CLASS 6

PW

MATHEMATiCS

Olympiad
Prepguide & PYQs

+

Workbook
After School Practice

- Concept Maps
- Olympiad Specific Concepts
- Topicwise Solved Examples
- Achievers MCQs
- Olympiad Exam PYQs
- Everyday Curiosity Qns

IMO, iOM, Hindustan Olympiad, NSTSE, SEAMO, ISTSE and others

Overview of Major Olympiad Exams

International Mathematics Olympiad (IMO)

Exam Details

Feature	Information
Frequency of conduct	Once a year
Exam Mode	Offline
Medium	English
Exam Duration	60 Minutes
Type of Questions	Multiple Choice Questions (Objective Type)

Syllabus

Section–1: Verbal and Non-Verbal Reasoning.

Section–2: Patterns in Mathematics, Lines and Angles, Number Play, Data Handling and Presentation, Prime Time, Perimeter and Area, Fractions, Playing with Constructions, Symmetry, The Other Side of Zero.

Section–3 : Syllabus as per Section–2.

Section–4: Higher Order Thinking Questions - Syllabus as per Section–2.

Exam Structure

Levels	Details
Level 1	All students are eligible
Level 2	Top 5% of the participating students in Level 1 exam

Note:

- **Level 1 Questions:** 60% from class 6 syllabus + 40% from class 5 syllabus.
- **Level 2 Questions:** From class 6 syllabus only.
- **Achievers Section Questions:** From class 6 syllabus only.

Exam Pattern

Levels	Sections	Questions	Marks/ Question	Total Marks
Level 1	1: Logical Reasoning	15	1	15
	2: Mathematical Reasoning	20	1	20
	3: Everyday Mathematics	10	1	10
	4: Achievers Section	5	3	15
	Total	**50**		**60**
Level 2	1: Mathematics	45	1	45
	2: Achievers Section	5	3	15
	Total	**50**		**60**

Silverzone Olympiad (iOM)

Exam Details

Feature	Information
Exam Frequency	Conducted annually, two dates to choose from
Exam Mode	Offline, conducted in schools during school hours
Medium	English
Exam Duration	40 minutes
Type of Questions	Multiple Choice Questions (Objective Type)

Syllabus

Section 1:

- ❑ **Number Systems:** Numbers and Their Operations, Factors and Multiples
- ❑ **Parts and Wholes:** Fractions and Decimals
- ❑ **Algebra, Ratio and Proportion:** Algebra, Ratio and Proportion
- ❑ **Geometry and Mensuration:** Mensuration, Geometry
- ❑ **Graphical Representation of Data:** Data Handling

Exam Structure

Levels	Details
Level 1	All students are eligible
Level 2	Top 1000 rank holders (Minimum 50% marks & Above)
Level 3	1st rank holders at Level 2

Exam Pattern

Sections	Questions	Marks/ Question	Total Marks
Section 1: Mathematics	25	2.5	62.5
Section 2: Reasoning and Aptitude	5	3.5	17.5
Section 3: Scholar's Zone	5	4	20
Total	35		100

Note: There is no negative marking for wrong answers.

Hindustan Olympiad

Exam Details

Detail	Information
Exam Frequency	Once a year
Exam Mode	Online
Duration	120 minutes
Medium	Hindi or English
Type of Questions	Multiple Choice Questions (Objective Type)

Note: An additional 10 minutes is provided for reading the instructions and filling the OMR sheet.

Exam Structure

Levels	Details
Level 1	All students are eligible (open-book exam)
Level 2	Top 10% of participants (proctored exam)

Exam Pattern

Sections	Questions	Marks/ Question	Total Marks
Section A: Mathematics	20	1	20
Section B: English	20	1	20
Section C: Science	20	1	20
Section D: General Knowledge	20	1	20
Section E: Logical Reasoning	20	1	20
Total	100		100

Note: There is no negative marking.

National Level Science Talent Search Examination (NSTSE)

Exam Details

Feature	Details
Exam Frequency	Once a year
Exam Mode	Online & Offline
Duration	60 minutes
Medium	English
Type of Questions	Multiple Choice Questions

Syllabus

Sections:

- ❑ **Section A (Mathematics):** Patterns in Mathematics, Lines and Angles, Number Play, Data Handling and Presentation, Prime Time, Perimeter and Area, Fractions, Playing with Constructions.

- ❑ **Section B (Physics):** Exploring Magnets, Measurement of Length and Motion, Temperature and its Measurement.

- **Section C (Chemistry):** Materials Around Us, A journey through States of Water.
- **Section D (Biology):** The Wonderful World of Science, Diversity in the Living World, Mindful Eating : A Path to a Healthy Body, Living Creatures : Exploring Their Characteristics.
- **Critical Thinking:** This section includes a combination of skills like conscious application in real life, Logical & Inductive Reasoning, Tactics & Strategies in decision making, higher order thinking.

Exam Pattern

Sections	Questions	Marks/Question	Total Marks
Section A: Mathematics	25	1	25
Section B: Physics	10	1	10
Section C: Chemistry	10	1	10
Section D: Biology	10	1	10
Section E: Critical Thinking	5	1	5
Total	60		60

Southeast Asian Mathematical Olympiad (SEAMO)

Exam Details

Feature	Details
Exam Frequency	Once a year
Exam Mode	Online
Duration	90 minutes
Medium	English
Type of Questions	Multiple Choice Ques. & Open-ended Ques.

Syllabus

The Four Operations, Whole numbers, Fractions, Permutation, Combination, Pigeonhole Principle, Number Sequence, Logic, Average, Square Number, Prime Numbers, Prime Factorization, Defining New Operations, Working Backwards, Speed, Ratio and Percentage, Area of Circle, Angles and Triangles, Probability, Charts

Exam Pattern

Sections	Questions	Marks/Question	Total Marks
Section A: MCQs	10	3	30
Section B: MCQs	10	4	40
Section C: Open-ended Ques	5	6	30
Total	25		100

Note: There is no negative marking for wrong answers.

How to Use this Book

This book is structured to support your learning journey of preparing for your olympiad exams through a variety of engaging and informative elements. Here's how to make the most of it:

The concept map appears to be a comprehensive study aid that outlines key concepts in a structured format. Use it to understand the chapter's concepts and as a quick reference to recall important highlights.

Concept Map
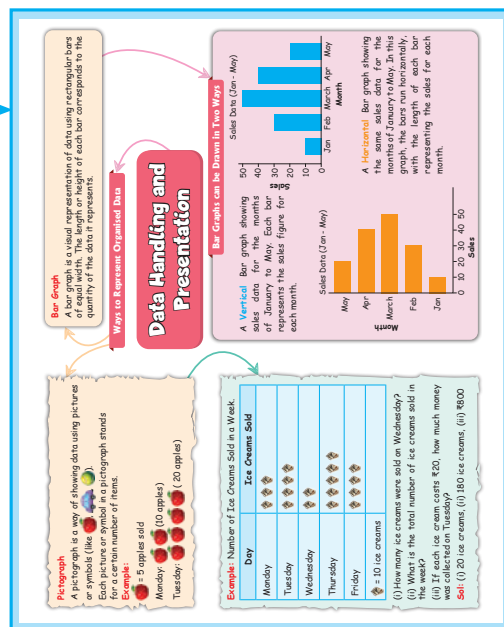
CuriousJr brings real-life questions that make you think and wonder. These questions help you see how what you learn connects to the world around you.

CuriousJr (Everyday Mathematics)

CuriousJr

1. On a sunny Monday morning, Neha's math teacher, Mr. Verma, called her to the blackboard. He gave her five digit cards labeled 1, 1, 3, 3, 4 and said: "Using all these digits, solve the following problems!" Neha picked up the chalk, ready for the challenge.

   (*i*) Arrange the digits to form the smallest possible 5-digit palindrome number. Now rearrange them to make the largest possible 5-digit palindrome number.
   (*ii*) Find the difference between the smallest palindrome and the largest palindrome.
   (*iii*) Add the smallest 5-digit number to your difference. Will the result be a palindrome? If not, find how much more you have to add to make it a next smallest possible palindrome.

2. Three friends named Aaryan, Deepak and Rahul are discussing Kaprekar's constant digit number studied in their maths class. They explored Kaprekar's routine using digits 0,1,2,5. Only Aaryan succeeded.

Rahul did it in the following manner:-
   ○ Largest number: 5210
   ○ Smallest number: 0125
   ○ 5210 − 125 = 5085

Solved Example

1. Take a central line of a different length and try to draw the wave on it.

Sol. Step 1: We start with the central line of different lengths, say, 10 cm.

Step 2: Since 10/2 = 5 cm, using a ruler, take point C on AB such that AC = 5 cm. C is the midpoint of AB.

As 5 ÷ 2 = 2.5, using a ruler, take points D on AC and E on CB such that AD = 2.5 cm and CE = 2.5 cm.

D is the midpoint of AC and E is the midpoint of CB.
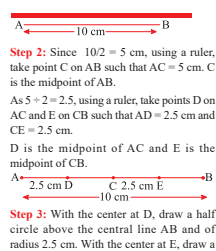
Step 3: With the center at D, draw a half circle above the central line AB and of radius 2.5 cm. With the center at E, draw a half circle below the central line AB and of radius 2.5 cm.

Step 4: Draw vertical lines in the half circles above and below the line AB.
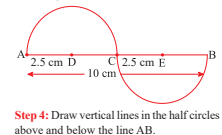
The above figure represents the required depiction of the given "Wavy Wave" with the central line of length 10 cm.

Solved Example

Solved Example contains solved questions for each topic. These examples show how to solve problems step by step, making it easier for you to understand the method and apply it on your own. It helps you build strong problem-solving skills.

This section gives you practice questions based on each concept. Solving these will show how well you have learned and help you find areas where you need more practice.

Test Yourself

6. In each case, determine which angle is greater and why.
(a) ∠AOB or ∠XOY (b) ∠AOB or ∠XOB (c) ∠XOB or ∠XOC
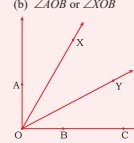
This section includes questions that were asked in past exams. Solving these helps you understand questions pattern, difficulty level, & most important topics. It's a great way to prepare for the actual exam with full confidence.

Olympiad Exam Previous Year Questions

Olympiad Exam Previous Year Questions

1. Which of the following figures has exactly three lines *(2023)*

(a)   (b)

(c)   (d) None of these

2. Which of the following has exactly two lines of symmetry? *(2023)*
(a) Equilateral triangle
(b) Isosceles triangle
(c) Rectangle
(d) Square

3. Which of the following figures has more than two lines of symmetry? *(2022)*
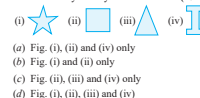
(i) (ii) (iii) (iv)

(a) Fig. (i), (ii) and (iv) only
(b) Fig. (i) and (ii) only
(c) Fig. (ii), (iii) and (iv) only
(d) Fig. (i), (ii), (iii) and (iv)

4. How many of the following letters have no line of symmetry? *(2022)*

PARKING

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

5. How many minimum number of squares that must be shaded to make the given figure symmetric? *(2021)*

(a) 1 (b) 2 (c) 3 (d) 4

6. Match the figures given in the Column-I with their line(s) of symmetry given in Column-II. *(2021)*

Column - I		Column - II	
(P)	Equilateral triangle	(1)	0
(Q)	Square	(2)	3
(R)	Parallelogram	(3)	2
(S)	Rhombus	(4)	4

(a) (P) → (2); (Q) → (4); (R) → (1); (S) → (3)
(b) (P) → (4); (Q) → (4); (R) → (3); (S) → (1)
(c) (P) → (4); (Q) → (2); (R) → (1); (S) → (3)
(d) (P) → (2); (Q) → (1); (R) → (4); (S) → (3)

7. Find the number of lines of symmetry of the given figure. *(2021)*
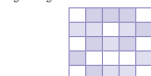
(a) 1 (b) 2 (c) 3 (d) 4

8. Seema drew the following shapes on a paper.

How many symmetrical shapes did she draw? *(2021)*

(a) 2 (b) 3 (c) 4 (d) 5

9. Which of the following figures has at least one line of symmetry? *(2020)*

P   Q   R   S

(a) Only P
(b) Only P and Q
(c) Only P, Q and S
(d) P, Q, R and S

Achievers Multiple Choice Questions

1. In the given figure, the dotted line is the line of symmetry. Which figure is formed if the given figure is reflected in the dotted line?

(a) A square (b) A rhombus
(c) A triangle (d) A pentagon

2. How many minimum number of squares that must be shaded to make the given figure symmetric?

(a) 1 (b) 2 (c) 3 (d) 4

3. Which of the following statements is correct?
(A) An equilateral triangle has three lines of symmetry.
(B) A rectangle has four lines of symmetry.
(C) A circle has only one line of symmetry.
(D) A parallelogram has two lines of symmetry.

(a) TTFF (b) TFFF (c) FFTT (d) FTFT

4. Match the figures in Column-I with their order of rotational symmetry in Column-II.

Column-I		Column-II	
(P)		(1)	One
(Q)		(2)	Four
(R)		(3)	Infinity
(S)		(4)	Two

(a) (P) → (2); (Q) → (1); (R) → (3); (S) → (4)
(b) (P) → (2); (Q) → (1); (R) → (4); (S) → (3)
(c) (P) → (2); (Q) → (3); (R) → (4); (S) → (1)
(d) (P) → (2); (Q) → (4); (R) → (3); (S) → (1)

5. How many lines of symmetry does the given figure have?

(a) No line of symmetry
(b) One line of symmetry
(c) Two lines of symmetry
(d) Four lines of symmetry

6. A teacher shows students four playing cards placed on a table:
Which of the following cards has two lines of symmetry?
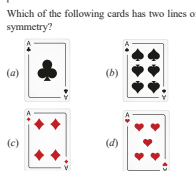
(a)   (b)

(c)   (d)

In this section, you'll get multiple-choice questions (MCQs) to strengthen your preparation. These questions help you practice in a way that is useful for exams.

Achievers Multiple Choice Questions

CONTENTS

Patterns in Mathematics

Mathematics as a study of Pattern

Definition: The search for patterns and their explanations.

Examples:
Patterns in nature (e.g., spirals in shells)
Patterns in technology (e.g., computer algorithms)
Patterns in celestial motion (e.g., planetary orbits)

Visualising numbers Sequences

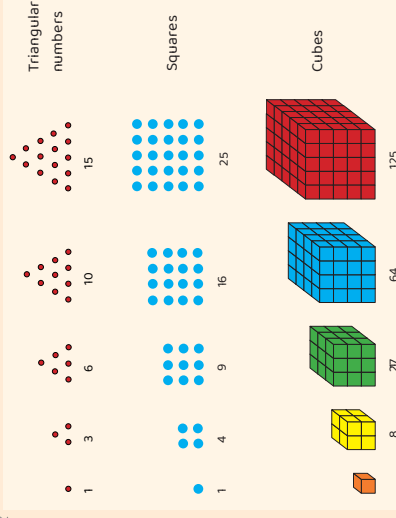**Definition:** Using diagrams to represent numerical patterns.

Examples:
Squares: Grid of dots forming squares (e.g., 1 × 1, 2 × 2, 3 × 3)
Triangular Numbers: Dots forming triangular shapes (e.g., 1, 3, 6, 10)
Cubes: e.g, 1, 8, 27, 64, 125

Triangular numbers

1   3   6   10   15

Squares

1   4   9   16   25

Cubes

1   8   27   64   125

Relations among Numbers Sequences

Sometimes, number sequences can be related to each other

Examples:
(i) Addition of odd numbers to form perfect square numbers
(ii) Addition of triangular numbers to form perfect square numbers
(iii) Partitioning the Dots for sum of odd numbers:
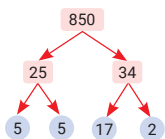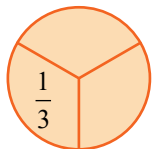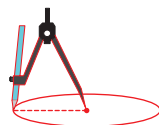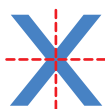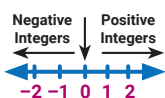
Patterns in Numbers

Definition: Basic numerical sequences observed in mathematics.

Examples:
Counting Numbers: 1, 2, 3, 4, 5...
Odd Numbers: 1, 3, 5, 7, 9...
Even Numbers: 2, 4, 6, 8, 10...
Triangular Numbers: 1, 3, 6, 10, 15...
Virahanka Numbers: 1, 2, 3, 5, 8, 13, 21...
Square Numbers: 1, 4, 9, 16, 25...
Cubic Numbers: 1, 8, 27, 64, 125...
Hexagonal Numbers: 1, 7, 19, 37, 61...

Patterns in Shapes

Regular Polygons
Triangle   Quadrilateral   Pentagon   Hexagon
Heptagon   Octagon   Nonagon   Decagon

Complete Graphs
K2   K3   K4   K5   K6

Stacked Squares

Stacked Triangles

Stacked Snowflake

Patterns in Mathematics

OLYMP-PICKS

1 → 3 → 6 → 10

Introduction

Mathematics is full of patterns that help us understand how numbers and shapes work. Patterns can be found in counting, shapes, and even in nature. In this chapter, you will learn to recognize and create number patterns, shape patterns, and sequences. You will also see how visual patterns like square numbers and triangular numbers help us understand number relationships in a fun and easy way.

What is Mathematics?

Mathematics is the search for patterns. Patterns exist all around us.

Mathematicians think of mathematics both as an art and as a science.

Mathematics seeks to find out what patterns exist and the explanations for why they exist.

Solved Example

1. Can you think of other examples where mathematics helps us in our everyday lives?

Sol. Mathematics is everywhere in our daily lives, even if we don't always notice it. Here are some examples:

Shopping: When you go shopping, you use math to add up the prices of the items in your cart and figure out how much money you need to pay. You also use math to figure out how much change you should get back.

Cooking: When you cook, you use math to measure ingredients. For example, you might need half a cup of sugar or a quarter teaspoon of salt.

Time Management: Math helps you manage your time. If you know that your favourite TV show starts at 5 PM and it takes 30 minutes to get home, you use math to figure out when you need to leave.

Playing Games: Many games, like board games or video games, involve math. You might need to count spaces, add up scores, or figure out probabilities.

Patterns in Numbers

Among the most basic patterns that occur in mathematics are patterns of numbers, particularly patterns of whole numbers: 0, 1, 2, 3, 4, ...

The branch of Mathematics that studies patterns in whole numbers is called number theory.

A sequence of numbers is called a number sequence.

Table 1 shows some key number sequences that are studied in Mathematics.

Table 1: Examples of number sequences	
1,1,1,1,1,1,1,…	(All 1 's)
1,2,3,4,5,6,7,…	(Counting numbers)
1,3,5,7,9,11,13,…	(Odd numbers)
2,4,6,8,10,12,14,…	(Even numbers)
1,3,6,10,15,21,28,…	(Triangular numbers)
1,4,9,16,25,36,49,…	(Squares)
1,8,27,64,125,216,…	(Cubes)
1,2,3,5,8,13,21,…	(Virahanka numbers)
1,2,4,8,16,32,64,…	(Powers of 2)
1,3,9,27,81,243,729,…	(Powers of 3)

Solved Example

2. Can you recognise the pattern in each of the sequences in Table 1?

Sol. Let's identify the pattern in each sequence from Table 1:

⇨ **All 1's Sequence:** 1, 1, 1, 1, 1, ...

⇨ **Counting Numbers Sequence:** 1, 2, 3, 4, 5, 6, 7, ...

⇨ **Odd Numbers Sequence:** 1, 3, 5, 7, 9, 11, 13, ...

⇨ **Even Numbers Sequence:** 2, 4, 6, 8, 10, 12, 14, ...

⇨ **Triangular Numbers Sequence:** 1, 3, 6, 10, 15, 21, 28, ...

⇨ **Squares Sequence:** 1, 4, 9, 16, 25, 36, 49, ...

⇨ **Cubes Sequence:** 1, 8, 27, 64, 125, 216, ...

⇨ **Virahanka Numbers Sequence:** 1, 1, 2, 3, 5, 8, 13, 21, ...

⇨ **Powers of 2 Sequence:** 1, 2, 4, 8, 16, 32, 64, ...

⇨ **Powers of 3 Sequence:** 1, 3, 9, 27, 81, 243, 729, ...
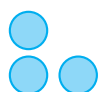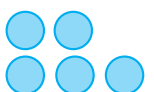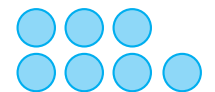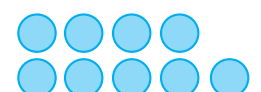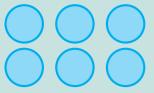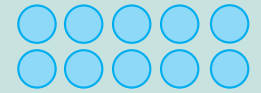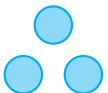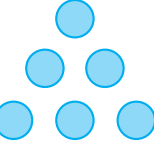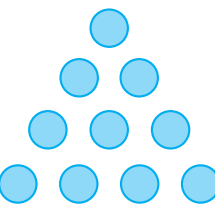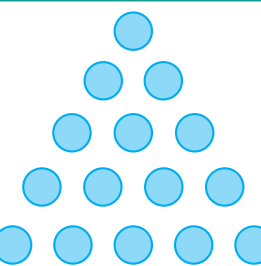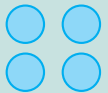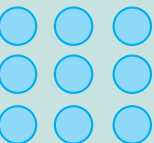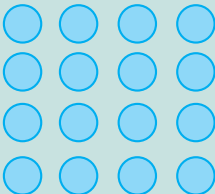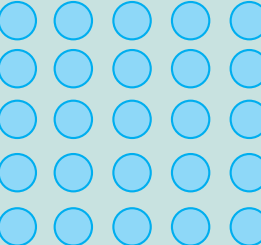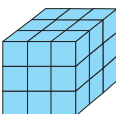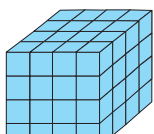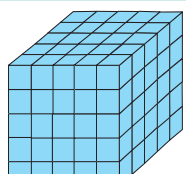
Visualising Number Sequences

Many number sequences can be visualised using pictures. Visualising mathematical objects through pictures or diagrams is a way to understand mathematical patterns and concepts.
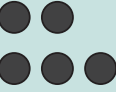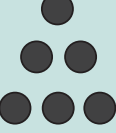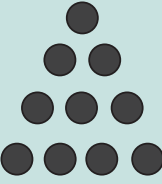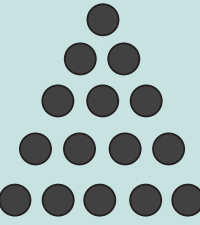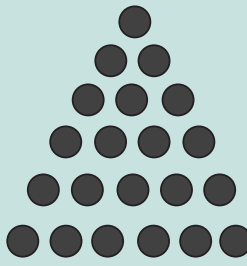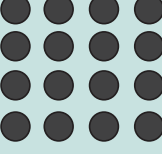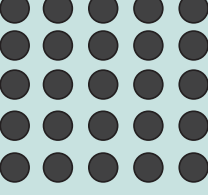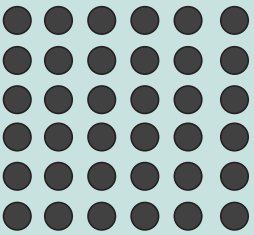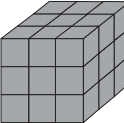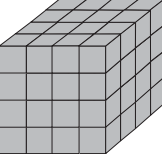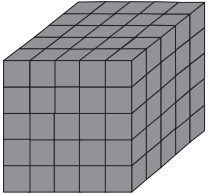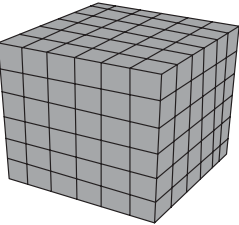
Let us represent the first seven sequences in Table 1 using the following pictures.

Table 2: Pictorial representation of some number sequences					
1	1	1	1	1	All 1's
1	2	3	4	5	Counting numbers
1	3	5	7	9	Odd numbers
2	4	6	8	10	Even numbers
1	3	6	10	15	Triangular numbers
1	4	9	16	25	Squares
1	8	27	64	125	Cubes

3. Copy the pictorial representations of the number sequences in Table 2 in your notebook, and draw the next picture for each sequence!

Sol.

1	1	1	1	1	1	All 1's
1	2	3	4	5	6	Counting numbers
1	3	5	7	9	11	Odd numbers
2	4	6	8	10	12	Even numbers
1	3	6	10	15	21	Triangular numbers
1	4	9	16	25	36	Squares
1	8	27	64	125	216	Cubes

⟨? TEST YOURSELF

3. Why are 1, 3, 6, 10, 15, … called triangular numbers? Why are 1, 4, 9, 16, 25, … called square numbers or squares? Why are 1, 8, 27, 64, 125, … called cubes?

Relations among Number Sequences

Sometimes, number sequences can be related to each other

Example:

(*i*) Addition of odd numbers to form perfect square numbers:

1 = 1 = square of 1

1 + 3 = 4 = square of 2

1 + 3 + 5 = 9 = square of 3

1 + 3 + 5 + 7 = 16 = square of 4

1 + 3 + 5 + 7 + 9 = 25 = square of 5

1 + 3 + 5 + 7 + 9 + 11 = 36 = square of 6

Each odd number can be expressed as $2n - 1$, where n is a positive integer. When we add the first n odd numbers together, the sum equals n^2, as shown below:

$$1 + 3 + 5 + ... + (2n - 1) = n^2$$

This pattern holds true indefinitely because it's a fundamental property of numbers. The sequence of odd numbers and their sums forming perfect squares is a natural characteristic of the number system.

(*ii*) Partitioning the Dots for sum of odd numbers:

We can divide the dots in a square grid into odd numbers like 1, 3, 5, 7, and so on. This is how the dots can be arranged in a pattern.
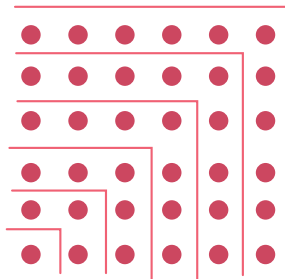
Here, First row: 1 dot, Second row: 3 dots, Third row: 5 dots and so on…

By drawing a similar picture, the sum of the first 10 odd numbers

= 1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17 + 19

$= n^2 = 10^2 = 10 \times 10 = 100$

4. Can you find a similar pictorial explanation for why adding counting numbers up and down, i.e., 1, 1 + 2 + 1, 1 + 2 + 3 + 2 + 1, …, gives square numbers?

Sol. The counting numbers are 1, 2, 3, 4, 5, 6, …

$1 = 1$

$1 + 2 + 1 = 4$

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

$1 + 2 + 3 + 4 + 3 + 2 + 1 = 16$

$1 + 2 + 3 + 4 + 5 + 4 + 3 + 2 + 1 = 25$

$1 + 2 + 3 + 4 + 5 + 6 + 5 + 4 + 3 + 2 + 1 = 36$

The sequence is 1, 4, 9, 16, 25, 36, … which is of form $1^2, 2^2, 3^2, 4^2, 5^2, 6^2, …$

1   4   9   16   25   36   ......
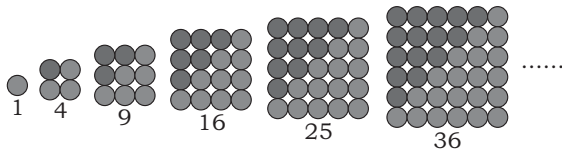
5. By imagining a large version of your picture, or drawing it partially, as needed, can you see what will be the value of $1 + 2 + 3 + ... + 99 + 100 + 99 + ... + 3 + 2 + 1$?

Sol. $1 + 2 + 3 + ... + 99 + 100 + 99 + ... + 3 + 2 + 1$
$= 100 \times 100 = 10000$.

6. Which sequence do you get when you start to add the All 1's sequence up? What sequence do you get when you add the All 1's sequence up and down?

Sol. All 1's sequence is 1, 1, 1, 1, 1, 1, ...

Adding all 1's sequence up

1

$1 + 1 = 2$

$1 + 1 + 1 = 3$

$1 + 1 + 1 + 1 = 4$

$1 + 1 + 1 + 1 + 1 = 5$

The sequence is 1, 2, 3, 4, 5, 6,…. which are natural numbers.

Adding all 1's sequence down

1

$1 + 1 = 2$

$1 + 1 + 1 = 3$

$1 + 1 + 1 + 1 = 4$

$1 + 1 + 1 + 1 + 1 = 5$

$1 + 1 + 1 + 1 + 1 + 1 = 6$

The sequence is 1, 2, 3, 4, 5, 6,….. which are again natural numbers.

TEST YOURSELF

4. Which sequence do you get when you start to add the counting numbers up? Can you give a smaller pictorial explanation?

5. What happens when you add up pairs of consecutive triangular numbers? That is, take 1 + 3, 3 + 6, 6 + 10, 10 + 15, … Which sequence do you get? Why? Can you explain it with a picture?

Patterns in Shapes
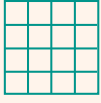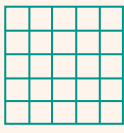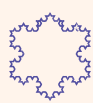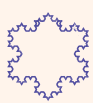
Patterns in shapes are important and basic patterns that occur in Mathematics, These shapes may be in one, two, three or multiple dimensions.

Geometry is the branch of Mathematics that studies patterns in shapes.

Shape sequences are one important type of shape pattern that mathematicians study.

Table 3 shows a few key shape sequences that are studied in Mathematics

Table 3: Examples of shape sequences

				Regular Polygons
Triangle	Quadrilateral	Pentagon	Hexagon	
Heptagon	Octagon	Nonagon	Decagon	

| K2 | K3 | K4 | K5 | K6 | Complete Graphs |

| | | | | | Stacked Squares |

| | | | | | Stacked Triangles |

| | | | | | Stacked Snowflake |

Solved Example

7. Can you recognise the pattern in each of the sequences in Table 3?

Sol. Recognizing the Pattern in Each Sequence:

⇨ **Regular Polygons:** These shapes follow a pattern where the number of sides increases by one, starting from the triangle (3 sides) and moving to shapes with more sides, such as the quadrilateral, pentagon, hexagon, and so on.

⇨ **Complete Graphs (K2, K3, K4, ...):** These are graphs where every pair of vertices is connected. The number of vertices increases with each graph, and the complexity of connections increases as well.

⇨ **Stacked Squares:** The number of squares increases, and they are arranged in a grid-like fashion, increasing the size of the square grid each time.

⇨ **Stacked Triangles:** Each shape builds upon the previous one by adding rows of smaller triangles to form larger stacked triangular shapes.

⇨ **Koch Snowflake:** This sequence shows an iterative process of constructing more complex shapes from a simple triangle by repeatedly adding smaller triangles to each side of the previous shape. The number of sides increases with each iteration, creating a fractal-like pattern.

6. Try and redraw each sequence in Table 3 in your notebook. Can you draw the next shape in each sequence? Why or why not? After each sequence, describe in your own words what is the rule or pattern for forming the shapes in the sequence.

Relation to Number Sequences

Shape sequences are connected to number sequences in interesting ways. Understanding these relationships helps in learning about both shapes and numbers.

Example: The number of sides in the shape sequence of Regular Polygons is given by the counting numbers starting at 3, i.e., 3, 4, 5, 6, 7, 8, 9, 10, ... That is why these shapes are called, regular triangle, quadrilateral (i.e., square), pentagon, hexagon, heptagon, octagon, nonagon, decagon, etc., respectively.

Solved Example

8. Count the number of sides in each shape in the sequence of Regular Polygons. Which number sequence do you get? What about the number of corners in each shape in the sequence of Regular Polygons? Do you get the same number sequence? Can you explain why this happens?

Sol.

Regular Polygons

Triangle   Quadrilateral   Pentagon   Hexagon

Heptagon   Octagon   Nonagon   Decagon

The series representing the number of sides in a regular polygon begins with 3 and continues as follows: 3, 4, 5, 6, 7, 8, 9, 10, and so on. Essentially, it is a sequence of consecutive numbers starting from 3.

Similarly, the sequence representing the number of vertices (or corners) in a regular polygon is identical: 3, 4, 5, 6, 7, 8, 9, 10, etc.

This repetition occurs because, in a regular polygon, the number of sides always matches the number of corners.

7. Count the number of lines in each shape in the sequence of Complete Graphs. Which number sequence do you get? Can you explain why?

1 Ravi is helping his younger sister decorate her study wall using patterns with dots. He wants to show her how powers of 2 grow using a fun wall art.

Using his decoration activity, how can Ravi think of pictorial ways to visualise the sequence of powers of 2 and powers of 3 while making the wall art?

Here is one possible way of thinking about Powers of 2:

1   2   4   8   16
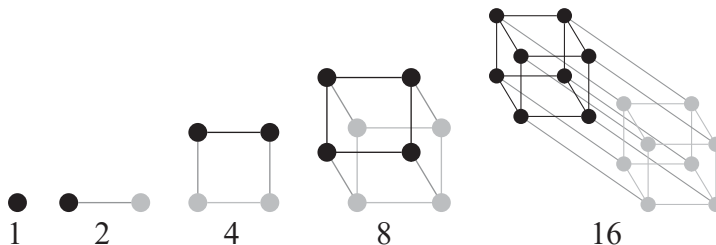
2 Aarav is helping his mother plant saplings in their garden. He first plants 1 sapling, then adds 2 more, then 4 more, then 8 more, each time adding double the previous number of plant saplings i.e, 1, 1 + 2, 1 + 2 + 4, 1 + 2 + 4 + 8, ….. Now, Aarav decides to plant 1 extra sapling each time after adding. What numbers of saplings does he get now after adding 1 each time? Can you explain why this happens in simple words?

3 Aryan is playing with his triangle tiles at home. He decides to make a sequence of Stacked Triangles with them, placing 1 triangle in the first row, then 2 in the second row, 3 in the third row, and so on to make bigger stacked triangles.

How many little triangles are there in each shape of the sequence of Stacked Triangles? Which number sequence does this give? Can you explain why?

4 Aryan and Meera are playing with counters. They decide to arrange the counters in specific patterns to represent numbers.

Aryan arranges his counters as follows:

○ A single counter in the first row,

○ Three counters in the second row,

○ Six counters in the third row, and so on.

Meera arranges her counters differently:

○ A single counter in the center,

○ Six counters forming a hexagon around the center

○ Twelve counters forming a larger hexagon around the previous arrangement, and so on.

One of their friends, Priya, observes the patterns and mentions that they are representing number patterns.

(a) What are the number patterns Aryan and Meera are showing?

(b) If Aryan continues his arrangement, how many counters will he use in the next two rows (4th and 5th rows)?

(c) If Meera continues her arrangement, how many counters will she use in her next (4th) arrangement?

5 Complete the following crossword puzzle:
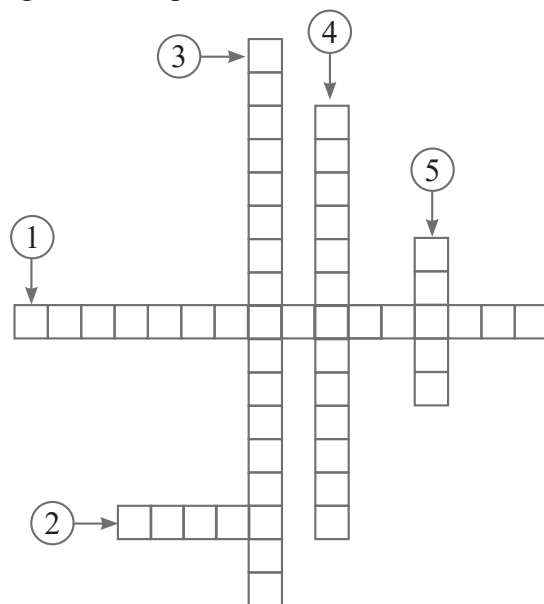
Directions:

Across:

(1) The sequence $1, 1 + 6, 1 + 12, 1 + 18$, represents _____.

(2) The set of counting numbers along with 0 is known as _____ numbers.

Down:

(3) The number sequence $1, 3, 6, 10, 15, ...$ represents _____.

(4) The sequence $1, 1 + 2 + 1, 1 + 2 + 3 + 2 + 1, ...$ represents _____.

(5) The number sequence $1, 8, 27, 64, 125, ...$ represents _____.

6 Students are given 50 cards numbered from 1 to 50 to sort into four groups based on these properties:

1. Triangular Numbers

    Formula: $T_n = \dfrac{n(n+1)}{2}$

    Examples: 1, 3, 6, 10, 15, 21, 28, 36, 45

2. Square Numbers

    Formula: $S_n = n^2$

    Examples: 1, 4, 9, 16, 25, 36, 49

3. Hexagonal Numbers

    Formula: $H_n = 3n(n-1) + 1$

    Examples: 1, 7, 19, 37

4. Cube Numbers

    Formula: $C_n = n^3$

    Examples: 1, 8, 27

Rules:

Each card must be placed in all groups that apply to its number.

All numbers in questions are between 1 and 50.

  (*a*) Aarav picks card 36. Which group(s) should this card be placed in?

  (*b*) Ananya needs to select the largest hexagonal number available. Which card should she choose?

  (*c*) Vihaan must find all numbers between 1 and 50 that are both triangular and square. Which numbers meet this criteria?

7   Ravi tracks his monthly expenses on snacks and toys for 5 months. The table below shows his spending:

Month	Snacks (Rs)	Toys (Rs)
January	200	300
February	250	250
March	300	200
April	350	150
May	400	100

  (*i*) Observe Ravi's expenditure on snacks over the 5 months. Can you identify a pattern in his spending?

  (*ii*) Now, analyze the spending on toys. Do you notice any pattern? How does it differ from the snack spending pattern?

 (*iii*) Based on the patterns, can you predict how much Ravi will spend on snacks and toys in June?

 (*iv*) If Ravi receives ₹600 in July and chooses to follow the snack spending pattern, how much will he spend on snacks and toys?

8   Rohit is trying to get the maximum number of bread pieces with each cut. He observes the following:

Number of cuts	0	1	2	3	
Maximum number of pieces	1	2	4	7	

When he makes 0 cuts, he gets 1 piece; with 1 cut, he gets 2 pieces; with 2 cuts, he gets 4 pieces; and with 3 cuts, he gets 7 pieces, and so on.

  (*i*) Can you identify a relationship between the number of cuts and the maximum number of pieces obtained? (Hint: Look at the number of cuts and the previous maximum number of pieces.)

  (*ii*) Complete the table and then make the final 4 cuts to get the most bread pieces possible.

Achievers Multiple Choice Questions

1. Rani is designing a new pattern for a garden using stones. She arranges the stones in hexagonal shapes. In her design, the first row has 1 stone, the second has 7 stones, the third has 19 stones, and the fourth has 37 stones. What would you call this sequence of numbers, and what is the next number in the pattern?
   - (a) Triangular numbers; 49
   - (b) Hexagonal numbers; 61
   - (c) Square numbers; 51
   - (d) Cube numbers: 60

2. To get from one shape to the next shape in the Koch Snowflake sequence, one replaces each line segment '–' by a 'speed bump' ‿/\‿ . As one does this more and more times, the changes become tinier and tinier with very very small line segments. What is the corresponding number sequence?
   - (a) 3, 12, 48, …
   - (b) 3, 9, 27, …
   - (c) 4, 16, 64, …
   - (d) 2, 8, 32, …

3. Which of the following options is correct?
   Statement P: The number 729 is the smallest 3 digit number that is both a square number and a cube number.
   Statement Q: A number that is both a square and a cube must also be a sixth power of an integer.
   - (a) Both Statement P and Statement Q are true.
   - (b) Both Statement P and Statement Q are false.
   - (c) Statement P is true but Statement Q is false.
   - (d) Statement P is false but Statement Q is true.

4. Read the statements carefully and state 'T' for true and 'F' for false
   - (i) The number 144 belongs to both the square numbers group and the triangular numbers group.
   - (ii) The difference between the 6th and 4th triangular numbers is equal to the 5th triangular number.
   - (iii) The sum of the first 6 hexagonal numbers is 161 .
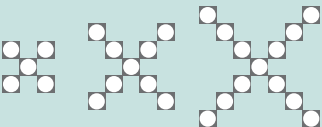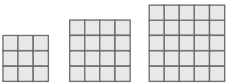
	(i)	(ii)	(iii)
(a)	F	F	T
(b)	T	T	F
(c)	T	T	T
(d)	F	F	F

5. Match the following and select the correct options.

Shape Sequence		Sequence	
(p)		(i)	1, 4, 9, 16...
(q)		(ii)	1, 3, 6, 10...
(r)		(iii)	1, 5, 9, 13...
(s)		(iv)	1, 3, 5, 7, 9...

   - (a) p-iii, q-iv, r-ii, s-i
   - (b) p-iv, q-iii, r-ii, s-i
   - (c) p-ii, q-iv, r-iii, s-i
   - (d) p-i, q-iv, r-ii, s-iii

6. Match the following:

Shape of Sequence		Sequence	
(p)		(i)	5,9,13...
(q)		(ii)	3,4,5, ...
(r)		(iii)	2,4,6, ...
(s)		(iv)	9,16,25,...

(a) p-iii, q-i, r-iv, s-ii

(b) p-ii, q-iii, r-iv, s-i

(c) p-ii, q-iv, r-iii, s-i

(d) p-iii, q-iv, r-ii, s-i

7. Fill in the blanks and select the correct option.

	p	q	r
(a)			
(b)			
(c)			
(d)			
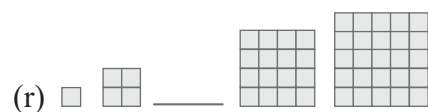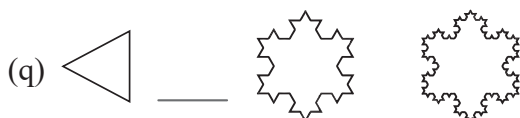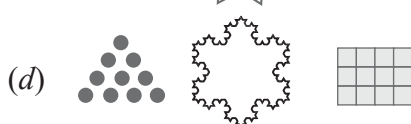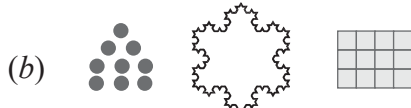
8. Nina is organizing a game of connections where 7 friends are each connected to each other by lines. Each friend is connected to every other friend with a line. Nina wants to know how many lines are needed to connect all her friends.

How many lines will be required for Nina's game?
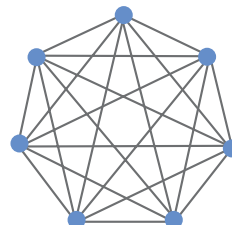
(a) 14   (b) 21

(c) 28   (d) 35

9. Rahul is helping his younger sister, Simran, build a colorful block pyramid in their backyard. They are stacking the blocks layer by layer. The first layer has 1 block, the second layer has 3 blocks, and the third layer has 5 blocks. Rahul wonders how many blocks Simran will need for the 9th layer. Can you help Rahul find out?

How many blocks are required in the 9th layer of the pyramid?
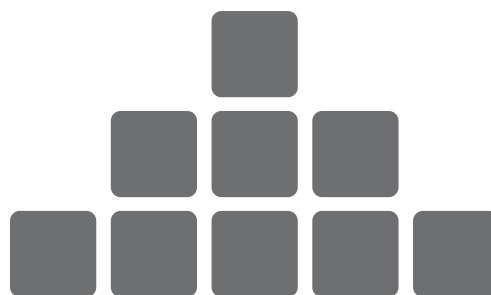
(a) 17   (b) 19

(c) 21   (d) 18

10. Ravi has a candle that starts at a height of 30 cm. He notices that the candle burns down by 2 cm every hour. After 5 hours, Ravi checks how much the candle has shrunk. What will

(*iii*) The shape of the Koch snowflake always starts with a circle.

(*iv*) The number 21 is both a triangular number and a Virahanka number.

	(*i*)	(*ii*)	(*iii*)	(*iv*)
(*a*)	T	F	T	F
(*b*)	F	T	F	T
(*c*)	F	T	F	F
(*d*)	F	T	T	F

15. Read the following statements carefully and select the correct option.

Ravi, a student, was studying patterns in number sequences for his upcoming exam. He encountered two different statements related to number sequences and needed to evaluate their correctness. Below are the statements he read:

Statement-I: Ravi noticed that when he subtracted 1 from each number in an even-numbered sequence, he got an odd-numbered sequence.

Statement-II: While exploring number patterns, Ravi found that if he took the difference between consecutive numbers in a hexagonal number sequence, the resulting numbers were multiples of 6.

(*a*) Statement-I is true but Statement-II is false.

(*b*) Statement-I is false but Statement-II is true.

(*c*) Both Statement-I and Statement-II are true.

(*d*) Both Statement-I and Statement-II are false.

Test yourself

1. Mathematics has played a huge role in advancing human civilization. Here are some ways math has helped:

Building Structures: Engineers and architects use math to design and build bridges, houses, and skyscrapers. Without math, we wouldn't be able to create safe and sturdy buildings.

Technology: Math is behind the technology we use every day, like mobile phones, computers, and TVs. Math is used to create software, design hardware, and even send signals to and from devices.

Transportation: Math is used to design and operate all kinds of transportation, like cars, trains, aeroplanes, and ships. Math helps to make these vehicles safe, efficient, and fast.
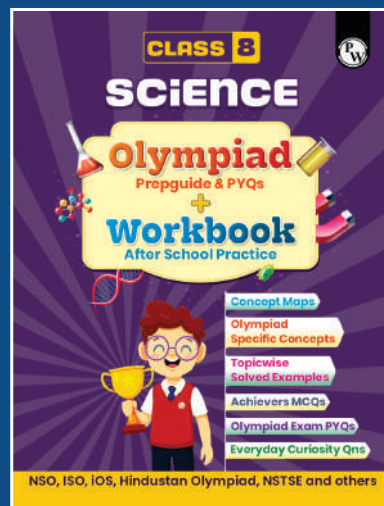
Medicine: Doctors and scientists use math to understand how diseases spread, develop treatments, and even perform surgeries. Math helps save lives.

Math is not just about numbers and equations; it's about finding patterns and solving problems, which helps make our lives better and the world a better place.

2. Now let's extend each sequence by three numbers and explain the rule:

- **All 1's Sequence:** 1, 1, 1, 1, 1, ...
  - ➢ **Next Three Numbers:** 1, 1, 1
  - ➢ **Rule:** Every number in this sequence is always 1.
- **Counting Numbers Sequence:** 1, 2, 3, 4, 5, 6, 7, ...
  - ➢ **Next Three Numbers:** 8, 9, 10
  - ➢ **Rule:** Start at 1 and add 1 each time to get the next number.
- **Odd Numbers Sequence:** 1, 3, 5, 7, 9, 11, 13, ...
  - ➢ **Next Three Numbers:** 15, 17, 19
  - ➢ **Rule:** Start at 1 and add 2 each time to get the next number.
- **Even Numbers Sequence:** 2, 4, 6, 8, 10, 12, 14, ...
  - ➢ **Next Three Numbers:** 16, 18, 20
  - ➢ **Rule:** Start at 2 and add 2 each time to get the next number.
- **Triangular Numbers Sequence:** 1, 3, 6, 10, 15, 21, 28, ...
  - ➢ **Next Three Numbers:** 36, 45, 55
  - ➢ **Rule:** Start at 1, then add increasing numbers (2, 3, 4, 5, etc.) each time.
- **Squares Sequence:** 1, 4, 9, 16, 25, 36, 49, ...
  - ➢ **Next Three Numbers:** 64, 81, 100
  - ➢ **Rule:** Each number is the square of a counting number (1, 2, 3, 4, etc.).

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