MATHEMATICS · GRADES 10-12

Arithmetic series

Difficulty level: Advanced

Mathematics: Grades 10-12

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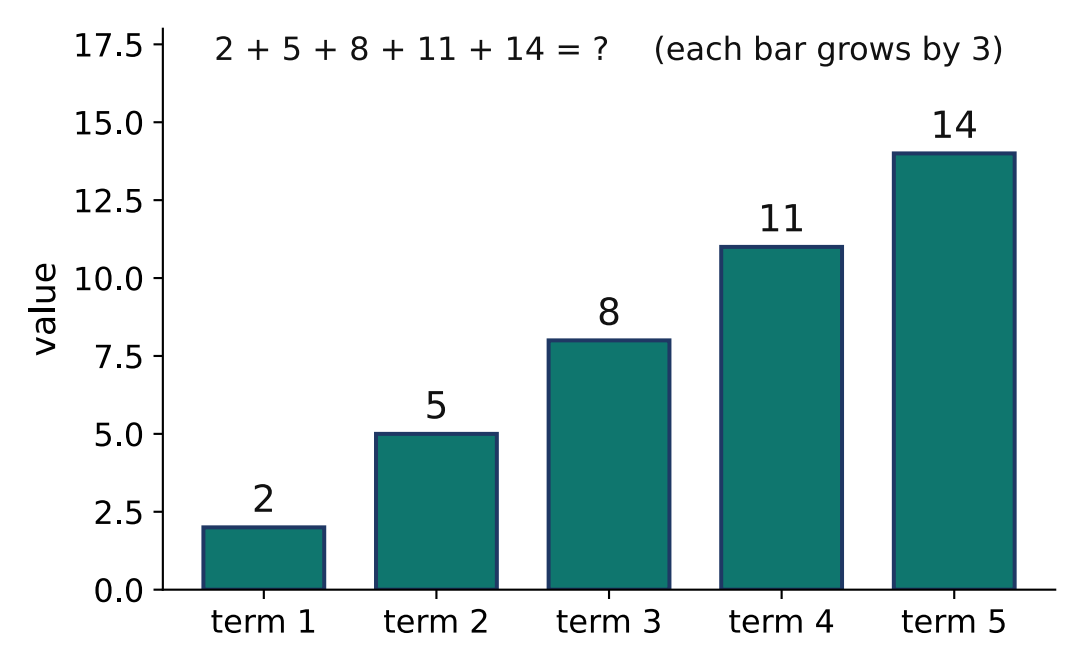
Overview of the concept

This is how you add up a whole run of steady weekly savings or payments at once. Adding each week separately works, but it is slow and easy to slip up on over a long run. The series shortcut gives you the total in one go, which is what you need when you are working out what a savings plan is worth after a year.





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Rule

Arithmetic series: the sum of the first n terms is $\frac{n}{2}$ times $(2a + (n - 1) \times d)$, where a is the first term and d is the common difference.

A series is the sum of the terms of a sequence, and this formula gives the total without adding term by term.

Worked examples

EXAMPLE 1

Q **Find the sum of the first 5 terms of 2, 5, 8, 11, 14.**

SOLUTION

Add the terms: 2 + 5 + 8 + 11 + 14

Group them: 2 + 14 = 16, 5 + 11 = 16, leaving 8.

Sum = 16 + 16 + 8 = 40

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EXAMPLE 2

Q Use the formula for the sum of the first 10 terms of 1, 3, 5.

SOLUTION

First term a = 1, difference d = 2, number of terms n = 10

Put the numbers in: n is 10, so n over 2 is 5; 2a is 2 times 1, which is 2; and (n minus 1) times d is 9 times 2, which is 18.

$$\text{Sum} = \frac{n}{2} \times (2a + (n - 1) \times d) = 5 \times (2 + 18)$$

Sum = 5 × 20 = 100

Practice questions

1 A theatre has rows with 3, 6, 9, 12 seats in the first four rows. How many seats are in the first 4 rows in total?

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2 A student saves 1, 2, 3, 4, 5 dollars over five weeks. How much has she saved in total?

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3 A series has first term 5 and common difference 3. What is the sum of the first 4 terms?

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4 Use the series formula to find the sum of the first 8 terms of 2, 5, 8, and so on.

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5 Three friends each score 7 points in a game. What is the sum of their scores?

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6 A machine stamps 1 part every minute for 10 minutes. How many parts is that in total?

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7 A sequence lists numbers. What do you call the sum of its terms?

A. A series

B. A sequence

C. A term

D. A difference

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8 **A runner covers 20, 18, 16, 14, 12 metres in five sprints. How many metres is that in total?**

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9 **What is the sum of the first 6 terms of 3, 7, 11, and so on?**

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10 **Add the numbers 1 to 20. What is their sum?**

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ANSWER KEY

1. 30

2. 15

3. 38

4. 100

5. 21

6. 10

7. A series

8. 80

9. 78

10. 210

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