

Case Study Based Questions

Class – VI

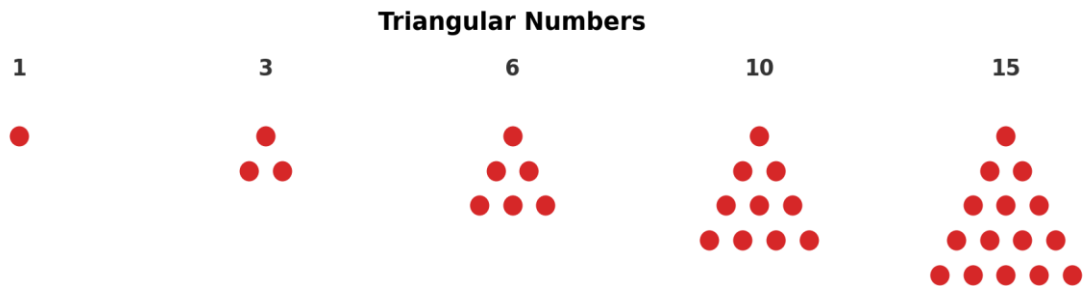
Subject – Mathematics

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Chapter 1: Patterns in Mathematics

Case Study 1: Triangular Numbers

Amit is arranging dots to form triangles, one row at a time. He starts with 1 dot, then adds a row below it to make 3 dots, then another row to make 6 dots, and so on, as shown in the picture below.



Q1. What is the next number in the sequence 1, 3, 6, 10, 15, ...?

- (a) 18 (b) 20 (c) 21 (d) 24

Q2. The triangular numbers are formed by adding which set of numbers, one at a time?

- (a) Consecutive odd numbers (b) Consecutive even numbers
(c) Consecutive square numbers (d) Consecutive counting numbers (1, 2, 3, 4, ...)

Q3. Which number is mentioned in the textbook as being both a triangular number and a square number?

- (a) 25 (b) 30 (c) 36 (d) 49

Q4. In the picture above, how many dots are in the bottom row of the 4th triangle shown (the one with 10 dots in total)?

- (a) 3 (b) 4 (c) 5 (d) 6

Q5. If you add any two consecutive triangular numbers together (for example, $6 + 10$), what type of number do you always get? *[HOTS]*

- (a) A triangular number (b) An odd number
(c) A square number (d) A cube number

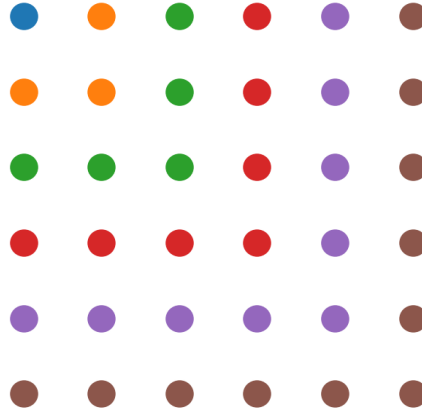
Answer Key

1. (c) 21
2. (d) Consecutive counting numbers
3. (c) 36
4. (b) 4
5. (c) A square number

Case Study 2: Odd Numbers and Squares

Riya arranged dots in a 6 x 6 square grid and coloured them in layers, starting from one corner dot and going outward, so that each coloured layer forms an 'L' shape, as shown below.

A 6 x 6 Square Grid split into Odd-Number Layers



Q1. How many differently coloured 'L-shaped' layers are there in the picture above?

- (a) 4 (b) 5 (c) 6 (d) 7

Q2. What is the total number of dots in the picture (i.e., $1 + 3 + 5 + 7 + 9 + 11$)?

- (a) 25 (b) 30 (c) 36 (d) 42

Q3. The picture illustrates that adding up the first six odd numbers gives:

- (a) The 6th triangular number (b) The 6th square number
(c) The 6th cube number (d) The 6th even number

Q4. How many dots are there in the outermost (6th) coloured layer of the picture?

- (a) 7 (b) 9 (c) 11 (d) 13

Q5. Using the same pattern shown in the picture, what would be the sum of the first 10 odd numbers ($1 + 3 + 5 + \dots + 19$)? *[HOTS]*

- (a) 90 (b) 100 (c) 110 (d) 120

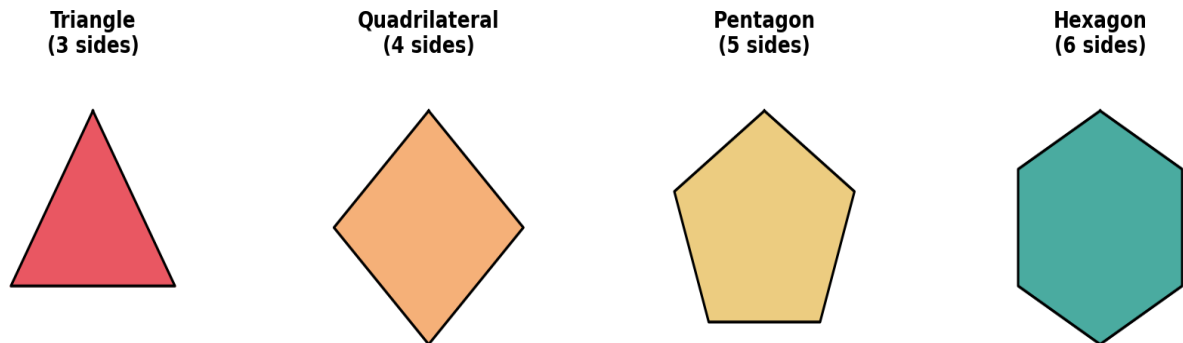
Answer Key

1. (c) 6
2. (c) 36
3. (b) The 6th square number
4. (c) 11
5. (b) 100

Case Study 3: Sequence of Regular Polygons

Farida is drawing a sequence of regular polygons, starting with a triangle, then a quadrilateral, then a pentagon, and then a hexagon, as shown below.

Sequence of Regular Polygons



Q1. What would be the next shape in this sequence, after the hexagon?

- (a) Heptagon (b) Octagon (c) Nonagon (d) Decagon

Q2. The number of sides in this sequence of shapes (3, 4, 5, 6, ...) forms which number pattern?

- (a) Odd numbers (b) Even numbers
(c) Counting numbers starting from 3 (d) Square numbers

Q3. For any regular polygon in this sequence, how does the number of corners compare to the number of sides?

- (a) Always one more than the sides (b) Always one less than the sides
(c) Always equal to the number of sides (d) Always double the sides

Q4. The branch of Mathematics that studies patterns in shapes, such as this sequence of polygons, is called:

- (a) Number theory (b) Algebra (c) Geometry (d) Statistics

Q5. If a 'Complete Graph' is formed by joining every pair of corners of the hexagon (6 corners) with straight lines, how many total line segments would this complete graph (K6) have? *[HOTS]*

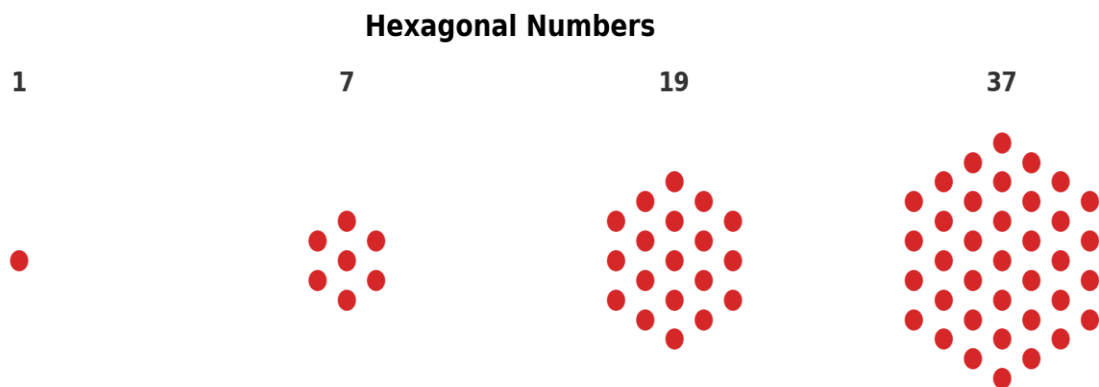
- (a) 6 (b) 10 (c) 15 (d) 21

Answer Key

1. (a) Heptagon
2. (c) Counting numbers starting from 3
3. (c) Always equal to the number of sides
4. (c) Geometry
5. (c) 15

Case Study 4: Hexagonal Numbers

Sameer is arranging red dots to form hexagons around a central dot, one ring at a time. The first few shapes he makes contain 1, 7, 19 and 37 dots, as shown in the picture below.



Q1. What is the next number in the sequence 1, 7, 19, 37, ...?

- (a) 55 (b) 61 (c) 67 (d) 73

Q2. The differences between consecutive hexagonal numbers ($7 - 1$, $19 - 7$, $37 - 19$, ...) form which pattern?

- (a) Consecutive odd numbers (b) Consecutive even numbers
(c) Consecutive multiples of 6 (d) Consecutive square numbers

Q3. What do you get when you start adding up hexagonal numbers, i.e., 1 , $1 + 7$, $1 + 7 + 19$, $1 + 7 + 19 + 37$, ...?

- (a) Triangular numbers (b) Square numbers (c) Cube numbers (d) Powers of 2

Q4. What is the correct name, as given in the textbook, for the sequence of numbers 1, 7, 19, 37, ...?

- (a) Pentagonal numbers (b) Hexagonal numbers
(c) Heptagonal numbers (d) Octagonal numbers

Q5. Since adding up hexagonal numbers gives cube numbers, what is the sum of the first five hexagonal numbers, $1 + 7 + 19 + 37 + 61$? *[HOTS]*

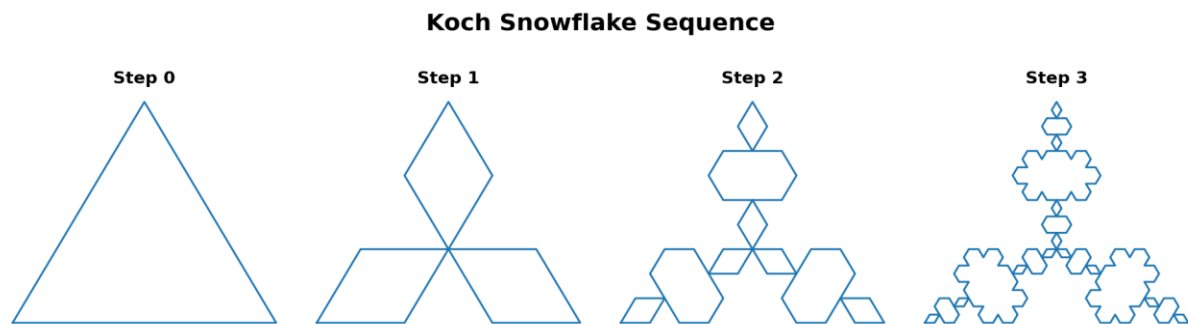
- (a) 100 (b) 121 (c) 125 (d) 144

Answer Key

1. (b) 61
2. (c) Consecutive multiples of 6
3. (c) Cube numbers
4. (b) Hexagonal numbers
5. (c) 125

Case Study 5: The Koch Snowflake

Meera is drawing the Koch Snowflake pattern. She starts with a triangle, and at every step, she replaces each straight line segment



Q1. At each step of the Koch Snowflake sequence, every straight line segment is replaced by a:

- (a) Bigger triangle (b) 'Speed bump' shape (c) Square (d) Semicircle

Q2. What is the sequence for the total number of line segments in each shape of the Koch Snowflake (Step 0, Step 1, Step 2, ...)?

- (a) 3, 6, 9, 12, ... (b) 3, 9, 27, 81, ...
(c) 3, 12, 48, 192, ... (d) 3, 6, 12, 24, ...

Q3. The textbook describes the Koch Snowflake's line-segment sequence as:

- (a) 3 times Powers of 2 (b) 3 times Powers of 3
(c) 3 times Powers of 4 (d) 4 times Powers of 3

Q4. The Koch Snowflake is an example of which type of pattern studied in mathematics?

- (a) A number sequence (b) A shape sequence
(c) An algebraic equation (d) A statistical pattern

Q5. Given the sequence 3, 12, 48, 192, ... for the Koch Snowflake, how many total line segments will the 5th shape in this sequence have? *[HOTS]*

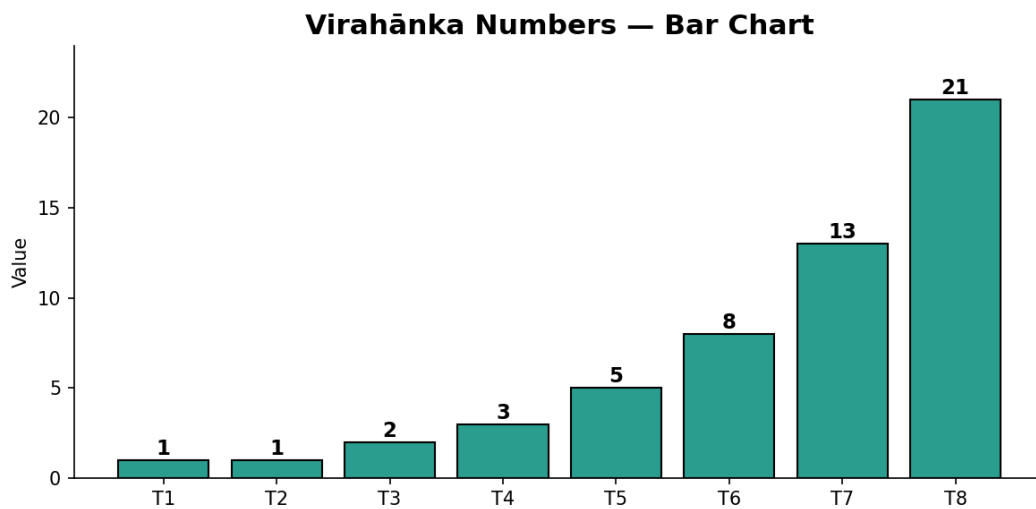
- (a) 384 (b) 576 (c) 768 (d) 960

Answer Key

1. (b) 'Speed bump' shape
2. (c) 3, 12, 48, 192, ...
3. (c) 3 times Powers of 4
4. (b) A shape sequence
5. (c) 768

Case Study 6: Virahānka Numbers (Bar Chart)

Instead of drawing dots, Kabir decided to show the Virahānka numbers as a bar chart, with the height of each bar equal to the value of that term, as shown below.



Q1. What is the next number in the sequence 1, 1, 2, 3, 5, 8, 13, 21, ...?

- (a) 29 (b) 34 (c) 36 (d) 42

Q2. From the 3rd term onward, each Virahānka number is obtained by:

- (a) Multiplying the previous two terms (b) Adding the previous two terms
(c) Squaring the previous term (d) Subtracting the previous two terms

Q3. Looking at the bar chart, what is the value of the 6th bar (T6)?

- (a) 5 (b) 8 (c) 13 (d) 21

Q4. Virahānka numbers are also popularly known in the West as:

- (a) Lucas numbers (b) Fibonacci numbers
(c) Catalan numbers (d) Prime numbers

Q5. If the bar chart were extended, what would be the height of the 10th bar (i.e., the 10th term of the sequence)? *[HOTS]*

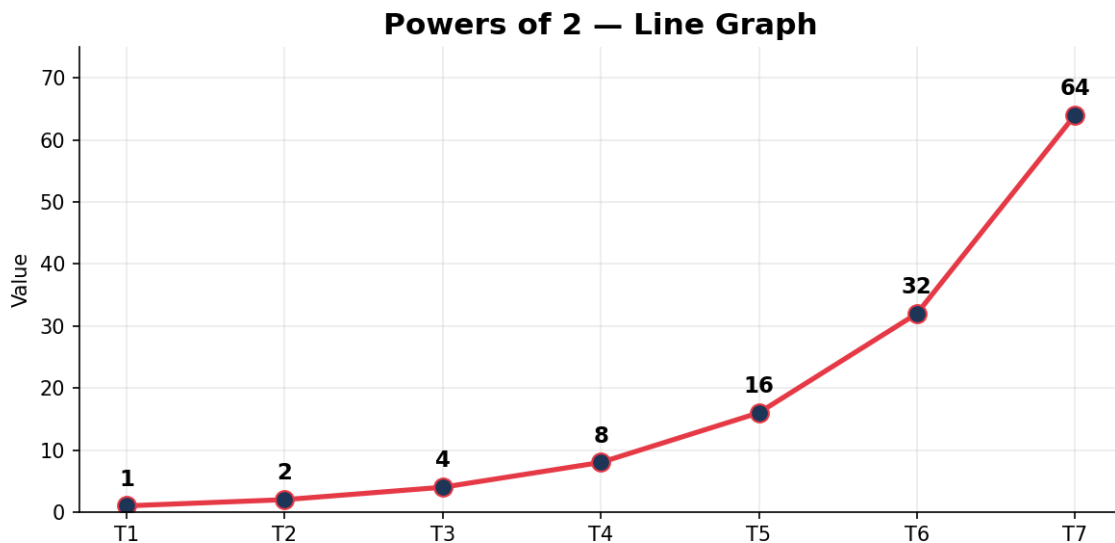
- (a) 45 (b) 50 (c) 55 (d) 60

Answer Key

1. (b) 34
2. (b) Adding the previous two terms
3. (b) 8
4. (b) Fibonacci numbers
5. (c) 55

Case Study 7: Powers of 2 (Line Graph)

Ananya plotted the sequence of Powers of 2 as a line graph, joining the value of each term with a line, as shown below.



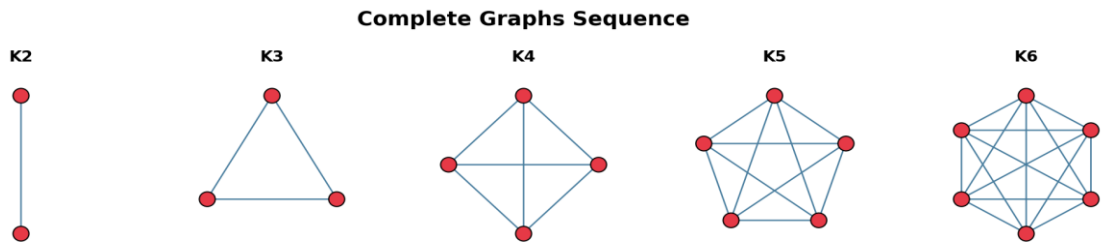
- Q1. What is the next number after 64 in the sequence shown in the line graph?**
(a) 96 (b) 100 (c) 128 (d) 256
- Q2. Each term in the Powers of 2 sequence is obtained from the previous term by:**
(a) Adding 2 (b) Multiplying by 2
(c) Squaring it (d) Adding the previous two terms
- Q3. Which point on the line graph (T1, T2, T3, ...) corresponds to the value 32?**
(a) T4 (b) T5 (c) T6 (d) T7
- Q4. The kind of rapid, steepening growth shown in this line graph is called:**
(a) Linear growth (b) Exponential growth
(c) Negative growth (d) Constant growth
- Q5. If the line graph were extended further, what would be the value of the 10th term of the Powers of 2 sequence? [HOTS]**
(a) 256 (b) 512 (c) 1024 (d) 2048

Answer Key

1. (c) 128
2. (b) Multiplying by 2
3. (c) T6
4. (b) Exponential growth
5. (b) 512

Case Study 8: Complete Graphs (Network Diagram and Table)

Vihaan drew the sequence of Complete Graphs, K2 to K6, joining every pair of dots with a straight line. He then recorded the number of nodes (dots) and lines (edges) for each graph in a table.



Graph	Nodes	Lines (edges)
K2	2	1
K3	3	3
K4	4	6
K5	5	10
K6	6	15

Q1. According to the table, how many lines are there in K4?

- (a) 4 (b) 5 (c) 6 (d) 7

Q2. The number of lines in K2, K3, K4, K5, K6 (1, 3, 6, 10, 15) forms which number sequence?

- (a) Counting numbers (b) Even numbers
(c) Triangular numbers (d) Square numbers

Q3. For a complete graph with n nodes, the number of lines is given by the formula:

- (a) $n(n-1)/2$ (b) $n(n+1)/2$ (c) n^2 (d) $2n$

Q4. As shown in the table, the number of nodes in this sequence of graphs increases by:

- (a) 1 each time (b) 2 each time
(c) Doubling each time (d) Its square each time

Q5. Using the pattern in the table, how many lines would K7 (a complete graph with 7 nodes) have? **[HOTS]**

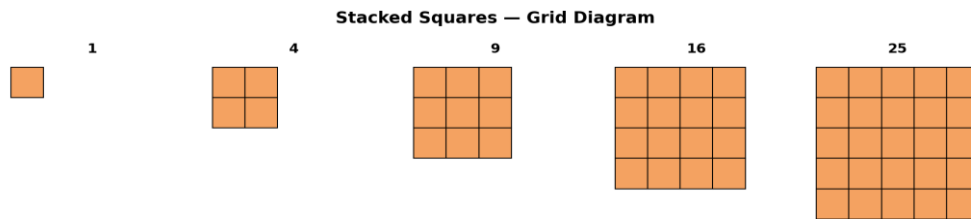
- (a) 15 (b) 21 (c) 28 (d) 36

Answer Key

- (c) 6
- (c) Triangular numbers
- (a) $n(n-1)/2$
- (a) 1 each time
- (b) 21

Case Study 9: Stacked Squares (Grid Diagram)

Instead of dots, Naina drew the Stacked Squares sequence using actual unit squares on a grid, building bigger and bigger square grids, as shown below.



Q1. How many little squares are there in the 4th grid shown (the 4 x 4 grid)?

- (a) 9 (b) 12 (c) 16 (d) 20

Q2. The number of little squares in each grid of this sequence forms which number pattern?

- (a) Triangular numbers (b) Square numbers
(c) Cube numbers (d) Powers of 2

Q3. For the n th grid in this sequence, the number of little squares is given by:

- (a) n (b) n^2 (c) $n(n + 1)/2$ (d) $2n$

Q4. How many little squares would the 6th grid (a 6 x 6 grid) have?

- (a) 25 (b) 30 (c) 36 (d) 42

Q5. The 5th grid has 25 little squares and the 6th grid has 36. How many new little squares were added in going from the 5th grid to the 6th grid? *[HOTS]*

- (a) 9 (b) 11 (c) 13 (d) 15

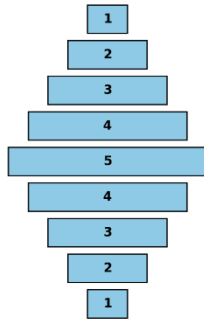
Answer Key

1. (c) 16
2. (b) Square numbers
3. (b) n^2
4. (c) 36
5. (b) 11

Case Study 10: Adding Numbers Up and Down (Pyramid Chart and Table)

Ishaan represented the pattern of 'adding counting numbers up and down' as a symmetric pyramid of horizontal bars, and recorded the results in a table, as shown below.

Adding Numbers Up and Down
($1+2+3+4+5+4+3+2+1 = 25$)



Term	Expression	Value
1	1	1
2	$1 + 2 + 1$	4
3	$1 + 2 + 3 + 2 + 1$	9
4	$1 + 2 + 3 + 4 + 3 + 2 + 1$	16
5	$1 + 2 + 3 + 4 + 5 + 4 + 3 + 2 + 1$	25

Q1. According to the pyramid chart and table,

what is the value of $1 + 2 + 3 + 4 + 5 + 4 + 3 + 2 + 1$?

- (a) 16 (b) 20 (c) 25 (d) 30

Q2. This pattern of 'adding numbers up and down' always gives the same result as:

- (a) Triangular numbers (b) Square numbers
(c) Cube numbers (d) Odd numbers

Q3. Following the same pattern, what would be the value of the 6th term,

$1 + 2 + 3 + 4 + 5 + 6 + 5 + 4 + 3 + 2 + 1$?

- (a) 25 (b) 30 (c) 36 (d) 42

Q4. The shape formed by the bars in the picture, growing and then shrinking symmetrically, looks like a:

- (a) Straight line (b) Circle (c) Pyramid (mountain) shape (d) Spiral

Q5. Using this same pattern, what is the value of $1 + 2 + 3 + \dots + 99 + 100 + 99 + \dots + 3 + 2 + 1$? [HOTS]

- (a) 5000 (b) 10000 (c) 15000 (d) 20000

Answer Key

1. (c) 25
2. (b) Square numbers
3. (c) 36
4. (c) Pyramid (mountain) shape
5. (b) 10000