Computational Thinking and Artificial Intelligence

Class 6

Student Handbook

CENTRAL BOARD OF SECONDARY EDUCATION

First Edition: March, 2026
Country of Publication: India
Published by: Central Board of Secondary Education, Integrated Office, Sector 23, Dwarka, New Delhi-110077

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The efforts of Prof. Manish Jain and his whole team from Centre for Creative Learning, IIT Gandhinagar are also acknowledged and deeply appreciated.

PREFACE

The National Education Policy (NEP) aims to position India as a leader in emerging knowledge fields by integrating technologies like AI, Machine Learning, Big Data, and Computational Thinking into school education. It promotes technology-enabled, interactive, and gamified learning using tools such as Augmented Reality (AR), Virtual Reality (VR), and virtual labs to foster creativity, problem-solving, and interdisciplinary exploration. NCFSE 23 carries this recommendation further for implementation.

While Artificial Intelligence (AI) is an important requirement, Computational Thinking (CT) should be a broader skill, developing a foundation for learning AI. It can cover various aspects like Cybersecurity, basic networking, etc. Hence, CBSE approaches this by integrating Computational Thinking with AI and other technological advancements, without dependence on any platform.

The book engages learners with problems involving constraints, dependencies, logical conditions, grids, data interpretation, and optimisation across numerical, spatial, and real-life contexts. It introduces foundational Artificial Intelligence concepts such as classification, pattern identification, data driven decision making, and ethical awareness, enabling students to understand how logical rules and data influence intelligent systems. The document further provides pedagogical guidance, learning resources, assessment support, and classroom implementation guidelines to facilitate competency-based learning in alignment with NEP 2020.

TEAM CBSE

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Introduction

Computational Thinking (CT) is a problem-solving approach that comprises Decomposition, Pattern Recognition, Abstraction, Algorithm Design, Data Analysis and Troubleshooting. Computational Thinking Skills involve solving complex problems that promote thinking skills such as critical & creative thinking, abstraction and pattern recognition, as well as algorithmic thinking. Problem identification and problem solving necessitate the application of multidisciplinary understanding for creating effective solutions.

Artificial intelligence (AI) is a cutting-edge technology that empowers machines and computers to perform tasks that usually require mimicking human intelligence. These machines can perform complex thinking processes such as data analysis, pattern recognition, prediction of trends, solving problems and decision making. Thus, AI involves simulating cognitive processes associated with human intelligence and is widely applicable in various sectors such as banking, healthcare, defence, education, entertainment, agriculture and others for processing information, solving intricate problems and for planning.

The National Education Policy (NEP) aims for India to emerge as a global leader in new emerging knowledge domains such as artificial intelligence, machine learning, data analytics, 3-D machining etc. To realise this goal, the policy suggests teaching students Mathematics and Computational Thinking, along with new subjects like Artificial Intelligence, Machine Learning, and Data Science during their school education. The policy also focuses on technology-enabled learning and classrooms by using tools like artificial intelligence, machine learning, and adaptive testing to create knowledge.

The National Curriculum for School Education draws from this policy aspiration and emphasizes the need to introduce these emerging domains of study and technologies in the school curriculum. It recommends inclusion of subjects such as design thinking, augmented reality, virtual reality, artificial intelligence, and computational thinking. Additionally, it promotes the use of gamified content, interactive content, and immersive experiences (such as AR, VR, or virtual labs) to enhance student learning. In a variety of subjects, including design, music, art, and sciences, these resources support students in knowledge creation and exploration, and development of capacities such as problem-solving, critical and creative thinking.

CBSE, under the aegis of the Department of School Education and Literacy, Ministry of Education, Govt. of India, is implementing a Curriculum on Computational Thinking and Artificial Intelligence (CT & AI) to inculcate AI-readiness in school students. This curriculum will be implemented from classes 3rd to 8th, in the session 2026-27, and aims to develop AI-Ready learners, by focusing on Computational Thinking Skills. The AI-readiness, so inculcated through CT Skills, will help develop the capacities of learners to use computational thinking, such as logical thinking, problem solving, pattern recognition, and so on, and understand the role and use of Artificial Intelligence in daily life. The Curriculum aims to build strong foundations in computational thinking, digital literacy, and responsible use of technology, along with nurturing innovation, critical thinking, and ethical decision-making capacities.

1. Relevance: Importance of introducing CT and AI

Introducing these concepts at the Grade 6 level is vital for several reasons:

- **Future Readiness:** It prepares students for the modern world of work where using data effectively and applying AI ethically are essential capabilities.
- **Holistic Development:** It fosters core cognitive capacities such as reasoning, logical thinking, and ethical decision-making, contributing to individual flourishing and responsible digital citizenship
- **Interdisciplinary Connection:** Integrating CT and AI across subjects like Mathematics and Science helps students see knowledge as interconnected rather than compartmentalized
- **Innovation:** It encourages an entrepreneurial mindset by teaching students to devise innovative solutions to real-world challenges

2. Objectives (Curricular Goals & Competencies)

- **CG-1:** Develops skills and capacities of computational thinking, namely, decomposition, pattern recognition, data representation, generalisation, abstraction, and algorithms to solve problems where such techniques of computational thinking are effective.
- **CG-2:** Develops spatial and visual reasoning.
- **CG-3:** Gain foundational knowledge of AI, its types, and domains.
- **CG-4:** Understand key ethical terms such as bias and fairness in relation to AI.
- **CG-5:** Demonstrates proficiency in using computers and other devices, computer applications for learning and practical purposes, such as data analysis, preparation of visual representations, and communication of ideas

3. Learning Outcomes

Computational Thinking (CT) Learning Outcomes

ABSTRACT THINKING

Students will be able to interpret and solve multi-step problems with layered and abstract clues, using:

- Advanced viewpoints and cross-sections of 3D objects
- Combined transformation of shapes (multiple flips, rotations, reflections, cuts/folds)
- Changes in orientation, position, order, and direction (clockwise, anticlockwise, diagonal)
- Identifying hidden, overlapping, or implied parts in complex visual patterns
- Symmetry across multiple axes and composite mirror/water image reasoning
- Visual reasoning involving scale, proportion, and spatial relationships

PATTERN RECOGNITION

Students will be able to identify, extend, and justify complex patterns involving multiple simultaneous changes, formed using:

- Numbers with mixed operations and logical rules
- Shapes/images with changing attributes (size, position, count, orientation)
- Letters and symbols with positional or alphabetical logic
- Patterns involving alternation, skipping, grouping, or cyclic behaviour
- Mixed patterns combining numbers, shapes, and letters with dependency rules

DECOMPOSITION

Students will be able to break down higher-order problems involving interdependent clues and constraints, using information from:

- Numerical clues involving place value, operations, factors, multiples, and comparisons
- Properties of 2D and 3D shapes (faces, edges, vertices, diagonals, angles
- Multi-step transfers or exchanges (money, quantities, digits, objects) with conditions
- Tables, grids, or charts requiring cross-referencing of multiple data points
- Conditional rules for counting, grouping, sorting, or eliminating possibilities
- Visual representations that encode numerical or logical values

ALGORITHMIC THINKING

Students will be able to follow, analyse, and apply multi-layered rules and procedures to solve complex problems involving:

- Number sequences formed using combined operations and logical conditions
- Movement on grids involving direction, distance, turns, and path constraints
- Stepwise changes where values increase/decrease based on rules
- Multi-step instructions involving swaps, shifts, transfers, and rearrangements
- Ordering people, objects, or events using multiple attributes or clues
- Logical flow of steps, identifying necessary vs redundant information

Artificial Intelligence (AI) Learning Outcomes

Learners will be able to:

- Summarise the basic ideas and concepts of AI and its application
- Describe key differences between machine intelligence and human intelligence
- Explain the difference between automation and AI using practical, real-world cases.
- Differentiate the three fundamental AI methodologies, namely supervised, unsupervised, and reinforcement learning
- Develop the skill of organizing and representing data and its various forms, including text, numbers, images, and sounds

- Recognize simple patterns in data and make decisions based on observations
- Demonstrate an understanding of ethics and digital responsibility in the use of AI, including digital footprints, privacy, and responsible technology behaviour.
- Practice essential internet safety protocols, such as creating secure passwords, maintaining safe online behaviour, and applying basic privacy measures while using digital and AI tools.
- Apply conceptual knowledge of AI to everyday activities by recognising human-centred design and ethical principles in how AI works and interacts with people

4. Mapped with NEP and NCF 2023

The Grade 6 curriculum is directly derived from the Aims of School Education outlined in the National Curriculum Framework for School Education (NCF-SE) 2023. It fulfills the NEP 2020 mandate to integrate Machine Learning and Computational Thinking into the school journey to foster creativity and interdisciplinary exploration.

5. Time Allocation

The Middle Stage (Classes 6–8) requires 100 hours annually. For Grade 6, this time is specifically divided as follows:

- **Advanced CT Skills:** 40 hours
- **Introductory AI Concepts:** 20 hours
- **Interdisciplinary Projects:** 40 hours (20 hours each for two projects)

6. Approach / Pedagogy

The pedagogical approach for Grade 6 is activity-based and inquiry-driven:

- **Experiential Learning:** Students engage with complex puzzles, riddles, and hands-on real-world problems
- **Collaborative Work:** The curriculum emphasizes group discussions, debates, and collaborative projects to solve multidisciplinary challenges
- **Project-Based Learning:** Students use AI tools and data analysis to create solutions for community or fictional city issues

7. Assessment

Assessment shifts from rote memorization to continuous, formative, and competency-based evaluation. Methods include:

- **Performance-Based Tools:** Project presentations, assignments, and reflective journals
- **Practical Evaluation:** Written tests with CT puzzles, practical examinations, and interactive activities
- **Qualitative Feedback:** Teachers use clear rubrics and Observation Journals to ensure consistency in tracking student development

How to Use This Book?

PART-1 Computational Thinking

Part 1 of this book is designed as a companion to the Mathematics textbook and is intended to be used alongside regular classroom teaching. Since it follows the same chapter sequence, the Mathematics teacher can seamlessly integrate it into daily instruction. As concepts are introduced in class, the corresponding questions from this book can be used to deepen understanding and encourage application.

Before beginning a chapter, the teacher is encouraged to read and identify the underlying concepts required for each question and plan how to align them with classroom teaching. As these concepts are taught, the teacher can introduce the related 'thinking questions' to students. It is important to note that the questions in this book are thinking-based and designed to promote analysis, reasoning, and problem-solving.

Teachers should adopt a facilitative approach, guiding students through prompts and discussions rather than directly providing solutions. Students should be given time to think and attempt independently, followed by classroom discussions where different approaches are shared and explored.

Some chapters also include activities that build intuition and engagement. These should be conducted before attempting the questions, as they help students approach the problems with better understanding.

PART-2 Artificial Intelligence

Part 2 of the handbook provides a structured introduction to Artificial Intelligence (AI) as a technology that enables machines to learn from data, recognise patterns, and make decisions. The concepts of AI are presented using simple explanations and real-life examples from areas such as healthcare, education, transport, and communication.

Each chapter includes:

- Foundational understanding of AI concepts
- Real-life examples and applications of AI
- Introduction to key AI domains such as Data Science, Computer Vision, and Natural Language Processing
- Activities and data-based tasks
- Reflection on ethical use of AI

The AI content progresses from introduction to application, including introductory predictive techniques such as regression, classification, and clustering. The book emphasises ethical and responsible use of AI, including introduction to bias, fairness, privacy, and safe use of technology, enabling informed and thoughtful engagement with AI systems.

Teachers should approach the book with the mindset that the process of thinking is more important than arriving at the correct answer. Creating a safe and encouraging environment where students feel comfortable making mistakes, exploring multiple strategies, and expressing their reasoning is essential. The goal is to nurture confident, independent thinkers rather than focus solely on correctness.

PART 1
COMPUTATIONAL THINKING

Chapter 1: Patterns in Mathematics

1. **The following series follows a fixed pattern:**
   2, 3, 3, 4, 4, 4, 5, 5, 5, 5, 6, …
   If the pattern continues, determine how many times the number 9 appears in the NEXT 20 terms.

   a) 3 b) 4 c) 7 d) 8

---

2. **The following number series is based on a pattern. One term is incorrect. Identify the incorrect term.**
   2, 3, 6, 11, 18, 25, 38, 51, 66, 83

   a) 11 b) 25 c) 51 d) 66

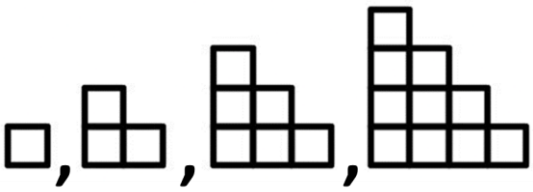
---

3. **What will come in place of "?" in the given series?**
   1@3, #5#, 7@9, #11#, 13@15, ?, 19@21

   a) @17@ b) #15# c) 16#18 d) #17#

---

4. **The first four terms of a block series are shown below.**
   If the pattern continues in the same manner, which term of the series will be the first to contain more than 20 blocks?



   a) 5th term b) 6th term c) 7th term d) 8th term

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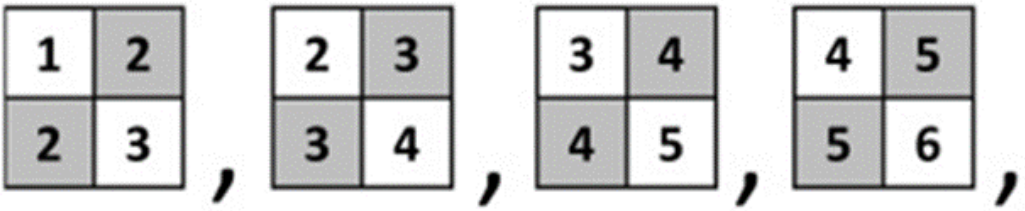
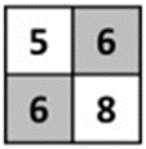
5. **What will come in place of "?" in the given series?**



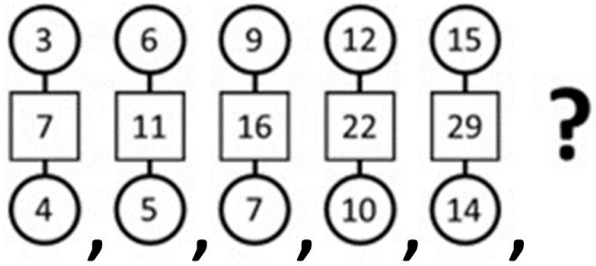
   a) 

   b) 

   c) 

   d) 

6. What will come in place of "?" in the given series?



a) 

b) 

c) 

d) 

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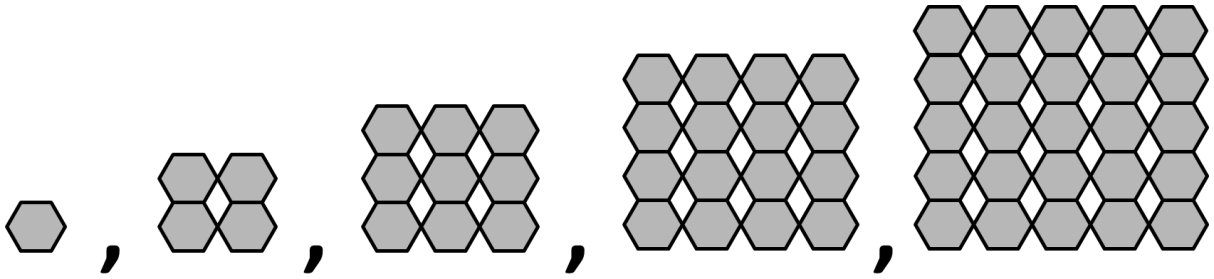
7. The first five terms of a series formed using grey hexagons and white diamonds are given below. If the same pattern continues, how many diamonds will be present in the term where the number of hexagons is 144?



a) 100 b) 135 c) 121 d) 169

---

8. Given below are two sets of numbers, P and Q. Which number from Set P can be interchanged with a number from Set Q such that both new sets follow a particular series or pattern?

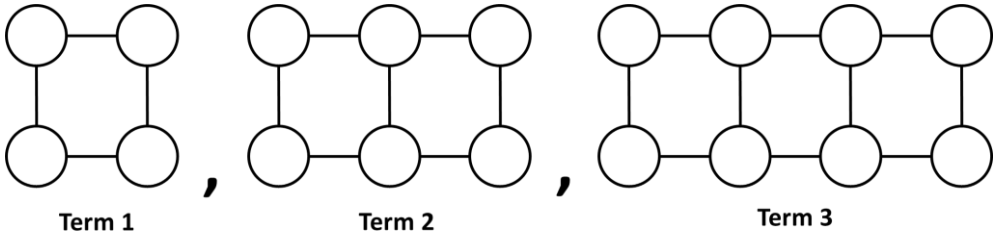
Set P: (18, 22, 24, 27, 30)

Set Q: (21, 24, 27, 31, 36)

a) 18 b) 27 c) 22 d) 30

---

9. The first three terms of a series of circles are shown below. If the pattern continues in the same manner, how many circles will be there in term 91?



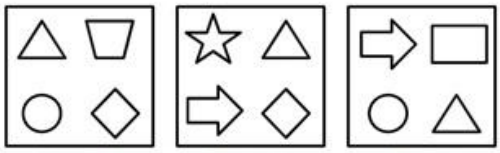
a) 184 b) 180 c) 194 d) 204

10. A pyramid has to be formed by combining cubes. Every level will have two fewer cubes than the level below it. If a pyramid is formed using at most 30 cubes, what is the maximum number of levels it can have?

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

The Thinking Spot

You must shoot exactly one item from each box, to eliminate it from its box. When an item is shot, the same item in the adjacent box is also eliminated. What is the MAXIMUM number of items that can be eliminated, after all 3 shots?

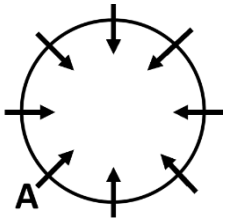


(a) 4 (b) 5 (c) 6 (d) 7

Chapter 2: Lines and Angles

1. **Eight friends (A, B, C, D, E, F, G, H) are sitting at equidistant positions around a circular table, each facing towards the centre, as shown below.**
   - **A is facing North-East**
   - **B and D are facing perpendicular directions**
   - **B is to the immediate left of A; while C is exactly between E and F**
   - **B and F are facing opposite directions**

   If G is sitting exactly between B and D, what is the angle between the directions that A and C are facing?



a) 45 degrees b) 90 degrees c) 135 degrees d) 180 degrees

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2. **Avi and Sam attend dance sessions in the afternoon.**
   - **Avi's session starts when the angle between the hour hand and the minute hand of the clock is 60 degrees**
   - **Sam's session starts at 1:55 PM**

   What is the least possible difference between the starting times of both sessions?

a) 2 minutes b) 5 minutes c) 10 minutes d) 15 minutes

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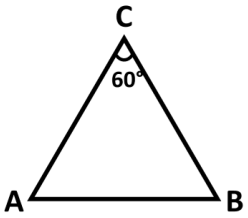
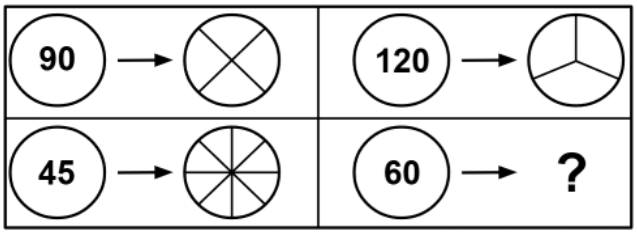
3. **An equilateral triangle (all the angles are equal) is given below. At minimum, by how many degrees should the given triangle be rotated anticlockwise so that it looks exactly like the original triangle?**

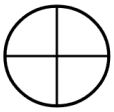
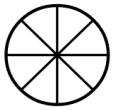


a) 30 degrees b) 60 degrees c) 120 degrees d) 90 degrees

---

4. **What will come in place of "?"**



a)  b)  c)  d) 

5. A and B visit a park in the evening.

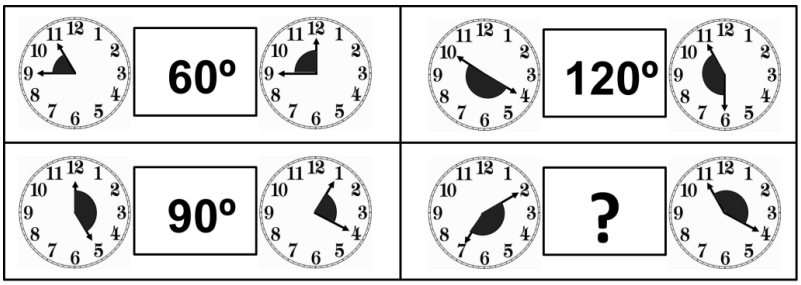
- **When A visited the park, the minute hand pointed at 12, and the other hand was 150° clockwise from it**
- **When B visited the park, the hour hand pointed at 5, and the other hand was 210° clockwise from it**

Based on the given information, which of the following statements is true?

a) A visited the park before B
b) B visited the park before A
c) A and B visited exactly at the same time
d) None of the above

---

6. What will come in place of "?"



a) 40°
b) 60°
c) 90°
d) 30°

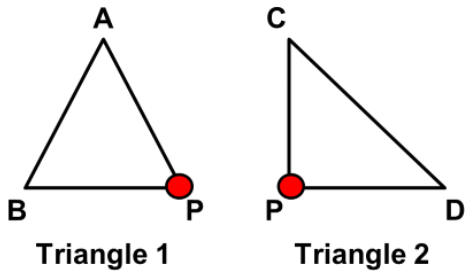
---

7. How many times in a day, on a 12 - hour format clock, do the minute and hour hands form a straight line (i.e., an angle of 180°)?

a) 11
b) 12
c) 22
d) 24

---

8. In the given figure, Triangle 2 is a right-angled triangle. Both triangles are arranged such that the red circles completely overlap, meaning both triangles meet at point P. The triangles cannot be rotated or flipped. If an angle of 30° is formed between Triangle 1 and Triangle 2 at point P, find the value of ∠APD?



a) 110°
b) 120°
c) 130°
d) 150°

---

9. Sam draws three line segments AB, BC, and BD (with a common point B) on a sheet of paper ∠ABC = 108° and ∠CBD = 162°, and these angles lie on either side of the line segment BC. Later, he draws a pair of parallel line segments EF and GH, both perpendicularly intersecting BD. How many pairs of parallel line segments appear on the sheet, finally?

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

10. A line segment AB is shown below. Five points: C, D, E, F, and G lie on the line segment AB such that

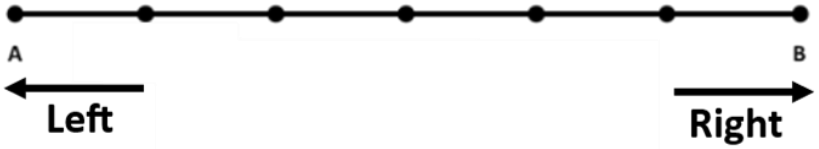
- All the points (including A and B) are at equal intervals

- The length of segment CB is equal to the length of segment GD

- Point E is immediately to the right of point C

- Point F cannot be next to E or D

Which segment among the following options is the longest?



a) GC b) FE c) GE d) FD

The Thinking Spot

There are four ropes: A, B, C, and D. Each rope has a different length and a different colour chosen from Blue, Red, Green, and Yellow. Rope B is longer than only the Green rope. The Blue rope is longer than B but shorter than C. Rope A is not Blue. If the Yellow rope is the longest, which rope is Red?

(a) A (b) B (c) C (d) D

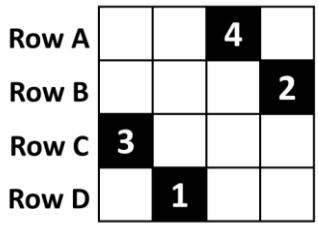
Chapter 3: Number Play

1. **Sachin plays a game using a standard die numbered 1 to 6. At each roll he scores points equal to the number shown. He may roll the die any number of times.**
   The game ends when the number 6 appears three times (the three 6's need not be consecutive).
   If the total score at the end of the game is 29, what is the minimum number of rolls Sachin could have made?

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

---

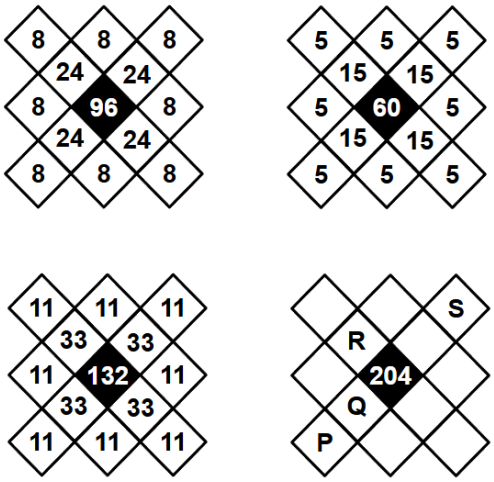
2. **In the given grid, each white square contains 1, 2, 3, or 4 hidden coins.**
   Each black square shows the maximum number of coins present in any of its adjacent white squares.
   If every row has the same total number of coins, what is the MAXIMUM possible number of white squares that contain exactly one coin?
   Note: *Two squares are adjacent only if they share a common side. Squares that share a common corner alone, are NOT considered as adjacent*



   a) 5 b) 6 c) 7 d) 8

---

3. **If each of the given terms follows the same theme, what will be the value of P + Q + R + S?**



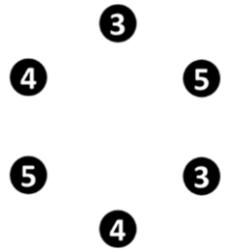
   a) 134 b) 136 c) 119 d) 142

4. **An arrow between any two squares, always points towards the square having a larger number. A and B are two DIFFERENT numbers. If the largest 5-digit number is formed using all five squares, what will be the difference between the final number and 10000?**

a) 44332 b) 54545 c) 54432 d) 44432

---

5. **How many different triangles can be formed by connecting the black dots in the image below, where the sum of the numbers at their corners is 12?**



a) 7 b) 6 c) 8 d) 5

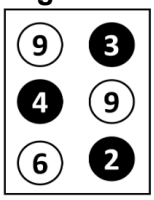
---

6. **Amat and Ankit each picked three numbers from the set {1, 2, 3, 4, 5, 6}.**
   - 3 different numbers picked by Amat add up to give the highest possible sum
   - 3 different numbers picked by Ankit add up to the second highest possible sum
   Which pair of numbers were picked by both Amat and Ankit?

   a) 3 and 4 b) 4 and 5 c) 5 and 6 d) 2 and 5

---

7. **A box contains six numbered circles coloured black and white.**
   A 6-digit number must be formed using all six circles, and the colours must alternate throughout the number. The first circle may be either black or white.
   Among all such numbers that can be formed, take the second smallest number and the second largest number. What is the difference between these two numbers?



Box

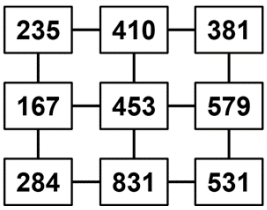
a) 683233 b) 684324 c) 685314 d) 583297

---

8. **I am a 5-digit number made up of both even and odd digits. I read the same backwards and forwards (palindrome). The greatest difference between at least two of my digits is 9. What is the smallest possible sum of my digits?**

   a) 9 b) 10 c) 11 d) 13

9. Count the number of blocks that are connected to at least one block containing a smaller number and one block containing a larger number than the number in it.



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

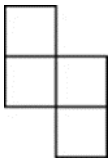
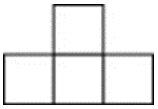
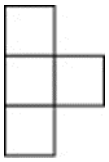
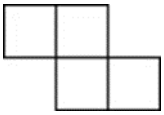
---

10. A 3 × 3 grid of digits is given below. Avi, Sam, Riya, and Maya each select a different digit from the grid such that:

- **The sum of the digits chosen by Avi and Sam is equal to the digit chosen by Maya**
- **The digit chosen by Riya is the largest among the four chosen digits**

Which of the following options shows a possible set of cells chosen by all four friends?
Note: *You cannot rotate the question or option images*

2	5	8
7	4	6
0	9	3

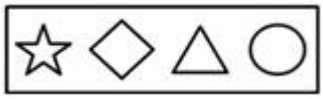
a)  b)  c)  d) 

The Thinking Spot

Four friends A, B, C, and D each selected a different shape from the shapes shown below, such that:

- **A selected a shape that is neither beside B's shape nor D's shape**
- **C and D did not select the triangle**

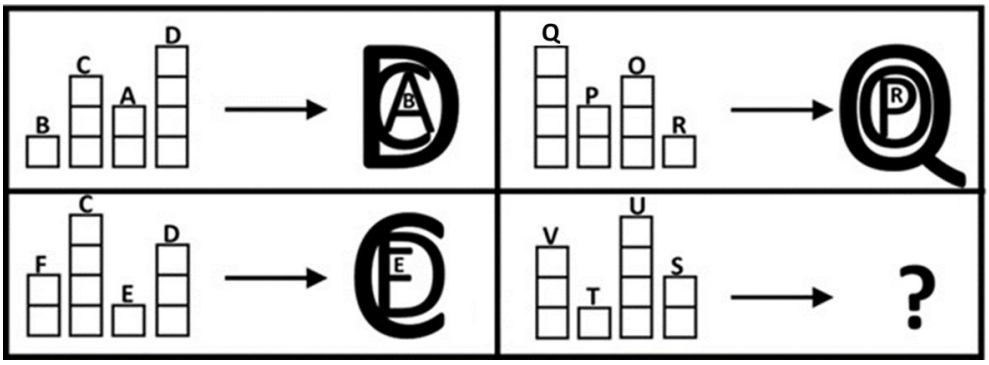
Who among them chose the circle?



(a) A (b) B (c) C (d) D

Chapter 4: Data Handling and Presentation

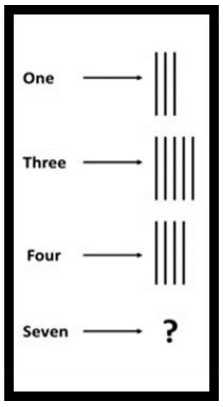
1. **What will come in place of "?"**

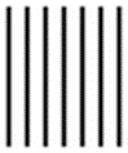
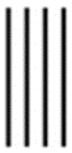


a) 
b) 
c) 
d) 

---

2. **What will come in place of "?"**



a) 
b) 
c) 
d) 

---

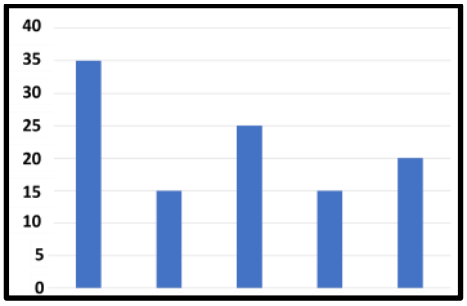
3. **Sales of 4 milk stores are given below, in the form of a pictograph. If each symbol in the pictograph represents 'x' litres, where x is a whole number and the sales made by any store is less than 100 litres, what is the MAXIMUM possible quantity of milk sold (in litres) by all the stores in total?**

Store	Quantity of Milk sold = x litres
A	
B	
C	
D	

a) 255 L b) 272 L c) 306 L d) 283 L

4. **The weights (in kg) of five friends, A, B, C, D, and E, are represented in the graph below (not necessarily in the same order).**
   - **E is lighter than C**
   - **Both B and D are lighter than E, and the difference between the weights of B and E is the same as the difference between the weights of D and E**
   - **The difference between the weights of A and any other friend is 10 kg or less**

   What is the difference between the weights of B and C?

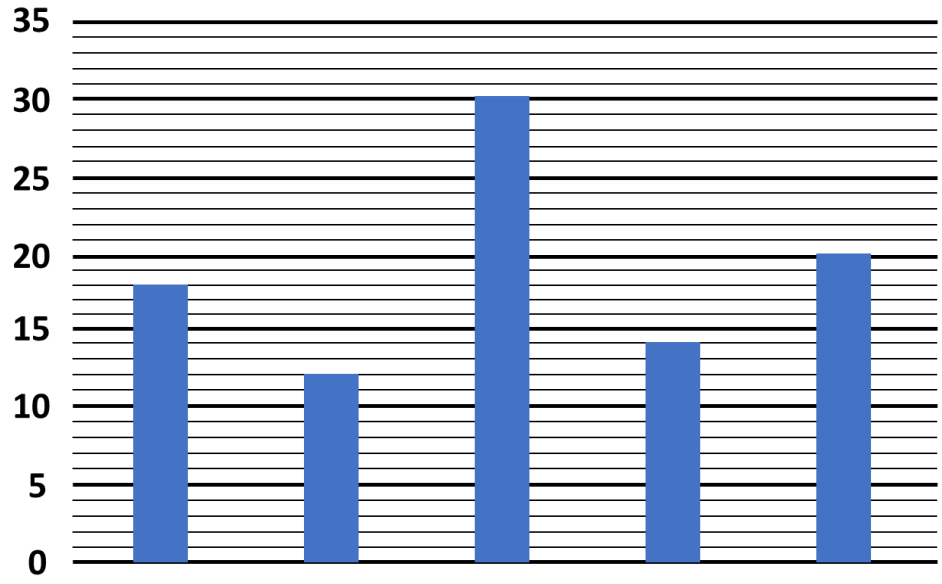


a) 10 kg b) 5 kg c) 20 kg d) 15 kg

---

5. **The bar graph shows the number of marbles collected by Monica, Rachel, Ross, Chandler, and Joey.**
   - **Rachel has collected more marbles than Joey and less than that of Chandler**
   - **Monica has collected as much as Rachel and Ross collected together**

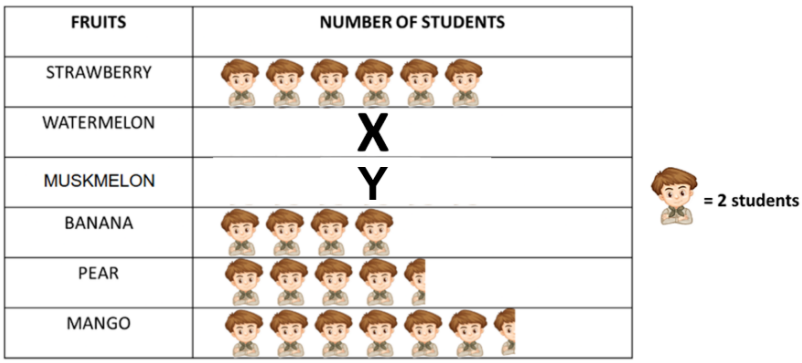
   How many marbles did Chandler collect?



a) 18 b) 14 c) 20 d) Cannot be determined

6. **The pictograph represents students' fruit preferences. Let X denote the number of students who like Watermelon and Y denote those who like Muskmelon.**
   - **X is half the total number of students who like Strawberry and Banana**
   - **Y equals the total number of students who like Pear and Mango**

   Which fruit has a number of students equal to the difference between X and Y?

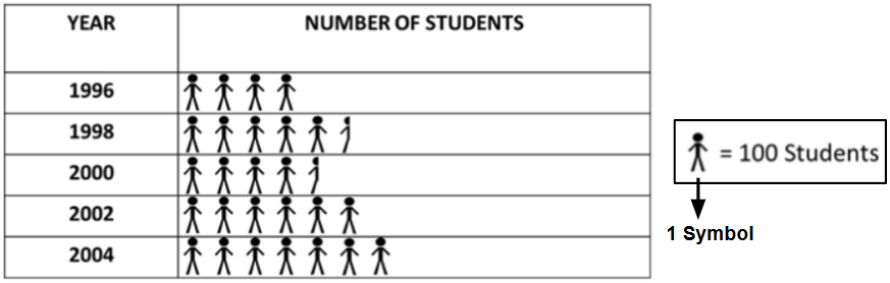


a) Strawberry b) Banana c) Pear d) Mango

---

7. **A pictograph with some missing data is shown below. Extra symbols need to be added (but none can be removed or shifted) to complete the pictograph, such that:**
   - **The number of students increases by 300 for every gap of 4 years**
   - **The number of students in each year is a multiple of 100**

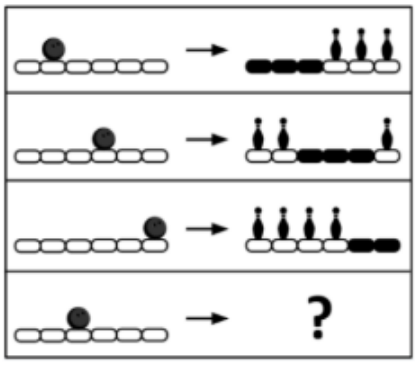
   What is the MINIMUM number of symbols that must be added to satisfy all the above conditions?



a) 8.5 b) 8 c) 9 d) 7.5

---

8. **What will come in place of "?"**

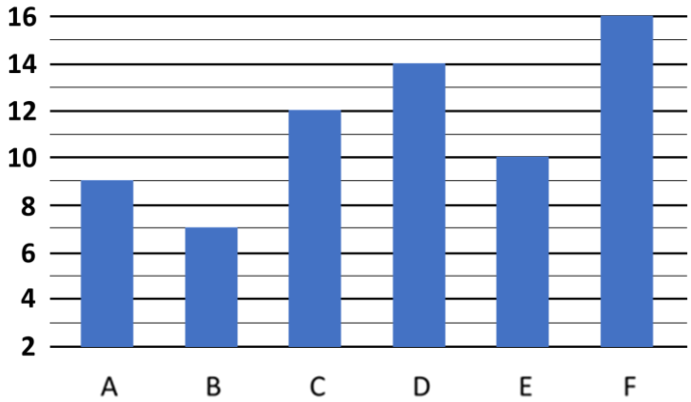


a)  b)  c)  d) 

9. The bar graph shows the quiz scores of six students A, B, C, D, E, and F. The students are grouped as follows:

- **Group 1: Students whose scores are composite numbers**
- **Group 2: Students whose score forms a perfect square when added to any other student's score**
- **Group 3: Students whose score is greater than the average score of all six students**

How many students belong to exactly two of these groups?



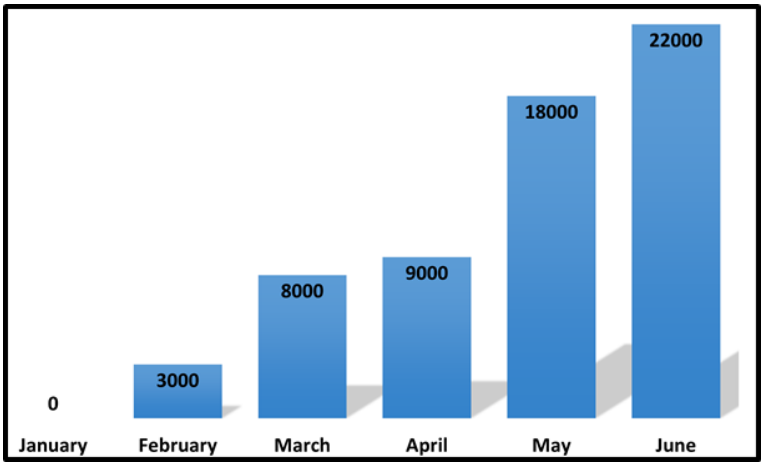
a) 2 b) 3 c) 4 d) 5

---

10. Raj saved some amount of money every month from January to June.

- **He saved a total of Rs. 30,000 in the first three months and Rs. 30,000 again in the last three months as well**
- **He did not save any money in February**
- **The maximum total saved in any two consecutive months is Rs. 40,000**
- **While drawing the chart, Raj arranged the savings in increasing order without matching them with the month names written below**

What was the actual amount saved in June?

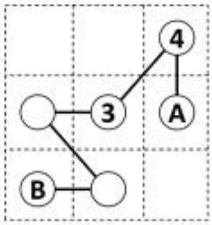


a) Rs. 22000 b) Rs. 9000

c) Rs. 3000 d) Cannot be determined

The Thinking Spot

The circles in the grid below can only contain numbers from 1 to 6.
- Every pair of connected circles contains consecutive numbers
- No two circles belonging to the same row or column can have the same number
- A number can be placed in more than one circle
What is the difference between A and B?

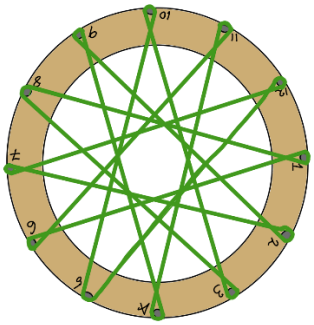


(a) 1 (b) 2 (c) 3 (d) 4

Chapter 5: Prime Time

Activity Time

Factors and multiples

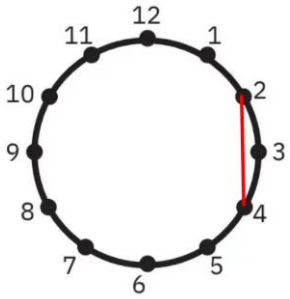


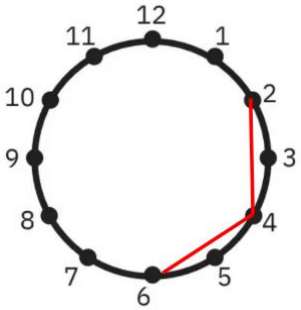
Activity

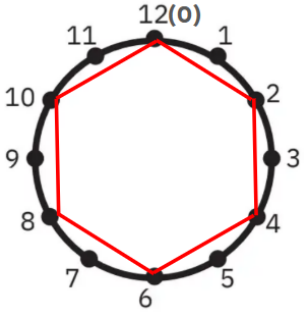
You are given a circle with 12 equally spaced points.
You have to connect these points using a rule.

Rule:

1. Starting from 2, add 2 to it and connect it with the next number i.e., 4.
2. Add 2 to 4, then connect it to the next.
3. Keep adding 2 until you reach the starting point.



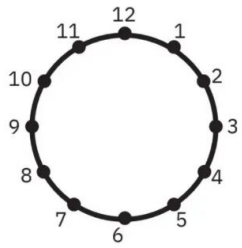




1. **How many steps did it take to reach the starting point?**

a) Three b) Four c) Five d) Six

Now starting from 3, add 3 to it and join to the next point. Keep adding 3 until you reach the starting point.



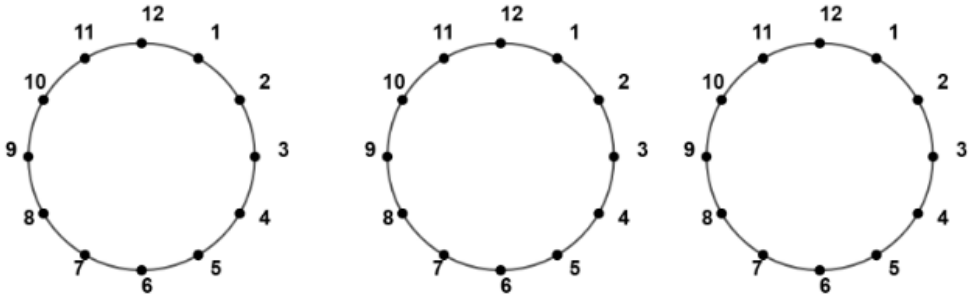
2. How many steps did you take to reach the starting point?

a) Two b) Three c) Four d) Five

<u>Repeat the same process by</u>

a) Starting from 4 and adding 4
b) Starting from 5 and adding 5
c) Starting from 6 and adding 6

Until you reach the starting point.



<u>What shapes do you get? Record your answers in the table below.</u>

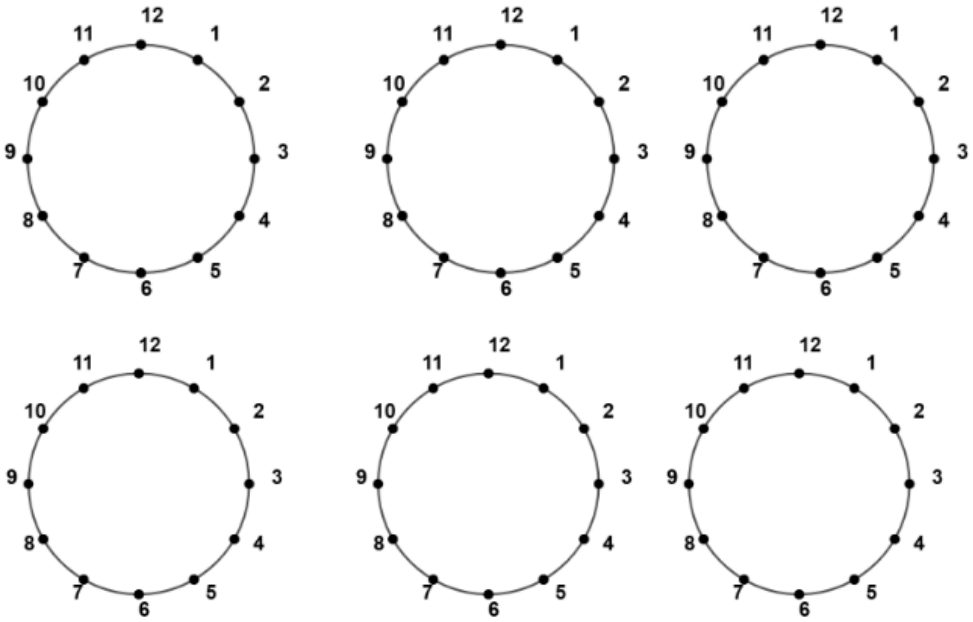
Number added	No. of steps till the starting point	Shape formed
2	6	Hexagon
3	4	Square
4		
5		
6		

Do you notice any **patterns** in the **numbers we are adding, the number of points on the circle, and the shape being formed in the circle**?

Why did you get polygons on adding 2, 3, and 4, while a star on adding 5? Is there any relationship between these numbers and 12, the number of points on the circle?

Explorations

1. **What shapes will you get when you add 7, 8, 9, 10, and 11 until you reach the starting point? Try to find out the relationship between the numbers and the number of points on a circle.**



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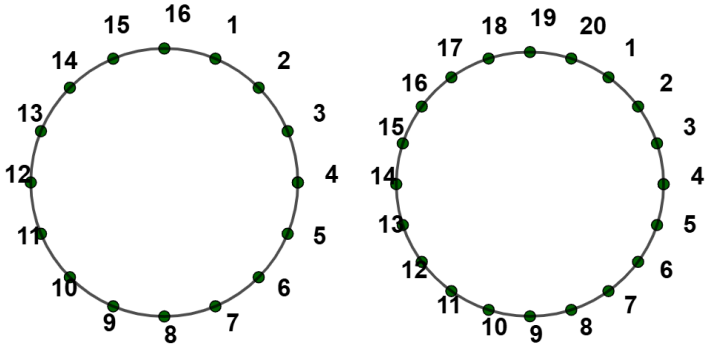
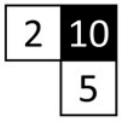
2. **Two circles, one with 16 points and the other with 20 points, are given. Which of the two will give a square when added to which number?**

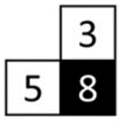


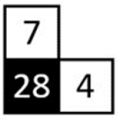
a) The 16-point circle, on adding 4
b) The 16-point circle, on adding 12
c) The 20-point circle, on adding 5
d) The 20-point circle, on adding 15

Questions

1. **Find the ODD one out.**

a) 

b) 

c) 

d) 

---

2. **If "X" is a number formed by the addition of two or more DIFFERENT single-digit prime numbers, which of the following options CANNOT be a value of the number "X"?**

a) 8 b) 10 c) 11 d) 15

---

3. **The sum of three consecutive natural numbers is equal to Y. Which of the following numbers will Y always be divisible by?**

a) 3 b) 2 c) 4 d) Cannot be determined

---

4. **A two-digit number is 1 more than a multiple of 3. How many different possible values can it have?**

a) 29 b) 30 c) 31 d) 32

---

5. **The product of a number 'PQ' and 7 is 'RSQ', where P, Q, R, and S are distinct digits. Which of the following CANNOT be the possible value of 'RSQ'?**

$$\begin{array}{r} PQ \\ \times \quad 7 \\ \hline RSQ \\ \hline \end{array}$$

a) 210 b) 315 c) 420 d) 105

---

6. **Nausheen thinks of 5 consecutive numbers. 3 of these numbers are prime and 3 of these are even numbers. What is the sum of these numbers?**

a) 10 b) 15 c) 20 d) Cannot be determined

---

7. **In a certain language, if 3 is coded as 'free', 5 is coded as 'dive', 10 is coded as 'hen', then what could be the possible code for the PRIME FACTOR of 169, in the same language?**

a) heighten b) throwing c) routine d) titan

---

8. **If "X" is a number formed by the multiplication of 2 single-digit prime numbers, which of the following options is ALWAYS TRUE about the number "X"?**

a) The number "X" cannot be even
b) The number "X" is a 2-digit number
c) The number "X" is a multiple of 4
d) The number "X" is less than 50

---

9. **In the letter grid below, the spelling of which prime number is immediately followed by the spelling of its succeeding number in the number series?**

ONEFIIVESIXTWOTHREENINETENELEVNTWELVEONEFOURSIXSEVEN

a) 3 b) 5 c) 11 d) 2

10. Alex, Jim, and Sam were born on prime-numbered dates in the same month and year. Sam was born on a Friday, and the month started on a Sunday.

- The difference between the dates of Alex's and Jim's birthdays is 20

- Jim was born 10 days after Sam

On which day of the week was Alex born?

a) Thursday b) Wednesday c) Tuesday d) Saturday

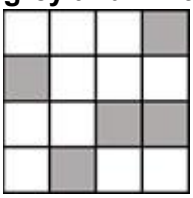
The Thinking Spot

The image given below contains ONLY white and grey squares. You can change the colour of a square by clicking on it.

- If you click a white square, the colour of that square and all squares that share a common corner (but do not share a common side) with it will change

- If you click a grey square, its colour and the colour of the squares that share a common side with it will change

What is the minimum number of squares that must be clicked to make the number of grey and white squares equal?



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

Chapter 6: Perimeter and Area

1. **Figures A and B represent squares which are divided into different parts, as shown in the image below. Which of the following options correctly represents the relation between the division?**

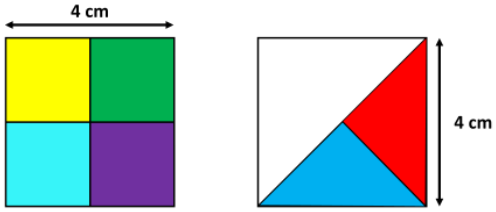
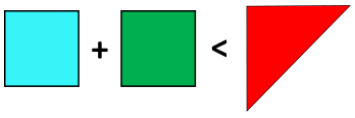
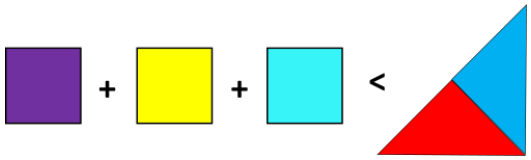


Figure A Figure B

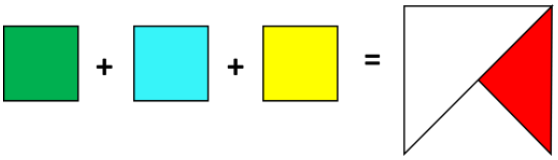
a)



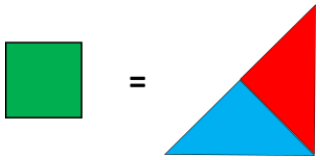
b)



c)



d)

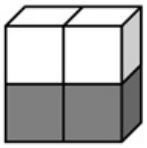


---

2. **The perimeter of a square X is 16 cm. The square is cut along its diagonal to form two identical triangles.**
   Which of these statements is DEFINITELY FALSE based on the above information?
   a) Two sides of the triangle meet each other perpendicularly
   b) The length of at least one side of each triangle is 4 cm
   c) The combined area of the triangles is 16 cm^2
   d) The combined perimeter of the triangles is 16 cm

---

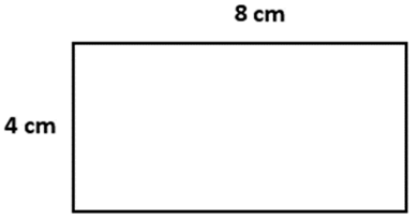
3. **A larger block is formed using 4 small cubes (2 grey cubes and 2 white cubes), as shown below. How many faces of the larger block have equal grey and white areas?**



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

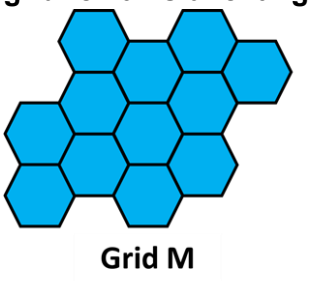
---

4. **How many times should the given paper sheet be folded in half so that the perimeter of the new shape is 16 cm?**



a) 0 b) 1 c) 2 d) 3

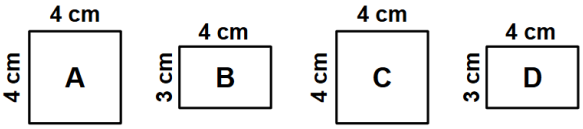
5. **Grid M is made using regular hexagons (like Shape A), as shown. Additional copies of Shape A may be attached only along the outer sides of Grid M, and each added shape must share at least one full side with the existing grid. The shapes must be added such that the total perimeter of the grid remains unchanged. What is the MAXIMUM number of Shape A pieces that can be added?**



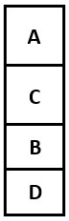
a) 2 b) 3 c) 4 d) 6

---

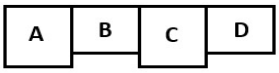
6. **All the squares and rectangles given below are to be used to form an arrangement. The arrangement shown in which of these options will give the HIGHEST perimeter?**



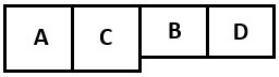
a)



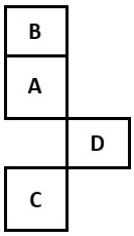
b)



c)

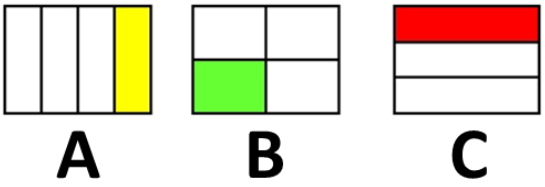


d)



---

7. **If figures A, B, and C are all of the same dimensions, which of the following coloured blocks has the largest area?**



a) Red
b) Yellow
c) Green
d) All of them have an equal area

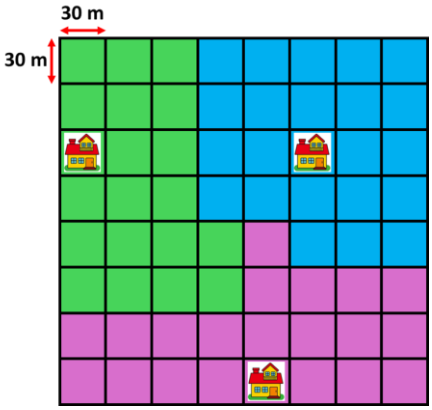
8. **A square frame has a side length of 16 cm. Inside it, four square-shaped photographs of side 4 cm are to be placed such that:**
   - **Each photograph touches the CORNER of at least one other photograph**
   - **No two photographs share a common side**
   - **The photographs do not overlap**

   What is the LARGEST square-shaped empty space that can be seen inside the frame, finally?

   a) 9 cm^2 b) 16 cm^2 c) 64 cm^2 d) 192 cm^2

---

9. **The grid shows a piece of land divided among three houses using different colours (including the area occupied by each house). The land is then redistributed so that all three houses receive equal areas. Which of the following options is NOT the exact area of land gained or lost by any house after this redistribution?**



a) 1200 sq. m. b) 1500 sq. m. c) 300 sq. m. d) 900 sq. m.

---

10. **Figures A, B, and C are three rectangles of equal dimensions. Figures A and B contain some shapes placed inside them. Using these shapes, completely fill figure C without leaving any gaps. Which set of options can be used to exactly fill figure C?**

    Note: *The shapes may be rotated but must not overlap. The dimensions of the shapes in the options are the same as the dimensions given in the question image*

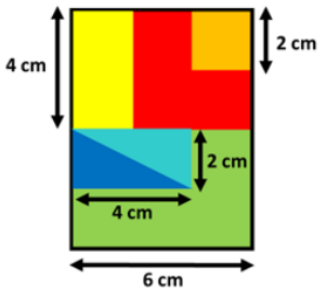


Figure A

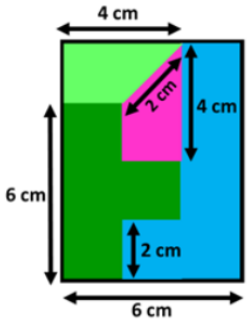
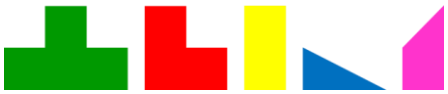


Figure B

Figure C

a) 

b) 

c) 

d) 

The Thinking Spot

The numbers given below are to be placed in the grid in such a way that the sum of two adjacent numbers in the grid should be greater than 9 but less than 17.
What will come in place of A?
Numbers to be placed: 11, 3, 5, 2

14			A	8		12

(a) A = 5 (b) A = 3 (c) A = 2 (d) A = 11

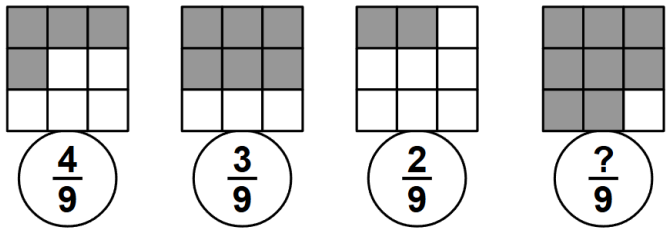
Chapter 7: Fractions

1. **Aashay scored the following marks in 3 subjects:**
   Dance: 22/25
   Maths: 41/50
   Science: 93/100
   Arrange the three subjects in descending order of how well he performed in them.

   a) Maths-Science-Dance
   b) Science-Maths-Dance
   c) Science-Dance-Maths
   d) Maths-Dance-Science

---

2. **What will come in place of "?"**



   a) 1
   b) 8
   c) 9
   d) 5

---

3. **Arrange the given fractions in ascending order. Which option can be placed exactly in the middle of the new arrangement so that the order remains ascending?**

   10/15, 8/9, 17/18, 5/6

   a) 68/90
   b) 71/90
   c) 77/90
   d) 84/90

---

4. **Two numbers, 23/18 and 7/54 are taken. A binary operation is performed on them and the result obtained is 31/27. What operation might have been performed on the numbers taken?**

   a) Addition
   b) Subtraction
   c) Multiplication
   d) None of these

---

5. **In a class of 50 students, 20 are boys and the remaining are girls. Of the girls in the class, one third like singing and two thirds like dancing. Some girls like both singing and dancing. If 5 girls like neither singing nor dancing, what fraction of the girls like both activities?**

   a) 1/3
   b) 1/4
   c) 1/5
   d) 1/6

---

6. **Tim has some sons, some daughters, and 27 grandchildren.**
   - **2/3 of his children are male and the rest are female**
   - **Each of his sons has 2 sons and 1 daughter**
   - **Each of his daughters has 2 daughters and 1 son**

   How many daughters does Tim have?

   a) 2
   b) 3
   c) 6
   d) 9

7. **Some numbers appear in a series as shown below:**
1/2, 3/4, 1, 5/4, 3/2, 7/4...
Which of the following statements is definitely true regarding the above sequence?

a) The seventh term of the series would be 5/2

b) The difference between the sixth and eighth terms would be 3/4

c) The product of seventh and tenth terms is 20/4

d) The sum of the ninth and eleventh terms is 22/4

---

8. **Aman and Samarth appear for an exam and each of them attempts all the questions.**
Aman says: "1/3rd of my answers were wrong"
Samarth says: "5 of my answers were wrong"
If both of them together get 3/4th of the answers right, how many questions did Aman get right?

a) 20 b) 30 c) 10 d) 15

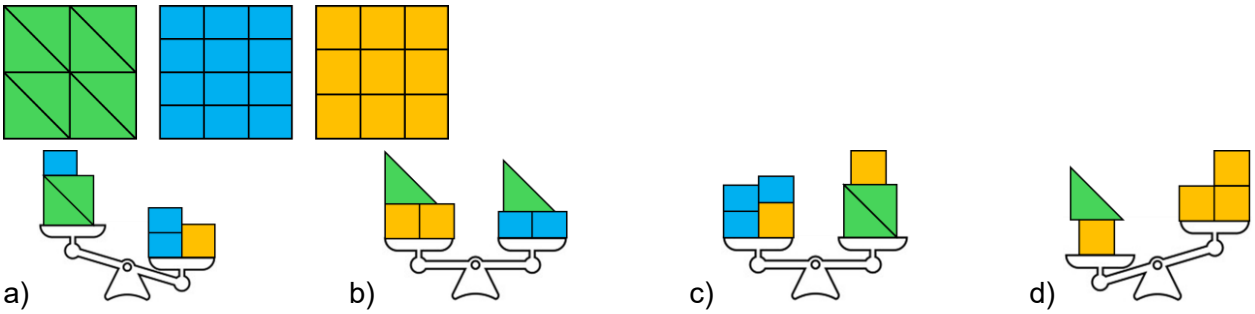
---

9. **Raju's age is 2/3 of his brother's age. Currently, if one of them is 30 years old, which of these options DOES NOT represent the possible age of Raju's brother?**

a) 45 years b) 30 years c) 27 years d) None of these

---

10. **The figure shows three square bricks of the same weight, each divided into equal pieces. Which option correctly represents the relationship among these pieces?**



a) b) c) d)

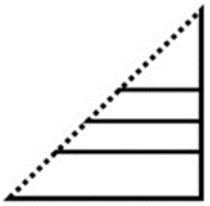
The Thinking Spot

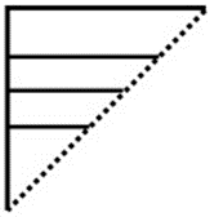
A always lies on Tuesdays, Wednesdays, and Saturdays but tells the truth on all other days. B always lies on Tuesdays, Fridays, and Sundays but tells the truth on all other days.
Today, A tells C, "Yesterday, I was lying."
Today, B also tells C, "Yesterday, I was lying."
If A told the truth to C and B lied to C, which day is today?

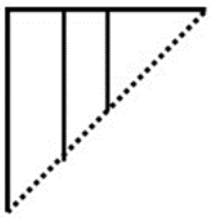
(a) Sunday (b) Wednesday (c) Thursday (d) Saturday

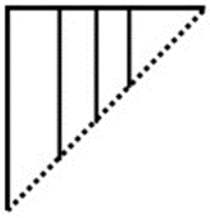
Chapter 8: Playing with Constructions

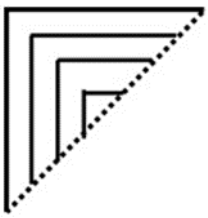
1. **An image made of squares is cut diagonally into two halves, and one half is shown below. Which option should be joined with the question image so that the resulting image forms exactly 4 squares?**
   Note: *You cannot rotate any of the images*



a) 

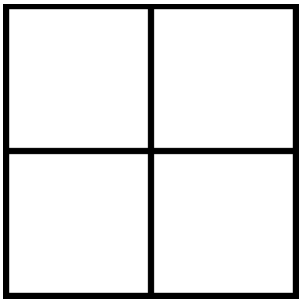
b) 

c) 

d) 

---

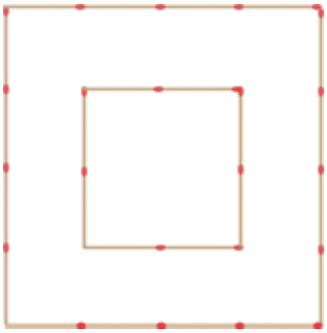
2. **Given below is an arrangement of squares. What is the minimum number of straight lines required so that the total number of square shapes that appear in the final image (including the existing ones) is more than 5?**



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

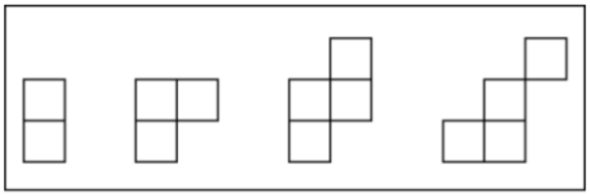
---

3. **The following arrangement is made up of matchsticks of the same dimensions. How many additional matchsticks are needed to divide the area between the outlines of the larger outer square and the smaller inner square into three parts, each having the same area as the smaller inner square?**

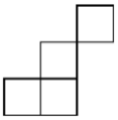
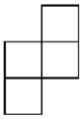


a) 4 b) 3 c) 2 d) 5

4. **Form a 3 × 3 square using exactly 3 shapes from the set given below. Which shape will NOT be used?**
Note: *You cannot rotate or overlap the shapes*

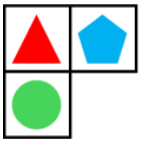
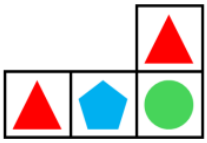


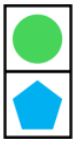
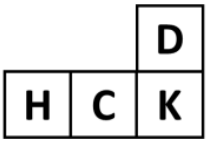
Set A

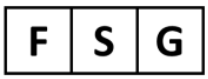
a) 
b) 
c) 
d) 

---

5. **Six pieces are given. Using all of them, form two separate 3 × 3 square grids, each containing both letters and shapes. In both completed grids, which shape will be adjacent to a letter?**
Note: *Two cells are considered adjacent only if they share a common side. Cells that share a common corner alone are not adjacent. Rotation of the pieces is not allowed*

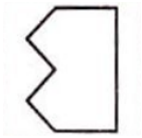






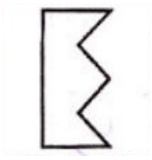
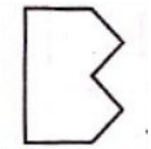
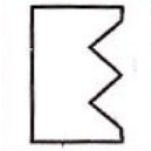
a) Red Triangle b) Green Circle c) Blue Pentagon d) Both options b and c

---

6. **Which of these options, when combined with the question image, will form a rectangle or a square? Note:** *The images cannot overlap each other*



Question Image

a) 
b) 
c) 
d) 

---

7. **When Figure A is placed over Figure B to form a square grid, which same digits will be positioned exactly on top of each other?**

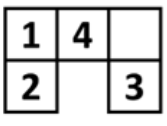


Figure A

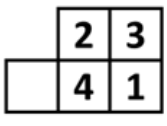
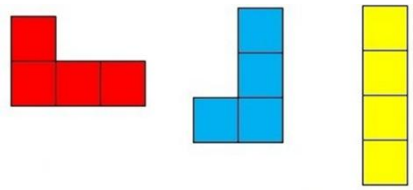
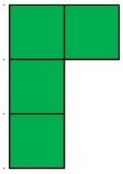
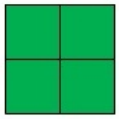
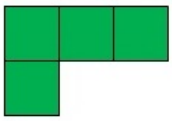
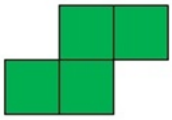


Figure B

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

8. **Four pieces together form a square. Only three of these pieces are shown. Which option represents the fourth piece that, when joined with the given three pieces, will complete the square?**
   Note: *The pieces must not overlap each other and rotation is not allowed*



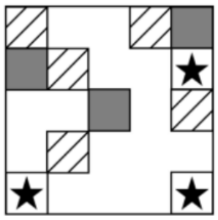
a) 
b) 
c) 
d) 

---

9. **Two identical paper sheets are joined together at one of their sides to form a square. Which of the following CAN DEFINITELY NOT be the shape of each of the paper sheets?**
   a) Triangle b) Square c) Rectangle d) None of these

---

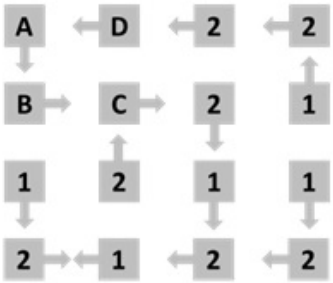
10. **A 5 × 5 grid is formed using three different pattern blocks, as shown in the image. Some blocks are missing from the grid. No two adjacent blocks in the grid can have the same pattern. Complete the grid and tell which pattern block is PRESENT the MOST.**
    Note: *Blocks that share common sides are considered to be adjacent. Blocks that share a common corner alone, are NOT adjacent*



a) Pattern 3 b) Pattern 2 c) Pattern 1 d) Both options b and c

The Thinking Spot

Place numbers inside every cell so that each cell indicates how many different numbers its arrow(s) point to. What will come in place of A and B?



(a) A = 1 B = 2

(b) A = 2 B = 1

(c) A = 2 B = 2

(d) A = 3 B = 2

Chapter 9: Symmetry

1. **Image A is placed exactly on top of Image B (exactly overlapping it). How many shapes with vertical symmetry overlap letters that also have vertical symmetry?**
   Note: *Rotation of the images is not allowed*

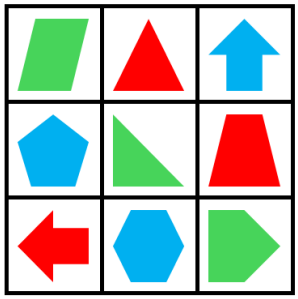


Image A

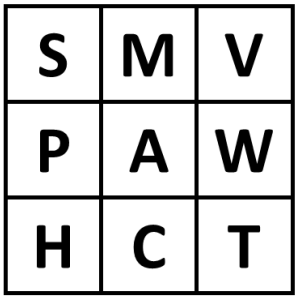
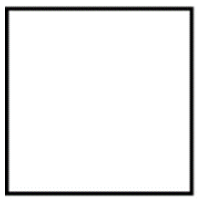


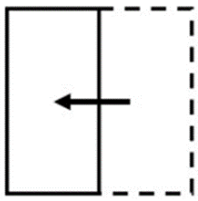
Image B

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

---

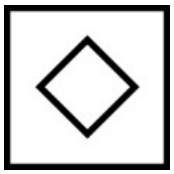
2. **A square sheet of paper is folded in half, as shown in Step 1. A triangular piece is then cut from the folded sheet, as shown in Step 2. Which option shows the final shape obtained when the paper is unfolded?**





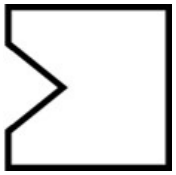
Step - 1

Step - 2

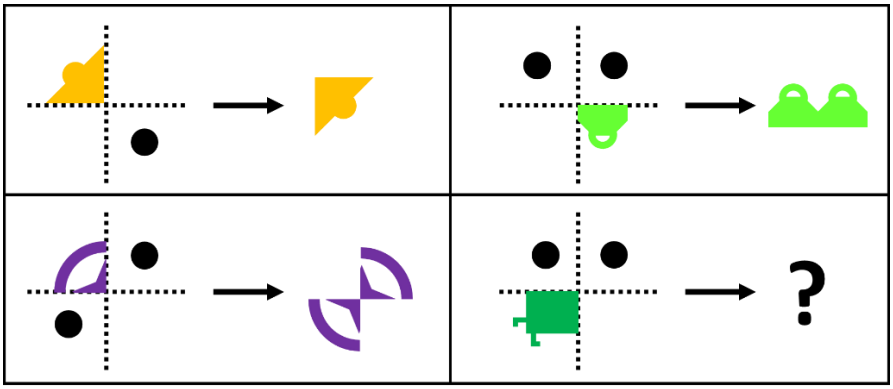
a) 

b) 

c) 

d) 

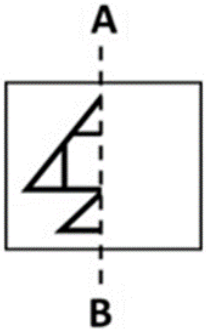
3. **What will come in place of "?"**



a)  b)  c)  d) 

---

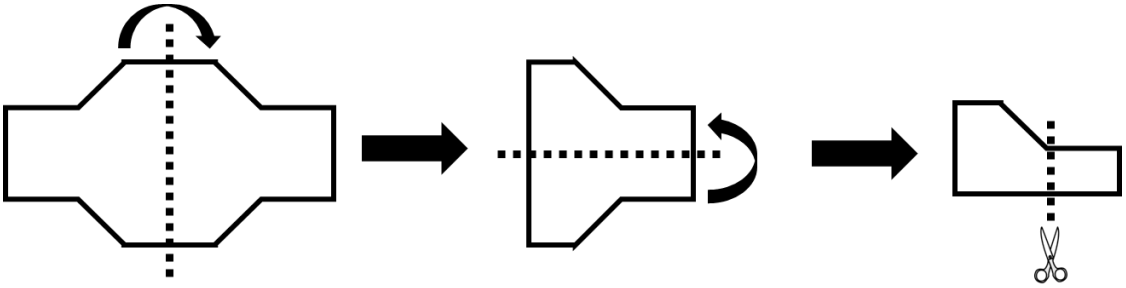
4. **A symmetrical transparent sheet of paper is folded in half along the dotted line AB. When the sheet is unfolded, what is the total number of triangles seen?**
   Note: *Line AB is not a part of the shape*



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

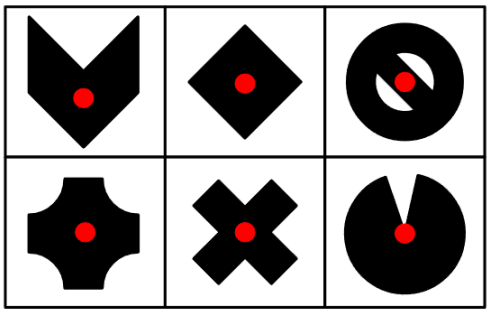
---

5. **The given shape is first folded vertically, then horizontally, and then cut along the dotted line as shown below. After unfolding, if the resultant shape has equal sides (edges), how many lines of symmetry does the resultant shape have?**



a) 10 b) 4 c) 6 d) 8

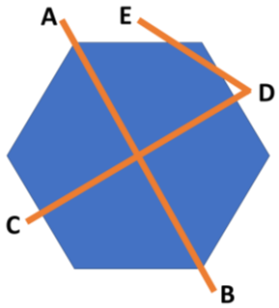
6. **The following grid is made of 6 small white squares. Each square has a black shape inside it. Count the number of squares which are adjacent to exactly two other squares, whose shapes have an angle of rotational symmetry of 90^0.**
Note: *The red circle in each shape acts as the centre of rotation. Two squares are said to be adjacent if they share the common sides. Squares that share common corner alone are not adjacent to each other*



a) 1 b) 2 c) 3 d) More than 3

---

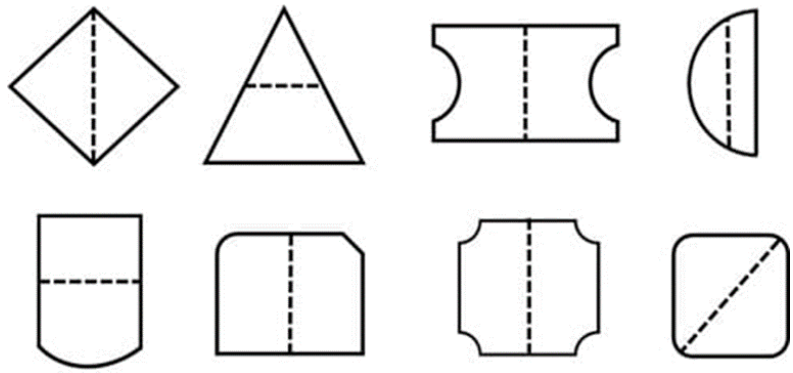
7. **Along which line should I cut the given paper sheet to get two identical Pentagons?**



a) AB b) CD c) DE d) None of These

---

8. **Eight shapes are shown below, each having a dotted line. Count the number of shapes in which the dotted line is a line of symmetry.**



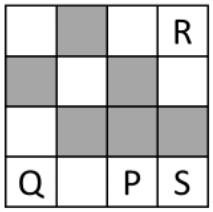
a) 3 b) 4 c) 5 d) 6

---

9. **How many of the following letters have at least one line of symmetry?**
RISTLHPACE

a) 5 letters b) 6 letters c) 8 letters d) 10 letters

10. In the given figure, exactly one square among the labelled squares – P, Q, R, and S must be shaded grey to make the complete grid symmetric, along any one of the directions. Which square must be shaded to satisfy the condition?



a) Q b) R c) S d) P

The Thinking Spot

There are 3 jars out of which one of them has candies and the other two are empty jars. There is a message printed on the lid of each jar. Only one of these messages is true and the others are false.
The message on the 1st jar is: "The Candies are not in this jar" and the same message is written on the 2nd jar as well.
The message on the 3rd jar is: "The Candies are in the 2nd jar".
Which jar has candies in it?

(a) 1st (b) 2nd
(c) 3rd (d) Cannot be determined

Chapter 10: The Other Side of Zero

1. **In the following series, which of these English alphabets would appear first alongside a negative number?**

   A165, B153, C141, D129, ...

   a) M b) N c) O d) P

---

2. **In the given grid, the empty cells in Column 2 must be filled using either ">" or "<". Three symbol stacks are provided, and each stack must be placed as given (without changing the order) into Column 2. Which two stacks, when placed in Column 2, result in the same number of correctly related integer pairs?**

CL 1	CL 2	CL 3
-41		-56
-80		78
39		-214
-31		-19

GRID

Stack A	Stack B	Stack C
<	<	>
>	>	<
<	>	>
<	>	>

   a) Stacks A and B b) Stacks B and C c) Stacks A and C d) All stacks A, B and C

---

3. **What will come in place of "?" in the given series?**

   -12, 2, -10, 4, -8, 6, -6, ?

   a) 7 b) 8 c) -4 d) 9

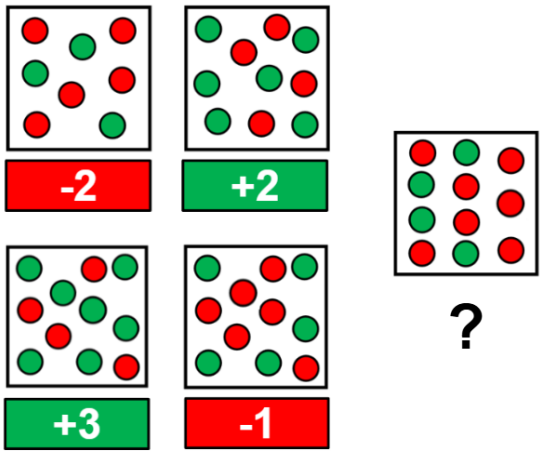
---

4. **If C is a positive integer, which of these options will have the LARGEST value, where "+" means "-" and "-" means "+"?**

   a) C + 151 - 41 b) C - 80 + 357 c) C + 50 + 93 d) C + 200 - 68

---

5. **If each of the given terms follows the same theme, what will come in place of "?"**



   a) +3 b) -2 c) -3 d) -3

6. In a shop, every customer receives a scorecard that starts with 0 points. If an item costing more than ₹500 is purchased, the amount exceeding ₹500 is added to the scorecard as points. If an item costing less than ₹500 is purchased, the amount by which it is less than ₹500 is subtracted from the scorecard as points. The data regarding the first five purchases of a customer is shown in the table below. Using the table, find the sum of A, B, C, D, and E.

Purchase Price	Score Card
B	A
200	C
600	40
420	D
E	-25

a) 1695 b) 1395 c) 1495 d) 1480

---

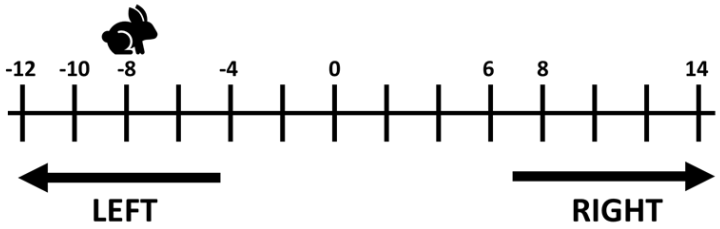
7. Alex has a magic box that changes a number based on these rules:
- **If the input is greater than 400, subtract 100**
- **If the input is less than 201, add 100**
- **If the input is between 201 and 401, it becomes 0**

After this, the sign of the number is reversed (positive becomes negative and vice versa)
Which input will produce an output of -345?

a) 445 b) 245 c) -445 d) 545

---

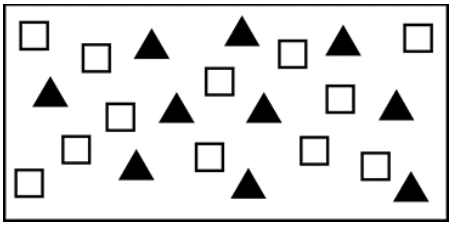
8. A number line has equally spaced points with values following a pattern, where some values are hidden. A rabbit starts at -8 and jumps on the 9th point to the right. From its new position, it then jumps on the 7th point to the left. What is the sum of the values of all the points it lands on, including the starting point?



a) 0 b) 2 c) -2 d) -4

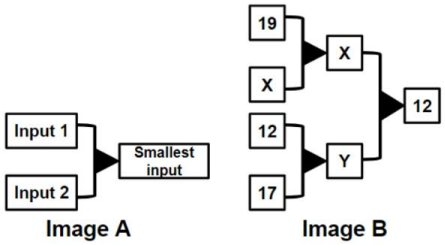
---

9. In the box below, each square represents +10, and each triangle represents -15. How many more such squares or triangles should be added to the box, such that the sum of all the shapes of the box is 50?



a) 3 triangles b) 1 triangle c) 8 squares d) 5 squares

10. Below is a logic machine that takes two numerical inputs and selects the smaller number to continue, as shown in Image A. Using this same logic, what could be the possible value of 'X' in Image B?



a) 24 b) 20 c) 14 d) 11

The Thinking Spot

All 26 letters of the English alphabet are arranged in a circle in the order A to Z, with Z next to A. Six groups of 4 consecutive letters are selected from this arrangement and each group is assigned a unique number from 1 to 6. The table below shows a letter and the number of the group it belongs to. Which option shows letters that could belong to the same group?

G	S	K	A	J	F	D	N	P
3	6	4	1	3	2	2	4	5

(a) A-B-C-D (b) G-H-I-J (c) L-M-N-O (d) I-J-K-L

PART 2
ARTIFICIAL INTELLIGENCE

Chapter 1: Introduction to AI and Everyday Examples

What is Intelligence?

Intelligence is a term that opens a room for discussions since it involves the ability to learn, think, understand, solve problems, and apply knowledge effectively. It is not just a cognitive skill, but a combination of many mental abilities. The level of intelligence differs in humans and animals in different ways based on how they perceive and behave. Therefore, it can be defined as the ability to use knowledge, interpretation, and insight to do any task successfully. It also includes the ability to adapt to new situations and make appropriate decisions based on experience.

Intelligence can be classified into several different types based on how individuals think, learn, and interact with the world. Some of them are explained here:

The Class Leader (Interpersonal Intelligence)

This is a student who naturally brings people together during a group project. When two classmates cannot agree on what to do, this person steps in and says something like, *"Tom, you're great at drawing, so you can make the poster. Jerry, you found the best information online, so you can write the report."* The student **understands** how others feel, communicate well, and helps the team work smoothly.

The Nature Lover (Naturalistic Intelligence)

This student is the one who, on a field trip to the garden, while everyone else is running around, huddled down over a long line of ants carrying a large leaf. He is aware of different types of plants and can even tell you which birds sing. The student is **smart** in the way they make sense of the natural world around them.

The Daydreamer (Intrapersonal Intelligence)

This student is self-aware. Before a big test, rather than panicking like everyone else, they might say to themselves, *I know I get distracted by noise so I'm going to put on my headphones. I also remember things better if I draw little pictures next to my notes.* He understands his own **feelings** and knows how is learn in the best positive manner.

What is Artificial Intelligence?

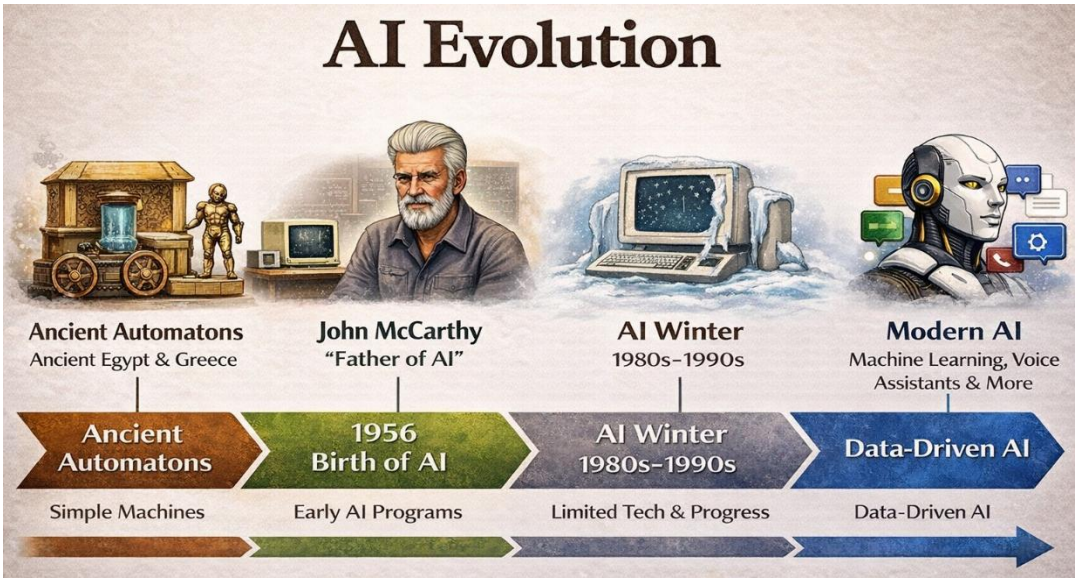
Artificial Intelligence (AI) is the field of computer science that makes machines intelligent, enabling machines to perform tasks that usually require human intelligence. These machines can conduct complex thinking processes such as data analysis, pattern recognition, prediction

of trends, solving problems, and decision-making by using data and learning from experience. AI systems are designed to learn, adapt, and improve their performance over a period of time.

Computing and **Intelligence** are the two important terms that help us understand the concepts of Artificial Intelligence.
Computing is all about using computers to conduct mathematical, logical, or relational calculations. Intelligence involves learning, reasoning, decision-making, and adapting to new situations. When these two concepts are combined together, then it forms an AI, which enables machines to simulate human intelligence and assist in decision-making.

History of Artificial Intelligence

Artificial intelligence has developed from simple rule-based programs into powerful systems capable of learning, reasoning, and creating. Here's a brief journey through its evolution:



Ancient ideas of Intelligent Machines

Long before computers existed, people built simple machines called **automatons** which were created using water, gears, and levers. These simple machines could perform fixed tasks repeatedly but could not learn from previous experience or data. Although these machines were not truly intelligent, those days these simple machines helped shape the idea of making a machine that can **think** and make **decisions** in future.

One famous example is of the mechanical water clock used in ancient Egypt and Greece, which used the flow of water to operate levers and gears.

Alan Turing and Machine Intelligence

The theory of intelligent machines began in the 1940s, and one of the significant contributions was from the great mathematician, **Alan Turing**. He asked a question, "***Can machines think***?" which inspired many researchers to explore intelligent computing.

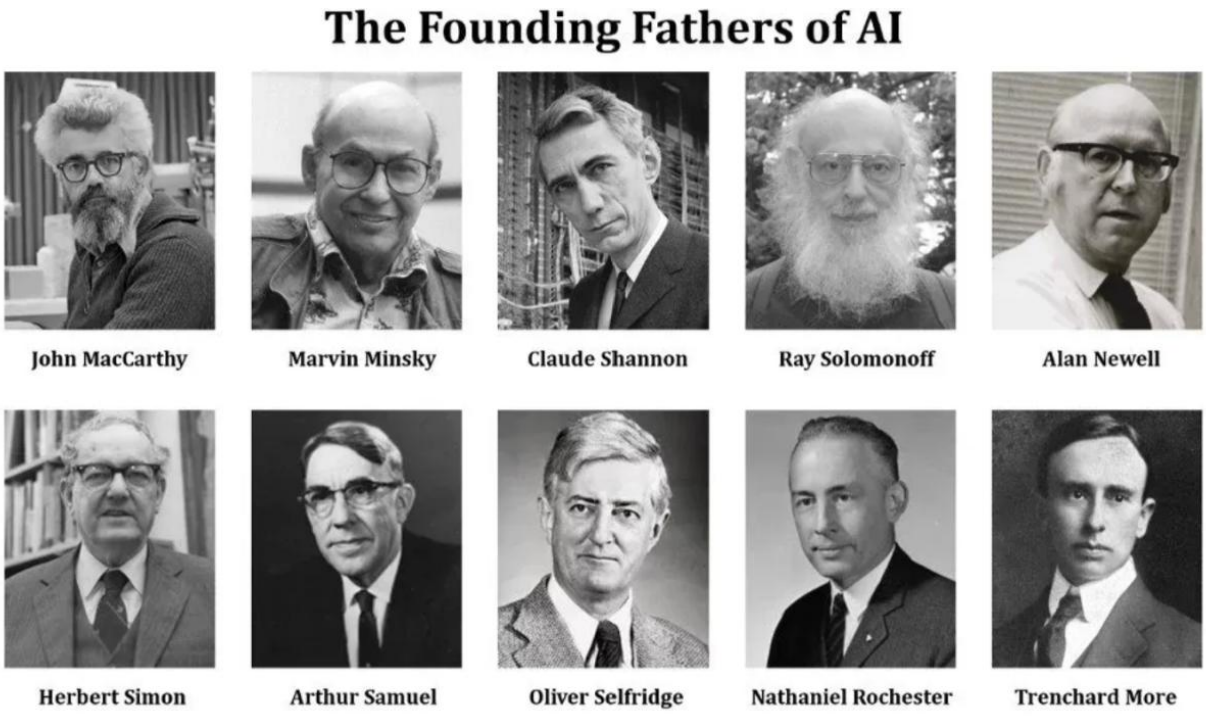
Turing further introduced the **Turing Test**, a method to calculate machine intelligence. This test would state whether a machine can perform in such a way that a person cannot tell whether they are talking to a machine or a human being. Alan Turing's ideas laid a strong foundation for Artificial Intelligence, that shaped the development of AI systems that are widely used today in applications such as search engines, voice assistants, and recommendation systems.

Birth of AI

In 1956, Dartmouth held the first Artificial Intelligence Summer Research Project. This was the first step toward AI. John McCarthy, a computer science professor at Stanford University who is known as the 'Father of Artificial Intelligence,' came up with the word **Artificial Intelligence** to describe the field of science and engineering that makes tools, especially computer programs, that can think for themselves. At this time, scientists started to make computers that could solve problems and play simple games. However, AI progress halted in the 1980s and 1990s due to slow processors, limited memory, and high cost. This period was referred to as the **AI Winter**.

Founding Fathers of Artificial Intelligence

1956 is the year associated with the birth of AI. Some of the most notable scientists who made important contributions include John McCarthy, Marvin Minsky, Claude Shannon, Herbert A. Simon, and Alan Newell. Their contribution includes their work in problem-solving, machine learning, and computational theory that laid the foundation for modern AI systems. These researchers are known to develop early AI programs and explore how machines could ignite human thinking and decision-making.



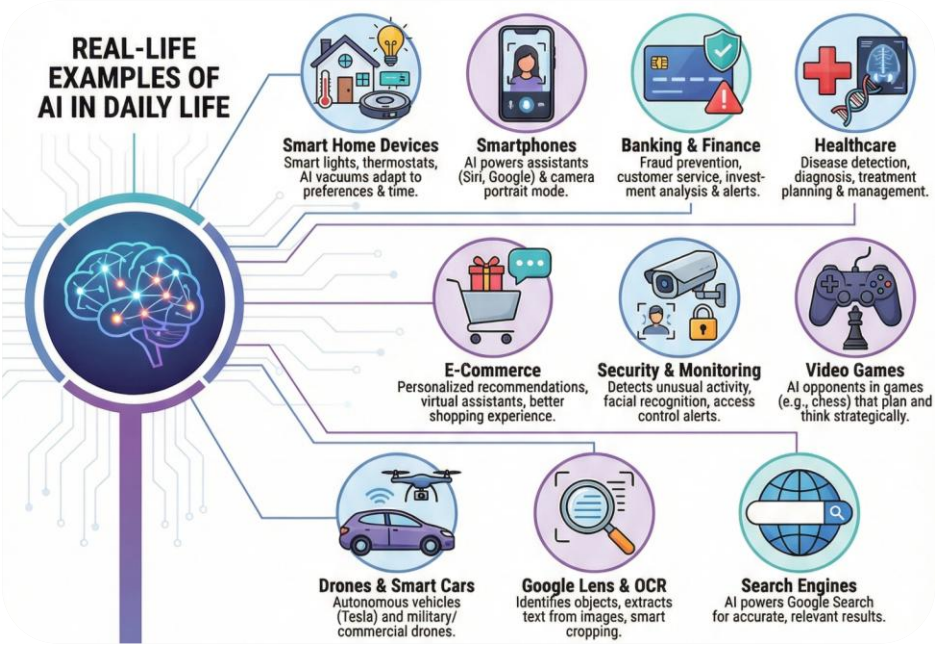
Modern Artificial Intelligence

The 2000s witnessed significant growth in technology, which made computers faster, cheaper, and more powerful. By now, AI systems could store and process a large amount of data. Instead of following only set rules, AI systems began to learn patterns from data and improve their performance over time. Modern AI systems can now recognize images, understand speech, and make simple decisions.

AI in our Daily Liver

AI has become an important part of our daily lives. AI technology is used in many ways, most of the time people don't even know it. AI helps make our tasks easier, faster, and more efficient by enabling machines and applications to learn, analyse data, and make smart decisions.

The following images illustrate a few real-life examples of AI in daily life.



- **Smart Home Devices:** There are smart lights that change colour and intensity based on time, smart thermostats that change the temperature based on your preferences, AI-based vacuum cleaners, and much more. In the near future, AI will impact most of our interactions with smart home appliances.

- **Smartphones:** Whether you realise it or not, if you use a smartphone, you are interacting with AI. AI has immense impact on our lives, from the obvious features like the integrated smart assistants to the less obvious ones like the camera's portrait mode.
  For example, you may know that voice assistants, food apps, and reservation portals are based on AI. However, many people do not realize that AI also works behind features like portrait mode in smartphones. Have you ever wondered how your phone takes such impressive portrait photos? The answer is, surprisingly, AI.

- **Banking and Finance:** Artificial intelligence is heavily used in the banking and finance sector for tasks like customer service, fraud prevention, investment, and more. An easy illustration is the automated emails you get from banks whenever there is an unusual transaction. That is AI keeping an eye on your account and attempting to alert you to any fraud.

- **Healthcare:** AI-powered systems have made it much easier to find and diagnose diseases. AI also helps doctors plan treatments and take care of their patients. Hospitals and other healthcare facilities are therefore gradually using technologies that are powered by AI to ease everything from research to the detection of diseases.

- **E-Commerce:** AI in e-commerce makes the shopping experience more personalized and easier. It suggests products you may like, makes personal recommendations, and helps through virtual assistants and chatbots. Each of these features saves time, guides customers, and makes online buying simpler and more convenient.

- **Security and Monitoring:** AI helps make security systems faster and more efficient. It can detect unusual activities, recognise faces, and identify objects like unattended bags. It also sends alerts and helps control access through smart systems, allowing quick response to security situations.

- **Video Games:** AI is used in some video games to improve computer players' abilities to play. In games such as chess, the computer can play against humans by studying the moves and choosing the best ones. These games need planning and careful thinking. When a computer plays well, it shows that AI can ‘think’, ‘make decisions’, and ‘solve problems’ just like a human player.

- **Drones and Smart Cars:** The use of AI in smart cars and drones is one of the most noticeable examples of modern technology. Using a fully automatic self-driven car was once only a dream, but thanks to advancements made by the self-driven car companies, we now have a fleet of automatic vehicles on the road. Remember that successful drone programs are already being used by the defence forces across the world.

- **Smart Features in Scanning Apps:** AI-powered image recognition devices use advanced technology to identify objects captured by a camera, such as shoes, plants, or text, and provide useful information about them. With the help of Optical Character Recognition (OCR), users can easily extract text from scanned images of books or even hand-written documents. AI also improves features like smart cropping and edge detection in scanning apps.

- **Search Engines:** Finding information online is one of the most basic internet activities. Search engines help users quickly find the information they need. What makes search engines so effective is Artificial Intelligence? AI helps analyse search queries and provides the most relevant results. Whenever you search for information online, you are using AI technology.

Understanding what is not 'AI'

Artificial intelligence is used in a number of ways in our daily lives. But do all smart machines use AI? The answer is no! Some machines only follow fixed instructions. This brings us to the difference between **Automation** and **Artificial Intelligence**.

Automation machines do not think or learn. Instead, they just do what they are programmed to do and producing the same outcome every time. On the other hand, Artificial Intelligence machines can not only think and learn from data but also make decisions.

For example,

A microwave oven heats food for a set time, or a traffic light system changes at fixed intervals. They are **smart** in doing tasks, but they **do not think** or **learn**.

Automation	Artificial Intelligence
Works on fixed rules and present instructions	Works by learning from data
Does not think or learn	Can think, learn, and improve
Same input gives same output every time	Output may differ as it learns continuously
Cannot manage new situations	Can manage new and unfamiliar situations
Human intervention is needed for changes	Can adjust its behaviour on its own
Example: Traditional Washing Machine, Standard Traffic Signals	Example: Voice Assistance, Face recognition

Human Intelligence and Machine Intelligence

The ability of AI-powered machines to think and learn raises a question: how is the intelligence shown by these powerful machines different from human intelligence? Understanding this lets us compare human intelligence with machine intelligence.

Human Intelligence	Machine Intelligence
Human Intelligence develops naturally through biological evolution and experience.	Machine Intelligence is created using algorithms and learns patterns from data through training.
Learns from experience, senses, emotions, and reasoning.	Learns from data, algorithms, and pre-defined rules.
Highly adaptable to new and unpredictable situations.	Limited adaptability, depends on programming and data.
Capable of original thought, creativity, and imagination.	Relatively limited creativity, mostly follows patterns and data.
It can perceive and respond to emotions.	Lacks true emotional understanding, simulates responses.
Slower processing speed, prone to errors.	Faster processing speed, high accuracy in many tasks.
Has self-awareness and consciousness.	No consciousness or self-awareness.

How does AI learn?

AI systems become intelligent because they can learn from the data. Data means information such as pictures, text, numbers, or sounds. AI studies this data to find patterns and improve its performance. Data may be labelled or unlabelled.

- **Labelled data** means the data already has a **predefined label or tag** assigned to it.
- **Unlabelled data** means the data does not have any **labels or tags** assigned.

Let's say a teacher collects students' notebooks after a test in a class.

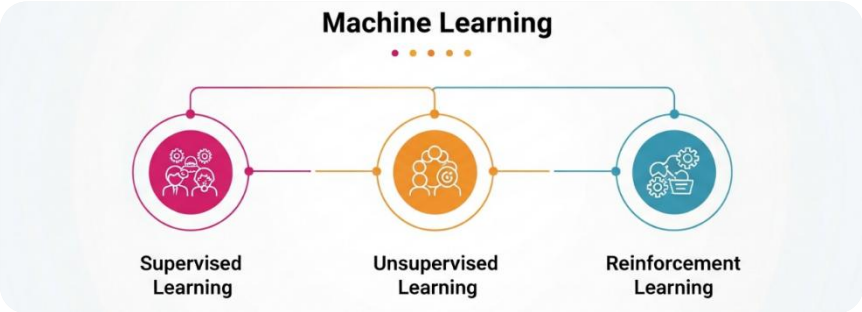
- If every book has the student's name written on it, the teacher knows whose book it is. This is like labelled data because each book already has the correct label (the student's name).
- If the books do not have names written on them, the teacher has to figure out whose book it is by looking at the handwriting or answers. This is like unlabelled data because there is no label to tell the correct owner.

What is Machine Learning?

The ability of AI to learn from data is called **Machine Learning** (ML). It is a branch of AI that enables machines to learn from data and improve their performance over time without being explicitly programmed for every task. In ML, algorithms are used to create models, which are trained using data. **Training** is the process by which the model learns patterns from data. By analysing large amounts of data, AI systems can make predictions, recognize patterns, and make decisions. Based on how data is used and how AI learns, Machine Learning is mainly divided into three types.

The three fundamental concepts of Machine Learning are:

- Supervised learning
- Unsupervised learning
- Reinforcement learning



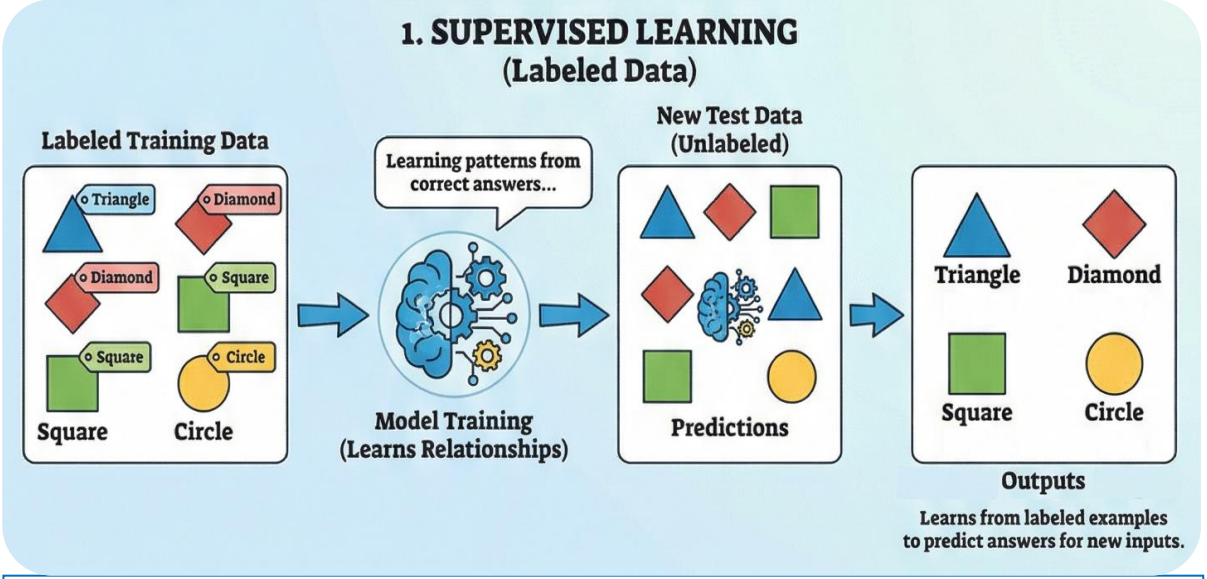
1. Supervised learning

Supervised learning is a type of machine learning where the machines learn from data that already has correct answers. The model learns the relationship between input data and their related output data, allowing it to make accurate predictions on new data. In this approach, the data provided to the model already includes the correct answers, enabling it to recognize patterns that lead to those answers. It is one of the simplest types of machine learning to implement and powers many modern applications.

Supervised Learning (Uses labelled data)

1. Email spam detection: Classifying emails as spam or not spam.
2. Image recognition: Identifying objects like cats, dogs, or cars in pictures.
3. House price prediction: Predicting house prices based on size, location, and features.
4. Handwritten digit recognition: Recognizing numbers written by hand (like in bank checks).
5. Medical diagnosis: Predicting diseases based on patient data and symptoms.

Key Concepts:



This diagram shows supervised learning. First, labelled data with different shapes (such as triangles, diamonds, squares, and circles) is used to train a model. Each shape has a correct label, helping the model learn how to tell them apart. After training, the model is given new data without labels. It uses what it has learned to identify the shapes and predict the correct labels. This shows how a trained model can classify new data based on patterns it has already learned.

2. Unsupervised learning

Unsupervised learning is a type of machine learning in which machines study data to identify hidden patterns, structures, or groupings. In this approach, the model learns from the patterns in data without any predefined labels or outputs.

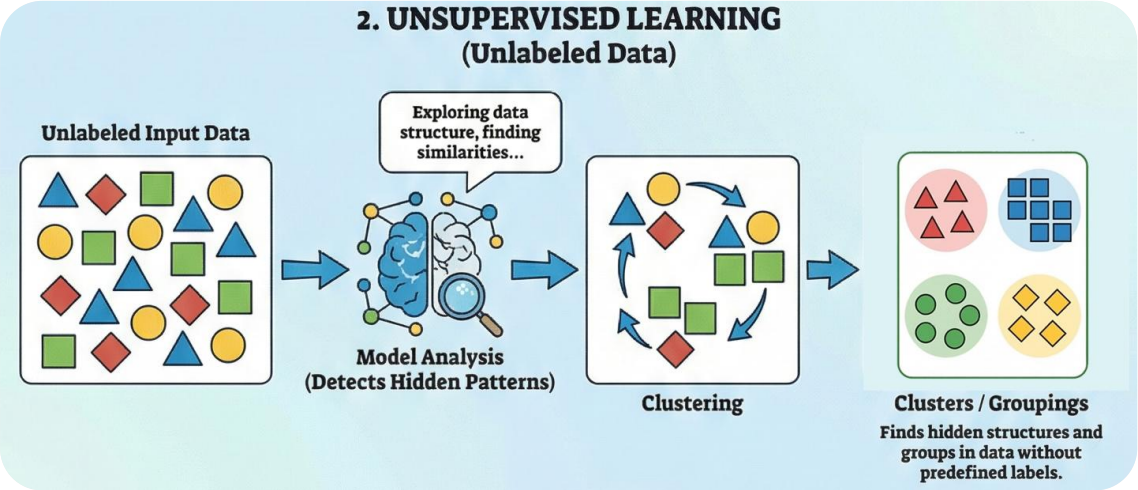
Unlike supervised learning, unsupervised learning does not provide definite guidance or correct answers to the model. Instead, the model independently explores the data to discover meaningful patterns and relationships. It is commonly used for tasks such as clustering similar data points and detecting anomalies in datasets.

Unsupervised Learning (Uses unlabelled data)

1. Customer Segmentation: Grouping customers with similar buying habits.
2. Market Basket Analysis: Finding products that customers often buy together.
3. Document Clustering: Grouping similar articles or news topics.
4. Anomaly Detection: Detecting unusual transactions in banking or fraud detection.

5. Social Network Analysis: Finding communities or groups with similar interest

Key Concepts:



This diagram shows unsupervised learning. In this approach. In this method, the model is trained on unlabelled data, such as various shapes. Since there are no specified labels, the model learns by finding patterns and similarities in the data. It then organizes comparable objects into clusters. When new data is introduced, the model assigns it to the most appropriate group based on patterns it has learned. This method is widely used for clustering and learning hidden patterns in data.

3. Reinforcement learning

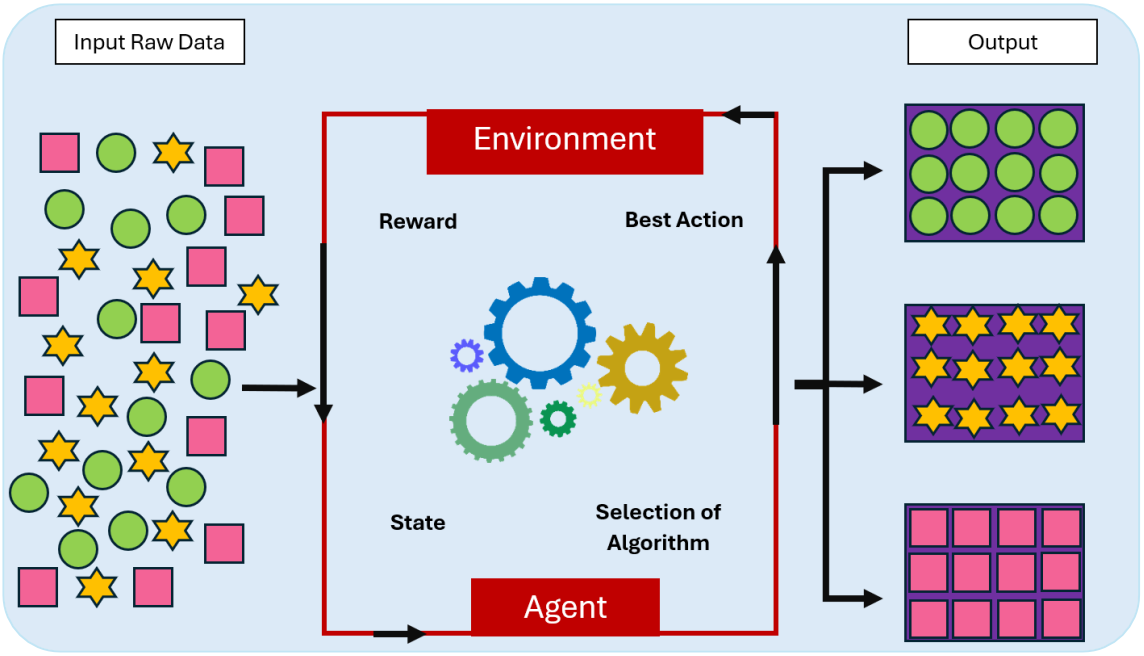
Reinforcement learning (RL) is based on trial and error. In this type of learning, machines learn by constantly searching for new and innovative approaches to solve a problem and improve the methods that maximize the defined reward. This type of learning is frequently used in robotics and gaming.

For example, a chess program based on RL learns by experimenting with several moves without knowing which one is the best. When it makes a successful move or wins a game, it receives a reward, and when it makes a wrong move or loses, it receives a penalty. By repeatedly playing and learning from rewards and penalties, the program gradually improves its strategy and learns how to play the game better.

Reinforcement Learning (Learning through rewards and penalties)

1. Game-playing AI: Learning to play chess, Go, or video games.
2. Self-driving cars: Learning safe driving decisions.
3. Robot navigation: Robots learning how to move through obstacles.
4. Recommendation Systems improvement: Improving suggestions based on user feedback.

Key Concepts:



This diagram shows Reinforcement Learning, a form of machine learning, where a system learns by trial and error.

What happens is, first, the data system gets some data. Now, within this process we have two key components: the **agent** and the **environment**. The agent is the learner or decision-maker, and the environment holds everything in it.

The agent observes the current situation (referred to as the state) and takes an action. After this action, the environment will provide feedback. This feedback is either a reward (good action) or no reward or reduced reward (not so good action). The new situation is visible in the environment too.

The agent then modifies or improves its decision for the next time based on the reward it gets. As the agent continues to repeat this process over and over, it gradually learns which actions are most optimal. This process eventually allows it to make the right decision, such as correctly selecting or identifying a square, circle, triangle, or diamond.

Points to remember:

- ✓ Intelligence is the ability to learn, think, and solve problems.
- ✓ Not all automated machines use Artificial Intelligence.
- ✓ AI learns from data using Machine Learning.
- ✓ AI improves its performance over time through experience and feedback.
- ✓ There are three types of Machine Learning: Supervised, Unsupervised, and Reinforcement.

Exercise

A. Multiple Choice Questions.

1. What is labelled data?
   a) Data without any tags
   b) Data with predefined labels or tags
   c) Random data
   d) Incorrect data
2. Who introduced the Turing Test?
   a) John McCarthy
   b) Alan Turing
   c) Charles Babbage
   d) Isaac Newton
3. In supervised learning, data is:
   a) Unlabelled
   b) Random
   c) Labelled
   d) Deleted
4. Predicting exam marks based on the trained data uses:
   a) Supervised Learning
   b) Unsupervised Learning
   c) Reinforcement Learning
   d) All of the above
5. Which of the following is not AI?
   a) Voice assistant
   b) Face recognition
   c) Traditional traffic signal
   d) Smart chatbot

B. Fill in the blanks.

1. Intelligence includes the ability to learn and _____ problems.
2. AI is a technique to make intelligent_____.
3. Automation works on fixed _____ and preset instructions.
4. Unsupervised learning is mainly used for _____.
5. Machine Learning allows machines to learn from _____.

C. Short answer questions.

1. Define intelligence in your own words.
2. State two differences between automation and AI.
3. What is reinforcement learning?
4. Name the three types of Machine Learning.
5. Give two examples of AI used in daily life.

D. Think and apply.

Identify the Type of Machine Learning

Scenario	Type of Learning
Grouping customers based on shopping habits without label	
Predicting house prices based on past labelled data	
A game AI improving after winning or losing	
Sorting emails into spam and not spam	

E. Classify the following as AI or Automation.

Example	AI or Automation?
Traffic light changing at fixed intervals	
Face Recognition System	
Washing machine with preset timer	
Voice assistant answering questions	

Chapter 2: Basic Data Concepts

In today's digital world, data is everywhere and plays a significant role in our daily lives. Therefore, understanding the basic concepts of data, its types, and analysis is very important in today's information-driven society.

Recording Attendance	Sending Messages	Checking Weather	Watching Videos Online	Using a Fitness App

Weather apps, for example, collect data from satellites and weather stations, whereas map applications use traffic data from a large number of users to recommend faster routes. A School report card is prepared by compiling attendance records and students' marks. In this way, data helps in understanding any situation, comparing information, and make better decisions.

What is Data?

Data means raw information that can be processed and analysed to get useful information, which provides meaningful insights for decision-making.

For example,

- The Number of friends you have
- The Weather report that tells the temperature
- The Marks you score in your exam
- The List of books in your school library

Hence, data consists of raw facts, and when it is organised and processed, it becomes information that helps us make correct decisions.

Importance of Data in Daily Lives

Decision Making

Data provides information, patterns, and results from the past, which makes it easy to make decisions. It does not depend on opinions or assumptions; one can study data to understand what has worked before and what needs improvement.

For example, exam result data can help the teacher understand which subject the student is struggling with and which subject the student is excelling at. Sales information, on the other hand, can help the store owner decide which items need to be stocked or which items need to be removed immediately. Using data correctly reduces uncertainties and leads to more reliable decisions.

Business Growth

Data like sales records, customer feedback, helps in identifying customers' choices and preferences, improving products and thereby reduce losses and increase profit.

Scientific Research and Development

Data forms the foundation of every scientific investigation. Researchers conduct experiments, observe results, and gather survey data, all with the goal of collecting information. With this data, they look for patterns, test assumptions, and draw correct conclusions. Trustworthy data fuels advancement in medicine, space exploration, and environmental research. Without it, progress comes to a halt.

Enhancing Cybersecurity

Cybersecurity systems always study large data sets to look for unusual activities and potential threats from the past and predict the vulnerabilities that may appear in the future. This makes the security systems stronger. Security systems gather data by analysing login information, network traffic, and access patterns to find out what went wrong and stop it from recurring.

Personalised User Experience

While using digital platforms, a user gets a personalised experience with the help of data. Apps and websites use data such as your search history and your preferences to show relevant content. For example, shopping apps suggest products based on past purchases, and music apps recommend songs based on what kind of music you prefer.

Types of Data

Data can come in many forms, such as numbers, text, pictures, video, and sounds. Each form has its own meaning, which affects how it is used and interpreted.

Let us explore primary data types detailing their properties and applications.

Numerical data (Numbers and Values)

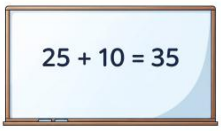
Numerical data is made up of numbers. You can count or measure this kind of data.

For example,

- Counting objects using numbers
- Measuring length using numbers
- Performing calculations using numbers
- Numbers used for counting and calculation

Counting Objects

Measuring Length



Calculation

Number Symbols

Text data (Words and Sentences)

Text data is made up of letters, words, or sentences. Text data helps you put things into words.

For example,

- A name written using letters
- List of names used for identification
- Written address
- Written communication through letters

Written Name

List of Names

Written Address

Written Messages

Image data (pictures and visuals)

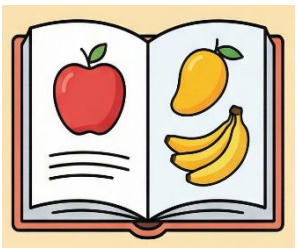
Pictures, drawings, or photos make up image data. Pictures make it easy for people to see and understand information.

For example,

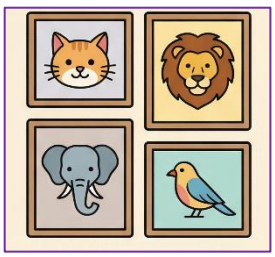
- An image of your pet
- You use emojis in chats
- A picture of your favourite fruits
- Collection of images

Image of a Pet

Emojis



Illustrated Pictures



Collection of Images

Video Data (Moving Visuals)

Video data is made up of moving pictures, sometimes with sound. Video data helps us see actions and understand events clearly.

For example,

- A movie in a theatre
- CCTV Footage
- Video Footage
- Online Meeting

Movie in Theatre

CCTV Security System

Video Footage

Online Meeting

Sound Data (Audio and Voice)

Sound data is made up of sounds, speech, or music. Sound data tells us what something sounds like.

For example,

- Voice recording waveform
- Listening to music
- The sound of your school bell
- Voice Communication

Voice Recording

Listening to Music

Bell Sound

Voice Communication

Collecting Data

Collecting Data means gathering information from people, books, the internet, or instruments to support analysis and making correct decisions.

Let us learn the various methods we can use to collect data in our daily lives.

Common sources are:

- **People**: Asking questions or surveys
- **Books**: Reading facts or information
- **Internet**: Searching for information online
- **Instruments**: Thermometer (for temperature), clock (for time), scale (for weight)

Examples of Data Collection

- Counting the total number of plants in the school premises
- Asking your classmates about their hobbies and writing down their answers
- Measuring your plant's height every week to see how it grows

This is how we collect data to learn or compare things.

Organising Data

Organising Data is the process of arranging, sorting, and classifying raw data into a logical, usable format. Remember, effective data organisation is important for finding, retrieving, sharing, and maintaining files to avoid loss or accidental disclosure.

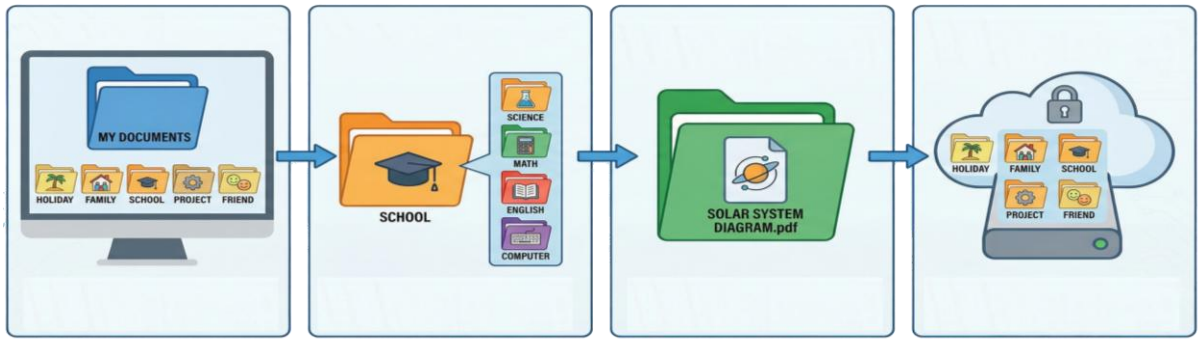
Organising Data in a systematic manner:

- **Classification:** Grouping of similar kinds of data
- **Structuring:** Arranging data into separate folders or a tabular format
- **Labelling:** Giving correct, clear, and descriptive names
- **Storage:** Saving data in appropriate and secure systems

For example,

Organising a Desktop:

→ A student has saved 50 images randomly on the desktop.
→ He needs to find an image for his science project.
→ Now he understands the importance of organising data.



Classification | Structuring | Labeling | Storage

Representing Data

Representing data means using tables and charts for accurate details and for visual comparisons. Tables organise information in rows and columns, while bar charts compare categories using proportional rectangular bars, and pictograms use symbols to represent data, thereby making complex data easy to understand.

Using Tables for Data Presentation

Objective: Tables arrange data in rows and columns so that it is simple to read and find specific values.

Structure: Each cell has data that consists of categories in columns and subcategories in rows.

Benefits: Excellent for comprehensive information and when exact numbers matter more than trends.

For example,

Family Kitchen Menu

The Scenario:

In a big family, everyone has different food preferences. The person managing the kitchen is getting confused with everyone's choices. You have been asked to organise the meal details in a table so that everything runs smoothly.

The Data:

After asking each family member, here are their meal preferences:

- ☆ **Grandfather:** Prefers soft chapatis with dal and a glass of warm milk.
- ☆ **Grandmother:** Likes vegetable khichdi and a cup of tea.
- ☆ **Father:** Wants rice, curds, and a glass of buttermilk.
- ☆ **Mother:** Prefers salad, soup, and fresh juice.
- ☆ **Brother:** Asked for a sandwich and a health drink.
- ☆ **Sister:** Wants spinach rice and a glass of lemonade.

The Task:

1. **Organize** this information into a neat table.
2. Your table must have the following columns: **Family Member**, **Food Item**, **Drink Item**.

The Table

Family Member	Food Item	Drink Item
Grandfather	Chapati and Dal	Warm Milk
Grandmother	Khichdi	Tea
Father	Rice and Curds	Buttermilk
Mother	Salad & Soup	Fresh Juice
Brother	Sandwich	Health Drink
Sister	Spinach Rice	Lemonade

Using Charts for Data Presentation

Objective: Charts transform numbers into pictures so you can see patterns, trends, and make quick comparisons.

Key Principle: The main idea is to plot data on coordinate axes, with the X-axis for categories and the Y-axis for values.

Types: Bar charts, line graphs, pie charts, scatter plots, and pictograms are some of the common charts.

Simple Bar Charts & Pictograms

Bar Charts:

Objectives: Uses rectangular bars, which can be vertical or horizontal, where the length or the height is proportional to the value.

Components: X-axis (categories), Y-axis (values/frequency), uniform bar width, and spacing.

Use: Excellent for comparing discrete categories (for example, sales by product).

For example,

The Lemonade

The Scenario:

Two friends, Aana and Sana, start a business of selling Lemonade. They sell three things at their school fair:

- 🍋 Regular Lemonade
- 🍓 Strawberry Lemonade
- 🍪 Lemon Cookies

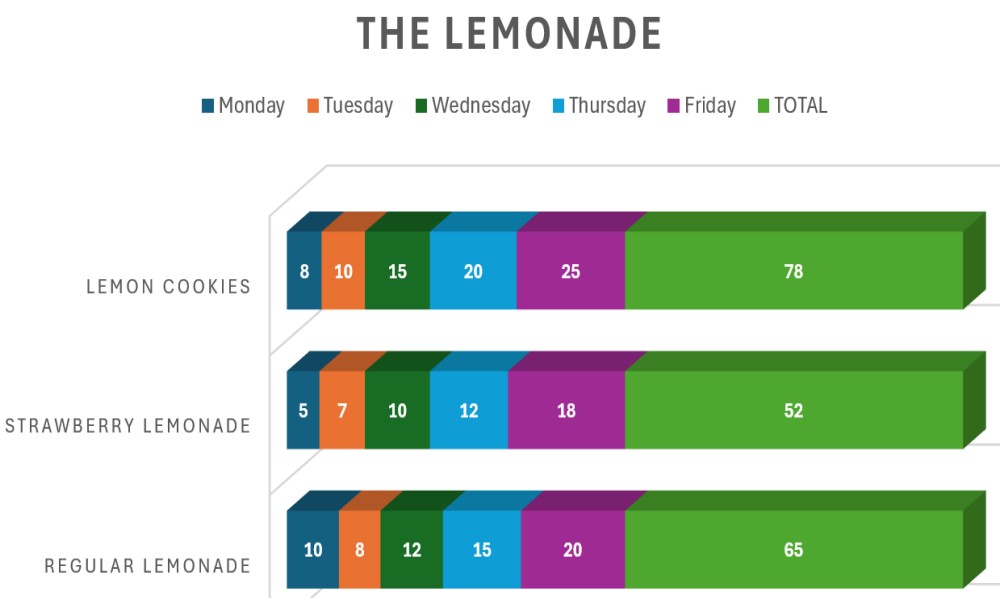
They want to know which item sold the most so that they can make more of it next time. You are the incharge of their business. To understand the sales, you need to make a bar chart.

The Sales Data (Monday to Friday):

Product	Monday	Tuesday	Wednesday	Thursday	Friday	**TOTAL**
Regular Lemonade	10	8	12	15	20	**65**
Strawberry Lemonade	5	7	10	12	18	**52**
Lemon Cookies	8	10	15	20	25	**78**

The Task:

1. Create a **Bar Chart** that shows how many of each product were sold in total.
2. Label the X-axis with Products and the Y-axis with Number Sold.
3. Give the chart a business title.



Pictograms

Objectives: Uses pictures or symbols to represent data quantities.
Components: A clear title, a key that explains what each picture means, for example, 1 image = 100 people, and evenly spaced, same-sized pictures.
Benefits: Great for simple data sets, as they are fun and easy to use.

For example,

The Eco Club Plantation Drive

The Scenario:

It was the Environment Week, and the Park Valley School Eco Club planned a tree-planting drive and students from Classes 6 to 9 participated enthusiastically. The school Principal wanted to know which class planted the most trees so they can be recognized during assembly.
You are Incharge of presenting the data. To understand the plantation results, you need to create a pictogram.

The Plantation Data:

Class	Trees Planted
Class 6	20
Class 7	15
Class 8	25
Class 9	10

The Task:

1. Create a Pictogram showing how many trees each class planted.
2. Add a clear title to the Pictogram.
3. Add a key so everyone knows what one tree symbol means.

4. Identify which class is the winner?

Key: 🌲 = 5 Trees

Pictogram:

The Eco Club Plantation Drive		
Class	**Trees Planted**	**Position**
Class 6	🌲🌲🌲🌲	2nd
Class 7	🌲🌲🌲	3rd
Class 8	🌲🌲🌲🌲🌲	★ Winner
Class 9	🌲🌲	4th

Points to remember:

- ✓ Data is information we collect, such as numbers, words, pictures, or sounds, which helps us understand things and make better decisions.
- ✓ Data can be numerical (numbers), text (words), image (pictures), or sound (audio).
- ✓ Data is collected from various sources like surveys, observations, schools, hospitals, and weather reports.
- ✓ Data is arranged neatly in rows and columns using tables to make it easy to read and understand.
- ✓ Data can be shown clearly using tables, bar charts, and simple pictorial representations.

Exercise

A. Multiple Choice Questions.

1. A teacher analyses last year's exam results to improve teaching methods. This is an example of:
   a) Guesswork b) Using data for decision-making
   c) Random selection d) Entertainment
2. A fitness app counts your daily steps and shows weekly progress. What type of data is mainly collected?
   a) Image Data b) Text Data
   c) Numerical Data d) Sound Data
3. A weather app predicts rain using satellite information. This shows that data helps in:
   a) Playing games b) Making future predictions
   c) Writing stories d) Sending messages
4. A security camera records activities at the school gate. What type of data is mainly collected?
   a) Text Data b) Video Data
   c) Image Data d) Numerical Data
5. Which of the following is an example of Image data?
   a) Your name b) Your address
   c) Your age d) Your photograph

B. Fill in the blanks.

1. Data means raw_____ and figures.
2. Tables arrange data in rows and _____.
3. Text data is made up of letters, words, and _____.
4. Grouping similar kinds of data is called _____.
5. Saving data in secure systems is known as_____.

C. Short answer questions.

1. What is Data?
2. State any two important aspects of Data in daily life.
3. Name the four main types of Data.
4. What is the difference between a table and a chart?
5. Define classification and labelling in Organising Data.

D. Think and apply.

1. A student measures the height of a plant every week. What type of data is being collected?
2. A teacher wants to compare the marks of students clearly. Should she use a table or a bar chart? Give one reason.
3. A shopping app suggests products based on your previous searches. How is data being used in this situation?
4. Your desktop has many mixed files with random names.

E. Classify the following as AI or Automation.

Example	Type of Data
Exam Marks	
A voice message	
School ID photo	
Your home address	
Number of students in the class	

Chapter 3: Simple Pattern Recognition and Decision Making

What is a Pattern?

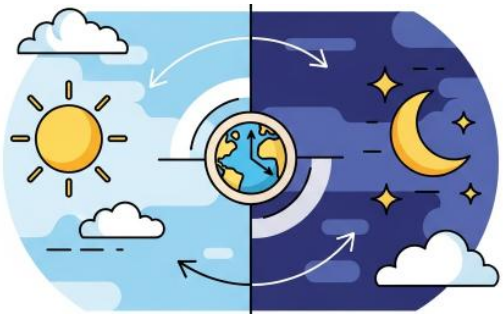
A pattern is a regular, consistent, repeated, or predictable sequence of elements like numbers, shapes, text, colours, or actions. Patterns can be seen everywhere around us. Just like in Mathematics, we see sequences like 2, 4, 6, 8; similarly, in art, we see repetition in designs, in science, we see weather cycles, and in our everyday life, we see changing seasons and days. These patterns provide a framework for predicting and understanding behaviours.

Importance of Patterns

- **Symmetry:** A pattern is something that may look the same every time it appears and can be repeated.
- **Series:** A series is a group of items, like numbers, forms, or events, which may all be connected by the same rule or relationship. For example, numbering by twos, or a pattern that repeats.
- **Predictability:** If you can see a pattern, you can figure out what will happen next, whether it is the next number in a sequence or the next event in a cycle.
- **Behaviour:** Patterns can be visible, like stripes or dots, or behavioural like habits or routines.

Patterns in Things We Do Every Day

Routines: Getting up, eating breakfast, and going to school are all things that happen every day.

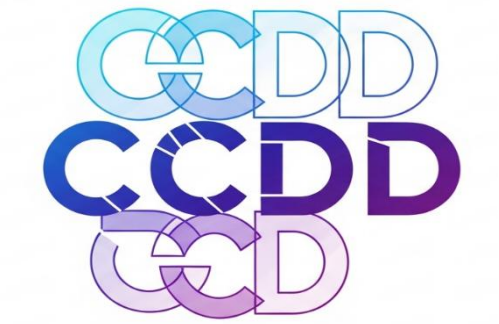


Schedules: Time patterns include the cycle of days and nights and the changing of the seasons.

Chores: Doing our homework and eating right can mean doing the same things over and over.

Shopping: Watching when grocery stores have sales or when they have to restock their items.

Nature: Natural patterns include the way leaves grow on a stem, the way birds migrate, and the spirals in a sunflower.



Language: Rhyming patterns in songs and poems, like CCDD are patterns in words.

Identifying Patterns

Identifying patterns means looking at data or events to see if there are any sequences, similarities, or behaviours that follow a rule or show a particular trend. Identifying patterns is useful for everything from understanding how to solve everyday problems to more advanced Data Science because it helps you predict what will happen, organize things, and make decisions.

For example,

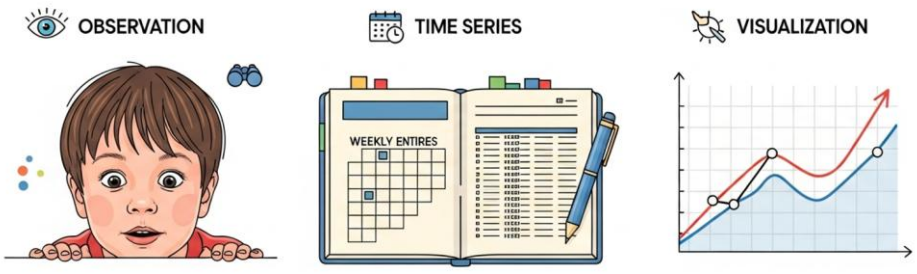
You have a basketball game every Friday. You practise for an hour after school every day, and you realize that you score a lot more points and your game improve noticeably. However, if you do not practice, your game will be affected, and you will score fewer points. When you notice this pattern, it makes sense; practice helps you improve. So, rather than waiting until game day, you should practice a little every day. You do not need to guess anymore; you know what works.

Recognising Repeated Actions or Events

To recognize repeated actions or events, you need to find things that happen over and over again or in response to a certain situation. These repetitions create patterns or habits that can be predicted.

Methods of Recognising Repeated Actions or Events

- **Observation:** Simple observation over a period of time is the most basic method for identifying repetitions.
- **Time Series Analysis:** This method evaluates data collected over time to identify variations in time such as seasons and trends over time.
- **Data Visualisation:** Sequences that repeat in data can be easily understood by using charts and graphs.

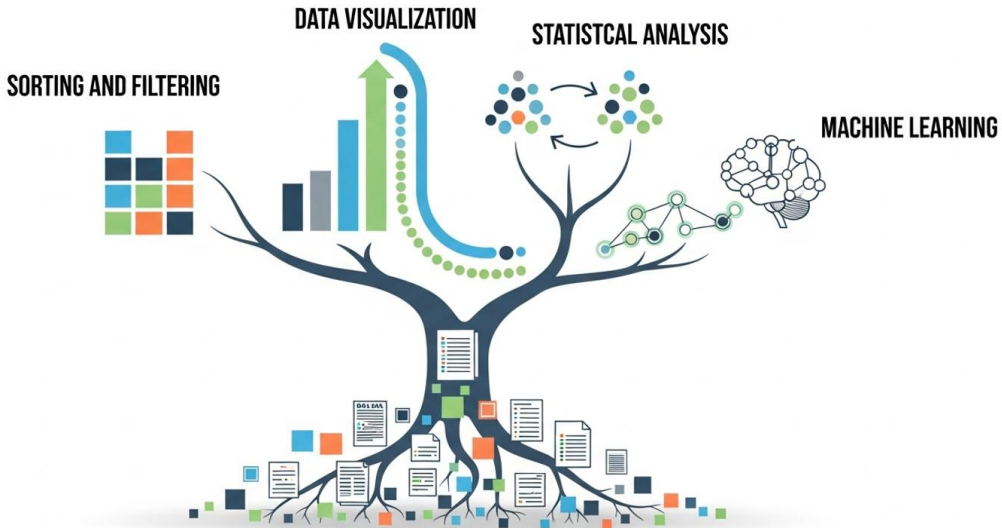


Finding Similarities in Data

Finding similarities in data means sorting data that have similar characteristics or elements. This sorting of data makes huge complex datasets into manageable and meaningful subsets.

Methods of Finding Similarities in Data

- **Sorting and Filtering:** Sorting data by its attributes makes it easier to identify groups with similar characteristics.
- **Data Visualisation:** The use of charts and graphs makes it simpler to understand a complex dataset.
- **Statistical Analysis:** Helps to understand large datasets, group similar data, understand connections between several factors, and see how changes in one can affect the other.
- **Machine learning:** Machine learning models are trained using data so they can identify patterns and make predictions or decisions.



Observations and Conclusion

Making observations from data is looking for patterns, trends, and key findings, while drawing conclusions, which means understanding and applying these observations to answer your questions.

Making Observations from Data (What did you see?)

- **Identify Key Findings:** What were the most important numbers, patterns, or relationships you observed in your data?
- **Look for Repeating Patterns:** Are there repeating themes or groupings in your data?
- **Note Irregularities:** What stands out as unusual or unexpected in your data?
- **Use Visuals:** Graphs and charts show patterns that might be hidden in raw data.

Examples:

- The number of students present is higher on Tuesday than on Monday
- The temperature is higher in the afternoon than in the morning
- More students like Cricket than Football

Drawing Simple Conclusions (What does it mean?)

- **Answering the Question:** A conclusion tells us the answer to the question we were trying to find from the data.
- **Explaining Why It Happened:** It explains why a pattern was seen in the data, like sales increased because more people liked the discount.
- **Learning a General Idea:** From small observations, we form one general idea; for example, if all plants grew better with water, we could say plants need water to grow.
- **Knowing the Limits:** Sometimes the data is small or limited, so the result may not apply everywhere.
- **Thinking of What Comes Next:** Conclusions help us think about new questions or what we should study next.

Examples:

- Students may feel more active after the weekend
- Afternoons are usually warmer than mornings
- Cricket is the most popular sport in the class

Decision Making

Decision-making means choosing what action to take after thinking carefully about the information available. In daily life, we often face situations where we must choose between two or more options. Good decision-making helps us select the option that is more useful, safe, or beneficial. Understanding the situation before making decisions usually leads to better results.

Making Simple Decisions Based on Observations

We make decisions by observing what is happening around us. Observations help us see patterns, changes, and results from the past. By looking at these observations, we can understand which decision gave reliable results and which ones did not. This helps us make better choices in similar situations and prevent repeating mistakes.

Examples of Decisions in Daily Life




- Deciding to revise a subject again after observing low marks in a test
- Carrying an umbrella after observing cloudy skies
- Choosing a quieter road after seeing heavy traffic on another route
- Saving money after observing increased monthly expenses

Points to remember:

- ✓ A pattern is a regular, consistent, repeated, or predictable sequence of elements like numbers, shapes, text, colors, or actions.

- ✓ Identifying patterns means looking at data or events to see if there are any sequences, similarities, or behaviors that happen repeatedly.
- ✓ Patterns in data can appear as simple number patterns or visual patterns like shapes and designs.
- ✓ Making observations from data involves looking for patterns, trends, and key findings, while drawing conclusions which means understanding and applying these observations to answer your questions.
- ✓ Decision-making means choosing what action to take after thinking carefully about the information available

.

Exercise

A. Multiple Choice Questions.

1. A student notices that every morning, he wakes up, brushes his teeth and eats breakfast in the same order.
   What does this represent?
   a) A random action b) A pattern
   c) A single event d) A mistake
2. Making observations from data means:
   a) Changing the data b) Looking for patterns and key findings
   c) Making guesses d) Hiding results
3. Arranging data by its attributes to find similar groups is called:
   a) Machine learning b) Sorting and Filtering
   c) Entertainment d) Prediction
4. Drawing a conclusion means:
   a) Copying data b) Understanding and applying observations
   c) Creating confusion d) Repeating the same data
5. Decision-making means:
   a) Acting without thinking b) Choosing an action after thinking
   c) Ignoring facts d) Random guessing

B. Fill in the blanks.

1. A pattern is a repeated and predictable _____of elements.
2. Identifying patterns means looking for repeated_____ or similarities in data.
3. Making observations from data means looking for patterns, trends, and _____ findings.
4. Drawing a conclusion means understanding observations to answer a_____.
5. Decision making means choosing an action after thinking carefully about the_____ available.

C. Short answer questions.

1. Define a pattern and give one example from daily life.
2. Name any two methods used to recognise repeated actions or events and briefly explain one of them.

3. Why is predictability important when identifying patterns?
4. What is statistical analysis used for when studying large datasets?
5. Explain the difference between making an observation and drawing a conclusion with an example.

D. Think and apply.

1. A student measures the height of a plant every week. What type of data is being collected?
2. A student notices that the temperature is higher in the afternoon than in the morning for several days. What is the student doing?
3. A student notices that practising every day improves performance in a Basketball game. What decision can the student make from this observation?
4. A class survey shows that more students like cricket than football. What can the teacher conclude from this data?

E. Identify the Method Used.

Situation	Method Used
Watching daily rainfall for a month	
Arranging students by height	
Using graphs to compare sales	
Studying trends over five years	
Using an algorithm to recognise faces	

Chapters 4: Ethics and Digital Responsibility

Technology is everywhere around us. It helps us learn, communicate and explore the world.
But think for a moment.
When we cross a road, do we just run across? No, we look both ways.
When we are in school, do we shout in the classroom? Of course not. We follow rules.
In the same way, when we use the internet and digital devices, we must also behave responsibly. Being careful, respectful and honest while using technology is called Digital responsibility.
Before we begin, let us consider a few important questions:

- ↳ What does it mean to behave properly online?
- ↳ How can we stay safe on the internet?
- ↳ Why are passwords so important?
- ↳ What happens to the information we share online?
- ↳ Let us begin our journey into the world of Ethics and Digital Responsibility.

Responsible Use of Technology

Technology is used in many aspects of our daily life, such as communication, education, entertainment, and financial transactions. Technology makes many things easier.
Examples:

- Students can learn difficult subjects by watching educational videos.
- Families who live in different cities can talk and see each other through video calls.
- A cell phone makes it easy to contact the police or doctors in an emergency.

We need to follow rules when we use technology, just like we do when we drive. The Internet can be useful, but it can also be **dangerous** if we are not **careful**. Being responsible with technology means thinking before you click, being careful about what you share, and being respectful to other people online.
When we use technology in a wise and polite way, we become responsible **Digital Citizens** who know how to keep ourselves and others safe.

What is Ethics?

Ethics means knowing what is right and wrong and choosing to do what is right.
Think about your everyday life.
If you find a lost pencil box in class, what should you do? Return it to the owner, right?
If your friend is upset, do you laugh at him or try to help? Most of us try to help.
These choices show ethical behaviour.
Ethics refers to the principles that help us distinguish between right and wrong and guide us to make responsible choices.
Ethical behaviour includes honesty, respect for others, and taking responsibility for one's actions.

Ethical Use of Technology

Computer Ethics is the set of rules that we must follow while using computers for various purposes. These rules prohibit misusing or accessing information that belongs to others. The importance of understanding computer ethics has grown because of problems like cybercrimes, plagiarism, hacking, and password thefts. Computer ethics provides a secure computing environment.

Internet Safety: A Case Study

Meet Arjun and His Digital Disaster

Arjun was a student in Class 6. He loved using the computer and believed he knew everything about it.

One day, his teacher gave the class a project on Save Water. Arjun wanted to finish it quickly so he could play games. He searched on the Internet, found a good essay, copied it, changed a few words, and submitted it.

"Done! Now I can play games," he said happily.

The Next Day

Arjun received an email. It looked like it came from his favourite gaming website.

The email said:

'CONGRATULATIONS ARJUN!
You have won a free game.
Click here to claim it now.'

Arjun became extremely excited.

"A free game? That is amazing!" he said.

Without thinking much, he clicked the link.

Suddenly, an advertisement popped up on his screen.

'WARNING! Your computer has a virus.
Click here to scan your computer for free.'

Arjun just wanted the message to disappear, so he clicked again.

One Week Later…

When Arjun turned on his computer, something was wrong. The computer was terribly slow. He opened his project folder. It was empty. All his files were gone. Even worse, strange messages had been posted from his social media account.

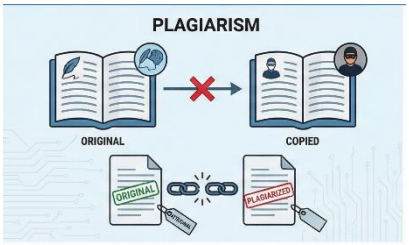
Arjun realised that he had made some serious mistakes while using the Internet.

Think About It

What mistakes did Arjun make?

Let us find out what mistakes Arjun made and learn how to stay safe while using the Internet. Some of these problems occur because of certain **unethical practices on the internet**.

Unethical practices prevalent in society, related to internet:



Plagiarism: Plagiarism is the act of copying or making minor modifications to a sentence or paragraph without referring the original author.

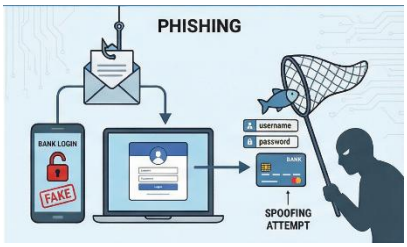
Steps to prevent Plagiarism:

- Always get a formal approval from the original author
- Always acknowledge and give proper credit to the original author
- Use quotation marks when copying exact text
- Try to express ideas in your own words

Hacking: Hacking refers to the unauthorized access to computer systems or networks with the intention of stealing, modifying, or misusing data.

Steps to prevent Hacking:

- Install firewall, antivirus and scan your hard disk drives periodically.
- Never share your password and always keep a strong password that should contain numbers, special characters, small letters, capital letters, and keep changing it periodically.
- Do not click on any ads that claim to scan viruses on your computer.
- Hackers often look for an open Bluetooth signal to gain access to your computers, so avoid keeping Bluetooth on unnecessarily and be careful while using public Wi-Fi.



Phishing: Phishing is an illegal attempt to obtain confidential information, such as usernames, passwords, bank details, and credit card details. This is done by sending fake emails, text messages or creating websites that look like they are from authentic companies. This type of attack is also known as spoofing.

Steps to prevent Phishing:

- Do not click on suspicious links or attachments in emails or messages.
- Check the sender's email address carefully before replying.
- Be careful of messages asking for urgent personal or bank information.

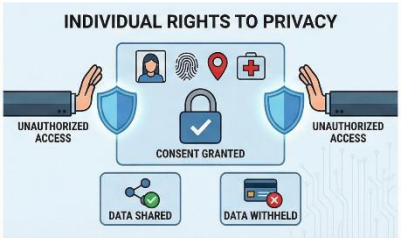
Spamming: Spamming is one of the most common methods of sending unwanted junk mail, or messages from unauthorized people. It involves the mass distribution of junk messages, advertisements, or inappropriate content to email accounts through social networking sites, commercial websites, or personal blogs.

Steps to prevent Spamming:

- Do not click on suspicious pop-up ads or links.
- Avoid sharing your email address on unknown websites.

- Use spam filters to block unwanted emails.
- Do not respond to or open emails from unknown senders.

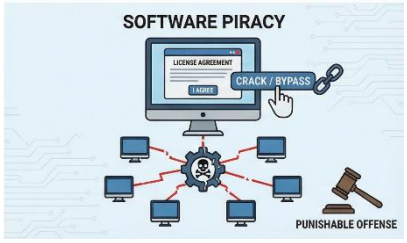
Individual rights to privacy: Individual right to privacy refers to the right that you are given to access your personal information and how it is used. Privacy is a concern that occurs when personal information is obtained, shared, or used without the approved person's consent.



Steps to protect privacy:

- Limit posting pictures and unnecessary sharing of information on social media.
- Never give out any of your password and bank details.
- Beware that any important or personal information that you provide may be shared, so it is best to read the privacy policy before signing up for an app or service.

Software Piracy: Software Piracy is the unauthorized copying, sharing, modification, or use of software. Software piracy is illegal and a punishable offense.



Steps to stop software Piracy:

- Purchase your own licensed software copy.
- Do not make and distribute the copies of the software.
- Download software only from official companies.

Intellectual property rights: Authors, inventors, and artists turn their ideas into a valuable creation called intellectual property. Under the law of intellectual property, the owner is given exclusive right over the use of his/her creation for a certain period of time. Intellectual property is a field of law that aims to protect the creator's hard work while avoiding misuse and illegal piracy.

Steps to protect Intellectual property rights:

- Keep business ideas and trade secrets confidential until secured.
- Apply for a trademark for your business name and logo.
- Copyright your work to prevent unauthorized use.
- Patent your inventions to take legal action if someone uses them without permission.

Digital Footprint

Have you ever walked on sand at the beach? When you walk, your footprints stay on the sand for some time. In the same way, when you use the internet, you leave **digital footprints**.

Digital footprints contain all the records of your online activity, including your feedback on news stories, social media posts, and online shopping records. You create a digital trail each time you post something online, share content, or when a website collects your information by installing cookies on your computer. It may include your IP address, email details, and other sensitive

information you are sharing online. Data shared about you by others may also be added to your digital record.

Types of Digital Footprints

Active digital footprints: Active digital footprints consist of the data you leave when making intentional online choices.

Examples of digital footprints in action:

- Finding any information or posting on the internet creates digital footprints
- Fill out online forms, for example, when you sign up to receive emails or texts
- Agreeing to install cookies on your computers when a browser requests them

Passive digital footprints:
Passive digital footprints are those you leave behind unintentionally or unknowingly.

Examples of passive digital footprints:

- Web sites that install cookies on your device without your knowledge.
- Apps and websites using location data to identify where you are located.
- Social media news and companies use your likes, shares, and comments and deliver ads based on your interests.
- Sometimes it may feel like your phone is listening to you because you see ads about things you talked about. This usually happens because apps use your online activity and interests to show ads.

Steps to protect your digital footprints:

- Before posting anything online, ask yourself if it is something you want everyone to see.
- Avoid giving out your full name, home address, phone number, or school to strangers online.
- Use social media privacy settings to decide who can view your posts.
- Remember, anything online can be permanent. Avoid posting content that could harm your reputation.
- Do not share photos, messages, or information about someone else without their consent.
- Share helpful, kind, or creative content to make your digital footprint a good one.

Importance of Good Digital Behaviour

Good digital behaviour helps you stay safe and be respectful online

1. **Never share any personal information** with strangers through email or any chat window without your parent's permission.
2. **Do not share your password** with anyone except your parents. When using a public computer, make sure you log out of any accounts you have accessed before leaving the terminal.
3. **Do not post photos** or **videos** online unless you have your parents' consent.

4. **Be careful when** someone offers you gifts or money online. Be especially careful if someone asks to meet you or visit your home.
5. **If you receive any messages that make you feel uncomfortable**, or see harmful or illegal content, tell your parents or guardians immediately. They can also contact the police if needed.
6. **Do not illegally download** music, movies, or any software.
7. **Avoid using** public Wi-Fi in places like airports, coffee shops, malls, or restaurants for sensitive activities such as checking email or bank accounts, as these networks may not be secure.

Points to remember:

- ✓ Think before you click, be careful about what you share, and be courteous to other people online.
- ✓ Never give out any personal information to any stranger through email or any chat window without your guardians' permission.
- ✓ Do not post photos or videos online unless you have your parents' consent.
- ✓ Install antivirus and firewall software, scan devices weekly.
- ✓ Ethics are the values that do not cause any harm or damage to anyone.
- ✓ Share helpful, kind, or creative content to make your digital footprint a good one.

Exercise

A. Multiple Choice Questions.

1. Copying text from a website without credit is:
   a) Hacking b) Plagiarism
   c) Spamming d) Phishing
2. You get a message: "Win a free phone! Share your password." You should:
   a) Send it b) Inform your parents
   c) Post online d) Give fake information
3. A pop-up says: *Scan viruses, win $1000!* Safest action:
   a) Click b) Ignore
   c) Ask someone else d) Download scanner
4. Checking bank on public Wi-Fi. Best action:
   a) Check now b) Use secure network
   c) Ask someone else d) Install random app
5. Posting helpful tips online while thinking about who sees them is:
   a) Active footprint b) Passive footprint
   c) Hacker footprint d) Phishing footprint

B. Fill in the blanks.

1. Responsible use of technology means thinking before you _____online.
2. Never give out your _____ information to strangers online.
3. Ethics in technology help prevent _____, plagiarism, and hacking.

4. A phishing attempt is an illegal attempt to obtain_____ information.
5. Active digital footprints are created when you _____ online intentionally.

C. Short answer questions.

1. Define responsible Digital Citizenship and give one example from daily life.
2. Name two ways to protect your privacy online and explain one.
3. What is the difference between active and passive digital footprints?
4. Why is it important to use strong passwords and change them periodically?
5. Explain software piracy and one step to prevent it.

D. Think and apply.

1. A student posts a picture of a school project online. Which type of Digital Footprint is this?
2. Your friend receives an email asking for their bank details. What should the do?
3. A social media app recommends content based on your likes. How is your data being used?
4. You want to download a new game safely. What steps will you follow to avoid malware?
5. You see someone copying your school assignment without permission. Which ethical rule is being broken?

E. Identify the Term.

Description	Identify the term
The act of sending fake emails or messages with the intention of stealing personal information.	
The act of copying someone else's work, text, or project without giving due credit.	
The record of all your online activities, including posts, likes, and websites visited.	
These are the rules and morals that should be followed while using computers and the internet to avoid causing harm.	
A document that explains how a website or app collects, uses, and protects users' personal data.	

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