

Programming Techniques

Solving problems is the main task of computer science, which is the job of a computer programmer. In order to do that, a programmer must understand the problem and then translate it into a set of instructions, in a programming language, which a computer can understand.

Defining the Problem: It is the initial and most crucial stage of problem solving. In order to understand the problem properly, a programmer must do the following:

1. Carefully read the problem to understand what it tells.
2. Find out what the problem asks to do.
3. What information can be obtained from the problem?
4. What is required to be calculated as the solution of the problem?

Example: A person is unhappy with a product or service he/she purchased from a company.

What can we understand from the problem above?

Ans. After reading the above statement, we understand that a customer has purchased any product or service from a Company and now the customer is not satisfied with it. This statement defines the problem clearly and requires the solution. It is a general type of problem.

Analyze the problem: In this stage, the programmer investigates the problem and gathers as much information as possible. The following questions should be asked to analyze a problem.

1. Is the problem solvable on a computer?
2. What is to be done to find the solution of the problem?
3. What is the proper sequence of steps to follow?
4. What are the inputs and outputs?
5. How many solutions are possible?

6. Which solution is the best and why?
7. How will the solution be implemented?

How can we analyze the problem above?

Ans. Think about what is important to you and what you want to achieve. For example, do you want a refund, a replacement?

Write down exactly what your complaint is, including details such as dates and times.

Planning the solution of the problem: Planning the solution is the creative stage of problem solving. It requires to divide the solution in steps and proper order that will solve the problem.

How can we plan the steps?

Ans. Talk to the right person. The person you speak to must have the ability to resolve the issue, e.g. a store manager, business owner or supervisor.

Focus on talking about the problem with the product or service, rather than taking issue with a person. Stay calm and reasonable.

Explain the problem in detail and provide any evidence you may have.

Listen to their response. Ask for time to consider it if you need to.

Candid Solution: All the possible solutions of a problem that are correct, are known as candid solutions. A programmer has to look for different methods to come up with several solutions.

What are the candid solutions for the problem above?

Solution 1: The customer can lodge the complaint personally visiting the company.

Solution 2: The customer can also use the courier services to send the product back.

Solution 3: The customer can use the company's website to file the complaint.

Algorithm: Algorithm is a step-by-step problem solving method that is easy to understand and follow. It is a set of steps that clearly defines a sequence of operations to solve a problem.

Role of algorithm: Creating an algorithm is the first step of developing a program. Computer programming is the process of taking an algorithm and coding it in a programming language.

Efficiency of Algorithm: The efficiency of an algorithm is about how much of a computer's resources it uses, like time, memory, or storage. To make an algorithm as efficient as possible, we want to use as few resources as we can. However, we can't compare two algorithms only by looking at resource use because their efficiency might depend on different needs. For example, if speed is the priority, one algorithm might be better than another, even if it uses more memory.

Find sum, product and average of five numbers

Planning the Solution:

Input: Five given numbers

Required Output: Sum, product and average of five numbers

Processing: Addition, multiplication and division of numbers

Algorithm:

Step 1: Start

Let the five numbers be A=2, B=5, C=8, D=4 and E=12

Step 2: FIND the sum (SUM)

$SUM = A + B + C + D + E$

Step 3: FIND the product (PROD)

$PROD = A * B * C * D * E$

Step 4: FIND the average (AVG)

$AVG = SUM / 5$

Step 5: Output SUM, PROD, AVG

Step 6: Stop

Find acceleration of a moving object for given mass and force applied.

Planning the Solution:

Input: Mass and the Force

Required Output: Acceleration of moving object

Processing: Divide the force by the mass

Algorithm:

Step 1: Start

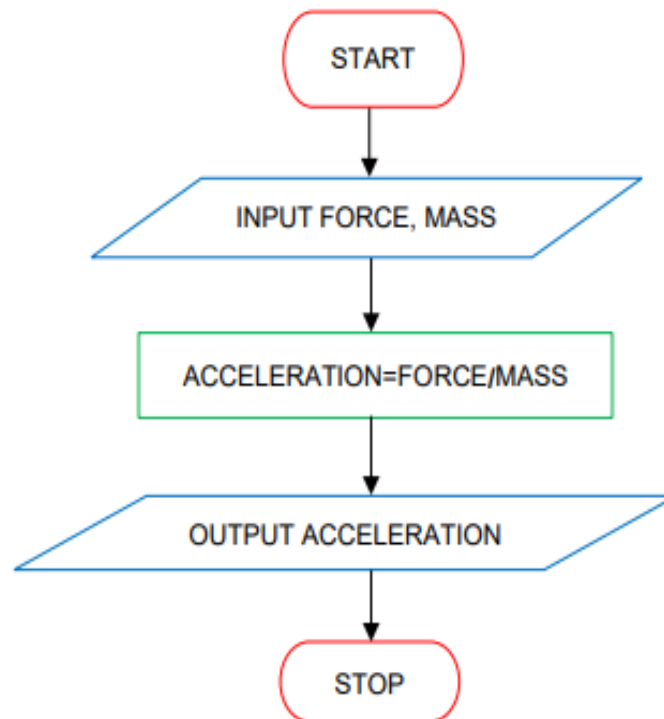
Let the mass (M) be 50 and the force (F) be 12

Step 2: CALCULATE the acceleration (A)

$$A = F/M$$

Step 3: Output A

Step 4: Stop



Finding the Factorial of a Given Number

Input: A given number (N)

Required Output: The factorial of the given number (N!)

Processing: Calculate the product of all numbers from 1 to N.

Algorithm:

Step 1: Start

Step 2: Let N be the given number.

Initialize a loop variable K and a factorial variable F to 1 ($K = 1$, $F = 1$).

Step 3: Calculate Product

Multiply F by K ($F = F * K$).

Step 4: Increment K

Increase K by 1 ($K = K + 1$).

Step 5: Check Condition

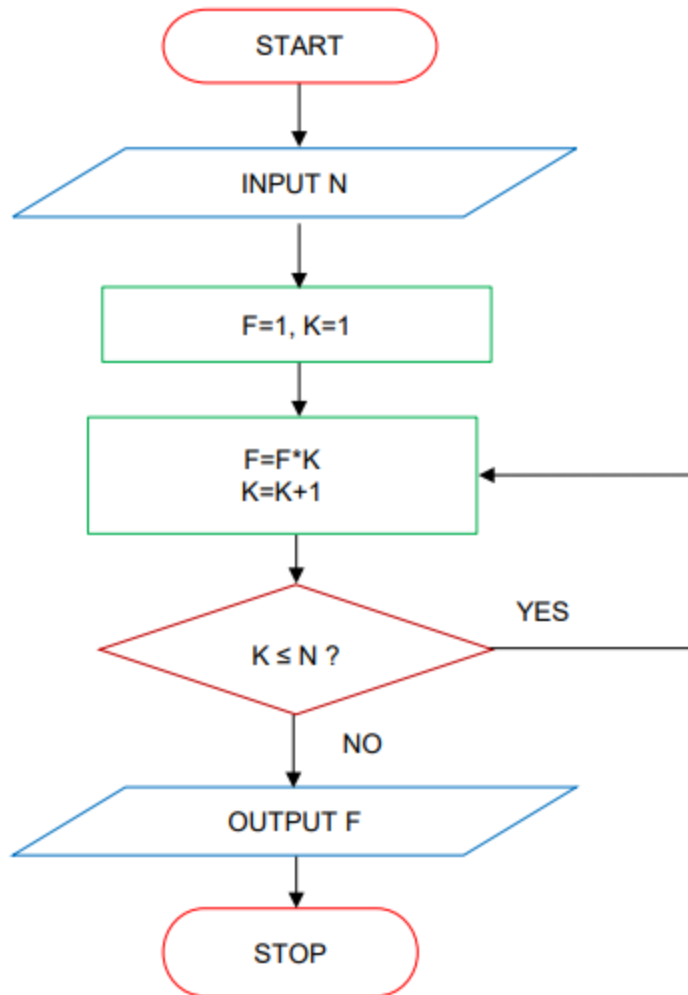
If K is less than or equal to (\leq) N, go back to step 3.

Otherwise, go to step 6.

Step 6: Output F

Print the value of F (the calculated factorial).

Step 7: Stop



Convert temperature from Fahrenheit to Celsius.

Planning the Solution:

Input: Temperature in Fahrenheit

Required Output: Temperature in Celsius

Processing: Compute the temperature in Celsius from Fahrenheit using conversion formula

Algorithm:

Step 1: Start

Let the temperature in Fahrenheit, F be 100

Step 2: CALCULATE temperature in Celsius ©

$$C = 5/9(F-32)$$

Step 3: Output C

Step 4: Stop

Flowchart: A flowchart is a diagrammatic representation of an algorithm, showing the steps required to solve a given problem.

Importance of Flowchart in Problem Solving

- **Visual Representation:** It shows the sequence of operations for solving a problem.
- **Pre-programming Tool:** Programmers use flowcharts before writing code, making it easier to convert into any high-level programming language.
- **Error Detection:** Helps in identifying and removing errors in the logic of the program.
- **Communication:** Simplifies the explanation of problem-solving methods to others.

Steps for Drawing a Flowchart

1. **Input:** The input is determined from the problem statement. E.g., converting Fahrenheit to Celsius requires Fahrenheit as input.
2. **Processing:** Type of calculation which is to be performed or the formula which is to be applied to obtain the required result. E.g., for finding the area of a triangle, use the appropriate formula.

3. **Decisions:** The flowchart developer must decide which control structures (sequence, repetition or selection) are to be applied for the solution of the problem. E.g., to print a letter grade based on marks, use a selection structure.
4. **Output:** The flowchart must provide the required output.

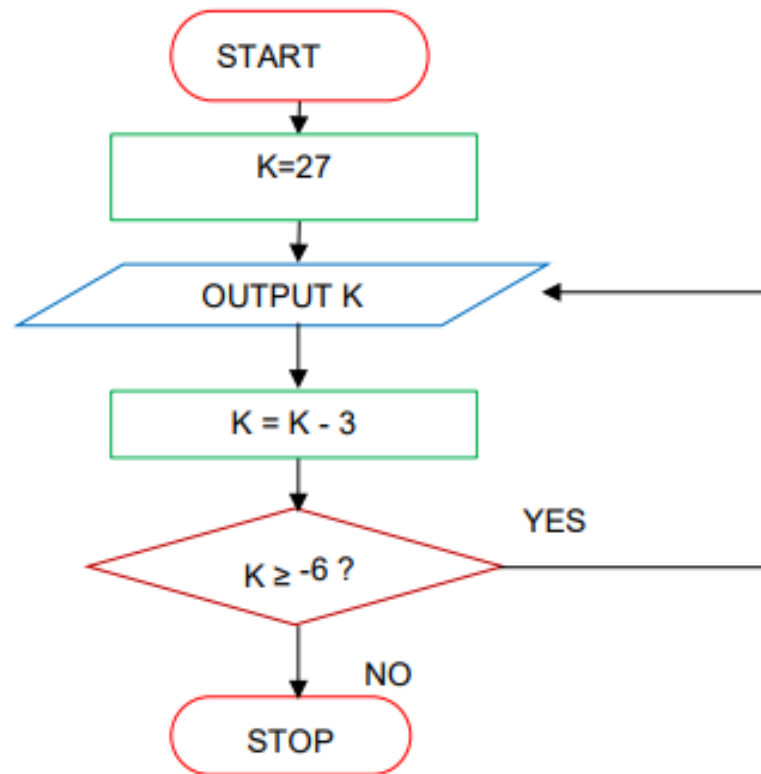
Flowchart Symbols

- **Flow Line:** Connects flowchart symbols and shows the direction of flow.
- **Start/Stop Symbol:** A rounded rectangle indicating the start or end of the flowchart. There can only be one start, but multiple stops.
- **Input/Output Symbol:** A parallelogram representing input/output operations, marked with "READ/INPUT" for input and "PRINT/OUTPUT" for output.
- **Process Symbol:**
 - A rectangle used to show a calculation or process.
 - Example: To add two numbers, you would write "SUM = A + B" inside the rectangle.
 - You can also use it to assign values, like "K = 1".
- **Decision Symbol:**
 - A diamond shape used to represent a decision or condition.
 - Example: If the condition is true, follow the path labeled "YES" or "TRUE". If false, follow the path labeled "NO" or "FALSE".
- **Connector Symbols:**
 - Used to link different parts of the flowchart.
 - **On-Page Connector:** Connects steps on the same page.
 - **Off-Page Connector:** Connects to steps on a different page.

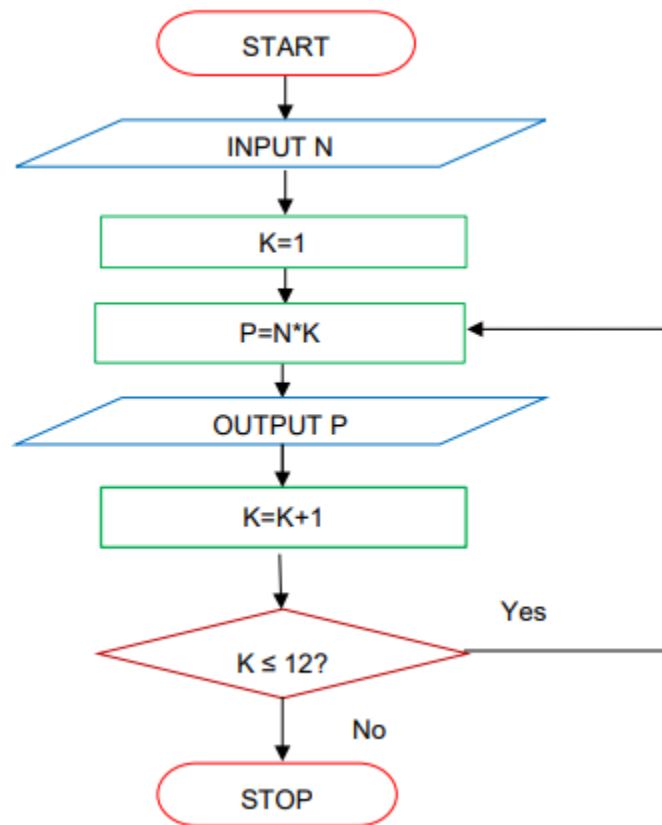
Using Flowcharts to Solve Problems

- Flowcharts can help convert algorithms into visual diagrams, making it easier to understand the logic of problem-solving.

Flowchart to print the given sequence of numbers in descending order
27 24 21 18 15 12 9 6 3 0 -3 -6



Flowchart to print a multiplication table of a given number



MCQs

i. Which of the following structures repeats one or more operations?

- A. Sequence
- B. Selection
- C. Loop**
- D. Decision

ii. Which of the following structures allows a choice among various options?

- A. Sequence
- B. Selection
- C. Loop
- D. Decision**

iii. Which of the following is a sequence of instructions written in a computer language to solve a problem?

- A. Algorithm
- B. Flowchart
- C. Program**
- D. Problem Analysis

iv. What illustrates a sequence of operations to be performed to solve a problem in the form of a diagram?

- A. Algorithm
- B. Flowchart**
- C. Program
- D. Problem Analysis

v. What is represented by a parallelogram in a flowchart?

- A. Input/Output**
- C. Start/Stop
- B. Processing
- D. Decision

vi. What is represented by a small circle in a flowchart?

- A. Start/Stop
- B. Decision
- C. Processing
- D. Connector**

vii. Which symbol is used for decision in a flowchart?

- A. Rectangle
- B. Parallelogram
- C. Diamond**
- D. Oval

viii. Which symbol is used for processing in a flowchart?

- A. Rectangle**
- B. Parallelogram
- C. Diamond
- D. Oval

SHORT QUESTIONS

Q1. Define a computer.

Ans. A computer is a general-purpose electronic machine invented to help people solve various problems. Computers must be programmed by human beings to perform various tasks. Various programming techniques are used for solving problems on computers.

Q2. What is an algorithm and what is the role of an algorithm in problem solving?

Ans. An algorithm is a step-by-step problem solving method that are easy to understand and follow. It is a set of steps that clearly defines a sequence of operations to solve a problem.

Algorithms play an important role in computer programming. Computer programming is the process of taking an algorithm and coding it in a programming language.

Q3. What is a flowchart?

Ans. Flowchart is a diagrammatic representation of an algorithm. It describes what operations are required to solve a given problem. Flowchart illustrates the sequence of operations to be performed to solve a problem in the form of a diagram.


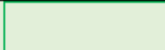


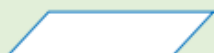


Q4. What are the advantages of using flowcharts?

Ans. Computer programmers draw flowcharts before writing computer programs.

- It provides an easy way to analyze and find solutions to problems.
- Once the flowchart is drawn, it becomes very easy to write the program in any high level language.
- It is very helpful in communicating the problem solving method to other people.
- It also helps in finding and removing errors in computer programs.

Q5. Draw any four graphical symbols used in flowchart and explain them.

Ans.

Symbol Description	Symbol Shape	Symbol Description	Symbol Shape	
Flow Line		Process		
Start/Stop		Decision		
Input/Output		Connector	 On-Page	 Off-Page

Flow Line: Connects flowchart symbols and shows the direction of flow.

Start/Stop Symbol: A rounded rectangle indicating the start or end of the flowchart. There can only be one start, but multiple stops.

Input/Output Symbol: A parallelogram representing input/output operations, marked with "READ/INPUT" for input and "PRINT/OUTPUT" for output.

Process Symbol:

A rectangle used to show a calculation or process.

LONG QUESTIONS

Q3. Describe the steps involved in problem solving

Ans. Following are the five steps involved in solving a problem

Defining the Problem: It is the initial and most crucial stage of problem solving.

In order to understand the problem properly, a programmer must do the following:

- Carefully read the problem to understand what it tells.
- Find out what the problem asks to do.
- What information can be obtained from the problem?
- What is required to be calculated as the solution of the problem?

Analyze the problem: In this stage, the programmer investigates the problem and gathers as much information as possible. The following questions should be asked to analyze a problem.

- Is the problem solvable on a computer?
- What is to be done to find the solution to the problem?
- What is the proper sequence of steps to follow?
- What are the inputs and outputs?
- How many solutions are possible?
- Which solution is the best and why?
- How will the solution be implemented?

Planning the solution of the problem: Planning the solution is the creative stage of problem solving. It requires to divide the solution in steps and proper order that will solve the problem.

Candid Solution: All the possible solutions of a problem that are correct, are known as candid solutions. A programmer has to look for different methods to come up with several solutions.

Algorithm: Algorithm is a step-by-step problem solving method that is easy to understand and follow. It is a set of steps that clearly defines a sequence of operations to solve a problem.

Q4. Write an algorithm to calculate the area of a rectangle for given breadth and length.

Ans.

Step1: Start

Let Width(W) = 5 and length (L) =10.

Step2: Multiply L by W to get the area

$A = L * W$

Step3: Output A

Print the calculated area (A).

Step4: Stop

Q5. Write an algorithm that inputs length in inches and calculates and prints it in centimeters.

(1 inch = 2.54 centimeters)

Step1: Start

Let length (L) =10.

Step2: Multiply L with 2.54 to calculate ANS (Answer)

$ANS = L * 2.54$

Step3: Output ANS

Print the calculated answer (ANS).

Step4: Stop

Q6. Write an algorithm that inputs marks and prints the message "PASS" or "FAIL". Passing marks are 33.

Ans.

Step1: Start

Step2: Input marks from the user.

Step3: Check if the marks are greater than or equal to 33:

- If **True** (marks ≥ 33), go to Step 4.
- If **False** (marks < 33), go to Step 5.

Step4: Print "PASS".

Step5: Print "FAIL".

Step6: End

Q7. Write an algorithm to find the sum of given sequence.

SUM=20+25+30+35+40+45+50+55+60

Ans.

Step1: Start

Let SUM = 0.

Step2: Initialize Loop

K = 20

Step3: Calculate SUM

SUM= SUM + K

Step4: Increment K

K = K + 5

Step5: Check if K <= 60

If K <= 60 goto step 3, otherwise goto step 6

Step6: Output SUM

Print the calculated sum.

Step7: End

Q8: Write an algorithm to find the product of given numbers.

PRODUCT = 1x3x5x7x9x11x13x15

Ans.

Step1: Start

Let PROD= 1.

Step2: Initialize Loop

K = 1

Step3: Calculate PROD

PROD= PROD * K

Step4: Increment K

K = K + 2

Step5: Check if K <= 15

If K <= 15 goto step 3, otherwise goto step 6

Step6: Output PROD

Print the calculated Product.

Step7: End

Q9. Write an algorithm to print a multiplication table of a number in reverse order.

Ans. (Considering table of 2)

Step1: Start

Let PROD= 1.

Step2: Initialize Loop

$K = 10$

Step3: Calculate PROD

$PROD = K * 2$

Step4: Increment K

$K = K - 1$

Step5: Check if $K \geq 1$

If $K \geq 1$ goto step 3, otherwise goto step 6

Step6: Output PROD

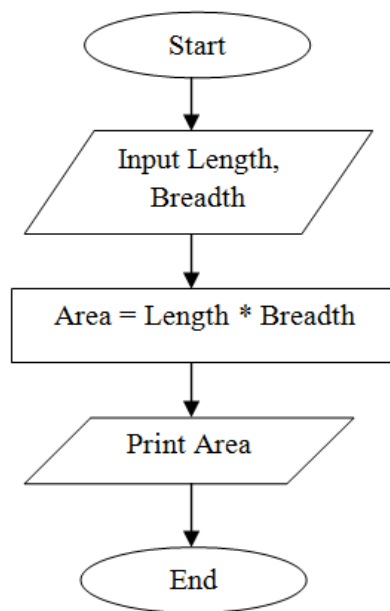
Print the calculated Product.

Step7: End

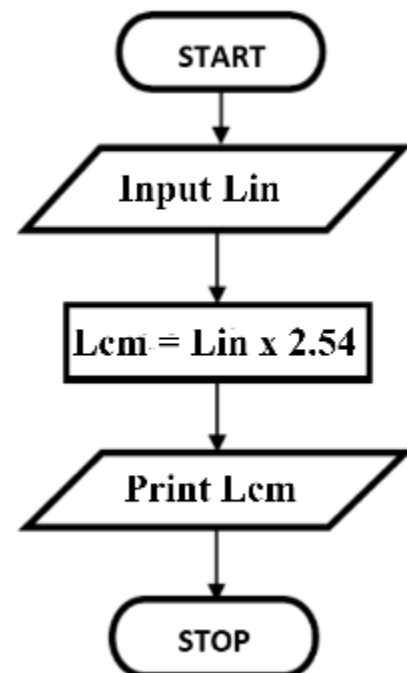
Q10. Convert the algorithms of questions Q4 to Q9 to flowcharts.

Ans.

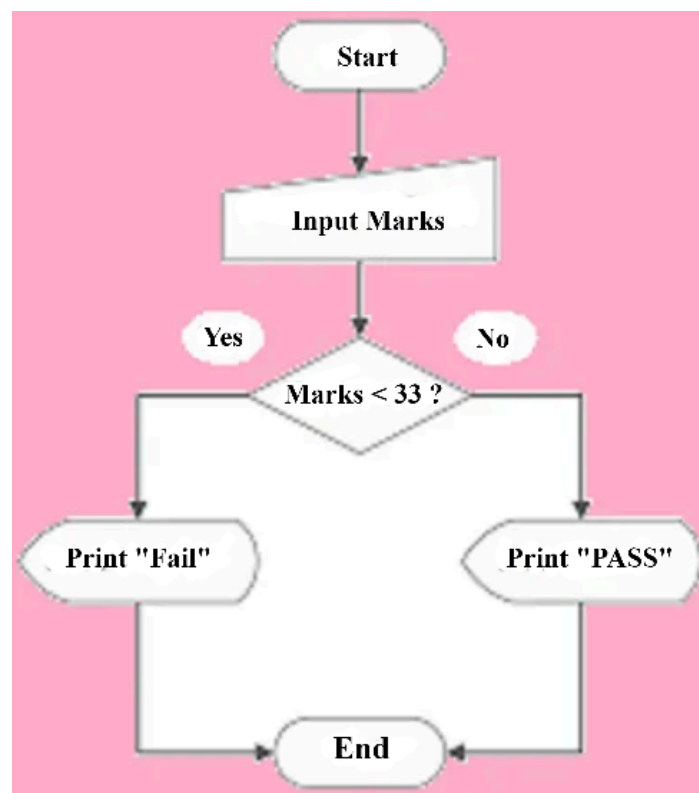
Flowchart for Question 4



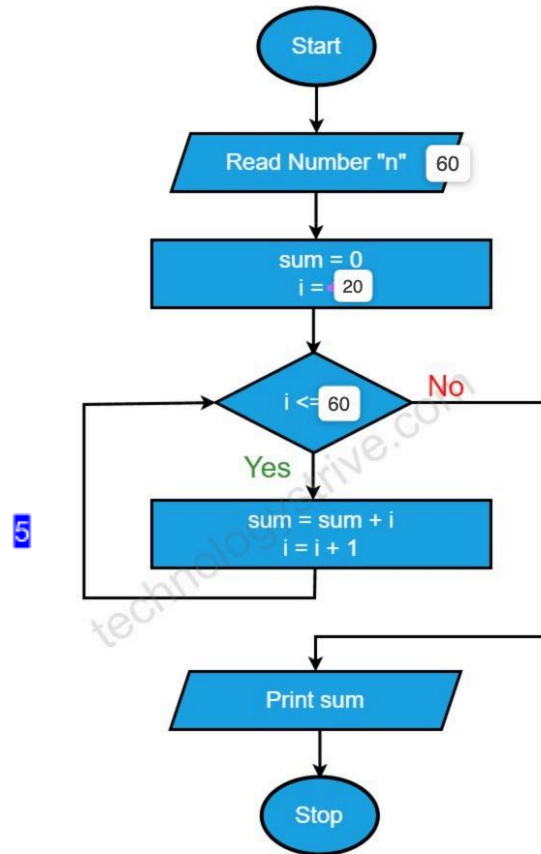
Flowchart for Question 5



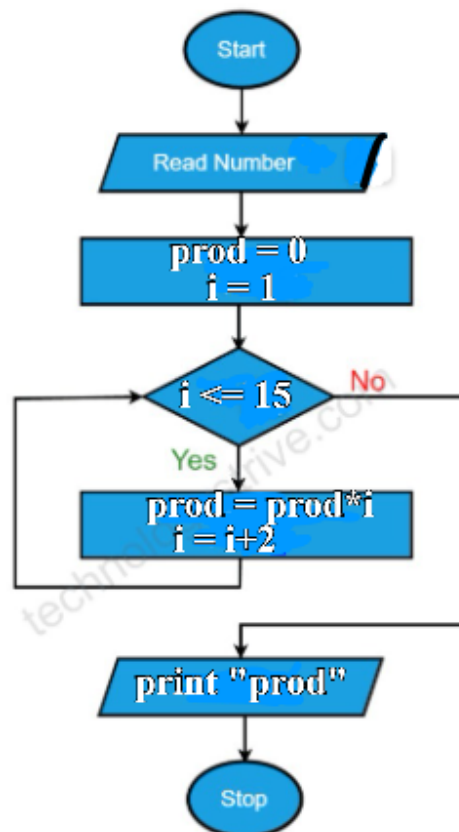
Flowchart of Question 6



Flowchart of Question 7



Flowchart for Question 8



Flowchart for Question 9

