CBSE GRADE 6
CHAPTER 1
PATTERNS IN MATHEMATICS

2 Marks

1. Write the next three numbers of the sequence: 1, 3, 6, 10, 15. What is the name of this sequence?

   Solution:

   STEP 1: First, observe the pattern in the sequence 1, 3, 6, 10, 15.

   STEP 2: Now look at how the numbers are increasing;

   From 1 to 3, we add 2

   From 3 to 6, we add 3

   From 6 to 10, we add 4

   From 10 to 15, we add 5

   STEP 3: Each time, we are adding the next natural number :2, 3, 4, 5...

   STEP 4: Now, we have to find the next 3 numbers,

   We add 15+6=21

   21+7=28

   28+8=36

   We have added the consecutive natural number to each of the value in the sequence.

   STEP 5: This pattern is called the **"triangular numbers**", because each number can form a triangle of dots.

2. Find the sum of the first 5 odd numbers.

   Solution:

   STEP 1: First, list the first 5 odd numbers: 1,3,5,7,9

   STEP 2: Now we have to the odd numbers.

   1+3=4

   4+5=9

   9+7=16

   16+9=25

   STEP 3: The total sum the odd numbers is 25

   If odd numbers added like this it forms square numbers.

3. What number comes next in the pattern: 1, 2, 4, 8, 16, ...?

   Solution:

   STEP 1: First, observe the pattern.

   STEP 2: Each number is doubling the previous number.

   $1 \times 2 = 2$

   $2 \times 2 = 4$

$4 \times 2 = 8$

$8 \times 2 = 16$

STEP 3: To find the next term, we have to multiply 16 by 2

$16 \times 2 = 32$

STEP 4: The next number is 32.

This is a sequence of powers of 2.

4. Find the square of the 6th natural number.

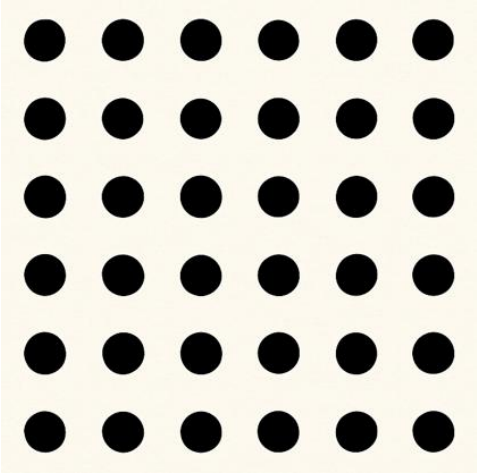
Solution:

STEP 1: We have to find the 6th natural number.(i.e.) 1,2,3,4,5,6.

STEP 2: The sixth natural number is 6.

STEP 3: We have to find the square value of 6.

STEP 4: Now, make a square of 6 using dots.



STEP 5: Count all dots in rows and columns.

STEP 6: There are totally 36 dots. The square of 6^{th} natural number is 36.

5. What shape comes after a hexagon in regular polygon sequence?

Solution:

STEP 1: A hexagon has 6 sides.

STEP 2: We are moving forward by increasing the number of sides by 1.

STEP 3: We have to find the name of the shape with 7 sides.

STEP 4: The name of the shape with 4 sides is heptagon.

6. Identify the sequence: 1, 4, 9, 16, 25...

Solution:

STEP 1: We have to observe the pattern in the sequence.

STEP 2: Look at how the numbers are growing.

STEP 3: We are adding odd numbers each time.

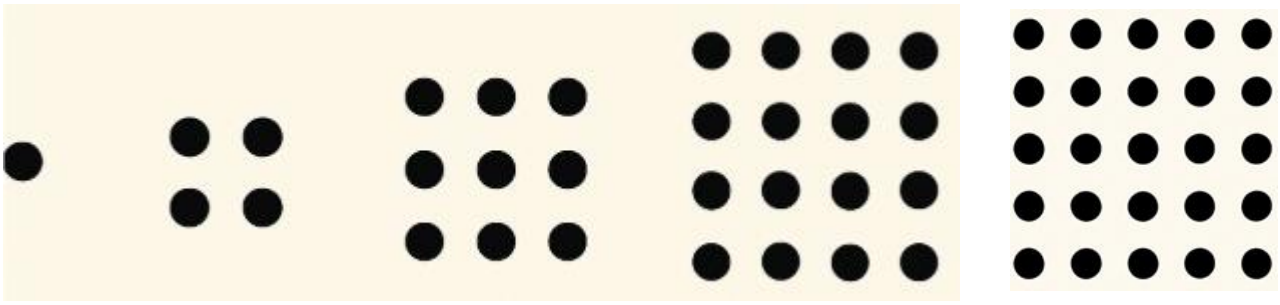
1+3=4

4+5=9

9+7=16

16+9=25

STEP 4: These are numbers formed by arranging dots in perfect squares.



STEP 5: this is a pattern of square numbers.

7. What is the 4th cube number?

Solution:

STEP 1: We have to find the cube value of 4.

STEP 2: The 4^{th} cube can be written as $4 \times 4 \times 4$.

STEP 3: The 4th cube number is 64

8. What is the rule for generating the sequence: 1, 3, 5, 7, 9...?

Solution:

STEP 1: We have to observe the pattern and identify the rule for generating the sequence.

STEP 2: Look at the numbers, we add 2 each times.

1+2=3

3+2=5

5+2=7

7+2=9

STEP 3: The rule is simple keep adding 2.

9. Find the next number in the sequence: 1, 3, 9, 27.

Solution:

STEP 1: We have to check the pattern and identify the next number.

STEP 2: Let's check the pattern;

$1 \times 3 = 3$

$3 \times 3 = 9$

$9 \times 3 = 27$

STEP 3: In the sequence we had multiplied each number by 3.

STEP 4: To identify the next term, we have to multiply 27 by 3.

$27 \times 3 = 81$

STEP 5: The next number in the sequence is 81.

This is the pattern of powers of 3

10. What is the sum of 1 + 2 + 3 + 2 + 1?

Solution:

STEP 1: We have to find the sum of the pattern.

STEP 2: We have to add the term in the form of patterns.

1+2=3

3+3=6

6+2=8

8+1=9

STEP 3: The sum is 9.

5 Marks

1. Prove that the sum of the first n odd numbers is a square number using the first 6 terms.

   Solution:

   STEP 1: We have to list the first 6 odd numbers: 1, 3, 5, 7, 9, 11.

   STEP 2: From this sequence we have to show that the sum of the first n odd numbers is a square number using the first 6 terms.

   STEP 3: We have to find the sum,

   1+3=4

   4+5=9

   9 + 7 = 16

   16 + 9 = 25

   25 + 11 = 36

   STEP 4: The sum of first 6 odd numbers form a sequence 4,9,16,25,36.

   STEP 5: The sum of odd numbers form the square numbers.

   STEP 6: We have proved that adding odd numbers gives us square numbers each time.

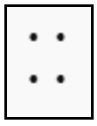
2. Explain with picture and steps how square numbers grow using dots (up to 5×5).

   Solution:

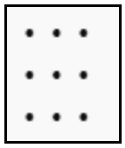
   STEP 1: We have to start with 1 dot.

   STEP 2: 

   STEP 3: Now add 2 dots around it, to form a 2×2 square.

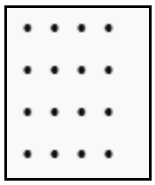
   STEP 4: 

   STEP 5: Add a new row and column to make 3×3

   STEP 6: 

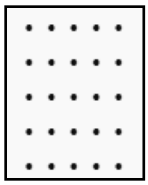
STEP 7: Again, add a row and column to make 4×4. To get the square value as 16.

STEP 8:



STEP 9: Now, we have t find the 5^{th} square. By adding one more row and column to make 5×5.

STEP 10:



STEP 11: Each time we are adding more layers of dots in L-shapes.

STEP 12: square numbers are built by stacking dots in square shapes.

3. Find the sum of the first 10 even numbers and identify the pattern.

Solution:

STEP 1: We start by listing the first 10 even numbers.

STEP 2: The first 10 even numbers are 2, 4, 6, 8, 10, 12, 14, 16, 18, 20.

STEP 3: Now, let's add them step by step

2 + 4 = 6
6 + 6 = 12
12 + 8 = 20
20 + 10 = 30
30 + 12 = 42
42 + 14 = 56
56 + 16 = 72
72 + 18 = 90
90 + 20 = 110

STEP 4: The total sum of the first 10 even numbers is 110.

STEP 5: All numbers increase by 2 each time.

STEP 6: This is a regular even number pattern.

STEP 7: The numbers are equally spaced and follow a smooth increasing order.

4. Complete and explain the pattern: 1 + 2 + 3 + 4 + 3 + 2 + 1

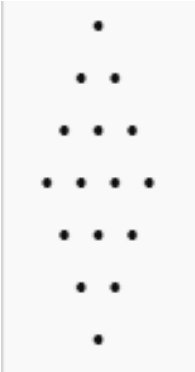
Solution:

STEP 1: Write down the full number pattern 1 + 2 + 3 + 4 + 3 + 2 + 1.

STEP 2: Let’s add the numbers from left to right step by step.

1+2=3
3+3=6
6+4=10
10+3=13
13+2=15
15+1=16

STEP 3: The total sum is 16.
STEP 4: It increases to 4, then decreases back to 1.
STEP 5: The number of blocks or dots in each line would be



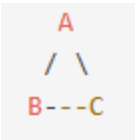
STEP 6: This creates a diamond or pyramid shape.
STEP 7: When arranged with dots, this symmetric pattern makes a perfect 4×4 square.

5. Find the number of line segments in Complete Graphs: K2, K3, K4, K5

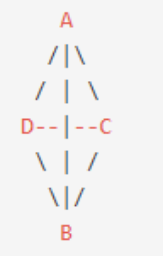
Solution:

STEP 1: In a complete graph, every point (or dot) is connected to every other point by a line.
STEP 2: Let's start with K2.
STEP 3: It contains 2 point namely A and B and connects AB.

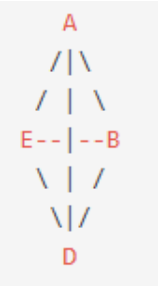
STEP 6: There is one line segment in the K2.
STEP 7: Now we have to find for K3.
STEP 8: It has 3 points A, B, C and connects AB, BC, CA.



STEP 9: There are 3 line segments in the K3.
STEP 10: Now we have to find for K4.
STEP 11: It has 4 points A, B, C, D and connects AB, BC, CD, DA.
STEP 12: There are 6 line segments in the K4.



STEP 13: Now we have to find for K5.
STEP 14: It has 5 points A, B, C,D, E and connects AB, BC, CD, DE,EA.



STEP 15: There are 10 line segments in the K5.

6. Determine the number of line segments in the Koch Snowflake for 4 stages.

Solution:

STEP 1: A Koch Snowflake begins with an equilateral triangle. It has 3 line segment.

STEP 2: Now, we can consider the initial value.

STEP 3: The initial value we be 0. The total line segment is 3.

STEP 4: Each segment is split into 4.

STEP 5: We have to multiply line segment and each split.

$$3 \times 4 = 12\ segments$$

STEP 6: Each of those 12 becomes 4 segments.

$$12 \times 4 = 48\ segments$$

STEP 7: Each of those 48 becomes 4 segments.

$$48 \times 4 = 192\ segments$$

STEP 8: Each of those 192 becomes 4 segments.

$$192 \times 4 = 768\ segments$$

STEP 9: We observe that the pattern follows number of segments is multiplied by 4 each time.

7. Find the 7th square number and draw it. Show relation to dot arrangement.

Solution:

STEP 1: We have to find the square value for the 7^{th} term.

STEP 2: Square numbers are formed by multiplying a number by itself.

STEP 3: The 7th square number can be written as 7×7.

STEP 4: The value of the 7^{th} square is 49.

STEP 5: We can arrange 49 dots in a 7 by 7 square.

8. Add first 5 triangular numbers: 1, 3, 6, 10, 15

Solution:

STEP 1: Observe the pattern.

STEP 2: Now, we have to add values of the pattern.

STEP 3: We have to add 1+3=4

4+6=10

10+10=20

20+15=35

STEP 4: The sum of the triangular number is 35.

9. Add 1, 1 + 2, 1 + 2 + 4, 1 + 2 + 4 + 8, ... up to 4 terms. Then add 1 to each. Explain pattern.

Solution:

STEP 1: We have to identify the first, second, third and fourth.

STEP 2: The first term is 1, second term is 1+2, third term is 1 + 2 + 4 and fourth term is 1 + 2 + 4 + 8.

STEP 3: Now, we have to add the terms separately,

1 + 2 = 3

1 + 2 + 4 = 7

1 + 2 + 4 + 8 = 15

STEP 4: The sequence become 1,3 ,7, and 15.

STEP 5: Now we have to add 1 to the above sequence.

STEP 6: The sequence will be 1+1=2

3+1=4

7+1=8

15+1=16

STEP 7: The new pattern is 2, 4, 8, and 16.

STEP 8: The new sequence follows the pattern power of 2.

10. Multiply first 5 triangular numbers by 6 and add 1. What sequence is this?

Solution:

STEP 1: The first 5 triangular numbers are 1,3,6,10,15.

STEP 2: Now, we have to multiply sequence by 6.

$1 \times 6 = 6$

$3 \times 6 = 18$

$6 \times 6 = 36$

$10 \times 6 = 60$

$15 \times 6 = 90$

STEP 3: The new sequence is 6, 18, 36, 60, and 90.

STEP 4: Now, we have to add 1 to each term of new sequence.

6+1=7

18+1=19

36+1=37

60+1=61

90+1=91

STEP 5: The sequence after adding 1; 7, 19, 37, 61, 91.

STEP 6: These numbers are 1 more than a multiple of 6.

STEP 7: This is called the Centered Hexagonal Number sequence.