COMPUTER SCIENCE PAPER 2

COMPUTER SCIENCE

Topic: Paper 2 Fundamental Problem-solving and Programming Skills
Duration: 2 hours

INSTRUCTIONS

- Carry out every instruction in each task.
- Answer **all** questions.
- Use a black or dark blue pen.
- You may use an HB pencil for any diagram, graphs or rough working.
- **Calculator Not Allowed**.
- Show your workings if relevant.

INFORMATION

- The total marks for this paper is **75 marks**.
- The number of marks for each question or part question is shown in brackets [ ].

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Refer to the insert for the list of pseudocode functions and operators.

1. A library management system is being developed.

(a) Details about each borrow is to be recorded. For each of the following data item, suggest appropriate identifier name and data type [2 + 4]

Data Item	Identifier Name	Data Type
Borrower's Name		
Date of Borrow		
Borrower's ID		
Fine Amount		

(a) Program variables have values as follows:

Variable	Value
Book	"Introduction to Algorithms"
Topic	"Computer Science"
ReleaseDate	2009
Price	79.99
Available	True
Author	"Thomas H. Cormen"

Evaluate each expression in the following table. If an expression is invalid, write ERROR. Refer to insert for built-in functions.

[4]

Expression	Value
Book + " by " + Author	
MID(Book,1,5) & "..."	
Available AND (Price < 100)	
Topic = "Computer Science"	

2.

(b) An algorithm will:

- Creates two arrays of size 100.
- Inputs 100 numbers from user and fills two array such that:
- First array contains the number
- Second array contains the frequency (number of times the number is entered.)
- Outputs the number with highest frequency

Write pseudo code corresponding to the algorithm. [8]

3. The implementation of a stack uses an integer variable and a 1D array Stack of type INTEGER. The array Stack is declared in pseudocode as follows:

```
DECLARE Stack :  ARRAY[1:200] OF INTEGER
```

The stack will operate as follows:

- Integer variable TOS will store the array index for the top element in the stack.
- The value -1 is used to indicate an empty stack.

(a) State why the value -1 has been selected to indicate an empty stack. [1]

(b) Give the range of valid values that could be assigned to variable TOS. [1]

(c) The following algorithm will push an item to stack:

```
 IF TOS = 200 THEN
   OUTPUT "Stack Overflow"
ELSE
   TOS = TOS + 1
   Stack[TOS] = Item
ENDIF
```

Draw flowchart to represent this algorithm graphically. [5]

(d) Similar algorithm is to be written for Pop operation. Write the algorithm using plain English. Do not include Pseudocode statement in your algorithm. [4]

4. A game uses "Info.txt" as savefile to store player progress.

(a) Give one reason to use a savefile. [2]

(b) The savefile is in form of csv(comma separated values) with PlayerId, Level and Health. i.e.

```
  P101, 3, 60
 P302, 2, 90
...
```

Write pseudocode for function that takes playerId as parameter and returns an array with Level and Health. [8]

(c) The company wants to create a file "HighScores.txt" which will Contain PlayerId of top 3 players from file "Info.txt". Write pseudocode that creates that file. [7]

5.

(a) Draw a state transition diagram that has the following description:

- Two states "open" and "closed" to represent the state of a door.
- Actions/inputs available are "push" and "pull".
- Starting state is closed.

[7]

(b) Fill the following state-transition table for the above diagram:

[4]

6. The following is a function design in pseudocode. Line numbers are given for reference only.

Current State	Action/Input	Next State
Closed	Push	
Closed	Pull	
Open	Push	
Open	Pull	

```
01 FUNCTION CountVowels(InString : STRING) RETURNS INTEGER
02
03 DECLARE nc : CHAR
04 DECLARE c : INTEGER
05 DECLARE n : INTEGER
06
07 c = 0
08 n = LENGTH(InString) // get number of characters for loop
09
10 WHILE n > 0 // repeat until no more characters left
11
12 nc = LEFT(InString,1)
13 n = n - 1
14 InString = RIGHT(InString,n) // remove first character
15
16 IF (nc = 'a') OR (nc = 'e') OR (nc = 'i') OR (nc = 'o') OR (nc = 'u') OR
17    (nc = 'A') OR (nc = 'E') OR (nc = 'I') OR (nc = 'O') OR (nc = 'U')
18 THEN
19 c = c + 1
20 ENDIF
21
22 ENDWHILE
23
24 RETURN c
25
26 ENDFUNCTION
```

(a) This pseudocode includes features that make it easier to read and understand. State such two features. [2]

(b) State two additional features that should be used to make this pseudocode easier to read and understand. [2]

(c) Study the function and identify the features of the function in the following table. [8]

Feature	Answer
A line number containing assignment statement	
A line number with pre-condition loop start	
A line number containing end of pre-condition loop	
A line number with selection statement	
Number of parameters that the function takes	
One boolean operator used	
Number of local variables used	
Number of times the loop is executed for parameter "Hello"	

(d) While developing program that takes a number between 1 and 100000 checks if it is a perfect square(like 1, 4, 9, 16 etc.), the programmer wants to test it. What are three

types of test data he should test the program with? Also, give one example of each type. [6]