Diploma Programme
Programme du diplôme
Programa del Diploma

Computer science
Higher level
Paper 1

Monday 20 May 2019 (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]**.

International Baccalaureate
Baccalauréat International
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Section A

Answer **all** questions.

1. Define the term *peripheral.* [1]

2. Identify **two** features of a graphical user interface (GUI). [2]

3. Outline the purpose of the memory address register (MAR) in the central processing unit (CPU). [2]

4. Outline why single processor computers may not be able to render 3D graphics effectively. [2]

5. (a) Outline **one** advantage of using virtual memory. [2]

(b) Outline **one** disadvantage of using virtual memory. [2]

6. State the hexadecimal equivalent of the following binary number:

11011111 [1]

7. Construct the truth table from the following logic circuit. [3]
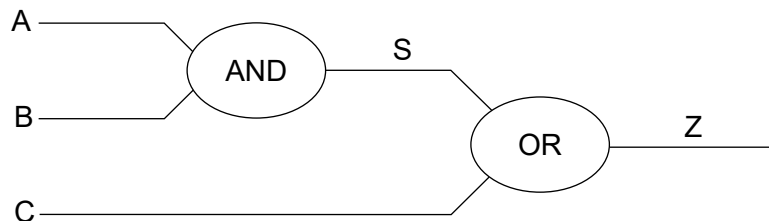
8. Outline **one** method of collecting information from stakeholders concerning the requirements for a new system. [2]

9. Identify **two** characteristics of a personal area network (PAN). [2]

10. Outline **one** reason why protocols are used in communications between computers. [2]

11. State the output from the binary tree using postorder traversal. [2]
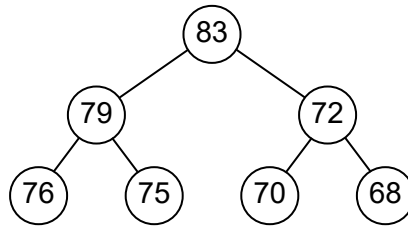
12. Outline why a binary tree would be a good choice of data structure for maintaining an address book. [2]

Turn over

Section B

Answer **all** questions.

13. A large mail order company is concerned about the security of its stored data.

    (a)   Describe **two** possible causes of data loss.   [4]

    (b)   Outline **two** backup strategies that may be used to limit data loss.   [4]

    The company decides to improve its service by introducing a new user interface for its
    customers and has developed this interface to the point that it needs to be tested by users
    who are outside of the company.

    (c)   Explain why beta testing is used to gather feedback for the new user interface.   [3]

    (d)   Outline **one** consequence of not involving end-users in the design and testing stages.   [2]

    (e)   Identify **two** features that could be used to improve the accessibility of the new user
          interface.   [2]

14. A company that provides training for teachers plans to set up a training room in its offices
    with a network of 15 computers. Each computer has 1 TB of storage and 16 GB of random
    access memory (RAM).

    (a)   Identify **two** characteristics of RAM.   [2]

    (b)   State the purpose of persistent storage on the computers.   [1]

    In order to minimize costs, the company decided only to install general application software
    on the training computers.

    (c)   Identify **two** types of general application software that would be installed on the training
          computers.   [2]

    The company has decided to allow the teachers to use their own devices in its training room
    by adding wireless networking.

    (d)   (i)   Outline **one** advantage to the company of implementing this change.   [2]

          (ii)   Outline **one** disadvantage to the company of implementing this change.   [2]

    (e)   Describe **one** method of security that may be used on this wireless network.   [2]

    (f)   Explain why the speed of data transmission on the wireless network in the training
          room may vary.   [4]

15. A school teacher decides to write a program to store class records and marks. Part of this program involves using a sort algorithm. The algorithm shown is a selection sort and to test it, the teacher has set up an array `VALUES[]` with 5 elements of test data.

```
LIMIT = 4

loop COUNTER1 from 0 to LIMIT – 1
MINIMUM = COUNTER1

   loop COUNTER2 from COUNTER1 + 1 to LIMIT
     if VALUES[COUNTER2] < VALUES[MINIMUM] then
       MINIMUM = COUNTER2
     end if
   end loop

   if MINIMUM ≠ COUNTER1 then
     TEMPORARY = VALUES[MINIMUM]
     VALUES[MINIMUM] = VALUES[COUNTER1]
     VALUES[COUNTER1] = TEMPORARY
   end if

end loop
```

(a)   Copy and complete the table below to trace the algorithm using the data set:
       20, 6, 38, 50, 40

			Array VALUES[]					
COUNTER1	MINIMUM	COUNTER2	[0]	[1]	[2]	[3]	[4]	TEMPORARY
0	0	1	20	6	38	50	40	

[5]

(This question continues on the following page)

(Question 15 continued)

```
                        ┌─────────────┐
                        │    START    │
                        └─────────────┘
                               │
                               ▼
                        ┌─────────────┐
                        │  LIMIT = 4  │
                        │ FLAG = TRUE │
                        └─────────────┘
                               │
                               ▼
                         ╱─────────────╲                          ┌──────────┐
                        ╱ Is FLAG = TRUE? ╲ ──── No ────────────▶ │   END    │
                         ╲─────────────╱                          └──────────┘
                               │
                              Yes
                               │
                               ▼
                        ┌─────────────┐
                        │ FLAG = FALSE│
                        │ COUNTER = 0 │
                        └─────────────┘
                               │
                               ▼
                         ╱─────────────╲
                  Yes   ╱  Is COUNTER >  ╲
                 ◀───── ╲   LIMIT – 1?   ╱
                         ╲─────────────╱
                               │
                              No
                               │
                               ▼
                    ╱───────────────────╲
                   ╱         Is           ╲
                  ╱  VALUES[COUNTER] >     ╲ ── Yes ──▶ ┌──────────────────────────────────┐
                  ╲ VALUES[COUNTER + 1]?   ╱            │ TEMPORARY = VALUES[COUNTER]      │
                   ╲───────────────────╱               └──────────────────────────────────┘
                               │                                     │
                              No                                     ▼
                               │                        ┌──────────────────────────────────┐
                               │                        │ VALUES[COUNTER] = VALUES[COUNTER + 1] │
                               │                        └──────────────────────────────────┘
                               │                                     │
                               │                                     ▼
                               │                        ┌──────────────────────────────────┐
                               │                        │ VALUES[COUNTER + 1] = TEMPORARY  │
                               │                        └──────────────────────────────────┘
                               │                                     │
                               │                                     ▼
                               │                        ┌──────────────────────────────────┐
                               │◀──────────────────────│          FLAG = TRUE             │
                               │                        └──────────────────────────────────┘
                               ▼
                    ┌────────────────────────┐
                    │ COUNTER = COUNTER + 1   │
                    └────────────────────────┘
```
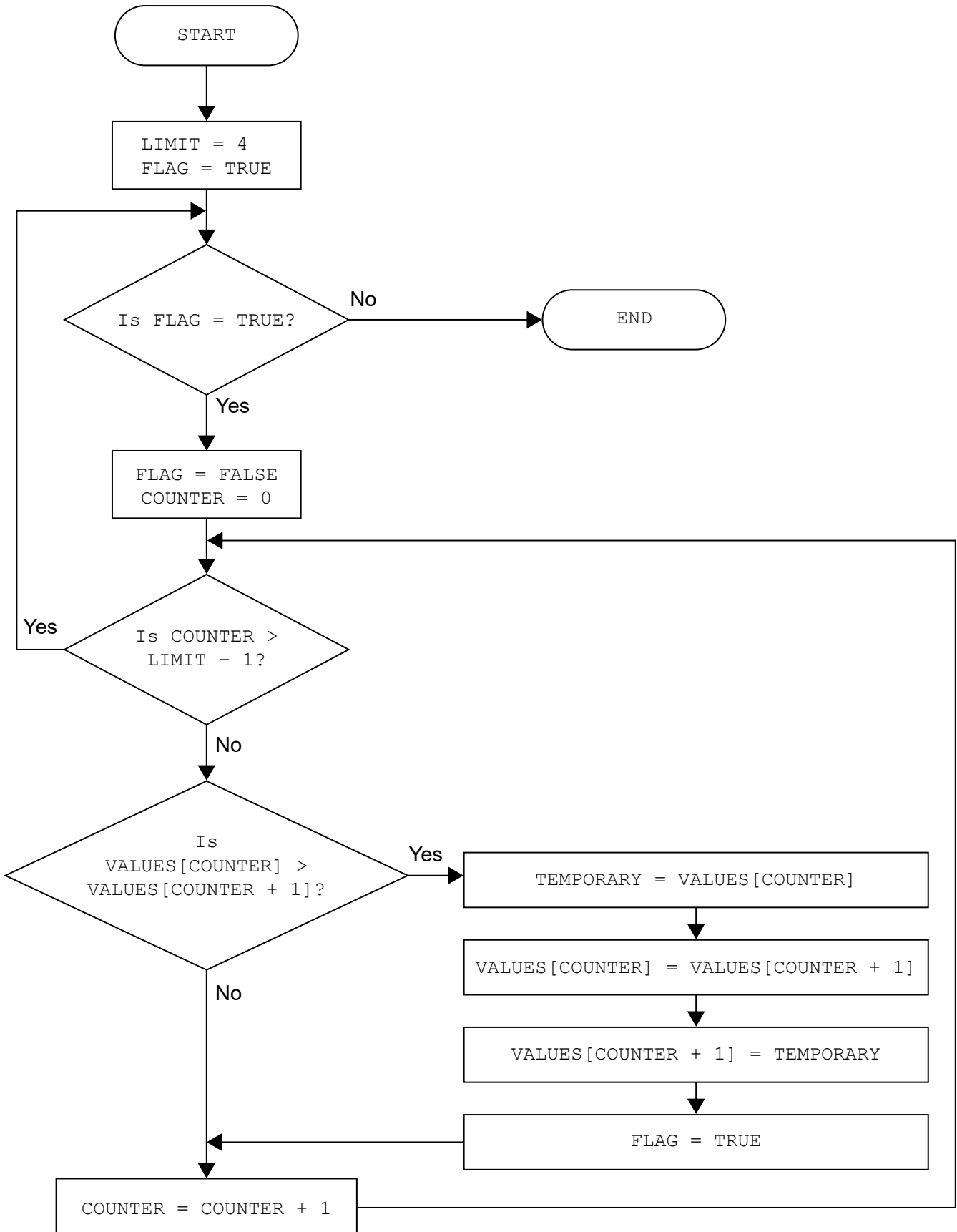
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(Question 15 continued)

    (b)   (i)   With reference to the algorithm in the flow chart, construct this algorithm in pseudocode so that it performs the same function. [3]

          (ii)   State the type of sort in the algorithm constructed in b(i). [1]

    (c)   Construct an algorithm fragment to output the data in the array `VALUES[]` [2]

The data structure used in this algorithm is a one-dimensional array. The teacher decides to experiment with alternative data structures.

    (d)   Explain the difference between a dynamic data structure and a static data structure. [3]

    (e)   Identify **one** alternative data structure for storing class marks. [1]

16.   A mobile phone has been developed with its own dedicated operating system and is to be used as part of a smart home system in Singapore. The smart home system includes a centralized air conditioning system, a burglar alarm and a surveillance system.

    (a)   Identify **two** functions of an operating system. [2]

    (b)   Explain **one** benefit of using a dedicated operating system on the mobile phone instead of a generic operating system. [3]

    (c)   Explain how sensors and microprocessors are used to ensure that the air conditioning system is able to maintain a constant temperature in the smart house. [5]

The developers of the smart home system are considering developing a smart home system that uses a distributed control system to manage the temperature.

    (d)   Contrast the use of a distributed air conditioning system with a centralized air conditioning system for maintaining a constant temperature in the smart home. [3]

Turn over

17. A two-dimensional array `CUSTOMERS[]` is used to store customer details for a mail order company such that each row of the array represents a customer record and each column represents a specific field. The fields currently in use are: `LASTNAME`, `FIRSTNAME`, `ADDRESS1`, `ADDRESS2`, `ADDRESS3`, `CITY`, `POSTCODE`.

The array currently holds 512 records.

(a) Construct the pseudocode that will find how many customers live in the city of `Cardiff` and display the results.   [5]

The company wishes to print a number of mailing labels, such as the one shown below, that will go to all customers called `Jones` who live in `Cardiff`.

```
FIRSTNAME LASTNAME
ADDRESS1
ADDRESS2
ADDRESS3
CITY
POSTCODE
```
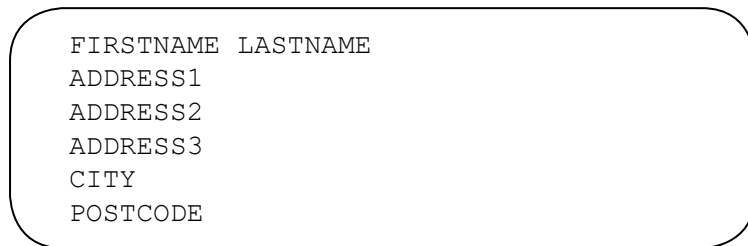
(b) Construct an algorithm that will enable the company to print the mailing labels for all customers called `Jones` who live in `Cardiff`.   [5]

A singly linked list has been created including the following surnames; `Bale, Cousens, Davies, Pugh, Williams`.

(c) Explain the steps to insert "`Jones`" into this singly linked list. You may draw a labelled diagram in your answer.   [5]

(d) Outline **one** example of where a circular linked list would be used in preference to a linear linked list.   [2]