UNIQUE STUDY POINT

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Class: VI	**Subject:** Mathematics	**Session:** 2025-26
Chapter: 01 - Patterns in Mathematics	**Time:** 1½ Hours	**Max. Marks:** 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. Visualizing mathematical objects through pictures helps in:

(a) Understanding patterns better

(b) Making mathematics boring

(c) Avoiding calculations

(d) None of these

2. The sequence 1, 1, 1, 1, 1, ... is called:

(a) Counting numbers

(b) All 1's

(c) Square numbers

(d) Odd numbers

3. In Virahānka sequence 1, 2, 3, 5, 8, 13, ..., to get the next number we:

(a) Add 5 to previous number

(b) Add previous two numbers

(c) Multiply previous number by 2

(d) Square the previous number

4. The 3rd power of 2 is:

(a) 6

(b) 8

(c) 9

(d) 12

5. A heptagon has:

(a) 5 sides

(b) 6 sides

(c) 7 sides
(d) 8 sides

6. The sum 1 + 2 + 3 + 4 equals:
(a) 8
(b) 10
(c) 12
(d) 14

7. Which of these is NOT a square number?
(a) 16
(b) 25
(c) 30
(d) 36

8. The first hexagonal number is:
(a) 1
(b) 6
(c) 7
(d) 12

9. In the Koch Snowflake sequence, to go from one shape to the next, each line segment is replaced by:
(a) Two line segments
(b) Three line segments
(c) A speed bump pattern
(d) A circle

10. The sequence of Stacked Squares represents which number sequence?
(a) Triangular numbers
(b) Square numbers
(c) Cube numbers
(d) Odd numbers

SECTION B - Short Answer Questions (2 marks each)

11. Explain why mathematics is considered both an art and a science.

12. List the first four cube numbers and explain what a cube number represents.

13. What is a regular polygon? Give two examples with their number of sides.

14. In the sequence of Stacked Triangles, how many small triangles are in the 3rd figure? Draw it.

SECTION C - Short Answer Questions (3 marks each)

15. What is the sum of 1 + 2 + 3 + ... + 99 + 100 + 99 + ... + 3 + 2 + 1? Explain your answer using the pattern of adding up and down.

16. Write the sequence you get when you add the All 1's sequence up: 1, (1+1), (1+1+1), ... What do you notice? What sequence do you get when you add All 1's up and down?

17. In a Complete Graph K5, how many lines are there? Explain your reasoning and show that this is the 4th triangular number.

SECTION D - Long Answer Question (5 marks)

18.

(a) Verify that 36 is both a triangular number and a square number by showing both representations.

(b) Draw pictorial representations using dots to illustrate that 36 can be arranged both as a triangle and as a square.

(c) Can you find another number less than 100 that is both triangular and square? Explain your method.

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

19.

Case Study 1: Patterns in Sports Tournament

In a badminton tournament, the organizer wants every player to play against every other player exactly once. With 2 players (A and B), there is 1 match (A vs B). With 3 players (A, B, C), there are 3 matches (A vs B, B vs C, A vs C). With 4 players, there are 6 matches, and so on.

Based on this case study, answer the following questions:

(i) If there are 5 players, how many matches will be played? (1 mark)

(ii) What number sequence does the number of matches follow? (1 mark)

(iii) If there are 10 players in the tournament, how many total matches will be played? Explain your reasoning. (2 marks)

20.

Case Study 2: Digital Display Patterns

A digital artist is creating a pattern on a square grid. The first design has 1 small square (1×1). The second design has 4 small squares arranged in a 2×2 grid. The third has 9 squares in a 3×3 grid, and the pattern continues. Additionally, the artist also creates stacked triangle patterns where the first has 1 triangle, the second has 4 triangles arranged in 2 rows, and the third has 9 triangles arranged in 3 rows.

Based on this case study, answer the following questions:

(i) How many small squares will be in the 7th design? (1 mark)

(ii) How many small triangles will be in the 5th stacked triangle pattern? (1 mark)

(iii) What do you notice about both these sequences? Why do they give the same numbers? Explain the mathematical reasoning. (2 marks)

DETAILED ANSWER KEY - PAPER 03

SECTION A - Answers to MCQs

1. (a) Understanding patterns better

Visualizing helps us understand mathematical patterns and concepts more clearly.

2. (b) All 1's

This is the sequence where every term is 1.

3. (b) Add previous two numbers

Virahānka sequence: each term = sum of previous two terms.

4. (b) 8

$2^3 = 2 \times 2 \times 2 = 8$.

5. (c) 7 sides

A heptagon has 7 sides and 7 corners.

6. (b) 10

$1 + 2 + 3 + 4 = 10$, which is the 4th triangular number.

7. (c) 30

30 cannot be expressed as n^2 for any whole number n.

8. (a) 1

The hexagonal number sequence starts with 1.

9. (c) A speed bump pattern

Each line segment is replaced by a "speed bump" creating a fractal pattern.

10. (b) Square numbers

Stacked Squares contain 1, 4, 9, 16, ... small squares (square numbers).

SECTION B - Answers to Short Answer Questions

11.

Mathematics is considered both an art and a science because:

As an Art: The search for patterns and their explanations is a creative and fun endeavor. It involves creativity, beauty, and aesthetic appreciation.

As a Science: Mathematics provides logical explanations for why patterns exist and uses systematic methods to study these patterns. These explanations can be applied to solve real-world problems and advance human knowledge.

12.

First four cube numbers: 1, 8, 27, 64

Calculations:

$1^3 = 1 \times 1 \times 1 = 1$

$2^3 = 2 \times 2 \times 2 = 8$

$3^3 = 3 \times 3 \times 3 = 27$

$4^3 = 4 \times 4 \times 4 = 64$

A cube number represents the total number of unit cubes needed to fill a cube of given dimensions. For example, 27 represents a 3×3×3 cube.

13.

A regular polygon is a closed figure with equal-length sides and equal angles at all corners.

Example 1: Regular Pentagon - 5 sides, all equal

Example 2: Regular Hexagon - 6 sides, all equal

In regular polygons, both the sides and the angles look the same throughout the figure.

14.

In the 3rd Stacked Triangle figure, there are 9 small triangles.

Pictorial representation:

△
△ △
△ △ △

This is arranged in 3 rows with 1, 2, and 3 triangles respectively: 1 + 2 + 3 = 6 triangles shown.

(Note: The actual count in the Stacked Triangles sequence follows the pattern of adding up and down, giving 1, 4, 9, 16... which are square numbers. The 3rd term is 9.)

SECTION C - Answers to Short Answer Questions

15.

The sum is: 1 + 2 + 3 + ... + 99 + 100 + 99 + ... + 3 + 2 + 1

This follows the pattern of adding counting numbers up and down.

Pattern observation:

$1 = 1^2$

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

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

Therefore, adding numbers from 1 up to 100 and back down to 1 gives:

Answer: 100^2 = 10,000

This happens because we're adding 100 layers of dots around a central point, forming a perfect 100×100 square.

16.

Adding All 1's up:

1 = 1

1 + 1 = 2

1 + 1 + 1 = 3

1 + 1 + 1 + 1 = 4

We get the counting numbers sequence: 1, 2, 3, 4, 5, ...

Adding All 1's up and down:

1 = 1

1 + (1 + 1) + 1 = 4

1 + (1 + 1) + (1 + 1 + 1) + (1 + 1) + 1 = 9

We get the square numbers sequence: 1, 4, 9, 16, ...

This is the same pattern as adding counting numbers up and down!

17.

In Complete Graph K5 (5 vertices), each vertex connects to every other vertex.

Method 1 - Counting:

Vertex 1 connects to 4 others

Vertex 2 connects to 3 others (already counted connection with 1)

Vertex 3 connects to 2 others (already counted connections with 1,2)

Vertex 4 connects to 1 other (already counted connections with 1,2,3)

Total lines = 4 + 3 + 2 + 1 = 10

Verification:

The 4th triangular number = 1 + 2 + 3 + 4 = 10 ✓

This shows that the number of lines in complete graphs follows the triangular number sequence!

SECTION D - Answer to Long Answer Question

18.

(a) Verification that 36 is both triangular and square:

As a square number: $36 = 6^2 = 6 \times 6$

As a triangular number: 36 = 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8

Let's verify: 1+2+3+4+5+6+7+8 = 36 ✓

(b) Pictorial representations:

Square arrangement (6×6):

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Triangular arrangement:

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• • • • • • • •

(c) Finding another such number:

The next number that is both triangular and square is actually quite large. We need to find n such that n^2 equals a triangular number.

After 36, the next such number is 1225 (which is 35^2 and also the 49th triangular number), but this exceeds 100.

Method: We look for numbers where $T(k) = n^2$, that is, $k(k+1)/2 = n^2$. This gives us special numbers. Between 1 and 100, only 1 and 36 satisfy this condition.

SECTION E - Answers to Case Study Based Questions

19.

(i) With 5 players, number of matches:

Following the pattern: 2 players→1, 3 players→3, 4 players→6

5 players → 4 + 3 + 2 + 1 = 10 matches

(ii) Number sequence:

The matches follow the triangular number sequence: 1, 3, 6, 10, 15, ...

(iii) With 10 players:

Total matches = 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 45 matches

This is the 9th triangular number.

Reasoning: Each player must play every other player once. Player 1 plays 9 matches, Player 2 plays 8 new matches (already played Player 1), Player 3 plays 7 new matches, and so on. This gives us the sum 9+8+7+...+1 = 45.

20.

(i) Small squares in 7th design:

The pattern is $1^2, 2^2, 3^2, 4^2, \ldots$, so the 7th design has $7^2 = 49$ small squares

(ii) Small triangles in 5th pattern:

Following the same pattern: $5^2 = 25$ small triangles

(iii) What we notice:

Both sequences give the same numbers: 1, 4, 9, 16, 25, 36, 49, ... (square numbers)

Mathematical reasoning:

In the square grid design, we have $n \times n$ squares in the nth design, giving n^2.

In the stacked triangle pattern, although triangles are arranged differently, the total count follows: $1 + 2 + \ldots + n$ added up and down, which we know gives n^2.

This beautiful connection shows how different geometric arrangements can represent the same mathematical sequence - the square numbers. It demonstrates that the same number can play different roles depending on the context of the pattern!
