Given AP: 10, 7, 4, ..., -62.
> Here, first term (a) = 10, common difference (d) = 7 - 10 = -3, and last term (l) = -62.
> Formula for nth term from the end = l - (n - 1)d.
> 11th term from the end = -62 - (11 - 1)(-3)
> = -62 - 10(-3) = -62 + 30 = -32.
> **Hence, the 11th term from the last term is -32.**

Question 8 [2020 Exam] (3 Marks - Proof)

If pth, qth, and rth terms of an AP are a, b, and c respectively, then show that: a(q - r) + b(r - p) + c(p - q) = 0.

[Marking Scheme] *Writing expressions for a, b, c using first term A and common difference D: 1 Mark | Substituting into LHS and expanding: 1 Mark | Simplifying to 0: 1 Mark.*

> **Answer:** Let 'A' be the first term and 'D' be the common difference of the AP.
> According to the question:
> a = A + (p - 1)D ..... (1)
> b = A + (q - 1)D ..... (2)
> c = A + (r - 1)D ..... (3)
> Substitute a, b, c in LHS: a(q - r) + b(r - p) + c(p - q)
> = [A + (p - 1)D](q - r) + [A + (q - 1)D](r - p) + [A + (r - 1)D](p - q)
> = A[(q - r) + (r - p) + (p - q)] + D[(p - 1)(q - r) + (q - 1)(r - p) + (r - 1)(p - q)]
> = A[0] + D[pq - pr - q + r + qr - pq - r + p + rp - rq - p + q]
> = 0 + D[0] = 0 = RHS. Hence Proved.

Question 9 [2024 Exam] (4 Marks - Case Study)

A manufacturer of TV sets produced 600 sets in the third year and 700 sets in the seventh year. Assuming that the production increases uniformly by a fixed number every year, find: (i) the production in the 1st year, (ii) the production in the 10th year, and (iii) the total production in the first 7 years.

[Marking Scheme] *Finding d and first year production a: 2 Marks | Finding 10th year production a_{10}: 1 Mark | Calculating S_7: 1 Mark.*

> **Answer:** Since production increases uniformly every year, the yearly production forms an AP.

Given: $a_3 = 600 \Rightarrow a + 2d = 600$ ..... (1)

And: $a_7 = 700 \Rightarrow a + 6d = 700$ ..... (2)

(i) Subtracting (1) from (2): $4d = 100 \Rightarrow d = 25$.

Substitute d = 25 in (1): $a + 2(25) = 600 \Rightarrow a = 550$. (Production in 1st year = 550 sets).

(ii) Production in 10th year: $a_{10} = a + 9d = 550 + 9(25) = 550 + 225 = 775$ sets.

(iii) Total production in first 7 years: $S_7 = (7/2)(a + a_7) = (7/2)(550 + 700) = (7/2)(1250) = 7 \times 625 = 4{,}375$ sets.

Part B: Basic Mathematics (241) Question Bank

Question 10 [2025 Exam] (1 Mark - MCQ)

If k + 2, 4k - 6, and 3k - 2 are three consecutive terms of an AP, then the value of k is:

(A) 3 (B) -3 (C) 4 (D) -4

[Marking Scheme] *Using common difference property 2b = a + c: 0.5 Mark | Solving linear equation for k: 0.5 Mark.*

Answer: Since k + 2, 4k - 6, and 3k - 2 are in AP, their common difference is equal:

$(4k - 6) - (k + 2) = (3k - 2) - (4k - 6)$

$3k - 8 = -k + 4$

$3k + k = 4 + 8 \Rightarrow 4k = 12 \Rightarrow k = 3$.

Hence, the correct option is (A).

Question 11 [2024 Exam] (2 Marks - Short Answer)

Find the 20th term of the Arithmetic Progression: 3, 8, 13, 18, ...

[Marking Scheme] *Identifying a and d: 1 Mark | Applying $a_n = a + (n - 1)d$ to find a_{20}: 1 Mark.*

Answer: Given AP: 3, 8, 13, 18, ...

Here, first term (a) = 3, common difference (d) = 8 - 3 = 5, and n = 20.

Using the formula $a_n = a + (n - 1)d$:

$a_{20} = 3 + (20 - 1)(5) = 3 + 19 \times 5 = 3 + 95 = 98$.

Hence, the 20th term of the AP is 98.

Question 12 [2024 Exam] (2 Marks - Short Answer)

Find the sum of the first 22 terms of the AP: 8, 3, -2, ...

[Marking Scheme] *Stating a, d, and S_n formula: 1 Mark | Substituting n = 22 and computing sum: 1 Mark.*

Answer: Given AP: 8, 3, -2, ...

Here, first term (a) = 8, common difference (d) = 3 - 8 = -5, and n = 22.

Using $S_n = (n/2)[2a + (n - 1)d]$:

$S_{22} = (22/2)[2(8) + (22 - 1)(-5)]$

$S_{22} = 11[16 + 21(-5)] = 11[16 - 105] = 11(-89) = -979$.

Hence, the sum of the first 22 terms is -979.

Question 13 [2023 Exam] (3 Marks - Short Answer)

How many two-digit numbers are divisible by 3?

[Marking Scheme] *Forming the AP of two-digit multiples of 3: 1 Mark | Applying $a_n = a + (n - 1)d$: 1 Mark | Solving for n: 1 Mark.*

> **Answer:** The two-digit numbers divisible by 3 are: 12, 15, 18, ..., 99.
>
> This forms an AP where first term (a) = 12, common difference (d) = 3, and nth term (a_n) = 99.
>
> Using $a_n = a + (n - 1)d$:
>
> $99 = 12 + (n - 1)3$
>
> $99 - 12 = 3(n - 1) \Rightarrow 87 = 3(n - 1)$
>
> $n - 1 = 87 / 3 = 29 \Rightarrow n = 30$.
>
> **Hence, there are 30 two-digit numbers divisible by 3.**

Question 14 [2022 Exam] (3 Marks - Short Answer)

Determine the AP whose 3rd term is 5 and the 7th term is 9.

[Marking Scheme] *Forming linear equations for a_3 and a_7: 1 Mark | Solving for a and d: 1 Mark | Writing the AP sequence: 1 Mark.*

> **Answer:** Let 'a' be the first term and 'd' be the common difference.
>
> Given: $a_3 = 5 \Rightarrow a + 2d = 5$ ..... (Equation 1)
>
> And: $a_7 = 9 \Rightarrow a + 6d = 9$ ..... (Equation 2)
>
> Subtracting Equation 1 from Equation 2: $(a + 6d) - (a + 2d) = 9 - 5 \Rightarrow 4d = 4 \Rightarrow d = 1$.
>
> Substitute d = 1 in Equation 1: $a + 2(1) = 5 \Rightarrow a = 3$.
>
> **Required AP: a, a + d, a + 2d, a + 3d, ... = 3, 4, 5, 6, ...**

Question 15 [2025 Exam] (1 Mark - MCQ)

The common difference of the AP: 1/p, (1 - p)/p, (1 - 2p)/p, ... is:

(A) 1 (B) 1/p (C) -1 (D) -1/p

[Marking Scheme] *Applying $d = a_2 - a_1$ and simplifying fraction: 1 Mark.*

> **Answer:** Common difference (d) = Second term (a_2) - First term (a_1)
>
> $d = (1 - p)/p - 1/p = (1 - p - 1) / p = -p / p = -1$.
>
> **Hence, the correct option is (C).**