

# UNIQUE STUDY POINT

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<b>Class:</b> VI	<b>Subject:</b> Mathematics	<b>Session:</b> 2025-26
<b>Chapter:</b> 01 - Patterns in Mathematics	<b>Time:</b> 1½ Hours	<b>Max. Marks:</b> 40

## General Instructions:

1. All questions are compulsory.
2. This question paper contains 20 questions divided into five sections A, B, C, D and E.
3. Section A contains 10 MCQs of 1 mark each.
4. Section B contains 4 questions of 2 marks each.
5. Section C contains 3 questions of 3 marks each.
6. Section D contains 1 question of 5 marks.
7. Section E contains 2 Case Study Based questions of 4 marks each.

## SECTION A - Multiple Choice Questions (1 mark each)

1. Mathematics is mainly the search for:
  - (a) Numbers only
  - (b) Patterns and their explanations
  - (c) Shapes only
  - (d) Calculations only
2. The branch of mathematics that studies patterns in whole numbers is called:
  - (a) Geometry
  - (b) Algebra
  - (c) Number theory
  - (d) Arithmetic
3. Which of the following is the sequence of triangular numbers?
  - (a) 1, 2, 3, 4, 5, ...
  - (b) 1, 3, 6, 10, 15, ...
  - (c) 1, 4, 9, 16, 25, ...
  - (d) 2, 4, 6, 8, 10, ...
4. The sum of the first three odd numbers ( $1 + 3 + 5$ ) equals:
  - (a) 6
  - (b) 9
  - (c) 12
  - (d) 15
5. In the Virahānka sequence 1, 2, 3, 5, 8, 13, 21, ..., the next number is:
  - (a) 29
  - (b) 32

- (c) 34  
(d) 36
6. Which number is both a triangular number and a square number?  
(a) 25  
(b) 36  
(c) 49  
(d) 64
7. The branch of mathematics that studies patterns in shapes is called:  
(a) Number theory  
(b) Geometry  
(c) Algebra  
(d) Calculus
8. A regular polygon with 5 sides is called a:  
(a) Pentagon  
(b) Hexagon  
(c) Heptagon  
(d) Octagon
9. The sequence 1, 8, 27, 64, 125, ... represents:  
(a) Square numbers  
(b) Cube numbers  
(c) Triangular numbers  
(d) Even numbers
10. In a regular polygon, the number of sides is always:  
(a) Equal to the number of corners  
(b) Greater than the number of corners  
(c) Less than the number of corners  
(d) Twice the number of corners

### SECTION B - Short Answer Questions (2 marks each)

11. Write the next three numbers in the sequence of counting numbers: 1, 2, 3, 4, 5, 6, 7, ... Also explain the pattern.
12. Why are the numbers 1, 3, 6, 10, 15, ... called triangular numbers? Draw a picture to illustrate the number 6.
13. What happens when you add  $1 + 3$ ? What about  $1 + 3 + 5$ ? What type of numbers do you get?
14. List the first five numbers in the sequence of Powers of 2 and explain the pattern.

### SECTION C - Short Answer Questions (3 marks each)

15. Find the sum of the first four odd numbers using addition. What do you notice about the result? Can you explain why this happens using a picture?
16. Draw the pictorial representation of the first four square numbers (1, 4, 9, 16) using dots. Explain why they are called square numbers.

17. Explain what happens when you start adding the counting numbers: 1, 1+2, 1+2+3, 1+2+3+4, ... Which number sequence do you get?

### SECTION D - Long Answer Question (5 marks)

- 18.
- (a) What is the sum of the first 5 odd numbers? Show your work.
- (b) What is the sum of the first 10 odd numbers? (You may use the pattern you discovered)
- (c) Draw a pictorial explanation showing why adding odd numbers gives square numbers for the case of the first 4 odd numbers.

### SECTION E - Case Study Based Questions (4 marks each)

19.

#### Case Study 1: Understanding Number Sequences in Nature

Ravi noticed that when he arranged pebbles in triangular patterns, he could form triangles with 1, 3, 6, 10, and 15 pebbles. He also noticed that when he tried to arrange pebbles in square patterns, he needed 1, 4, 9, 16, and 25 pebbles.

Based on this case study, answer the following questions:

- (i) What is the 6th triangular number? (1 mark)
- (ii) What is the 6th square number? (1 mark)
- (iii) Is there any relationship between consecutive triangular numbers and square numbers? Explain with an example. (2 marks)

20.

#### Case Study 2: Patterns in Architecture

An architect is designing a building with polygonal windows. She starts with a triangular window (3 sides), then a square window (4 sides), then a pentagonal window (5 sides), and continues this pattern.

Based on this case study, answer the following questions:

- (i) How many sides will the 7th window have? (1 mark)
- (ii) What is the name of a polygon with 8 sides? (1 mark)
- (iii) In any regular polygon, what is the relationship between the number of sides and the number of corners? Explain why this relationship exists. (2 marks)



SECTION A - Answers to MCQs

1. (b) Patterns and their explanations

Mathematics is the search for patterns and explanations of why those patterns exist.

2. (c) Number theory

Number theory is the branch that studies patterns in whole numbers.

3. (b) 1, 3, 6, 10, 15, ...

Triangular numbers can be represented as triangular arrangements of dots.

4. (b) 9

$1 + 3 + 5 = 9$ , which is  $3^2$ .

5. (c) 34

In Virahānka sequence, each number is the sum of previous two:  $13 + 21 = 34$ .

6. (b) 36

$36 = 6^2$  (square number) and  $36 = 1+2+3+4+5+6+7+8$  (triangular number).

7. (b) Geometry

Geometry studies patterns in shapes in one, two, or three dimensions.

8. (a) Pentagon

A pentagon has 5 sides.

9. (b) Cube numbers

These are cubes:  $1^3, 2^3, 3^3, 4^3, 5^3$ .

10. (a) Equal to the number of corners

In any closed polygon, number of sides = number of corners (vertices).

SECTION B - Answers to Short Answer Questions

11.

The next three numbers are: 8, 9, 10

Pattern: Each number increases by 1 from the previous number. This is the sequence of counting numbers where we count 1, 2, 3, and so on.

12.

They are called triangular numbers because they can be arranged as dots in a triangular pattern.

Pictorial representation of 6:

•  
••

• • •

This shows  $1 + 2 + 3 = 6$  dots arranged in a triangle.

**13.**

$$1 + 3 = 4 = 2^2$$

$$1 + 3 + 5 = 9 = 3^2$$

We get square numbers. Adding consecutive odd numbers starting from 1 always gives square numbers.

**14.**

The first five numbers in Powers of 2 are: 1, 2, 4, 8, 16

Pattern: Each number is obtained by multiplying the previous number by 2.

$$1, 2 \times 1 = 2, 2 \times 2 = 4, 2 \times 4 = 8, 2 \times 8 = 16$$

$$\text{Or: } 2^0, 2^1, 2^2, 2^3, 2^4$$

**SECTION C - Answers to Short Answer Questions**

**15.**

Sum of first four odd numbers:

$$1 + 3 + 5 + 7 = 16 = 4^2$$

The result is a square number ( $16 = 4 \times 4$ ).

Pictorial explanation: We can arrange 16 dots in a  $4 \times 4$  square. The picture shows how adding L-shaped layers of odd numbers builds up a square:

• • • •  
• • • •  
• • • •  
• • • •

The layers contain 1, 3, 5, and 7 dots respectively, forming a complete square.

**16.**

Pictorial representation:

$$1 = 1^2 : \bullet$$

$$4 = 2^2 : \bullet \bullet$$

$$9 = 3^2 : \bullet \bullet \bullet$$

$$16 = 4^2 : \bullet \bullet \bullet \bullet$$

They are called square numbers because they can be arranged as dots in a perfect square grid formation,

where the number of rows equals the number of columns.

17.

When we add counting numbers:

$$1 = 1$$

$$1 + 2 = 3$$

$$1 + 2 + 3 = 6$$

$$1 + 2 + 3 + 4 = 10$$

$$1 + 2 + 3 + 4 + 5 = 15$$

We get the sequence: 1, 3, 6, 10, 15, ...

This is the sequence of triangular numbers because these numbers can be represented as triangular arrangements of dots.

## SECTION D - Answer to Long Answer Question

18.

(a) Sum of first 5 odd numbers:

$$1 + 3 + 5 + 7 + 9 = 25 = 5^2$$

(b) Sum of first 10 odd numbers:

Using the pattern that sum of first  $n$  odd numbers =  $n^2$ , we get:

$$\text{Sum} = 10^2 = 100$$

(c) Pictorial explanation for first 4 odd numbers:

••••  
••••  
••••  
••••

We can partition this  $4 \times 4$  square into L-shaped regions:

- First L (red): 1 dot in corner
- Second L (blue): 3 dots forming an L around the first
- Third L (green): 5 dots forming an L around the previous
- Fourth L (yellow): 7 dots forming an L around the previous

$$\text{Total: } 1 + 3 + 5 + 7 = 16 = 4^2$$

This shows why adding odd numbers gives square numbers.

## SECTION E - Answers to Case Study Based Questions

19.

(i) The 6th triangular number:

$$T_6 = 1 + 2 + 3 + 4 + 5 + 6 = 21$$

**(ii)** The 6th square number:

$$S_6 = 6^2 = 36$$

**(iii)** Relationship between consecutive triangular numbers and square numbers:

When we add two consecutive triangular numbers, we get a square number.

$$\text{Example: } T_3 + T_4 = 6 + 10 = 16 = 4^2$$

$$\text{Or: } T_4 + T_5 = 10 + 15 = 25 = 5^2$$

This happens because when we combine two triangular arrangements, they form a rectangular arrangement that can be seen as a square.

## 20.

**(i)** The 7th window will have:

Following the pattern (3, 4, 5, 6, 7, 8, 9), the 7th window will have 9 sides.

**(ii)** Name of polygon with 8 sides:

Octagon

**(iii)** Relationship between sides and corners:

In any regular polygon, the number of sides is always equal to the number of corners (vertices).

Reason: A polygon is a closed figure formed by connecting points (corners) with straight lines (sides). Each corner connects two sides, and each side connects two corners. Therefore, in a closed figure, the number of sides must equal the number of corners.

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