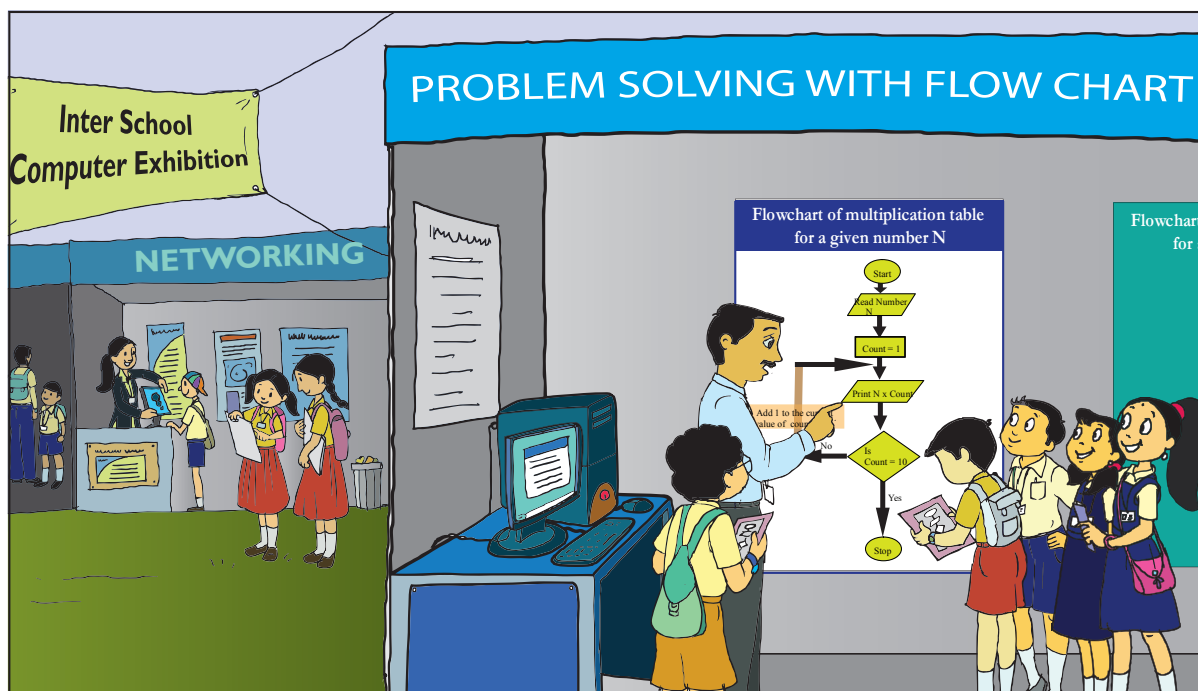# 7. Flowchart

Aim: In this lesson, you will learn:

To use spreadsheet to enter data.

Do simple calculations like sum, percentage and average on the given data.

Tejas: We visited a computer exhibition for school students. We saw a super computer, demonstration of many uses of computer and many more interesting applications.

Jyoti: In one of the stalls, we could enter any number as input and the computer was displaying the multiplication table of the number. (Shown above) This picture used by the person at the stall, to explain the sequence of steps followed by the computer, to display the table.

Jyoti: We observed that those who did not know about computers and programming could also understand what was explained by the picture.

Moz: This picture is a graphical representation called a flowchart. One of the main uses of a flowchart is to write the sequence of steps and logic of solving a problem, before writing the full computer program. It also helps in communicating the steps of the solution to others.

What is a flow chart?

Concept

- A flowchart is a graphical representation of the problem solving process.
- A flowchart gives a step-by-step procedure for solution of a problem.

What is a flow chart?

- Various geometrical shaped boxes represent the steps of the solution.
- The boxes are connected by directional arrows to show the flow of the solution problem solving.
- The main use of a flowchart is to show the sequence of steps and the flow of a computer program.
- Some of the other uses of a flowchart are to communicate a solution to a problem, explain a concept, and show the logic of classification of data, rules and flow of playing a game.

Tejas: I see that various geometrical shapes are used in this representation. We are eager to learn about flowcharts.

Moz: Let us start with a simple example. Look at the following flowchart of adding two natural numbers A and B. Let us discuss the problem solution and the geometrical shapes used.

Start

Read A

Read B

Sum= A+ B

Print Sum

End

Start
|
A= 845
|
B= 247
|
Sum= 845+ 247
|
Sum= 1092
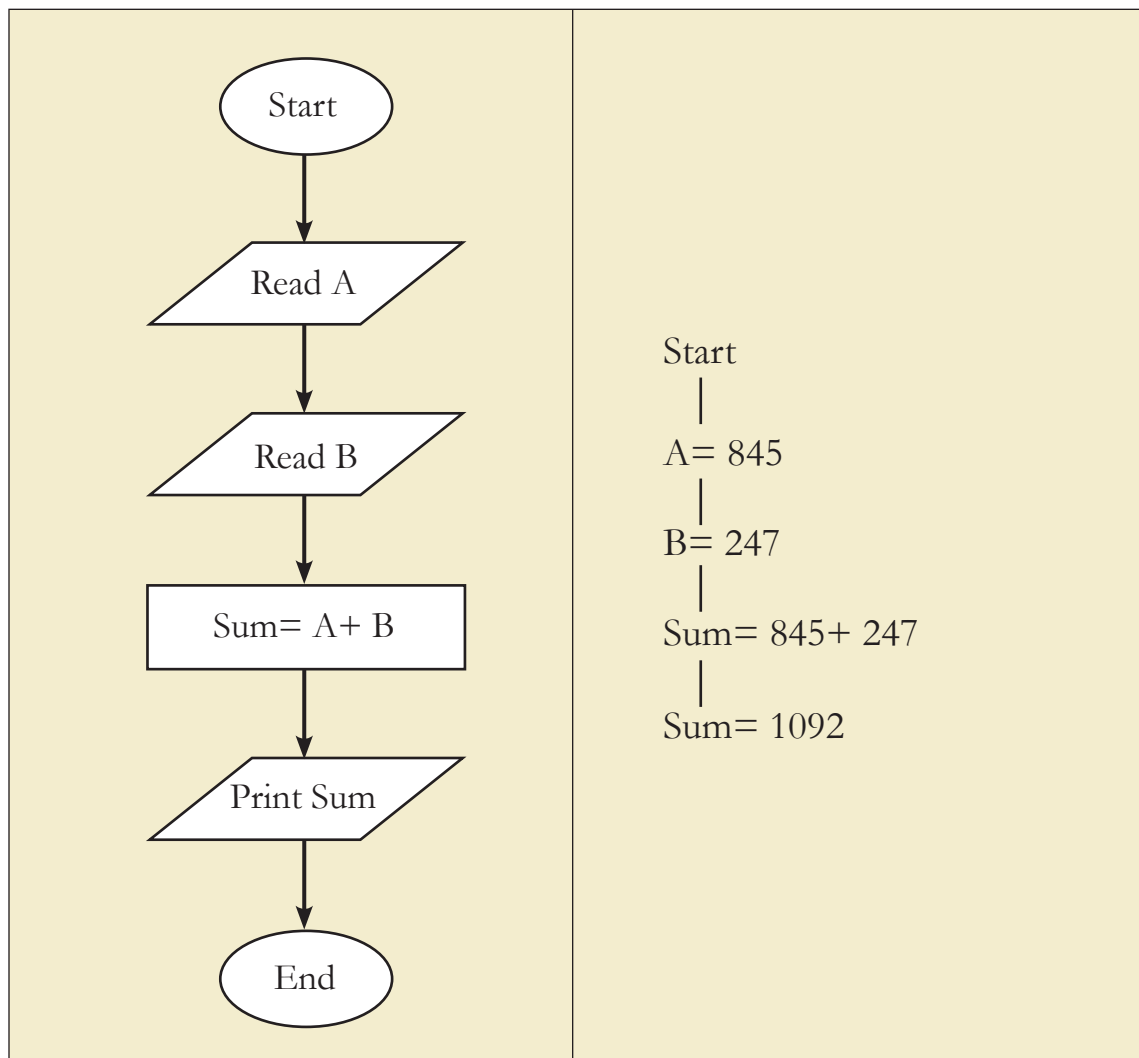
Moz: What do you do when you are given a problem?

Tejas: First we identify the goal. Here it is addition of tow given numbers.

Moz: How do you achieve this goal?

Jyoti: First we identify the data that is given. In this problem we have the two numbers A and B. Reading their values represented by parallelograms.

Moz: Right. What would you call this in computer terms?

Jyoti: Input.

Moz: The data or information that is available, (which is called input) is represented using a parallelogram in the flowchart.

Moz: What is the next step?

Tejas: The next step is to add the numbers, which is called processing in computers. We learned this term in "Inside computer" lesson.

Moz: Correct. The details of processing of data is represented in a rectangle.

Jyoti: The next step is to write the result of the addition which is output in computer terms. This is also specified in a parallelogram.

Moz: Right. A parallelogram is used to specify both input and output in a flowchart. What else do you notice in the flowchart?

Tejas: An arrow points from one step to the next step in the flowchart.

Moz: In a flowchart arrows are used not only to connect the steps in a sequence but also to show a clear flow of the problem solving process.

Jyoti: Start and also end of the flowchart are shown with an ellipse.

Moz: A flowchart should give a clear indication as to where the problem solving flow starts and where it ends. The start of a problem solving process and the end are indicated using the ellipse.

Jyoti: This is just like using 'step-wise thinking' lesson step by step to solve a problem.

Moz: Yes. The step by step method of solving the problem is specified using a flowchart. This helps you to be clear about the input, procedure and output. It also helps you to communicate the solution.

Concept

Uses of flowchart

- To specify the method of solving a problem.
- To plan the sequence of a computer program.
- Communicate ideas, solutions.

Guidelines

Drawing of a flowchart

- Follow step-by-step thinking and logical reasoning of solving a problem.
- Identify the goal or the solution to be found.
- Think of the sequence of steps for working out the solution to the problem.
  - o Identify start, input, process, output and end.
- Use appropriate symbol to represent each step in the sequence.
- Use directional arrows to show the flow of the sequence of steps.
- Check that the flow of the solution is clearly communicated through the flowchart.

Moz: Now consider the following problem and draw the flowchart for its solution.

> Savani bought a toy for Rs. 325 and sold the same for Rs. 458. Explain how we can find if Savani has made a profit or a loss.

Tejas: In this problem the goal is to find whether Savani makes a profit or loss.

Jyoti: We know the Cost Price and the Selling Price. We can read them as input, so they are represented as parallelograms.

Tejas: Next we have to compare Selling Price and Cost Price to find which price is more. This will tell us whether Savani has made profit or loss. How do we show comparison in a flowchart?

Moz: Can you phrase this step as a question with the two possible answers?

Tejas: We can ask a question "Is selling price more than cost price?". The answer to this question can be "Yes" or "No". If, answer is "Yes" we have to calculate profit and if, answer is "no" we have to calculate loss.

Moz: Right. In this step you have two alternate actions that can be taken. The decision of which action has to be taken is decided by the answer to the question. The answer can be "Yes" or "No". This decision taking step is represented as follows in a flowchart.
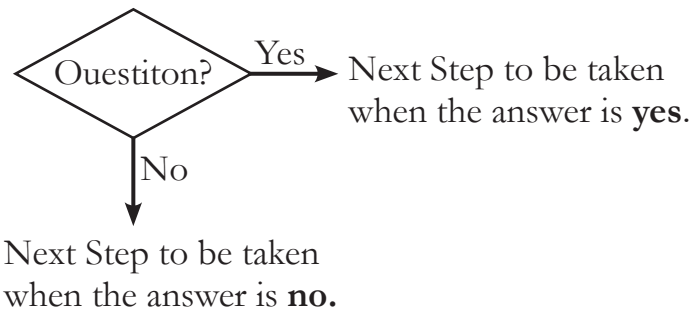
Jyoti: If the answer is "Yes", it means that selling price is more than the cost price and Savani has made profit. Profit is calculated as,

            Selling price – cost price

If the answer is "No" it means that cost price is less than selling price and Savani has made loss. Loss is calculated as

            Cost price – Selling price.

Moz: Good. You have used logical reasoning to solve this problem. Now draw the flowchart.

Flowchart - How to find profit or loss.

For given example

1. Read
CP=325
SP= 458

2. Condition
SP is grater than CP

3. Processing
Profit= 458-325
      = 133

4. Output
Savani made profit of
Rs. 133
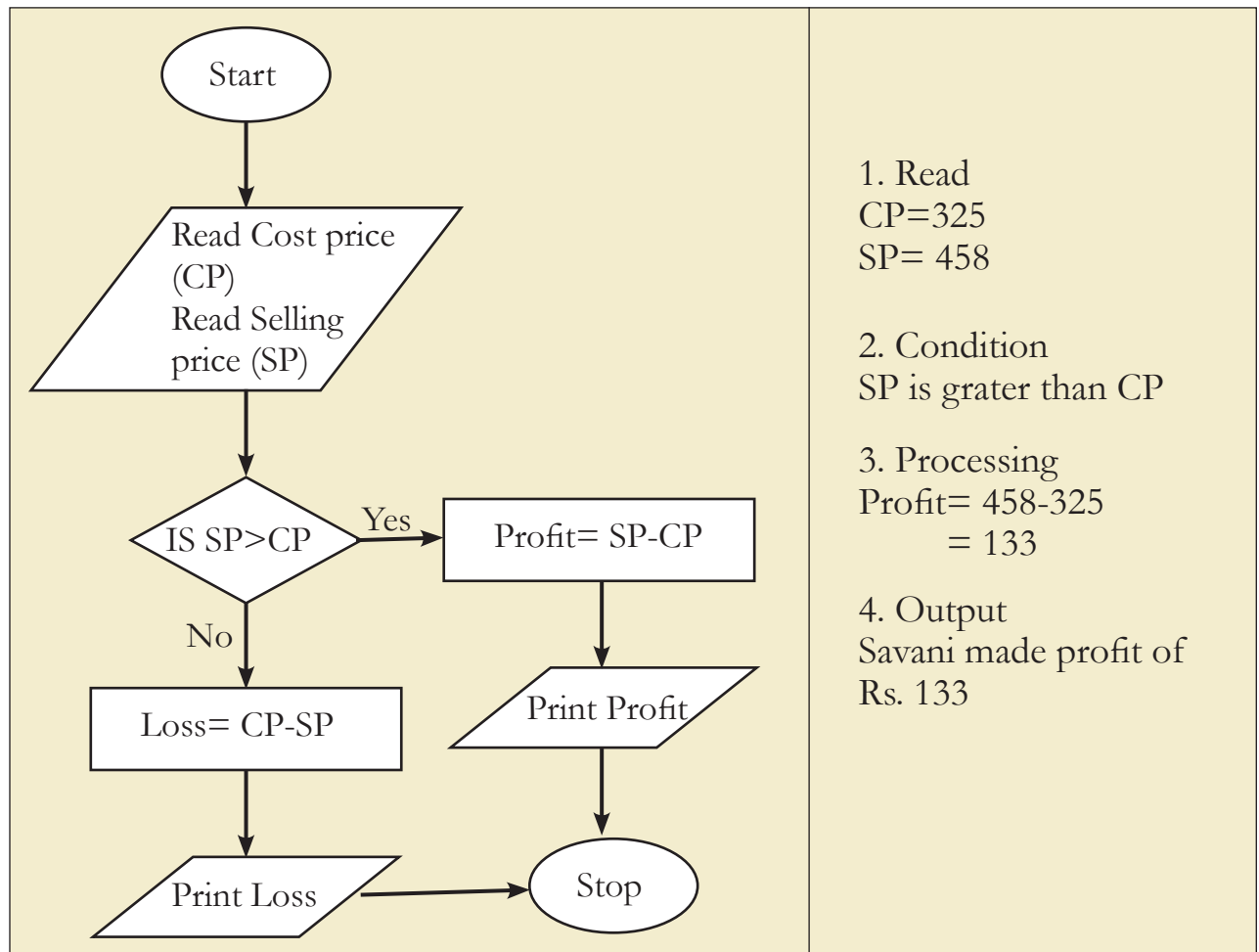
Flowchart symbols and their purpose	
Geometric shape	**Purpose**
Ellipse	Start, End, Stop, Exit. (Stop or End or Exit – these all mean End).
Parallelogram	Data, Input, output.
Rectangle	Action, activity, process.
Diamond	Decision making step. Specify the question in the diamond. The next logical step is based on the answer "Yes" or "No" to the question.
Arrows	Arrows are used to connect the steps in a flowchart, to show the flow or sequence of the problem solving process.

Moz: Suppose you have to write a scratch program for the above. Can you do it now?

Tejas: Yes. We can!
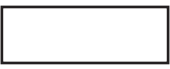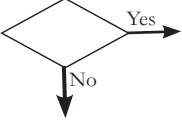
Jyoti: This is great. We can also plan a computer program using flowcharts.

Jyoti: Sometimes we need to repeat a sequence. How do we represent this in the flowchart?

Moz: Let us consider the multiplication table flowchart that you saw at the exhibition. See how repetition is represented in a flowchart.

Flowchart of multiplication table for a given number N

Start
N = 12
Count =1
12 * 1 = 12
Count = 1+1 = 2
12 * 2 = 24
Count = 2+1 = 3

Count = 9+1 = 10
12 * 10 = 120
Count =10
End
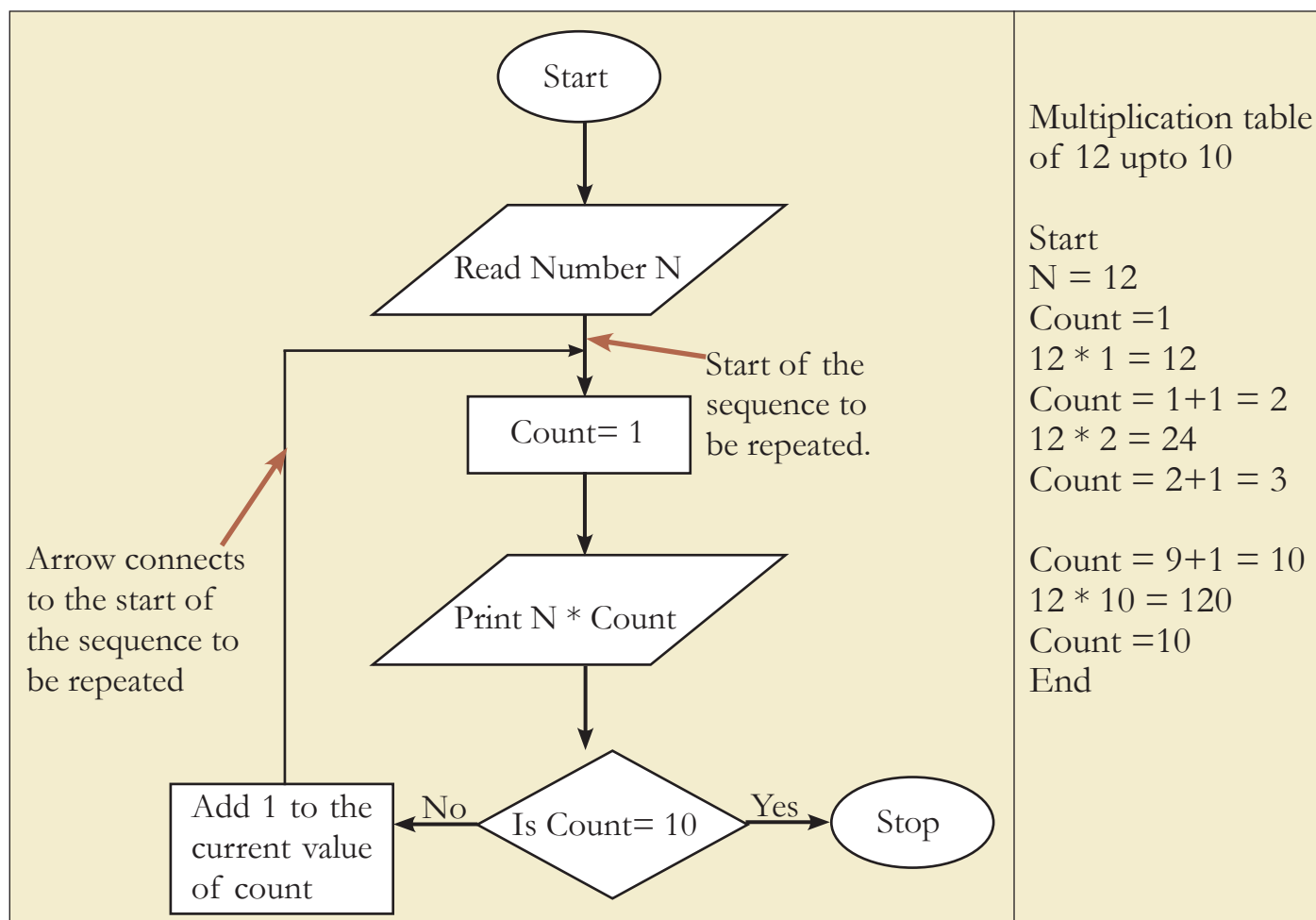
Tejas: The repetition sequence stops when count =10. So here a decision structure has been used to start and stop the repetition.

Moz: Try out another problem to see how you can use such an assignment.

Tejas: Let us draw a flowchart to find the factorial of a number.

Moz: How do you find the factorial of a number?

Jyoti: Suppose the number is 10. Then factorial of ten is calculated as

$$10! = 1*2*3*4*5*6*7*8*9*10$$

Moz: Good. Draw the flowchart.

Find factorial of N

Start
N = 10
M = 1
F = 1
F = 1 * 1 = 1; M<10; M = 1 +1 = 2
F = 1 * 2 = 2; M<10; M = 2 +1 = 3
F = 2 * 3 = 6; M<10; M = 3 + 1= 4
F = 6 * 4 = 24;M<10; M = 4 +1 = 5

M<10; M = 9 + 1 = 10
F = 362880 * 10 = 3628800
M = N = 10
Factorial of 10 = 3628800
End

Flowchart:
Start → Read N → Set M= 1 Set F= 1 → New value of F= Current value of F multiplied by M → Is M=N? → (No) Add 1 to the Current value of M (loops back) / (Yes) Print Loss → End
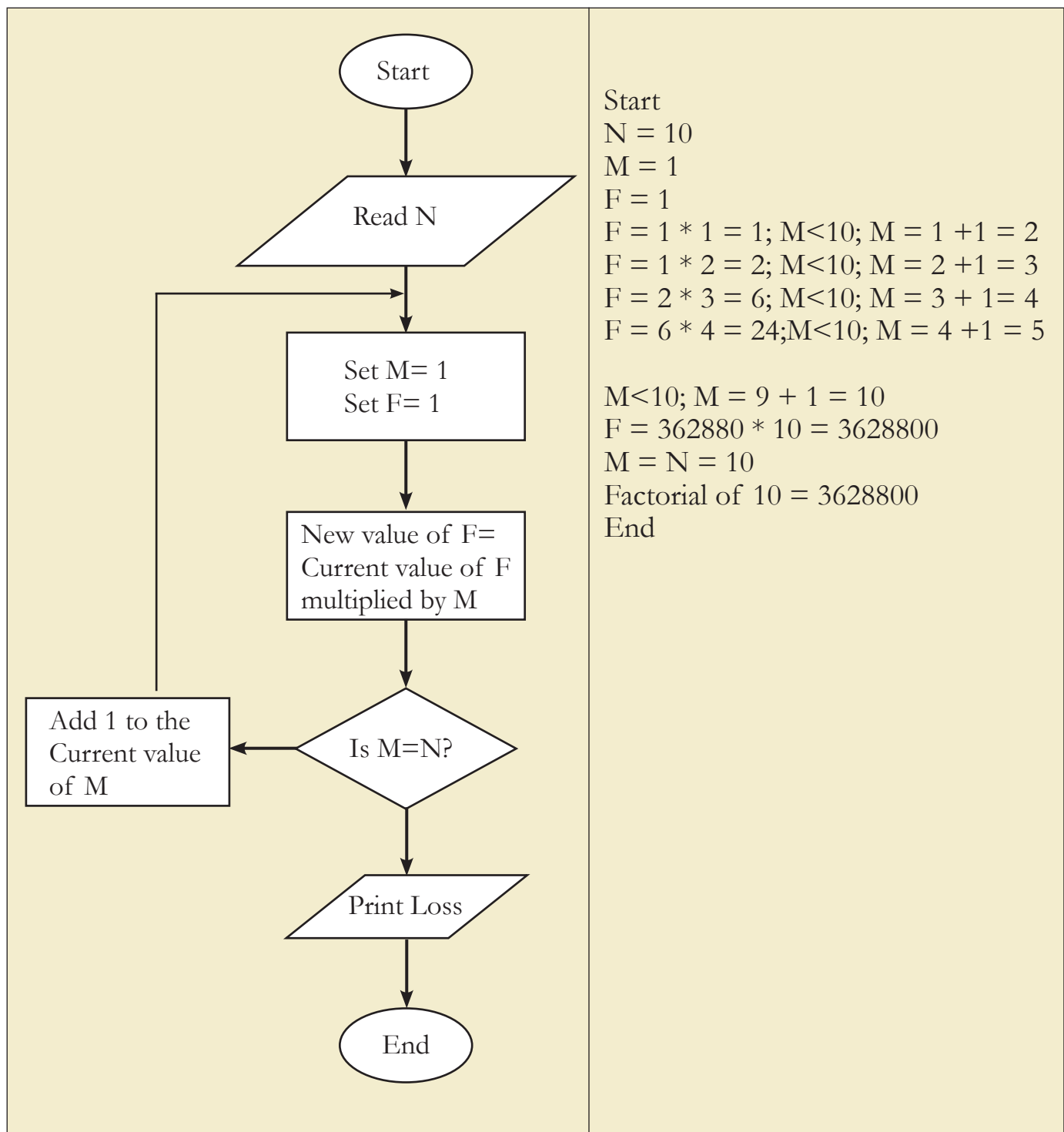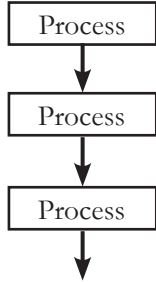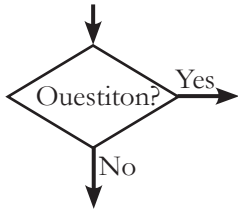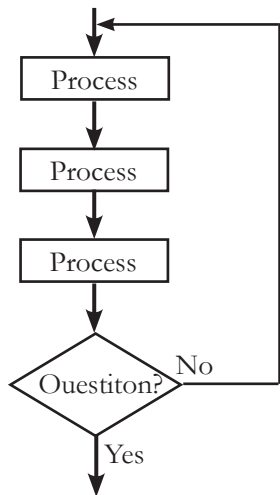
Moz: Good. From the examples that you have seen, can you summarize what are all the basic structures of representation?

Tejas: In the addition of numbers example, we saw how to show a sequence of processing steps.

Jyoti: In the finding profit and loss example, we saw how alternate sequences can be specified using a decision box.

Tejas: In the multiplication table and factorial examples, we saw how to show repetition of a sequence.

Jyoti: Flowcharts can be drawn for a problem solving process using these three basic structures.

Sequence	
Sequence of steps are represented by symbols that follow each other top to bottom or left to right.	
Selection	
A condition or a question is specified in the Decision box. Based on the evaluation of the condition one of the logical steps is taken next. The next logical step can be a process, decision, or end of the flowchart.	
Repetition	
Either the processing repeats or the control leaves the structure.	

Moz: Good. Now let us consider a game. Do you know the game of snakes and ladders?

Tejas: Yes.

Moz: Ok. Draw a flowchart to show how the game is played.

Start

Give dice to next player

Throw the dice

Move your coin

Landed on Snake head? — Yes → Slide down to the tail of the snake

Landed at the bottom of the ladder? — Yes → Move up the ladder

Reached the last Block of the game? — No

You are the Winner

End
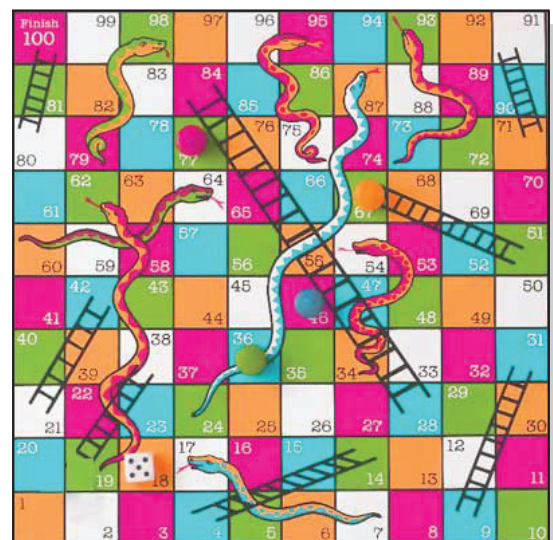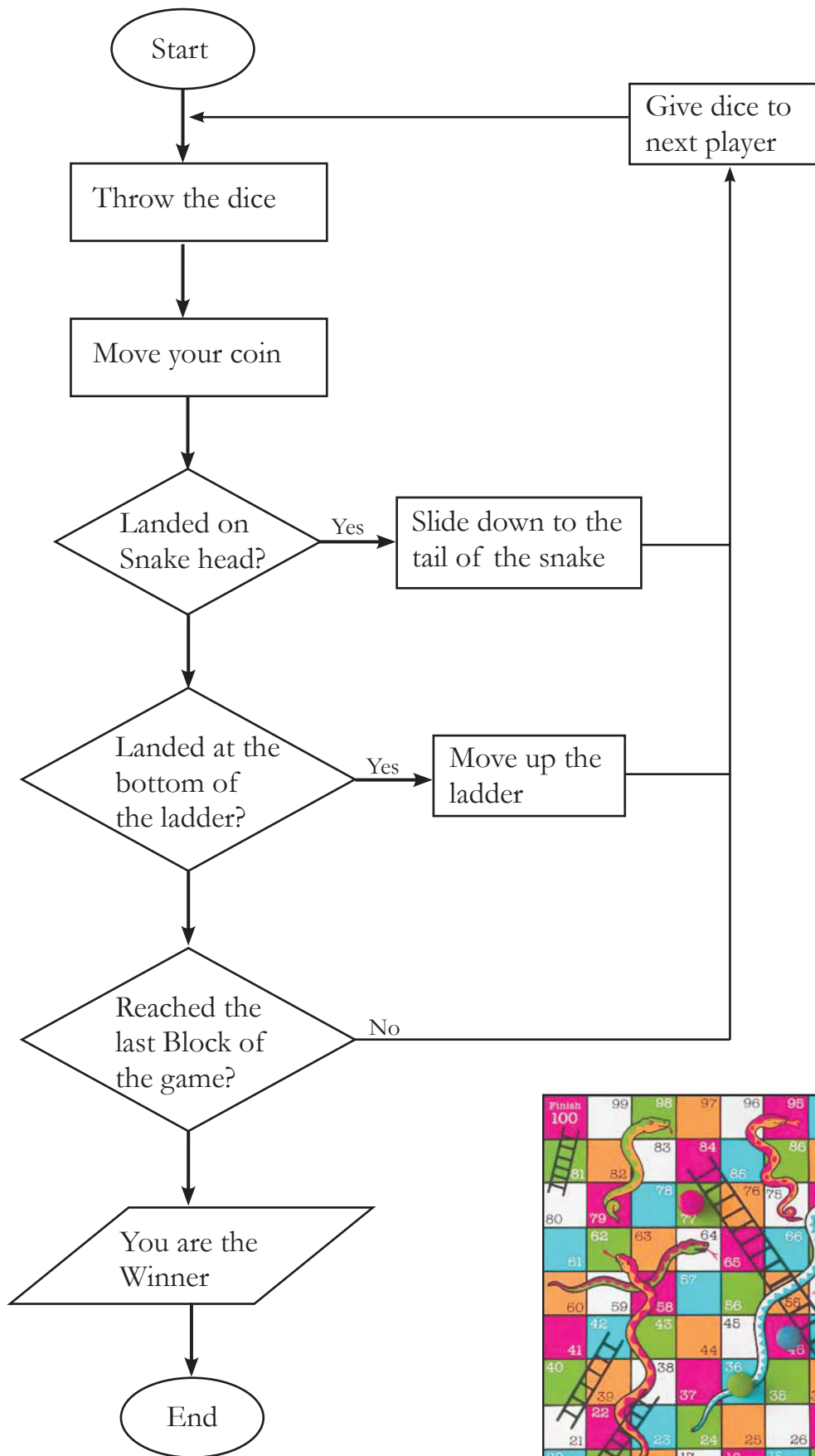
Tejas: The flowchart itself can be put into the box of the game so that those who want to play know the rules of the game and can easily understand how they win.

Moz: We have seen some examples where flowcharts are used. There are many more uses of flowcharts and they can be used whenever you feel that you can communicate better with this graphical representation.

Tejas: We are eager to learn another programming language.

Moz: Sure. Next you will be learning BASIC where you can use some of the flowcharts that you have drawn in this lesson. Chin Chinaki...

Outline

Main Points

Presentation

Create

Lesson Outcome

At the end of the lesson, you will be able to:
- Write an outline for a given topic.
- ......into the
  ......plication.
- ......or consistency
  ......spellings) and use design options.
- Follow guidelines for creating presentations.

1.

   a. A flowchart which calculates the average of 3 numbers is shown. Using the flowchart calculate the average of three numbers: 52, 68, 74. Show the steps you followed.

   b. Add the necessary steps and extend the flowchart, so that students who secure an average above 75 are given a star while the others are encouraged to do better.

   c. The table below gives the marks scored by Riya and Suman in Science, Mathematics and English. Using the extended flowchart, calculate who will get a star?

	Science	Mathematics	English
Riya	75	80	72
Suman	72	70	82

Start

↓

Read A, B, C

↓

Sum= A+B+C

↓

Average= Sum/3

↓

Print Average

↓

End

WORKSHEETS
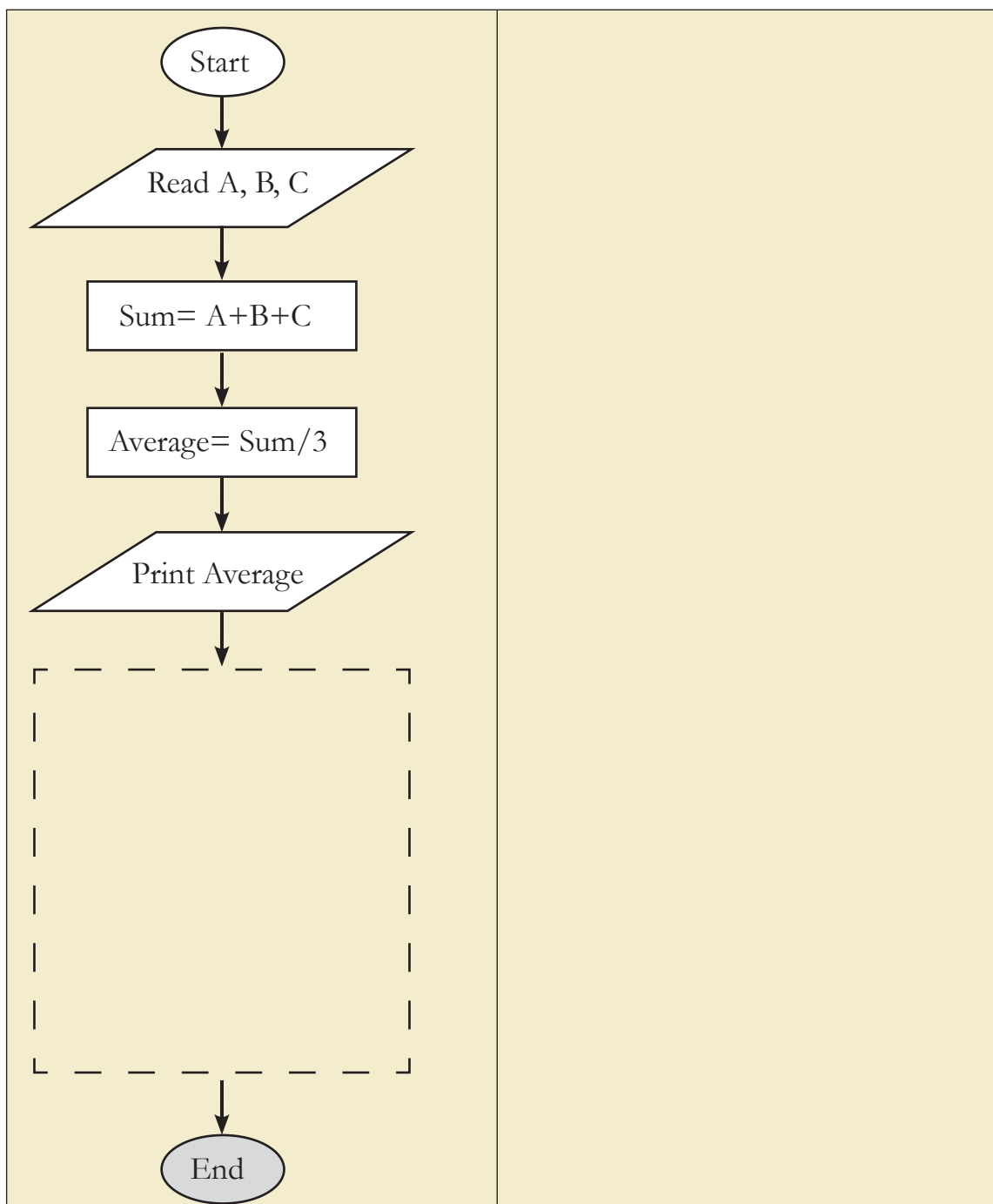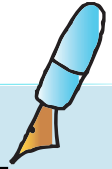
2. Two flowcharts are given below. Study them carefully and figure out the function of the flowcharts?

```
                    ┌─────────┐
                    │  Start  │
                    └─────────┘
                         │
                         ▼
              ╱──────────────────────╲
             ╱  Read the Numerator (N) ╲
            ╱   and Denominator (D)      ╲
            ╲───────────────────────────╱
                         │
                         ▼
                   ╱───────────╲      Yes
                  ╱   Is N>D     ╲─────────────┐
                  ╲──────────────╱             │
                         │ No                  │
                         ▼                     ▼
            ╱──────────────────╲    ╱──────────────────╲
           ╱  Print "This is a   ╲  ╱  Print "This is a  ╲
          ╱   improper fraction." ╲╱   proper fraction."  ╲
          ╲──────────────────────╱╲─────────────────────╱
                    │
                    ▼
          ┌──────────────────┐
          │  Divide and make │
          │  it a mixed      │
          │  fraction        │
          └──────────────────┘
                    │
                    ▼
          ┌──────────────────┐
          │  Print the       │
          │  mixed fraction  │
          └──────────────────┘
                    │
                    ▼
              ┌─────────┐
              │   End   │◀──────────────┐
              └─────────┘
```
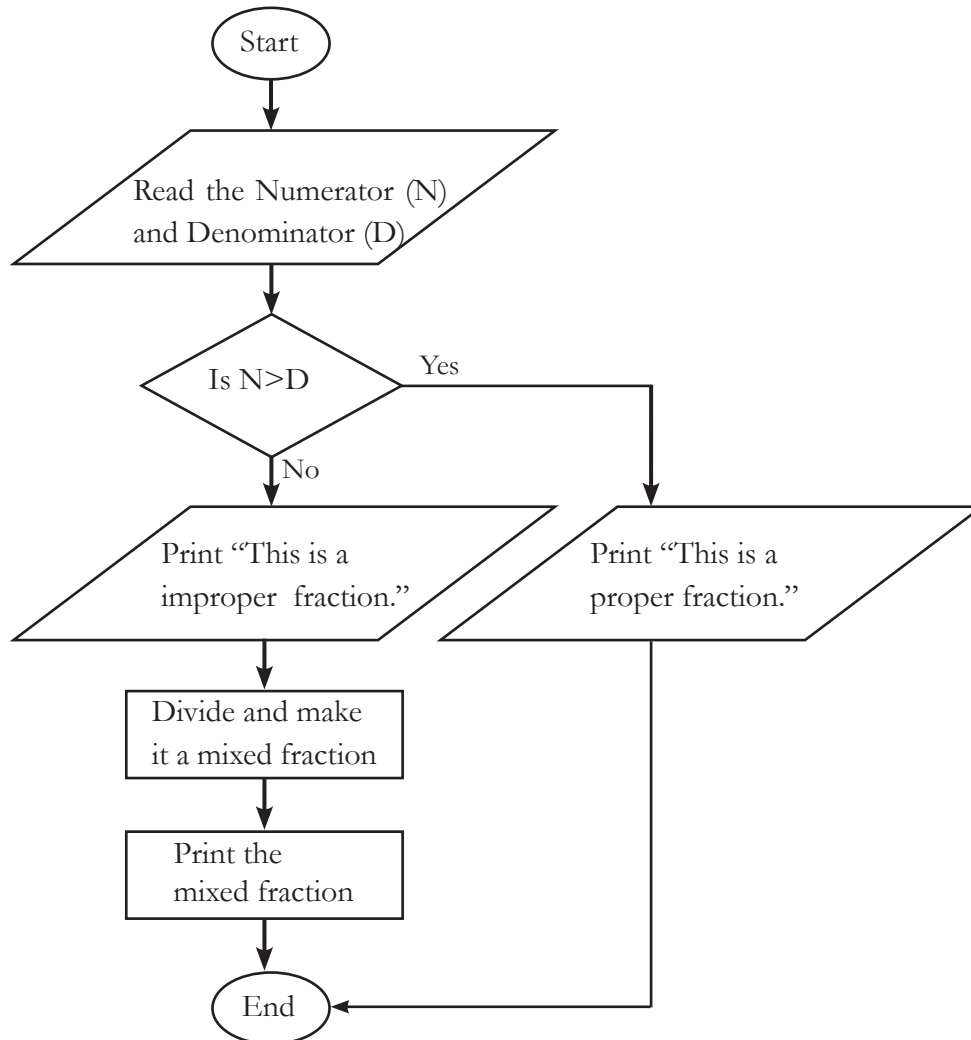
Ans: _____

Based on the above flowchart answer the following questions.
a. When N=5, D=3, what is the output?
b. When N= 7, D=10, what is the output?
c. When N=12, D=36, what is the output?

WORKSHEETS

```
                    ┌─────────┐
                    │  Start  │
                    └────┬────┘
                         ↓
                    ┌─────────┐
                    │ Sum= 0  │
                    └────┬────┘
                         ↓
                    ┌─────────┐
                    │  N= 0   │
                    └────┬────┘
                         ↓
              ┌──────────────────┐
              │ Add 1 to the     │
              │ current value of N│
              └────────┬─────────┘
                       ↓
              ┌──────────────────┐
              │  Sum= Sum + N    │
              └────────┬─────────┘
                       ↓
  No               ◇─────────◇
 ─────────────────◇  Is N=10 ◇
                   ◇─────────◇
                       │ Yes
                       ↓
              ╱──────────────────╱
             ╱   Print sum      ╱
            ╱──────────────────╱
                       ↓
                  ┌─────────┐
                  │   End   │
                  └─────────┘
```

Start
SUM = 0
N = 0
Inside the loop:
N = 0+1=1, SUM = 0+1=1; N not equal to 10
N = 1+1=2, SUM = 1+2=3; N not equal to 10
N = _____, SUM =_____; N _____
N =_____, SUM =_____; N _____
N = _____, SUM =_____; N _____
N =_____, SUM =_____; N _____
N = _____, SUM =_____; N _____
N = _____, SUM =_____; N _____
N = _____, SUM =_____; N _____
N = _____, SUM =_____; N _____

Print
End

Ans: _____

WORKSHEETS
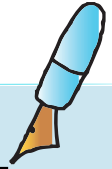
3. **A flowchart which gives an algorithm to check whether a triangle is equilateral, isosceles or scalene is given below. Fill in the missing information.**
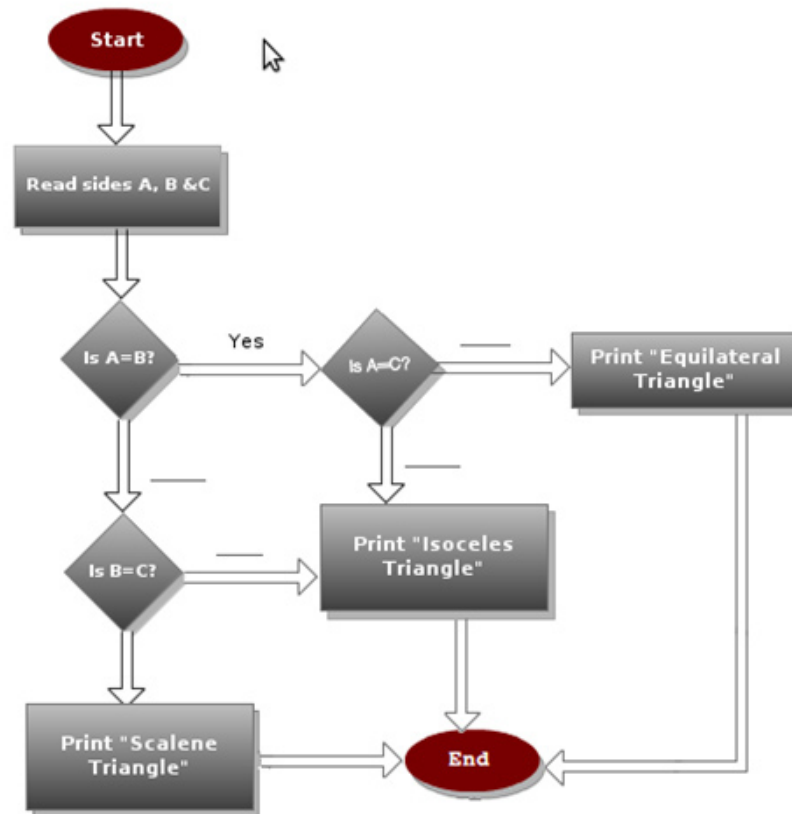
4. **The steps to be followed to classify given animals to birds or mammals are given below.**
   - Get the name of the animal.
   - Check whether the animal gives birth to young ones.
   - If yes, then it is a mammal.
   - If it is not giving birth to young ones, check if it has feathers and wings.
   - If yes, then it is a bird.
   - If it doesn't have wings and feathers, then it is not a bird or mammal.

   Draw the flowchart using the above steps.

WORKSHEETS

5. A flowchart which gives information about mixtures is given below.
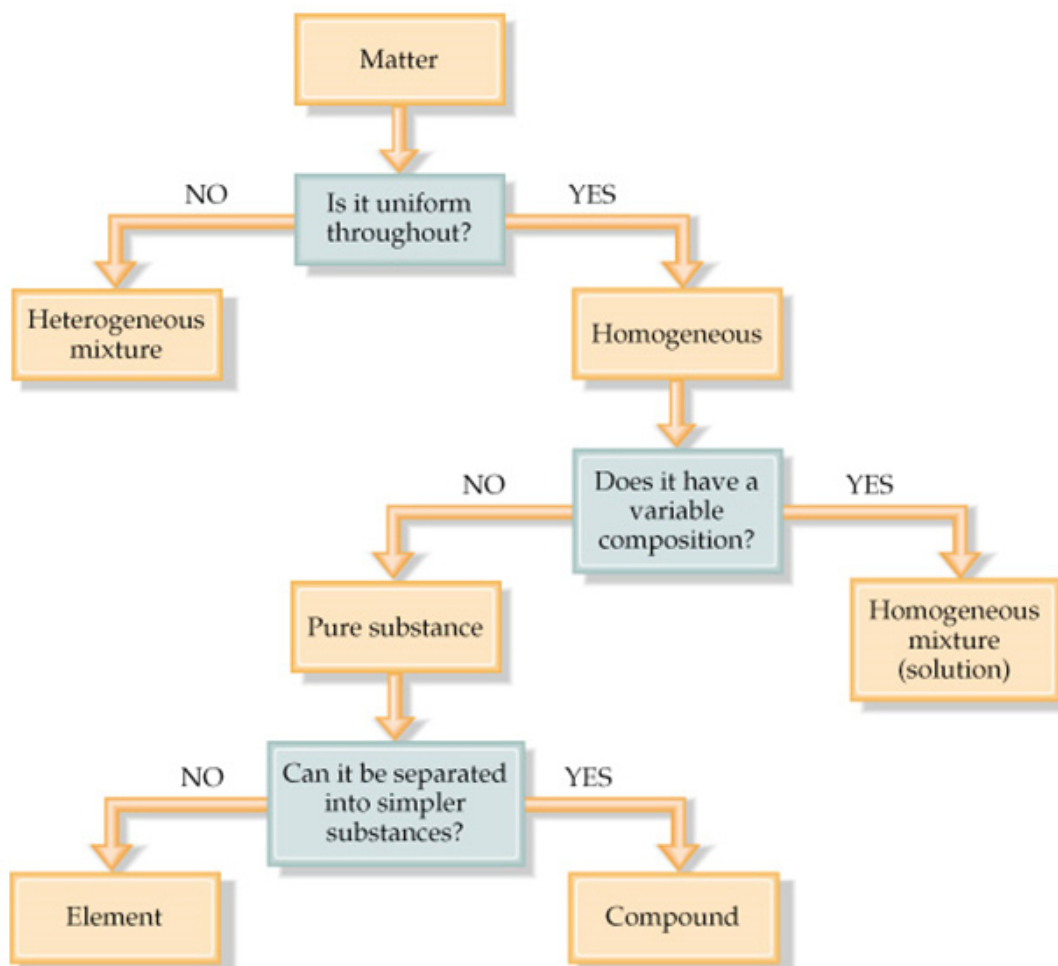
a. Based on the flow chart answer the questions (T/F):

   i. An element is a pure substance

   ii. A compound can be separated into simpler substances

   iii. If matter is uniform throughout , it is called homogeneous

   iv. If homogeneous matter does not have a variable composition, it is called a pure substance.

b. Based on the passage given below, extend the above flowchart.

Particle size distinguishes homogeneous solutions from heterogeneous mixtures. A suspension is a heterogeneous mixture of larger particles. These particles are visible with our naked eyes and will settle out on standing. Muddy water and tomato juice are examples of suspensions. A colloid is a homogeneous solution with intermediate particle size between a solution and a suspension. An example of colloid is milk.

WORKSHEETS
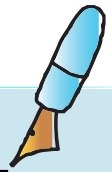
6. **Frame a question(Hint: Try to make a question, which will have the answer given below)**
   For example:
   The answer given is:
      Some of the boxes of different shapes used in a flowchart are
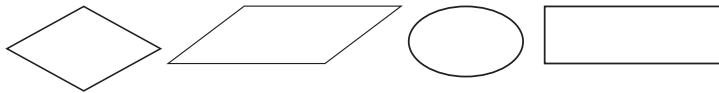
   The question can be: Name some of the symbols used in a flowchart?
   Now try these:
   a. The answer given is : In a flowchart, to represent a process we use a rectangular box.
      The question can be: _____?

   b. The answer given is : In a repetition structure, the process is repeated till the condition is satisfied. Once the condition is satisfied control comes out of the structure.
      The question can be: _____?

7. **Label the various structures in the following flowcharts as selection, sequence or repetition. Justify your answer.**
   a. A flowchart which gives the steps to be followed while saving a document.

   Reasons: _____

   _____
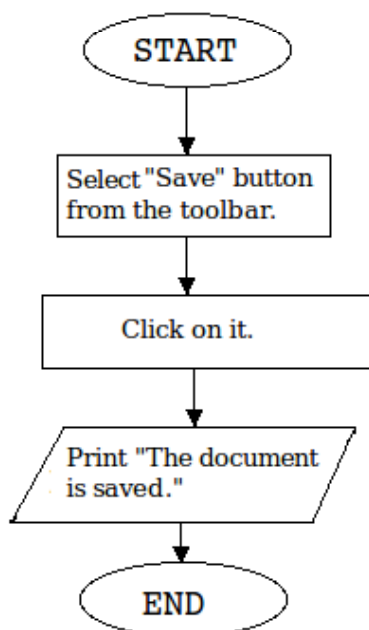
WORKSHEETS

b. Flowchart which classify animals as herbivore or carnivore.

```
        ┌───────┐
        │ Start │
        └───┬───┘
     ┌──────┴──────┐
     │ Read the    │
     │ name of the │
     │ animal.     │
     └──────┬──────┘
         ╱──┴──╲         No
        ╱ Does it ╲──────────┐
        ╲ eat only ╱         │
         ╲plants?╱           │
          ╲──┬──╱            │
          Yes│               │
     ┌───────┴──────┐   ┌─────┴────────┐
     │ Print "It is │   │ Print "It is │
     │ a Herbivore."│   │ a Carnivore."│
     └───────┬──────┘   └─────┬────────┘
        ┌────┴────┐           │
        │   End   │───────────┘
        └─────────┘
```
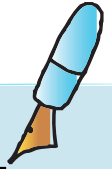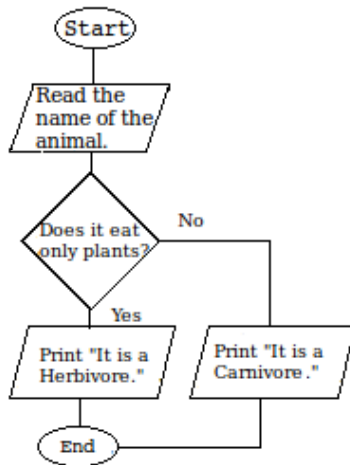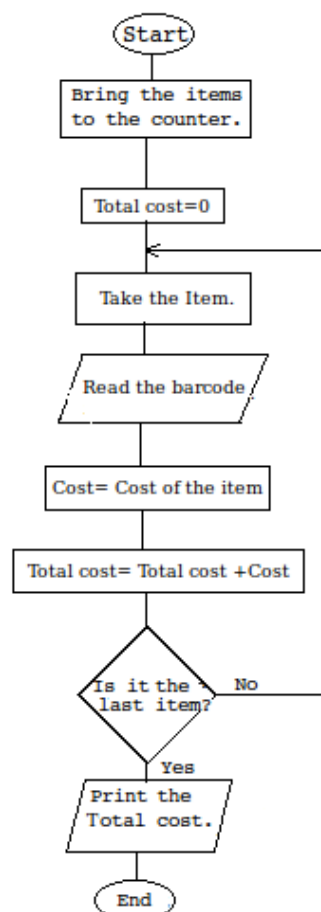
Reasons: _____

_____

c. A flowchart which calculates the sum and print the total bill amount for the things purchased in a shop.

```
            ┌───────┐
            │ Start │
            └───┬───┘
        ┌───────┴───────┐
        │ Bring the items│
        │ to the counter.│
        └───────┬───────┘
        ┌───────┴───────┐
        │ Total cost=0  │
        └───────┬───────┘
                │ ◄─────────────┐
        ┌───────┴───────┐       │
        │ Take the Item.│       │
        └───────┬───────┘       │
        ┌───────┴───────┐       │
        │ Read the barcode│     │
        └───────┬───────┘       │
        ┌───────┴───────┐       │
        │Cost= Cost of  │       │
        │the item       │       │
        └───────┬───────┘       │
    ┌───────────┴───────────┐   │
    │Total cost= Total cost │   │
    │+Cost                  │   │
    └───────────┬───────────┘   │
            ╱───┴───╲     No     │
           ╱ Is it the ╲─────────┘
           ╲ last item?╱
            ╲───┬───╱
            Yes │
        ┌───────┴───────┐
        │ Print the     │
        │ Total cost.   │
        └───────┬───────┘
            ┌───┴───┐
            │  End  │
            └───────┘
```

Reasons: _____

_____

WORKSHEETS
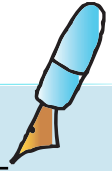
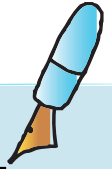8. **Which is not true about the arrows used in a flowchart?**
    - Direction of arrow shows the flow in a flowchart.
    - Arrows are used show the sequence of the problem solving.
    - Arrows are used to connect boxes in a flowchart.
    - Arrows can be used to represent an input.

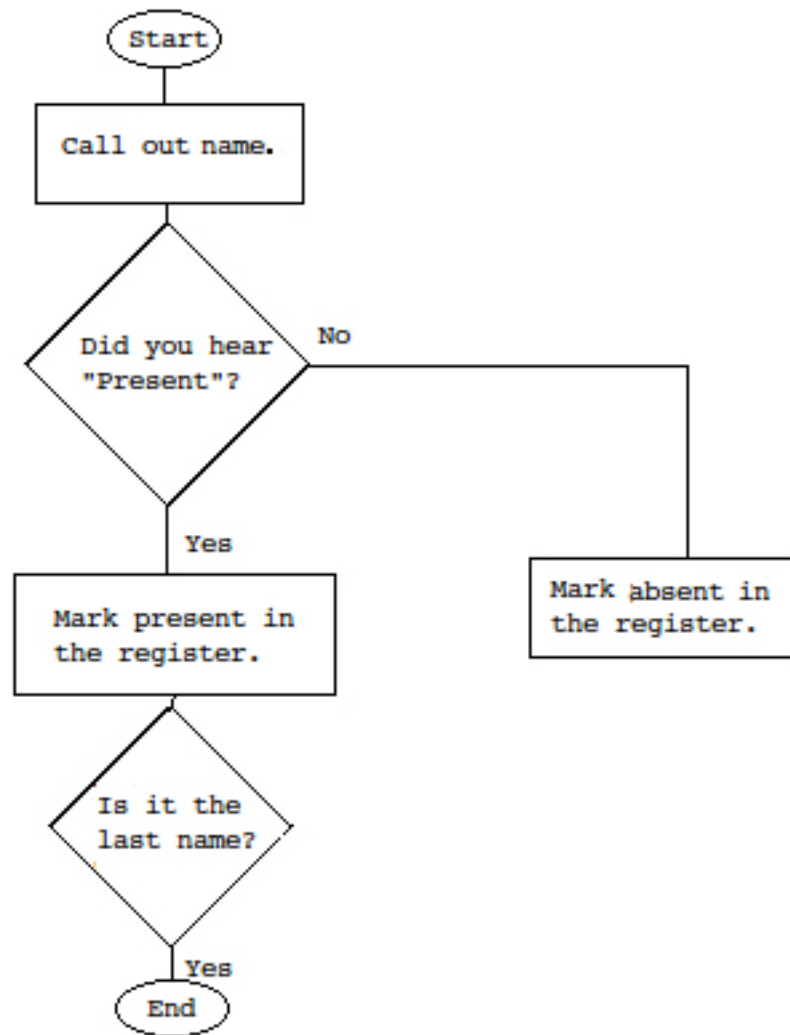9. **The following empty flowchart gives the steps to be followed while seeking admission to new school. The phrases to be filled in the boxes are also given. Fill in the flowchart and complete it.**
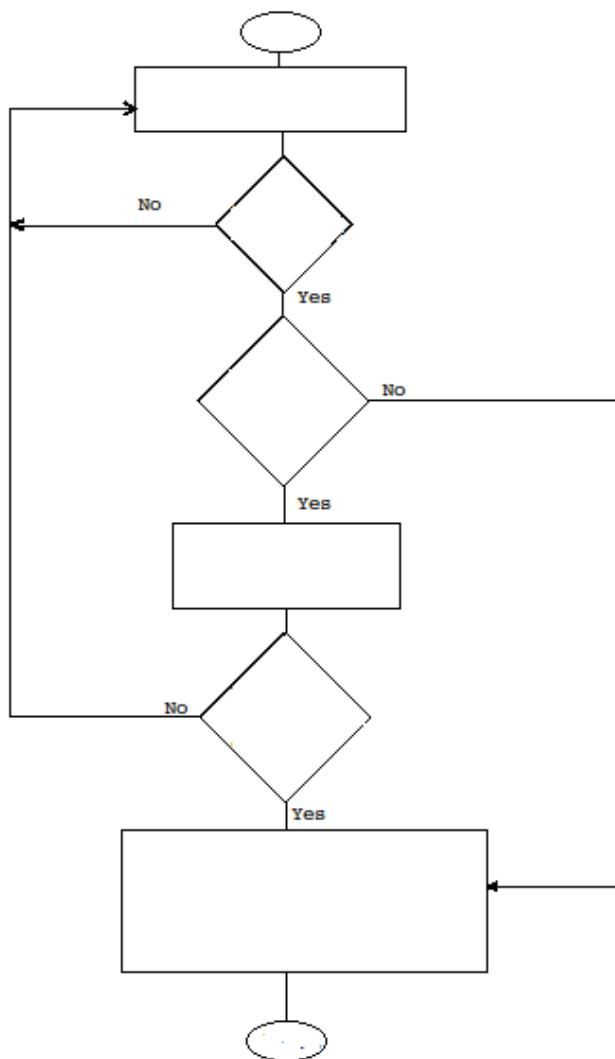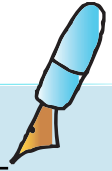
1. Search for a school
2. Prepare for the admission test and write the test.
3. Did you pass the exam?
4. Submit necessary documents and get admission.
5. End
6. Are seats available?
7. Start
8. Is there an admission test?

10. The following flowchart gives the steps followed while taking attendance in a class. Find out what is wrong in the following flowchart and correct flowchart.

```
                    ( Start )
                        |
            ┌───────────────────────┐
            │    Call out name.     │
            └───────────────────────┘
                        |
                      /   \
                     /     \      No
                    < Did you hear >──────────────┐
                     \ "Present"? /               │
                      \   /                        │
                        |                          │
                       Yes                         │
            ┌───────────────────────┐   ┌──────────────────────┐
            │   Mark present in     │   │   Mark absent in     │
            │    the register.      │   │    the register.     │
            └───────────────────────┘   └──────────────────────┘
                        |
                      /   \
                     / Is it \
                    <  the    >
                     \ last   /
                      \name? /
                        |
                       Yes
                    ( End )
```

WORKSHEETS

11. Draw a flowchart for the following situation:

There are four types of fruits:
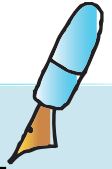
Apples, Oranges, Bananas and Grapes.

Each one of you must pick two types of fruits.
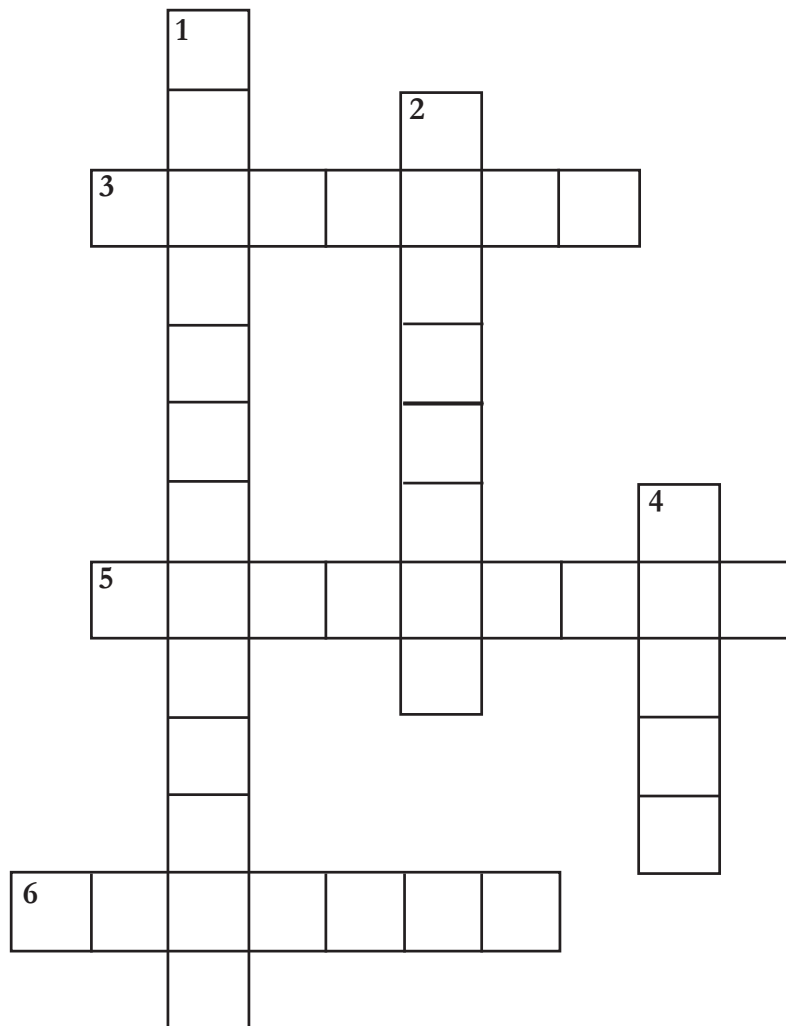
Note the following conditions:

If you pick apple you cannot pick orange.

If you pick orange you cannot pick banana.

If you pick grapes you cannot pick apple.

WORKSHEETS

12. Complete the crossword puzzle.

Across

    iii. I am a rectangle in a flowchart. What do I represent?

    v.   You can use me to communicate ideas, graphically represent a problem solving process.

    vi. When you want to show a decision making step, you can use this box.

Down

    i.   In the flowchart, I represent data or information that is available.

    iv. In a flowchart if the problem solving is flowing straight from top to bottom, what structure am I?

    v.   I connect two geometrical boxes in a flowchart.

1. Select one of the games from GCompris and draw a flowchart to explain its rules.

2. Use one of the following applications - open office draw/ Kivio (available for Linux)/ Diagram Ring (available for windows) --- to draw a flow chart for the above on the computer.

Group Activity

3. **Play Computer Class:** Divide the class into four teams - INPUT DATA, DECISION, and OUTPUT. Nominate one person from input and output team to play the role of start and end box respectively. Each group has a set task to perform based on instructions given to them by another team. You can give the following situations for students to work through the process of flow chart.

   i. **Switch on the computer and open and application.**

   (Hint: Include the name of hardware/software involved along with their functions).

   Choose one from the list below:

   ii. **Visit to health clinic**

   iii. **Admission to a school.**

   iv. **Receive calls on landline telephone**

Some of the steps involved in three of the above activities are given below. Add more steps as required.

   Example (ii) – Visit to health clinic

   a. Take an appointment on the telephone to check availability of doctor.
   b. Visit the hospital.
   c. Stand in queue for your turn to talk to the assistant/clerk.
   d. If you are already registered, your record will be retrieved, else fill a form for new patient.
   e. Make the payment.
   f. Go and meet the doctor.

   Example (iii) - Admission process in school

   a. Check availability of seats in a school.
   b. If seats are available, find the procedure for admission.
   c. If there are entrance exams, prepare and write for exams and check for results.
   d. If you clear the entrance, submit the form along with performance record of entrance and report card of earlier class.
   e. For schools that do not have entrance exams, submit the form along with report card of earlier class.
   f. Wait for list of students to put up.
   g. You name figures in the list, pay admission fees to the school.

   (Hint: What if your name does not appear in the list?)

Example (iv) - Receive calls on landline telephone

a.   Telephone rings.

b.   Pick up the phone

c.   Wish hello and find out who is calling and wants to talk to whom.

d.   Check availability of person for whom the call is addressed.

e.   If the person to whom the call is addressed is available at home handover the telephone to him/her.

f.   If the person is not available, take the message and later convey it.

   (Hint: note the phone number to call back).

Project

4.   **In the four boxes given below some words and phrases are given under four categories:**

   Resources   Contents   Conditions   Decisions

   The list is not an exhaustive one. Go ahead add more words and phrases.

Resources	Contents	Conditions	Decisions
Textbook	Games	Is it authentic?	Can use it
Internet	Worksheets	Did you ask permission?	Cannot meet strangers
Library	Personal information	Is it free or licensed under CC?	Get permission
Parents	Stories	Is there a copyright?	Cannot use it
Friends	Pictures	Does it need permission?	Acknowledge and use it.
	Information	Can you trust?	Get approval
	Pop up	Can it be used?	
	Chat		

Now recall the posters for SMART(Rules for safe Internet usage) and AWARE (copyright sensitisation) and draw 2 flowcharts on these rules, by taking at least one term from each of these boxes.

Expl●re

1.   E