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Computer science
Higher level
Paper 1

Tuesday 11 May 2021 (afternoon)

2 hours 10 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer all questions.
- The maximum mark for this examination paper is **[100 marks]**.

Section A

Answer **all** questions.

1. Identify **two** roles that a computer can perform in a network. [2]
2. Describe **one** method of implementation for a new computer system. [2]
3. Draw the logic circuit represented by the following truth table. [2]

| A | B | Z |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

4. (a) Identify **two** reasons why patches may be necessary for an operating system. [2]
(b) Identify **two** methods that can be used to obtain these patches. [2]
5. Calculate the denary (base 10) equivalent of the hexadecimal number BF. [2]
6. Identify **two** reasons why fibre optic cable would be preferred over wireless connectivity. [2]
7. Distinguish between a *variable* and a *constant*. [2]

8. List the output from the given algorithm for the following input. [3]

2, 6, 8, 9, 12, 15, 18, 20

```
loop for Count from 0 to 7
  input NUMBER
  if NUMBER div 2 = NUMBER / 2 then
    if NUMBER div 3 = NUMBER / 3 then
      output NUMBER
    end if
  end if
end loop
```

9. Identify **one** advantage of using a dedicated operating system on a mobile phone. [1]

10. Identify **two** characteristics of a dynamic data structure. [2]

11. Sketch a balanced binary tree that would allow the following output when traversed using inorder traversal:

Zebra, Tango, Hotel, Foxtrot, Delta, Bravo, Alpha. [3]

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Section B

Answer **all** questions.

12. A school currently has a cabled network but wants to add wireless networking across the whole campus.

(a) Describe **two** hardware components the school will need to implement the wireless network. [4]

(b) Identify **two** advantages to the students of the new wireless network. [2]

There are concerns that unauthorized people could access the data on the wireless network.

(c) Outline **two** methods the school could employ to prevent network data from being accessed over their wireless system. [4]

The school has decided to implement a virtual private network (VPN) to provide access to its network.

(d) Identify **two** technologies the school would require to provide a VPN. [2]

(e) Explain **one** benefit to the staff of using a VPN to remotely access the school network. [3]

13. A company has 600 employees whose names are currently stored using a collection called `NAMES`. The names are stored as surname, first name. For example: Smith, Jane, Uysal, Rafael, Ahmed, Ishmael, Jonsonn, Sara, ...

(a) Construct a pseudocode algorithm that will store the surnames in one array and first names in another. [4]

The names in the collection are kept in a random order. However, it would be more useful if they were kept in alphabetical order.

(b) Construct a pseudocode algorithm that will sort the surnames into alphabetical order using the *bubble sort* method. The order of the first names must also be changed so that they keep the same index as their corresponding surname. [5]

The company's staff list is now organized in the arrays in alphabetical order.

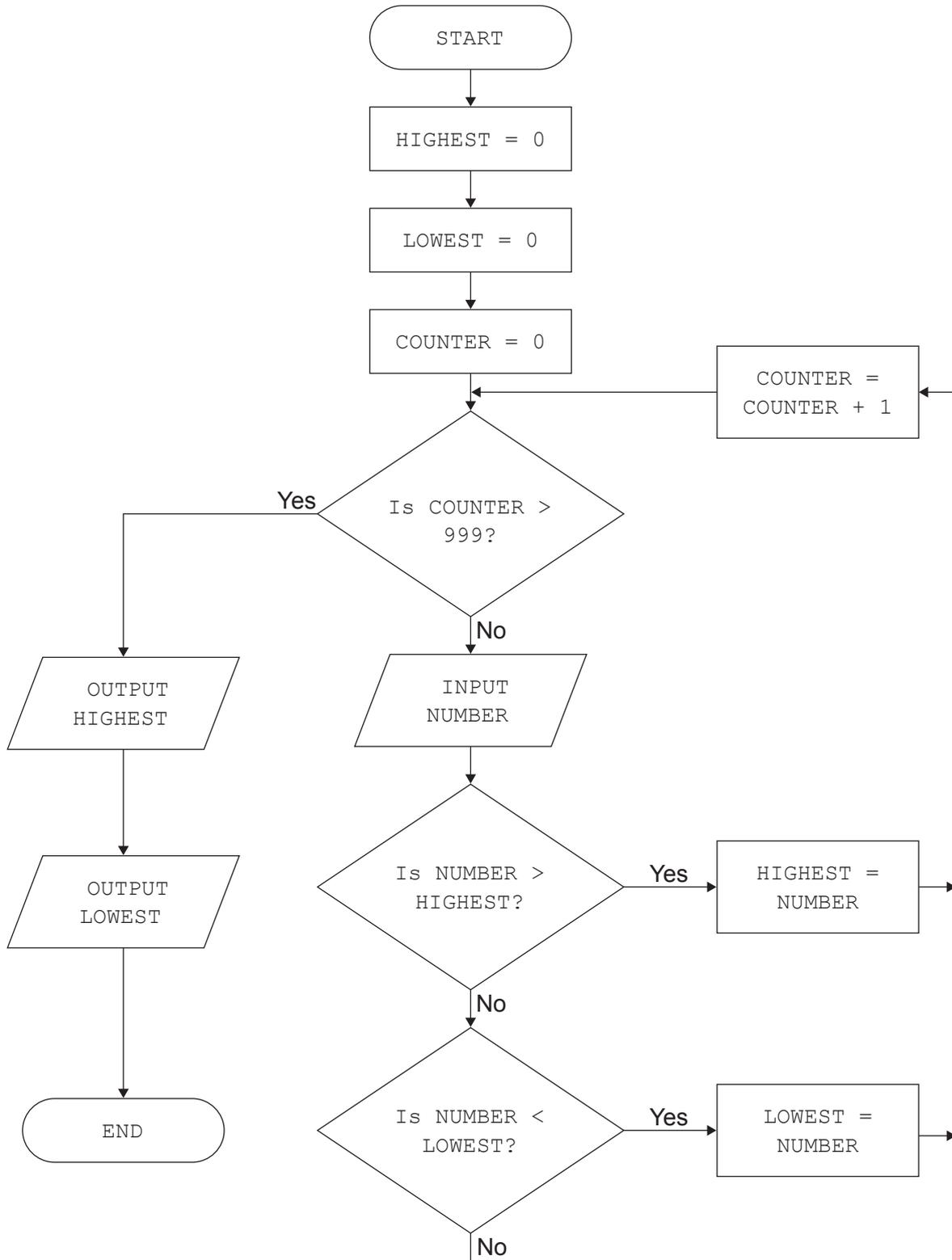
A binary search was used to find a specific name in the array.

(c) Describe the process a binary search would follow to find a record in the surname array. [4]

(d) Outline **one** benefit of using sub-programmes to implement your algorithms from parts (a) and (b). [2]

14. The following flowchart is intended to represent an algorithm in which numbers that are input cannot be negative.

The flowchart contains a logic error that will affect the algorithm's functionality.



(This question continues on the following page)

(Question 14 continued)

- (a) (i) Identify the logic error in the algorithm. [1]
- (ii) Outline how the error in the algorithm identified in part (i) can be corrected. [2]

The algorithm is to be altered to restrict the values that are input to whole numbers between 0 and 1000.

- (b) State the name of the method that could be used to restrict the values that are input. [1]

A further change has been requested for the algorithm to enable it to calculate the average of all the numbers entered. The average will be output when the algorithm terminates.

- (c) Based on the flowchart, construct this algorithm using pseudocode. You must include the required changes:
 - correction of logic error
 - only allow input of integers between 0 and 1000
 - calculation of average of all numbers entered
 - output of final average. [8]

15. A business has a range of different computers within the organization, including laptops, desktops and file servers. Wherever possible the organization uses a common operating system on its computers.

- (a) Outline **two** resource management techniques that are likely to be carried out by the operating system of a desktop computer. [4]
- (b) Outline **one** way the operating system hides the complexity of the hardware from the computer user. [2]

Memory requirements and processor speed will vary depending on the tasks required of the computer.

- (c) (i) Contrast the memory requirements of a laptop computer and a file server. [2]
- (ii) Contrast the processor speed requirements of a laptop computer and a file server. [2]

The business has decided to implement a computer-based system to switch the room lights on and off automatically. The lights will only be switched on if the level of light is below a specific reading and there are people in the room. The lights will be switched off when the room has been unoccupied for at least five minutes.

- (d) State **two** types of sensor that are required to control the lighting to ensure it switches on when it is required. [2]
- (e) Explain how the system makes use of the data it receives from the sensors to determine when to switch the lights on. [4]
- (f) Outline how the system will prevent the lights from being switched off too quickly when it thinks the room is unoccupied. [2]

16. A network is set up with shared printers so that when a user wishes to print, print jobs are sent to a queue until the printer is available.

- (a) Outline why a queue is the appropriate data structure to manage print jobs. [2]
- (b) Draw a diagram to show how a print queue may be implemented using a linked list. [3]
- (c) Explain why a stack would not be appropriate as a data structure for managing print jobs. [3]

The *factorial* of the positive integer n , which is written $n!$, is the product of all the positive integers less than or equal to n . A stack may be used to perform a factorial calculation as shown by the algorithm:

```
//stack for factorial(NUM)
//creates a stack of (NUM - 1) elements
//when NUM = 6
NUM = 6
loop while NUM > 1
    stack.push(NUM)
    NUM = NUM - 1
end loop
PRODUCT = 1
loop while not stack.isEmpty()
    NUM = stack.pop()
    PRODUCT = PRODUCT * NUM
end loop
output PRODUCT
```

- (d) Copy and complete the trace table for the algorithm shown for $NUM = 6$. [3]

| NUM | PRODUCT | OUTPUT |
|-----|---------|--------|
| 6 | | |
| | | |

- (e) Explain how a stack may be used in the implementation of a recursive function. [4]

References: