

OLYMPIAD · MENTAL ABILITY · OLYMPIAD PREPARATION · SHORT NOTES

Chapter 1: Number and Letter Series

Topic-wise short notes with solved examples

How to find the rule behind a number or letter series, with the common patterns, worked examples and practice.

1 Reading a number series

- A **series** is a list of numbers that follows one rule. Find the rule from the first few terms, then use it to find the missing term.
- First write the **differences** between neighbouring terms. If they are equal, the series is arithmetic.
- If the differences are not equal, try the **ratios**, then the differences of the differences.
- Always check the rule on **every** term you were given, not only the first two.

Example 1.1 Find the next term: 4, 9, 14, 19, ?

SOLUTION

The differences are 5, 5, 5.

24

2 Common patterns

Pattern	Example	Rule
Constant difference	7, 11, 15, 19	add 4 each time
Constant ratio	3, 6, 12, 24	multiply by 2
Squares	1, 4, 9, 16, 25	n^2
Cubes	1, 8, 27, 64	n^3
Square plus or minus one	2, 5, 10, 17, 26	$n^2 + 1$
Growing differences	1, 2, 4, 7, 11	add 1, then 2, then 3, then 4
Sum of the last two	1, 1, 2, 3, 5, 8	each term is the sum of the two before it
Primes	2, 3, 5, 7, 11, 13	the prime numbers in order

Example 2.1 Find the next term: 2, 5, 10, 17, 26, ?

SOLUTION

The terms are $1^2 + 1$, $2^2 + 1$, $3^2 + 1$, $4^2 + 1$, $5^2 + 1$.

The next is $6^2 + 1$.

37

Example 2.2 Find the next term: 3, 4, 6, 9, 13, ?

SOLUTION

The differences are 1, 2, 3, 4, so the next difference is 5.

18

3 Two series mixed together

- If the terms look unrelated, read the **odd places** and the **even places** as two separate series.
- Another trick: two operations used one after the other, such as "multiply by 2, then add 1".

Example 3.1 Find the next term: 2, 5, 4, 10, 8, 15, ?

SOLUTION

The terms in odd places are 2, 4, 8 and are doubled each time, so the next is 16.

The terms in even places are 5, 10, 15.

16

Example 3.2 Find the missing term: 1, 3, 7, 15, 31, ?

SOLUTION

Each term is double the one before it, plus 1.

63

4 Letter series

- Give every letter its **position**: A = 1, B = 2, ..., Z = 26. Then treat the series as a number series.
- The letter at position n from the front is the letter at position $27 - n$ from the back: A and Z, B and Y, C and X, and so on.
- Letter groups usually follow one rule for the first letters, and another rule for the next letters.

Example 4.1 Find the next term: B, E, H, K, ?

SOLUTION

The positions are 2, 5, 8, 11, so each step is $+3$. The next position is 14.

N

Example 4.2 Find the next term: AZ, BY, CX, ?

SOLUTION

The first letters move forward A, B, C, D . The second letters move backward Z, Y, X, W .

DW

REMEMBER

Write the position numbers under the letters before you look for the rule. It turns every letter series into a number series.

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