**CBSE Class–10 Mathematics**

**NCERT solution**

**Chapter - 5**

**Arithmetic Progressions - Exercise 5.2**

**1. Find the missing variable from a, d, n and $a_n$, where a is the first term, d is the common difference and $a_n$ is the nth term of AP.**

**(i) a = 7, d = 3, n = 8**

**(ii) a = –18, n = 10,** $a_n = 0$

**(iii) d = –3, n = 18,** $a_n = -5$

**(iv) a = –18.9, d = 2.5,** $a_n = 3.6$

**(v) a = 3.5, d = 0, n = 105**

**Ans. (i)** a = 7, d = 3, n = 8

We need to find $a_n$ here.

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

Putting values of a, d and n,

$a_n$ = 7 + (8 – 1) 3

= 7 + (7) 3 = 7 + 21 = 28

**(ii)** a = –18, n= 10, $a_n = 0$

We need to find d here.

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

Putting values of a, $a_n$ and $n$,

0 = –18 + (10 – 1) d

⇒ 0 = −18 + 9$d$

⇒ 18 = 9$d$ ⇒ $d$ = 2

**(iii)** d = –3, n = 18, $a_n = -5$

We need to find a here.

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

Putting values of d, $a_n$ $and$ $n$,

–5 = a + (18 – 1) (–3)

⇒ −5 = $a$ + (17) (−3)

⇒ −5 = $a$ – 51 ⇒ $a$ = 46

**(iv)** a = –18.9, d = 2.5, $a_n = 3.6$

We need to find n here.

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

Putting values of d, $a_n$ $and$ $n$,

3.6 = –18.9 + (n – 1) (2.5)

⇒ 3.6 = −18.9 + 2.5$n$ − 2.5

⇒ 2.5$n$ = 25 ⇒ $n$ = 10

**(v)** a = 3.5, d = 0, n = 105

We need to find $a_n$ here.

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

Putting values of d, n and a,

$a_n$ = 3.5 + (105 − 1) (0)

$\Rightarrow a_n = 3.5 + 104 \times 0$

$\Rightarrow a_n = 3.5 + 0 \Rightarrow a_n = 3.5$

**2.Choose the correct choice in the following and justify:**

**(i) 30$^{th}$ term of the AP: 10, 7, 4... is**

**(A) 97**

**(B)** 77

**(C)** –77

**(D)** –87

**(ii) 11$^{th}$ term of the AP: −3, −12, 2... is**

**(A) 28**

**(B) 22**

**(C) –38**

**(D)** $-48\frac{1}{2}$

**Ans.(i)** 10, 7, 4...

First term = a = 10, Common difference = d = 7 – 10 = 4 – 7 = –3

And n = 30{Because, we need to find 30$^{th}$ term}

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

⇒ $a_{30}$ = 10 + (30 − 1) (−3) = 10 – 87 = −77

Therefore, the answer is (C).

**(ii)** −3, −½, 2...

First term = a = –3, Common difference = d = $-\frac{1}{2}$ − (−3) = 2 − ($-\frac{1}{2}$) = $\frac{5}{2}$

And n = 11 (Because, we need to find $11^{th}$ term)

$a_n$ = −3 + (11 – 1) $\frac{5}{2}$ = −3 + 25 = 22

Therefore $11^{th}$ term is 22 which means answer is (B).

**3. In the following AP's find the missing terms:**

**(i) 2, __ , 26**

**(ii) __, 13, __, 3**

**(iii) 5, __, __, $9\frac{1}{2}$**

**(iv) –4. __, __, __, __, 6**

**(v) __, 38, __, __, __, –22**

**Ans. (i)** 2, __ , 26

We know that difference between consecutive terms is equal in any A.P.

Let the missing term be *x*.

*x* – 2 = 26 – *x*

⇒ 2*x* = 28 ⇒ *x* = 14

Therefore, missing term is 14.

**(ii)**__, 13, __, 3

Let missing terms be $x$ and $y$.

The sequence becomes $x$, 13, $y$, 3

We know that difference between consecutive terms is constant in any A.P.

$y - 13 = 3 - y$

$\Rightarrow 2y = 16 \Rightarrow y = 8$

And $13 - x = y - 13$

$\Rightarrow x + y = 26$

But, we have $y = 8$,

$\Rightarrow x + 8 = 26 \Rightarrow x = 18$

Therefore, missing terms are 18 and 8.

**(iii)** 5, __, __, $9\frac{1}{2}$

Here, first term = $a = 5$ And, 4th term = $a_4 = 9\frac{1}{2}$

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

$a_4 = 5 + (4 - 1)\,d$

$\Rightarrow \frac{19}{2} = 5 + 3d$

$\Rightarrow 19 = 2\,(5 + 3d)$

$\Rightarrow 19 = 10 + 6d$

$\Rightarrow 6d = 19 - 10$

$\Rightarrow 6d = 9 \Rightarrow d = \frac{3}{2}$

Therefore, we get common difference = d = $\frac{3}{2}$

Second term = a + d = $5+\frac{3}{2}=\frac{13}{2}$

Third term = second term + d = $\frac{13}{2}+\frac{3}{2}=\frac{16}{2}=8$

Therefore, missing terms are $\frac{13}{2}$ and 8

**(iv)**–4. __, __, __, __, 6

Here, First term = a = –4 and 6th term = $a_6 = 6$

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

$a_6$ = −4 + (6 − 1) $d$

$\Rightarrow$ 6 = −4 + 5$d$

$\Rightarrow 5d = 10 \Rightarrow d = 2$

Therefore, common difference = d = 2

Second term = first term + d = a + d = –4 + 2 = –2

Third term = second term + d = –2 + 2 = 0

Fourth term = third term + d = 0 + 2 = 2

Fifth term = fourth term + d = 2 + 2 = 4

Therefore, missing terms are –2, 0, 2 and 4.

**(v)** __, 38, __, __, __, –22

We are given $2^{nd}$ and $6^{th}$ term.

Using formula $a_n = a + (n-1)d$, to find $n^{th}$ term of arithmetic progression,

$a_2 = a + (2 - 1)\ d$ and $a_6 = a + (6 - 1)\ d$

$\Rightarrow 38 = a + d$ and $-22 = a + 5d$

These are equations in two variables, we can solve them using any method.

Using equation ($38 = a + d$), we can say that $a = 38 - d$.

Putting value of $a$ in equation ($-22 = a + 5d$),

$-22 = 38 - d + 5d$

$\Rightarrow 4d = -60$

$\Rightarrow d = -15$

Using this value of $d$ and putting this in equation $38 = a + d$,

$38 = a - 15 \Rightarrow a = 53$

Therefore, we get $a = 53$ and $d = -15$

First term = a = 53

Third term = second term + d = 38 – 15 = 23

Fourth term = third term + d = 23 – 15 = 8

Fifth term = fourth term + d = 8 – 15 = –7

Therefore, missing terms are 53, 23, 8 and –7.

**4. Which term of the AP: 3, 8, 13, 18 ... is 78?**

**Ans.** First term = $a = 3$, Common difference = d = 8 – 3 = 13 – 8 = 5 and $a_n = 78$

Using formula $a_n = a + (n-1)d$, to find n$^{th}$ term of arithmetic progression,

$a_n$ = 3 + ($n$ − 1) 5,

⇒ 78 = 3 + ($n$ − 1) 5

⇒ 75 = 5$n$ − 5

⇒ 80 = 5$n$⇒ $n$ = 16

It means 16$^{th}$ term of the given AP is equal to 78.

**5. Find the number of terms in each of the following APs:**

**(i) 7, 13, 19...., 205**

**(ii) 18, $15\frac{1}{2}$, 13..., −47**

**Ans. (i)** 7, 13, 19 ..., 205

First term = a = 7, Common difference = d = 13 – 7 = 19 – 13 = 6

And $a_n = 205$

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

205 = 7 + ($n$ − 1) 6 = 7 + 6$n$ – 6

⇒ 205 = 6$n$ + 1

⇒ 204 = 6$n$⇒ $n$ = 34

Therefore, there are 34 terms in the given arithmetic progression.

**(ii)** 18, $15\frac{1}{2}$, 13 ..., −47

First term = a =18, Common difference = d = $15\frac{1}{2}-18=\frac{31}{2}-18=\frac{31-36}{2}=\frac{-5}{2}$

And $a_n = -47$

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

$-47 = 18 + (n-1)\left(-\frac{5}{2}\right)$

$= 36 - \frac{5}{2}n + \frac{5}{2}$

$\Rightarrow -94 = 36 - 5n + 5$

$\Rightarrow 5n = 135 \Rightarrow n = 27$

Therefore, there are 27 terms in the given arithmetic progression.

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**6. Check whether –150 is a term of the AP: 11, 8, 5, 2...**

**Ans.** Let −150 is the $n^{th}$ of AP 11, 8, 5, 2... which means that $a_n = -150$

Here, First term = a = 11, Common difference = d = 8 – 11 = –3

Using formula $a_n = a + (n-1)d$, to find $n^{th}$ term of arithmetic progression,

$-150 = 11 + (n-1)(-3)$

$\Rightarrow -150 = 11 - 3n + 3$

$\Rightarrow 3n = 164 \Rightarrow n = \frac{164}{3}$

But, n cannot be in fraction.

Therefore, our supposition is wrong. −150 cannot be term in AP.

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**7. Find the 31st term of an AP whose 11th term is 38 and 16th term is 73.**

**Ans.** Here $a_{11} = 38 and\ a_{16} = 73$

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

38 = $a$ + (11 − 1) ($d$)And73 = $a$ + (16 − 1) ($d$)

⇒ 38 = $a$ + 10$d$ And 73 = $a$ + 15$d$

These are equations consisting of two variables.

We have, 38 = $a$ + 10$d$

⇒ $a$ = 38 − 10$d$

Let us put value of a in equation (73 = $a$ + 15$d$),

73 = 38 − 10$d$ + 15$d$

⇒ 35 = 5$d$

Therefore, Common difference = $d$ = 7

Putting value of $d$ in equation 38 = $a$ + 10$d$,

38 = $a$ + 70

⇒ $a$ = −32

Therefore, common difference = d = 7 and First term = a = –32

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

$a_{31}$ = −32 + (31 − 1) (7)

= −32 + 210 = 178

Therefore, 31st term of AP is 178.

**8. An AP consists of 50 terms of which 3rd term is 12 and the last term is 106. Find the 29th term.**

**Ans.** An AP consists of 50 terms and the 50th term is equal to 106 and $a_3 = 12$

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

$a_{50}$ = $a$ + (50 − 1) $d$ And $a_3$ = $a$ + (3 − 1) $d$

⇒ 106 = $a$ + 49$d$ And12 = $a$ + 2$d$

These are equations consisting of two variables.

Using equation 106 = $a$ + 49$d$, we get $a$ = 106 − 49$d$

Putting value of $a$ in the equation 12 = $a$ + 2$d$,

12 = 106 − 49$d$ + 2$d$

⇒ 47$d$ = 94 ⇒ $d$ = 2

Putting value of $d$ in the equation, $a$ = 106 − 49$d$,

$a$ = 106 – 49 (2) = 106 – 98 = 8

Therefore, First term = $a$ = 8 and Common difference = $d$ = 2

To find 29th term, we use formula $a_n = a + (n-1)d$ which is used to find nth term of arithmetic progression,

$a_{29}$ = 8 + (29 − 1) 2 = 8 + 56 = 64

Therefore, 29th term of AP is equal to 64.

**9. If the third and the ninth terms of an AP are 4 and –8 respectively, which term of this AP is zero?**

**Ans.** It is given that 3rd and 9th term of AP are 4 and –8 respectively.

It means $a_3 = 4 and\ a_9 = -8$

Using formula $a_n = a + (n-1)d$, to find n$^{th}$ term of arithmetic progression,

4 = a + (3 – 1) d And, –8 = a + (9 – 1) d

⇒ 4 = $a$ + 2$d$ $a$nd −8 = $a$ + 8$d$

These are equations in two variables.

Using equation 4 = $a$ + 2$d$, we can say that $a$ = 4 − 2$d$

Putting value of $a$ in other equation −8 = $a$ + 8$d$,

−8 = 4 − 2$d$ + 8$d$

⇒ −12 = 6$d$ ⇒ $d$ = −2

Putting value of $d$ in equation −8 = $a$ + 8$d$,

−8 = $a$ + 8 (−2)

⇒ −8 = $a$ – 16 ⇒ $a$ = 8

Therefore, first term = $a$ = 8 and Common Difference = $d$ = −2

We want to know which term is equal to zero.

Using formula $a_n = a + (n-1)d$, to find n$^{th}$ term of arithmetic progression,

0 = 8 + ($n$ − 1) (−2)

⇒ 0 = 8 − 2$n$ + 2

⇒ 0 = 10 − 2$n$

⇒ 2$n$ = 10⇒ $n$ = 5

Therefore, 5$^{th}$ term is equal to 0.

**10. The 17th term of an AP exceeds its 10th term by 7. Find the common difference.**

**Ans.** $a_{17} = a_{10} + 7$ ... (1)

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

$a_{17} = a + 16d$... (2)

$a_{10} = a + 9d$... (3)

Putting (2) and (3) in equation (1),

$a + 16d = a + 9d + 7$

$\Rightarrow 7d = 7$

$\Rightarrow d = 1$

**11. Which term of the AP: 3, 15, 27, 39... will be 132 more than its 54th term?**

**Ans.** Lets first calculate 54th of the given AP.

First term = a = 3, Common difference = d = 15 – 3 = 12

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

$a_{54} = a + (54 - 1)\, d = 3 + 53\,(12) = 3 + 636 = 639$

We want to find which term is 132 more than its 54th term.

Let us suppose it is nth term which is 132 more than 54th term.

$a_n = a_{54} + 132$

$\Rightarrow 3 + (n - 1)\, 12 = 639 + 132$

$\Rightarrow 3 + 12n - 12 = 771$

$\Rightarrow 12n - 9 = 771$

$\Rightarrow 12n = 780$

$\Rightarrow n = 65$

Therefore, $65^{th}$ term is 132 more than its $54^{th}$ term.

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**12. Two AP's have the same common difference. The difference between their $100^{th}$ terms is 100, what is the difference between their $1000^{th}$ terms.**

**Ans.** Let first term of $1^{st}$ AP = $a$

Let first term of $2^{nd}$ AP = $a'$

It is given that their common difference is same.

Let their common difference be $d$.

It is given that difference between their $100^{th}$ terms is 100.

Using formula $a_n = a + (n-1)d$, to find $n^{th}$ term of arithmetic progression,

$a + (100 - 1)\, d - [a' + (100 - 1)\, d]$

$= a + 99d - a' - 99d = 100$

$\Rightarrow a - a' = 100 \ldots (1)$

We want to find difference between their $1000^{th}$ terms which means we want to calculate:

$a + (1000 - 1)\, d - [a' + (1000 - 1)\, d]$

$= a + 999d - a' - 999d = a - a'$

Putting equation (1) in the above equation,

$a + (1000 - 1)\, d - [a' + (1000 - 1)\, d]$

$= a + 999d - a' + 999d = a - a' = 100$

Therefore, difference between their $1000^{th}$ terms would be equal to 100.

**13. How many three digit numbers are divisible by 7?**

**Ans.** We have AP starting from 105 because it is the first three digit number divisible by 7.

AP will end at 994 because it is the last three digit number divisible by 7.

Therefore, we have AP of the form 105, 112, 119..., 994

Let 994 is the $n^{th}$ term of AP.

We need to find n here.

First term = a = 105, Common difference = d = 112 – 105 = 7

Using formula $a_n = a + (n-1)d$, to find $n^{th}$ term of arithmetic progression,

$994 = 105 + (n - 1)(7)$

$\Rightarrow 994 = 105 + 7n - 7$

$\Rightarrow 896 = 7n \Rightarrow n = 128$

It means 994 is the $128^{th}$ term of AP.

Therefore, there are 128 terms in AP.

**14. How many multiples of 4 lie between 10 and 250?**

**Ans.** First multiple of 4 which lie between 10 and 250 is 12.

The last multiple of 4 which lie between 10 and 250 is 248.

Therefore, AP is of the form 12, 16, 20... ,248

First term = a = 12, Common difference = d = 4

Using formula $a_n = a + (n - 1)\, d$, to find $n^{th}$ term of arithmetic progression,

$248 = 12 + (n - 1)\,(4)$

$\Rightarrow 248 = 12 + 4n - 4$

$\Rightarrow 240 = 4n$

$\Rightarrow n = 60$

It means that 248 is the $60^{th}$ term of AP.

So, we can say that there are 60 multiples of 4 which lie between 10 and 250.

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**15. For what value of n, are the nth terms of two AP's: 63, 65, 67... and 3, 10, 17... equal?**

**Ans.** Lets first consider AP 63, 65, 67...

First term = a = 63, Common difference = d = 65 – 63 = 2

Using formula $a_n = a + (n - 1)d$, to find $n^{th}$ term of arithmetic progression,

$a_n = 63 + (n - 1)\,(2)$... (1)

Now, consider second AP 3, 10, 17...

First term = a = 3, Common difference = d = 10 – 3 = 7

Using formula $a_n = a + (n - 1)d$, to find $n^{th}$ term of arithmetic progression,

$a_n = 3 + (n - 1)\,(7)$... (2)

According to the given condition:

(1) = (2)

$\Rightarrow 63 + (n - 1)\,(2) = 3 + (n - 1)\,(7)$

$\Rightarrow 63 + 2n - 2 = 3 + 7n - 7$

$\Rightarrow 65 = 5n \Rightarrow n = 13$

Therefore, 13$^{th}$ terms of both the AP's are equal.

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**16. Determine the AP whose third term is 16 and the 7$^{th}$ term exceeds the 5$^{th}$ term by 12.**

**Ans.** Let first term of AP = a

Let common difference of AP = d

It is given that its 3$^{rd}$ term is equal to 16.

Using formula $a_n = a + (n-1)d$, to find n$^{th}$ term of arithmetic progression,

$16 = a + (3 - 1)(d)$

$\Rightarrow 16 = a + 2d$... (1)

It is also given that 7$^{th}$ term exceeds 5$^{th}$ term by12.

According to the given condition:

$a_7 = a_5 + 12$

$\Rightarrow a + (7 - 1)\, d = a + (5 - 1)\, d + 12$

$\Rightarrow 2d = 12 \Rightarrow d = 6$

Putting value of d in equation $16 = a + 2d$,

$16 = a + 2(6) \Rightarrow a = 4$

Therefore, first term = a = 4

And, common difference = d = 6

Therefore, AP is 4, 10, 16, 22...

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**17. Find the 20th term from the last term of the AP: 3, 8, 13... , 253.**

**Ans.** We want to find 20th term from the last term of given AP.

So, let us write given AP in this way:253 ... 13, 8, 3

Here First term = a = 253, Common Difference = d = 8 – 13 = –5

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

$a_{20}$ = 253 + (20 − 1) (−5)

⇒ $a_{20}$ = 253 + 19 (−5) = 253 – 95 = 158

Therefore, the 20th term from the last term of given AP is 158.

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**18. The sum of the 4th and 8th terms of an AP is 24 and the sum of 6th and 10th terms is 44. Find the three terms of the AP.**

**Ans.** The sum of 4th and 8th terms of an AP is 24 and sum of 6th and 10th terms is 44.

$a_4 + a_8 = 24$

and $a_6 + a_{10} = 44$

Using formula $a_n = a + (n-1)d$, to find nth term of arithmetic progression,

=> $a$ + (4 − 1) $d$ + [$a$ + (8 − 1) $d$] = 24

And, $a$ + (6 − 1) $d$ + [$a$ + (10 − 1) $d$] = 44

⇒ $a$ + 3$d$ + $a$ + 7$d$ = 24

And $a$ + 5$d$ + $a$ + 9$d$ = 44

⇒ 2$a$ + 10$d$ = 24 And 2$a$ + 14$d$ = 44

⇒ $a$ + 5$d$ = 12 And $a$ + 7$d$ =22

These are equations in two variables.

Using equation, $a + 5d = 12$, we can say that $a = 12 - 5d$... (1)

Putting (1) in equation $a + 7d = 22$,

$12 - 5d + 7d = 22$

$\Rightarrow 12 + 2d = 22$

$\Rightarrow 2d = 10$

$\Rightarrow d = 5$

Putting value of $d$ in equation $a = 12 - 5d$,

$a = 12 – 5\ (5) = 12 – 25 = -13$

Therefore, first term = $a = -13$ and, Common difference = $d = 5$

Therefore, AP is –13, –8, –3, 2...

Its first three terms are –13, –8 and –3.

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**19. Subba Rao started work in 1995 at an annual salary of Rs 5000 and received an increment of Rs 200 each year. In which year did his income reach Rs 7000?**

**Ans.** Subba Rao's starting salary = Rs 5000

It means, first term = a = 5000

He gets an increment of Rs 200 after every year.

Therefore, common difference = d = 200

His salary after 1 year = 5000 + 200 = Rs 5200

His salary after two years = 5200 + 200 = Rs 5400

Therefore, it is an AP of the form 5000, 5200, 5400, 5600... , 7000

We want to know in which year his income reaches Rs 7000.

Using formula $a_n = a + (n-1)d$, to find n$^{th}$ term of arithmetic progression,

7000 = 5000 + ($n$ − 1) (200)

⇒ 7000 = 5000 + 200$n$ − 200

⇒ 7000 – 5000 + 200 = 200$n$

⇒ 2200 = 200$n$

⇒ $n$ = 11

It means after 11 years, Subba Rao's income would be Rs 7000.

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**20. Ramkali saved Rs. 5 in the first week of a year and then increased her weekly savings by Rs. 1.75. If in the nth week, her weekly savings become Rs 20.75, find n.**

**Ans.** Ramkali saved Rs. 5 in the first week of year. It means first term = a = 5
Ramkali increased her weekly savings by Rs 1.75.
Therefore, common difference = d = Rs 1.75
Money saved by Ramkali in the second week = a + d = 5 + 1.75 = Rs 6.75
Money saved by Ramkali in the third week = 6.75 + 1.75 = Rs 8.5
Therefore, it is an AP of the form:5, 6.75, 8.5 ... , 20.75
We want to know in which week her savings become 20.75.
Using formula $a_n = a + (n-1)d$, to find n$^{th}$ term of arithmetic progression,
20.75 = 5 + ($n$ − 1) (1.75)
⇒ 20.75 = 5 + 1.75$n$ − 1.75
⇒ 17.5 = 1.75$n$
⇒ $n$ = 10
It means in the 10$^{th}$ week her savings become Rs 20.75.