

SAMPLE CONTENT

Std. X

MATHEMATICS



CHALLENGING QUESTIONS

Exclusively Covers

22 out of 80 Marks



Mr. Biju B
B.Sc. (Maths)

Ms. Komal Atha
B.Ed, M.Com.

Mr. Raju Chettiar
B.Sc. (Maths)

Mr. Vinod Singh
M.Sc. (Mathematics)

Amit Waghmare
B.E. (EXTC)

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Std. X

MATHEMATICS

CHALLENGING QUESTIONS

Salient Features

- In accordance with the New Paper Pattern
- Covers Challenging Questions across chapters
- Challenging questions provided as per level of difficulty - Level I, Level II and Level III
- Mathematical viewpoint explaining how to approach a problem
- Similar Type Questions are provided for additional practice
- Includes constructions with accurate measurements
- Includes questions of past board papers

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PREFACE

Std. X Mathematics Challenging Questions is a meticulously compiled handbook for students of Std. X. It is in accordance to the latest guidelines furnished in the *Evaluation Pattern for Std. 10th* by the Maharashtra State Bureau of Textbook Production & Curriculum Research, Pune.

According to the New Paper Pattern of Std. X, students would be asked challenging questions of Mathematics as they would appear in the Board Examination. Taking cognizance of this change, we have meticulously crafted this book that includes exhaustive yet carefully selected challenging questions along with solutions spanning across all the chapters of the Text Book.

We are confident that this book will cater to the needs of students and will help them to prepare extremely well for their SSC Board Examination.

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you on mail@targetpublications.org

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PAPER PATTERN

Question No.	Type of Questions	Total Marks	Marks with option
1.	(A) Solve 4 out of 4 MCQ (1 mark each)	04	04
	(B) Solve 4 out of 4 subquestions (1 mark each)	04	04
2.	(A) Solve 2 activity based subquestions out of 3 (2 marks each)	04	06
	(B) Solve any 4 out of 5 subquestions (2 marks each)	08	10
3.	(A) Solve 1 activity based subquestion out of 2 (3 marks each)	03	06
	(B) Solve any 2 out of 4 subquestions (3 marks each)	06	12
4.	Solve any 2 out of 3 subquestions (4 marks each)	08	12
5.	Solve any 1 out of 2 subquestions (3 marks each)	03	06
Total Marks		40	60

The division of marks in question papers as per objectives will be as follows.

Distribution of Marks	
Easy Questions	40%
Medium Questions	40%
Difficult Questions	20%

Objectives	Maths – 1
Knowledge	20%
Understanding	30%
Application	40%
Skill	10%

[Maharashtra State Board of Secondary and Higher Secondary Education, Pune - 04]

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Note: Steps of construction are provided in
Chapter 4 : Geometric constructions for the students' understanding.

3

Arithmetic Progression

LEVEL - 1

1. Babubhai borrows ₹ 4000 and agrees to pay with a total interest of ₹ 500 in 10 instalments, each instalment being less than the preceding instalment by ₹ 10. What should be the first and last instalment?



Mathematical Viewpoint

In such word problems, try to understand the given data and write the values of d (common difference) and a (first term). Use below formulae,

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

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

By using the above formulae, find the required solution.

Solution:

Babubhai repays ₹ 4,000 + ₹ 500 = ₹ 4,500

Number of instalments = 10

$$\therefore n = 10 \text{ and } S_n = S_{10} = 4500$$

Each instalment is ₹ 10 less than the preceding one.

$$\therefore d = -10$$

It forms an A.P.

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

$$\therefore S_{10} = \frac{10}{2} [2a + (10-1)(-10)]$$

$$\therefore 4500 = 5[2a + (9)(-10)]$$

$$\therefore \frac{4500}{5} = (2a - 90)$$

$$\therefore 900 = 2a - 90$$

$$\therefore 990 = 2a$$

$$\therefore a = \frac{990}{2}$$

$$\therefore a = 495$$

t_n = last instalment

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

$$\therefore t_{10} = 495 + (10-1)(-10)$$

$$\therefore t_{10} = 495 - 90$$

$$\therefore t_{10} = 405$$

\therefore The first instalment is ₹ 495 and last instalment is ₹ 405.



Similar Type Question

A man has to repay a loan of ₹ 3,000 and agrees to pay with a total interest of ₹ 250 in 20 instalments, each instalment being less than the preceding instalment by ₹ 15. What should be the first and last instalment?

Ans: First instalment = ₹ 305

Last instalment = ₹ 20

2. Insert five number between 4 and 8 so that the resulting sequence is an A.P.



Mathematical Viewpoint

In such word problems, try to analyse the given data and assume the number of terms to be inserted in between the two numbers, as $t_2, t_3, t_4 \dots$

$$\begin{array}{l} \text{Total number} \\ \text{of terms} \end{array} = \begin{array}{l} \text{Number of} \\ \text{terms to} \\ \text{be inserted} \end{array} + 2 \text{ (First and last term)}$$

By using the above formula, get the value of n . Use given numbers as a and t_n . Use the below formula, to get the required numbers.

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

Solution:

Let the required numbers be t_2, t_3, t_4, t_5 and t_6

Thus, 4, $t_2, t_3, t_4, t_5, t_6, 8$ are in A.P.

In this case, $t_7 = 8$

$$t_1 = a = 4, t_7 = 8, n = 7$$

We know that,

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

For $n = 7$

$$t_7 = a + (7-1)d$$

$$\therefore 8 = 4 + (7-1)d$$

$$\therefore 8 = 4 + 6d$$

$$\therefore 4 = 6d$$

$$\therefore d = \frac{2}{3}$$

For $n = 2$

$$t_2 = a + (2-1)d$$

$$= 4 + (1) \times \frac{2}{3}$$

$$= 4 + \frac{2}{3}$$

$$\therefore t_2 = \frac{14}{3}$$



$$\begin{aligned} \text{For } n = 3 \\ t_3 &= a + (3 - 1)d \\ &= 4 + 2 \times \frac{2}{3} \\ &= 4 + \frac{4}{3} \end{aligned}$$

$$\therefore t_3 = \frac{16}{3}$$

$$\begin{aligned} \text{For } n = 4 \\ t_4 &= a + (4 - 1)d \\ &= 4 + 3 \times \frac{2}{3} = 4 + 2 \end{aligned}$$

$$\therefore t_4 = 6$$

$$\begin{aligned} \text{For } n = 5 \\ t_5 &= a + (5 - 1)d \\ &= 4 + 4 \times \frac{2}{3} = 4 + \frac{8}{3} \end{aligned}$$

$$\therefore t_5 = \frac{20}{3}$$

$$\begin{aligned} \text{For } n = 6 \\ t_6 &= a + (6 - 1)d \\ &= 4 + 5 \times \frac{2}{3} \\ &= 4 + \frac{10}{3} \end{aligned}$$

$$\therefore t_6 = \frac{22}{3}$$

\therefore The required numbers are $\frac{14}{3}, \frac{16}{3}, 6,$

$$\frac{20}{3}, \frac{22}{3}$$



Similar Type Question

Insert four numbers between 10 and 30 so that the resulting sequence is an A.P.

Ans: 14, 18, 22, 26.

3. How many 2 digit numbers leave the remainder 1 when divided by 5?



Mathematical Viewpoint

In such word problem, try to find out the two digit numbers which are divisible by given number and then add remainder to each number to obtain required A.P. of two digit numbers.

Use the below formula, to get the value of n.

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

Solution:

The two digit numbers that leave remainder 1 when divided by 5 are 11, 16, 21, 26, 31 ... , 96.

This sequence is an A.P. with

$$a = 11, d = 16 - 11 = 5 \text{ and } t_n = 96$$

$$\text{Now, } t_n = a + (n - 1)d$$

$$\therefore 96 = 11 + (n - 1)5$$

$$\therefore 96 = 11 + 5n - 5$$

$$\therefore 96 = 5n + 6$$

$$\therefore 5n = 90$$

$$\therefore n = \frac{90}{5}$$

$$\therefore n = 18$$

\therefore There are 18 two digit numbers that leave remainder 1 when divided by 5.



Similar Type Question

How many two digit numbers leave the remainder 2 when divided by 10?

Ans: 9

4. Find the sum of the first 'n' odd natural numbers. Hence, find $1 + 3 + 5 + \dots + 101$.



Mathematical Viewpoint

In such word problem, try to analyse the given data and write the values of a, d, t_n .

Use the below formula, to get the value of S_n in terms of n.

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

To get the required answer the value of n is necessary. To find out the value of n use the below formula,

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

Substitute the value of n in S_n to get the required solution.

Solution:

The sequence of odd natural numbers is 1, 3, 5, ...

This sequence is an A.P. with

$$a = 1, d = 3 - 1 = 2$$

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

$$= \frac{n}{2} [2 \times 1 + (n - 1)2]$$

$$= \frac{n}{2} [2 + 2n - 2] = \frac{n}{2} [2n]$$

$$\therefore S_n = n^2 \quad \dots(i)$$

For 1, 3, 5, ..., 101,

$$a = 1, d = 3 - 1 = 2, t_n = 101$$

$$\text{But, } t_n = a + (n - 1)d$$

$$\therefore 101 = 1 + (n - 1)2$$

$$\therefore 101 - 1 = (n - 1)2$$

$$\therefore 100 = (n - 1)2$$

$$\therefore \frac{100}{2} = n - 1$$

$$\therefore 50 = n - 1$$



- $\therefore n = 50 + 1 = 51$
 $\therefore 1 + 3 + 5 + \dots + 101 = S_{51}$
 $\therefore 1 + 3 + 5 + \dots + 101 = (51)^2 \quad \dots[\text{From (i)}]$
 $\therefore 1 + 3 + 5 + \dots + 101 = 2601$
 \therefore **The sum of the first 'n' odd natural numbers is n^2 and $1 + 3 + 5 + \dots + 101$ is 2601.**

**Similar Type Question**

Find the sum of the first 'n' even natural numbers. Hence, find $2 + 4 + 6 + \dots + 100$.

Ans: $n(n + 1)$, 2550

5. **In winter, the temperature at a hill station from Monday to Friday is in A.P. The sum of the temperatures of Monday, Tuesday and Wednesday is zero and the sum of the temperatures of Thursday and Friday is 15. Find the temperature of each of the five days.**

**Mathematical Viewpoint**

In such word problem, try to understand the number of terms and assume unknown terms using following table.

Number of terms	Terms	Common Difference
3	$a - d, a, a + d$	d
4	$a - 3d, a - d, a + d, a + 3d$	$2d$
5	$a - 2d, a - d, a, a + d, a + 2d$	d

Use the given condition to form equations with a and d .

Solve the two equations to get the values of a and d .

Solution:

Let the temperatures from Monday to Friday in A.P be $a - 2d, a - d, a, a + d, a + 2d$.

According to the first condition, the sum of the temperatures of Monday, Tuesday and Wednesday is zero.

$$\begin{aligned} \therefore a - 2d + a - d + a &= 0 \\ \therefore 3a - 3d &= 0 \\ \therefore a - d &= 0 \\ \therefore a &= d \quad \dots(i) \end{aligned}$$

According to the second condition, the sum of the temperatures of Thursday and Friday is 15.

$$\begin{aligned} \therefore a + d + a + 2d &= 15 \\ \therefore 2a + 3d &= 15 \\ \therefore 2a + 3a &= 15 \quad \dots[\text{From (i)}] \\ \therefore 5a &= 15 \\ \therefore a &= 3 \end{aligned}$$

$$\begin{aligned} \therefore d &= 3 \quad \dots[\text{From (i)}] \\ \text{Thus, } a - 2d &= 3 - 2 \times 3 = -3 \\ a - d &= 3 - 3 = 0 \\ a &= 3 \\ a + d &= 3 + 3 = 6 \\ a + 2d &= 3 + 2 \times 3 = 9 \end{aligned}$$

- \therefore **The temperature of each of the five days is $-3, 0, 3, 6$ and 9 .**

**Similar Type Question**

In winter, the temperature at a hill station from Monday to Friday is in A.P. The sum of the temperatures of Monday, Tuesday and Wednesday is 6 and the sum of the temperatures of Thursday and Friday is 19. Find the temperature of each of the five days.

Ans: $-1, 2, 5, 8$ and 11 .

LEVEL - 2

6. **Suppose you wish to buy a pencil, a notebook and a pen. The prices of these are in A.P. are such that the sum of prices of these three things is 27 and sum of the squares of their prices is 341. Find the price of each thing.**

**Mathematical Viewpoint**

In such word problem, try to understand the number of terms and assume unknown terms using following table.

Number of terms	Terms	Common Difference
3	$a - d, a, a + d$	d
4	$a - 3d, a - d, a + d, a + 3d$	$2d$
5	$a - 2d, a - d, a, a + d, a + 2d$	d

Use the given condition to form equations with a and d . Solve the two equations to get the values of a and d .

Solution:

Let the prices of a pencil, a notebook and a pen be $a - d, a$ and $a + d$ respectively.

According to the first condition, the sum of prices of these three things is 27.

$$\begin{aligned} (a - d) + (a) + (a + d) &= 27 \\ \therefore 3a &= 27 \\ \therefore a &= 9 \quad \dots(i) \end{aligned}$$

According to the second condition, sum of the squares of their prices is 341.

$$(a - d)^2 + a^2 + (a + d)^2 = 341$$



$\therefore (9 - d)^2 + 9^2 + (9 + d)^2 = 341$...[From (i)]
 $\therefore 81 - 18d + d^2 + 81 + 81 + 18d + d^2 = 341$
 $\therefore 2d^2 + 243 = 341$
 $\therefore 2d^2 = 98$
 $\therefore d^2 = 49$
 $\therefore d = \pm 7$
 When $a = 9, d = 7$ When $a = 9, d = -7$
 $a - d = 9 - 7 = 2$ $a - d = 9 - (-7) = 16$
 $a = 9$ $a = 9$
 $a + d = 9 + 7 = 16$ $a + d = 9 - 7 = 2$
 \therefore **The prices of a pencil, a notebook and a pen are 2, 9, 16 or 16, 9, 2 respectively.**



Similar Type Question

Suppose you wish to buy a notebook, a pen and a calculator. The prices of these are in A.P. such that the sum of prices of these three things is 60 and sum of the squares of their prices is 1232. Find the price of each thing.

Ans: 16, 20, 24

7. **2 posts were offered to a man. In one, the starting salary was ₹ 120 per month and the annual increment was ₹ 8. In the other post the salary commenced at ₹ 85 per month but the annual increment was ₹ 12. The man decides to accept the post which would give him more earning in the first twenty years of his service. Justify your answer.**



Mathematical Viewpoint

In such word problem, try to understand the values of a, d, n . Based on these information use the below formula to obtain the value of S_n in two different situations.

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

Compare both the situations and accordingly write your conclusion.

Solution:

For first post, the monthly salary was ₹ 120 and annual increment was ₹ 8

$$\text{Annual salary} = 120 \times 12 = 1440$$

$$\text{Annual increment} = 8$$

$$a = 1440, d = 8, n = 20$$

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

$$S_{20} = \frac{20}{2} [2(1440) + (20 - 1)8]$$

$$= 10 [2880 + 19(8)]$$

$$= 10(2880 + 152)$$

$$= 10 \times 3032 = 30320$$

For second post, the monthly salary was ₹ 85 and annual increment was ₹ 12.

$$\text{Annual salary} = 85 \times 12 = 1020$$

$$\text{Annual increment} = 12$$

$$a = 1020, d = 12, n = 20$$

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

$$S_{20} = \frac{20}{2} [2(1020) + (20 - 1) 12]$$

$$= 10 [2040 + 19 (12)]$$

$$= 10 (2040 + 228)$$

$$= 10(2268) = 22680$$

$$\text{Additional income} = 30320 - 22680 = 7640$$

\therefore **He would accept the first post because he will earn ₹ 7,640 more.**



Similar Type Question

2 posts were offered to a Prashant. In one, the starting salary was ₹ 5,000 per annum and the annual increment was ₹ 400. In the other post the salary commenced at ₹ 4,300 per annum but the annual increment was ₹ 600. The man decides to accept the post which would give him more earning in the first fifteen years of his service. Justify your answer.

Ans: He would accept the second post because he will earn ₹ 10,500 more.

8. **A man set out on a cycle ride of 50 km. He covers 5 km in the first hour and during each successive hour his speed falls by $\frac{1}{4}$ km/hr. How many hours will he take to finish his ride?**



Mathematical Viewpoint

In such word problem, try to understand the given data and write the values of a, S_n and d . Use the below formula,

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

Solution:

$$\text{Here, } a = 5, S_n = 50, d = -\frac{1}{4}$$

Let the number of hours required to finish the ride be 'n'.

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

$$\therefore 50 = \frac{n}{2} \left[2 \times 5 + (n - 1) \left(-\frac{1}{4} \right) \right]$$

$$\therefore 50 = \frac{n}{2} \left[10 + \frac{1}{4} - \frac{n}{4} \right]$$

$$\begin{aligned} \therefore 100 &= n \left[\frac{41-n}{4} - \frac{n}{4} \right] \\ \therefore 100 &= n \times \left(\frac{41-n}{4} \right) \\ \therefore 400 &= 41n - n^2 \\ \therefore n^2 - 41n + 400 &= 0 \\ \therefore n^2 - 25n - 16n + 400 &= 0 && \begin{array}{l} 400 \\ \swarrow \quad \searrow \\ -25 \quad -16 \\ -41 = -25 - 16 \end{array} \\ \therefore n(n-25) - 16(n-25) &= 0 \\ \therefore (n-25)(n-16) &= 0 \\ \therefore n-25=0 &\quad \text{or} \quad n-16=0 \\ \therefore n=25 &\quad \text{or} \quad n=16 \end{aligned}$$

If $n = 25$

$$\begin{aligned} t_n &= a + (n-1)d \\ t_n &= 5 + (25-1) \times \left(-\frac{1}{4} \right) \\ &= 5 + 24 \times \left(-\frac{1}{4} \right) \\ &= 5 + (-6) \\ &= -1 \end{aligned}$$

However, speed cannot be negative.

- $\therefore n = 16$
 \therefore **16 hours are required to finish the ride.**



Similar Type Question

A child puts one five-rupee coin of her saving in the piggy bank on the first day. She increases her saving by one five-rupee coin daily. If the piggy bank can hold 190 coins of five rupees in all, find the number of days she can continue to put the five-rupee coins into it.

Ans: 19

LEVEL - 3

9. **If the ratio of the sum of m terms and n terms of an A.P. is $m^2 : n^2$, prove that the ratio of m^{th} and n^{th} terms is $(2m-1) : (2n-1)$.**



Mathematical Viewpoint

In such word problem, use the given condition of ratio and use the formula,

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

to get the value of a and d . After getting the values take the required ratio and use the formula, $t_n = a + (n-1)d$, simplify.

Proof:

Sum of first m terms of an A.P.
 $= S_m = \frac{m}{2} [2a + (m-1)d]$

Sum of first n terms of an A.P.
 $= S_n = \frac{n}{2} [2a + (n-1)d]$

It is given that $\frac{S_m}{S_n} = \frac{m^2}{n^2}$

$$\therefore \frac{\left(\frac{m}{2}\right)[2a + (m-1)d]}{\left(\frac{n}{2}\right)[2a + (n-1)d]} = \frac{m^2}{n^2}$$

$$\therefore \frac{2a + (m-1)d}{2a + (n-1)d} = \frac{m^2}{n^2} \times \frac{\frac{n}{2}}{\frac{m}{2}}$$

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

$$\therefore \left. \begin{aligned} 2a + (m-1)d &= km && \dots(i) \\ 2a + (n-1)d &= kn && \dots(ii) \end{aligned} \right\} [k \text{ is constant}]$$

Subtracting equation (ii) from equation (i), we get

$$2a + (m-1)d - 2a - (n-1)d = km - kn$$

$$(m-1)d - d(n-1) = km - kn$$

$$\therefore md - d - nd + d = k(m-n)$$

$$\therefore d(m-n) = k(m-n)$$

$$\therefore d = k$$

Substituting value of d in equation (i), we get

$$2a + (m-1)k = km$$

$$\therefore 2a + mk - k = km$$

$$\therefore 2a = k$$

$$\therefore a = \frac{k}{2}$$

Now, $t_m = a + (m-1)d$ and $t_n = a + (n-1)d$

$$\therefore \frac{t_m}{t_n} = \frac{a + (m-1)d}{a + (n-1)d}$$

Substituting value of a and d , we get

$$\frac{t_m}{t_n} = \frac{\left(\frac{k}{2}\right) + (m-1)k}{\left(\frac{k}{2}\right) + (n-1)k}$$

$$= \frac{k\left(\frac{1}{2} + m - 1\right)}{k\left(\frac{1}{2} + n - 1\right)}$$

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

$$\therefore \frac{t_m}{t_n} = \frac{2m-1}{2n-1}$$



Similar Type Question

If the ratio of the sum of first n terms of two A.P.'s is $(7n + 1) : (4n + 27)$, find the ratio of their m^{th} terms.

Ans: $(14m - 6) : (8m + 23)$.

10. Find the sum of the two middle most terms of the A.P.: $-\frac{4}{3}, -1, -\frac{2}{3}, \dots, 4\frac{1}{3}$.



Mathematical Viewpoint

In such word problem, from the given A.P., use formula, $t_n = a + (n - 1)d$ and find the value of n .

If $n = \text{even}$, two middle terms will be $\left(\frac{n}{2}\right)^{\text{th}}$ term

and $\left(\frac{n}{2} + 1\right)^{\text{th}}$ term.

Again use the same formula to get the values of two terms. Add the values of two terms.

Hence, write the required solution.

Solution:

The given A.P. is $-\frac{4}{3}, -1, -\frac{2}{3}, \dots, 4\frac{1}{3}$.

Here, $a = -\frac{4}{3}$, $d = -1 - \left(-\frac{4}{3}\right) = -1 + \frac{4}{3} = \frac{1}{3}$,

$$t_n = 4\frac{1}{3} = \frac{13}{3}$$

Since, $t_n = a + (n - 1)d$

$$\therefore \frac{13}{3} = -\frac{4}{3} + (n - 1)\left(\frac{1}{3}\right)$$

$$\therefore 13 = -4 + n - 1$$

$$\therefore 13 = -5 + n$$

$$\therefore n = 13 + 5$$

$$\therefore n = 18, \text{ which is an even number.}$$

$\therefore \left(\frac{n}{2}\right)^{\text{th}}$ and $\left(\frac{n}{2} + 1\right)^{\text{th}}$ terms are the two middle most terms.

i.e., $\left(\frac{18}{2}\right)^{\text{th}}$ and $\left(\frac{18}{2} + 1\right)^{\text{th}}$ terms

i.e., 9^{th} and 10^{th} terms

$$\therefore \left. \begin{aligned} t_9 &= a + (9 - 1)d = a + 8d \\ &= -\frac{4}{3} + 8\left(\frac{1}{3}\right) = \frac{-4}{3} + \frac{8}{3} = \frac{4}{3} \\ t_{10} &= a + (10 - 1)d = a + 9d \\ &= -\frac{4}{3} + 9\left(\frac{1}{3}\right) = \frac{-4}{3} + \frac{9}{3} = \frac{5}{3} \end{aligned} \right\} \therefore t_n = a + (n - 1)d$$

$$\therefore t_9 + t_{10} = \frac{4}{3} + \frac{5}{3} = \frac{9}{3} = 3$$

\therefore The sum of the two middle most terms of the given A.P. is 3.



Similar Type Question

Find the sum of the two middle most terms of the

A.P. $-\frac{8}{5}, -\frac{6}{5}, -1, \dots, 4\frac{3}{5}$.

Ans: 3



AVAILABLE NOTES FOR STD. X:

PERFECT SERIES

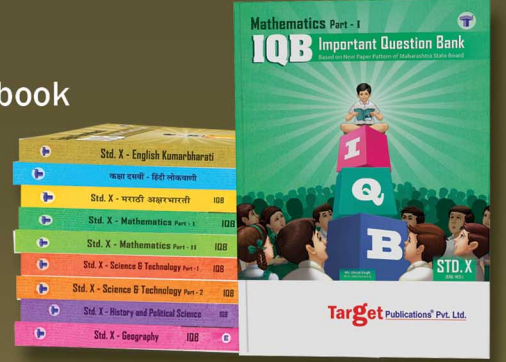
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- English Kumarbharati
- मराठी अक्षरभारती
- हिंदी लोकभारती
- हिंदी लोकवाणी
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