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CLASS	9TH	CHAPTER	02
SUBJECT	COMPUTER	BOARD	FEDERAL

CHAPTER 2: COMPUTATIONAL THINKING AND ALGORITHMS

Multiple-Choice Questions (MCQs)

1. **For a problem, we face in real world situations. In what sequence we follow the steps:**
   - a) I, II, III b) I, III, II c) II, I, III d) II, III, I
   - **Answer:** c) II, I, III
2. **Following are types of computing problems:**
   - a) I and II b) I and III c) II and III d) I and II and III
   - **Answer:** d) I and II and III
3. **Computational thinking is**
   - a) Programming b) Thinking like a computer c) Coding d) Logically solving problems
   - **Answer:** d) Logically solving problems
4. **To solve Search problems, we need to**
   - a) Provide the moves. b) Provide start state. c) Provide the end state. d) a, b and c
   - **Answer:** d) a, b and c
5. **The eight queens puzzle is the problem of**
   - a) Sorting b) Searching c) Counting d) Both a and b
   - **Answer:** b) Searching
6. **Finding the location of the element with a given value is**
   - a) Search b) Traversal c) Sort d) None of above
   - **Answer:** a) Search
7. **In IPO Charts, we have**
   - a) Input, Plan, Output b) Input, Program, Output c) Input, Process, Output d) Input, Proceed, Output
   - **Answer:** c) Input, Process, Output

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Short Response Questions (SRQs)

1. **What is the major difference in solving simple problems and complex problems?** Simple problems can be solved directly with straightforward steps and minimal planning. Complex problems require breaking them down into smaller, manageable sub-problems using decomposition and abstraction. This structured approach helps manage intricate details and ensures accurate solutions.
2. **Why software designers prefer to use IPO charts?** IPO (Input-Process-Output) charts provide a clear visual layout of how data enters a system, what transformations occur, and what results are produced. They help programmers map out logic clearly before writing actual code, reducing errors and saving development time.
3. **Differentiate between Computational thinking and Logical thinking.** Logical thinking is a general cognitive process of reasoning step-by-step to reach a valid conclusion based on given facts. Computational thinking specifically applies computer science principles—such as decomposition, pattern recognition, abstraction, and algorithms—to formulate solutions executable by humans or machines.
4. **Write four properties of Computational thinking.** The four core properties are decomposition (breaking problems into parts), pattern recognition (finding similarities), abstraction (filtering out irrelevant details), and algorithm design (developing step-by-step instructions). Together, these enable efficient problem-solving across various complex domains.
5. **What are the methods used to design a solution?** Common methods used to design a solution include flowcharts, pseudo-code, algorithms, and IPO charts. These tools allow developers to structure program logic visually or textually before implementing it in a specific programming language.
6. **Which Computational thinking technique breaks down the problem into smaller parts?** Decomposition is the computational thinking technique used to break down a large, complex problem into smaller, manageable, and independent sub-problems. This makes troubleshooting and designing individual module solutions much easier.
7. **Identify 3 computing problems from other subjects that you are studying in your class.**
    1. Calculating projectile motion equations in Physics using algorithmic steps.
    2. Analyzing genetic probability ratios (Punnett squares) in Biology using counting and combinatorics.
    3. Translating grammatical sentence structures into syntax rules in Language studies.
8. **Why do we need to think computationally?** Computational thinking equips us with structured problem-solving skills to tackle complex real-world challenges efficiently. It allows us to automate repetitive tasks, design logical algorithms, and formulate solutions that both humans and computers can process effectively.
9. **The telephone numbers usually have 9 digits. Out of these 9, the first two digits represents the area code and it remained constant within a given area. The last 7**

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digits represents the number, and it cannot begin with 0. How many different telephone numbers are possible with a given area code? The last 7 digits represent the phone number where the first digit cannot be 0 (9 choices: 1–9), and the remaining 6 digits each have 10 choices (0–9). Total possible numbers are $9 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 9{,}000{,}000$ (9 million).

10. **From city A to city B, there are 4 different roads and from city B to city C there are 2 different roads. Draw a map of given situation and identify how many possible routes are there that someone can follow to reach from city A to city C passing by city B?** By the multiplication rule of counting, if there are 4 ways from A to B and 2 ways from B to C, the total independent route combinations are $4 \times 2 = 8$. Thus, there are 8 distinct possible routes to travel from city A to city C through city B.

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Long Response Questions (ERQs)

Q1. Identify whether the given problems are Decision Problem, Counting Problem or Search Problem:

- **a. Does a given binary string have an even number of zeros?** Decision Problem
- **b. Flipping a coin result in Head or tails. I flip a coin 20 times, how many different sequences of heads and tails are possible?** Counting Problem ($2^{20} = 1{,}048{,}576$)
- **c. Does a certain Java program say "yes" to an empty input?** Decision Problem
- **d. How many ways can the letters of the word TRIANGLE be arranged?** Counting Problem ($8! = 40{,}320$)
- **e. N-queens problem: where the goal is to place eight queens on a chessboard such that no queen attacks any other.** Search Problem

Q2. A student has to take one course of physics, one of science and one of mathematics... In how many ways can this student select the 3 courses he has to take?

- **Solution:** According to the Fundamental Counting Principle (Multiplication Rule), the total number of combinations is the product of choices in each category:
  - Physics choices = 3 (P_1, P_2, P_3)
  - Science choices = 2 (S_1, S_2)
  - Mathematics choices = 2 (M_1, M_2)
  - **Total Combinations** = $3 \times 2 \times 2 = 12$ ways.
- **List of 12 Combinations:**

1. (P_1, S_1, M_1)	5. (P_2, S_1, M_1)	9. (P_3, S_1, M_1)
2. (P_1, S_1, M_2)	6. (P_2, S_1, M_2)	10. (P_3, S_1, M_2)
3. (P_1, S_2, M_1)	7. (P_2, S_2, M_1)	11. (P_3, S_2, M_1)
4. (P_1, S_2, M_2)	8. (P_2, S_2, M_2)	12. (P_3, S_2, M_2)

Q3. Create an IPO chart which will accept the ages of four boys and calculate their total age and average age.

- **IPO Chart:**

Input	Process	Output
Accept ages of four boys: age1, age2, age3, age4	1. Calculate total age: Total = age1 + age2 + age3 + age4 2. Calculate average age: Average = Total / 4	Display Total and Average

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Q4. Create an IPO chart of a scenario that allows a user to enter in two numbers and select an operation (+, -, *, /) to get the output.

- **IPO Chart:**

Input	Process	Output
Enter two numbers (num1, num2) and operator (op: +, -, *, /)	1. If op == '+', Result = num1 + num2 2. If op == '-', Result = num1 - num2 3. If op == '*', Result = num1 * num2 4. If op == '/' and num2 != 0, Result = num1 / num2	Display calculated Result

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Q5. The child wants to plan a birthday party for their friend.

- **a) IPO chart of this situation:**

Input	Process	Output
Guest list, budget, venue preference, date/time, menu items	1. Allocate budget across food, decoration, and venue. 2. Send invitations and track RSVPs. 3. Finalize food orders and schedule activities.	Party plan schedule, final shopping list, and invitation confirmation summary

- **b) Properties of Computational Thinking used:**
  - **Decomposition:** Breaking the party planning into separate tasks (invitations, food, venue booking, decorations).
  - **Pattern Recognition:** Utilizing data from previous parties to estimate guest counts and food quantities.
  - **Abstraction:** Focusing on core variables like budget and guest list while ignoring minor details initially.
  - **Algorithm Design:** Creating a sequential checklist and timeline leading up to the event day.

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