Diploma Programme
Programme du diplôme
Programa del Diploma

Computer science
Higher level
Paper 1

2 May 2024

Zone A afternoon | **Zone B** afternoon | **Zone C** 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]**.

2224 – 6914

10 pages

Section A

Answer **all** questions.

1. (a) State **one** benefit of using software-as-a-service (SaaS). [1]

(b) State **one** drawback of using software-as-a-service (SaaS). [1]

2. Describe the purpose of user acceptance testing. [2]

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

4. State **two** usability issues that could occur when using a cell phone (mobile phone). [2]

5. Identify **two** methods that can be used to improve the accessibility of a computer system for users. [2]

6. Outline the purpose of the memory address register (MAR). [2]

7. (a) State the hexadecimal equivalent of the binary number 11111011. [1]

(b) State the binary equivalent of the denary number 89. [1]

8. Identify **two** applications of a stack. [2]

9. Outline **two** operating system resource management techniques. [4]

10. A temperature sensor is used in an automatic washing machine to help maintain the temperature of the water.

Outline the use of **one other** type of sensor used in an automatic washing machine. [2]

11. Describe the role of feedback in a system that uses sensors and a microprocessor to control the temperature of a room. [4]

Section B

Answer **all** questions.

12. Different transmission media may be used within a network.

(a) (i) Identify **two** characteristics of fibre optic cables as a transmission medium. [2]

(ii) Identify **two** characteristics of wireless transmission. [2]

(b) Describe how encryption is used to protect data during transmission. [3]

(c) Explain how data is transmitted using packet switching. [5]

(d) Explain **one** social implication of changes to working patterns due to the use of a virtual private network (VPN). [3]

13. (a) Define the NOR Boolean operator. [1]

A car has features that monitor its speed, direction and distance from the car in front. This is shown in **Figure 1**.

Figure 1: Rules to control car motion

Input	Binary representation	Description
A	0	Car is less than 20 metres from the vehicle in front.
	1	Car is 20 metres or more from the vehicle in front.
B	0	Car is travelling in reverse or stationary.
	1	Car is travelling forward.
C	0	Car speed is more than 130 kilometres per hour.
	1	Car speed is 0–130 kilometres per hour.

For example, if the car is travelling forward, input B would have a binary representation of 1.

(b) Construct a logic diagram with inputs A, B, and C and output Z to represent the following scenario:

Output Z equals 1 when:

- the car is travelling forward AND it is less than 20 metres from the vehicle in front.

  OR

- the car speed is more than 130 km per hour.

In all other conditions, output Z equals 0. [4]

An additional row (input D) is to be added to assist when the car is in reverse or stationary. Input D checks if there are obstructions less than 3 metres from the rear of the car.

(c) State the rules that need to be added to **Figure 1** to test this condition. [2]

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(Question 13 continued)

Information similar to that presented in **Figure 1** could be used to construct decisions and conditions in program design (see **Figure 2**).

Figure 2: Identifiers for car motion rules

Identifier	Description
F	Distance in metres to the vehicle in front
S	Speed of car in kilometres per hour
T	Travelling in a forward direction

(d) Determine the value of the following expression given that the input values for F, S and T are:

```
F = 40
S = 115
T = true

F >= 25 AND S >= 5 AND S <= 130 AND T = true
```

You must show your working. [2]

(e) Construct an algorithm in pseudocode that repeats the following steps while the car is moving:

- Input the value for the distance from the vehicle in front.
- Input the value for the speed of the car.
- Check the inputs and notify the user if either the distance from the car in front is less than 15 metres or if the speed of the car is more than 115 kilometres per hour.

The algorithm will only terminate when the car stops moving. [6]

14. A large hotel chain runs hotels in many locations around the world. Data is kept locally at each property, and centrally, so that the hotel chain can be managed.

Any computer system that stores data runs the risk of data loss.

(a) State **two** causes of data loss. [2]

(b) Outline **one** consequence for a hotel of the loss of its reservations data. [2]

(c) Describe **one** method the hotel chain could use to prevent its data from being lost. [2]

The hotel chain has implemented a significant upgrade to its computer system that requires the data to be migrated from the legacy system to the new system.

(d) Outline **one** problem that may arise during the data migration process. [2]

The hotel chain makes use of tablet computers for use around its hotels as well as fixed desktop computer terminals at key locations. The resources available on these computers include primary and secondary storage.

(e) Compare and contrast the primary and secondary storage resources of tablet computers and desktop computers. [3]

(f) (i) Identify **one other** hardware resource within tablet computers and desktop computers. [1]

(ii) Explain why the network connectivity of a desktop computer is different to the network connectivity of a tablet computer. [3]

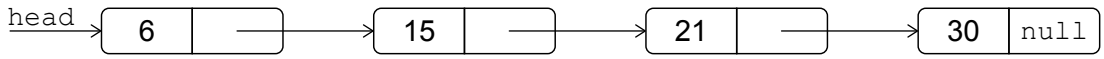
15. Linked lists and binary trees are examples of dynamic data structures.

(a) (i) Outline **one** benefit of using dynamic data structures. [2]

(ii) Outline **one** drawback of using dynamic data structures. [2]

Figure 3 represents a linked list containing the numbers 6, 15, 21 and 30.

Figure 3: A linked list



(b) Describe the steps to find and delete the node containing data item 21. [5]

(c) Describe the structure of a node in a binary tree. [2]

These numbers are input in the following order:

18 15 25 6 2 21 36 30 40

and inserted in a binary tree such that an inorder traversal of the binary tree outputs the numbers sorted in ascending order.

(d) (i) Sketch the resulting binary tree. [3]

(ii) State all the leaf nodes in the binary tree sketched in part (d)(i). [1]

16. String manipulation is a useful programming concept.

Strings are zero-indexed: the index of a string's first character is 0, and the index of a string's last character is the length of the string minus 1.

A set of string manipulation sub-programs is given **in Figure 4**.

Figure 4: String manipulation sub-programs

Name	Description	Example
`subString(X, Y, Z)`	Returns a new string that is a substring of `X`. The length of the substring is `Z` and the substring begins with the character at index `Y`.	`subString("Test", 2, 1)` returns `"s"`
`lenString(X)`	Returns the length of the string `X`.	`lenString("Test")` returns `4`
`revString(R)`	Returns a copy of the string `R` in reverse order.	`revString("Test")` returns `"tseT"`
`joinString(S, J)`	Returns a new string by concatenating the strings `S` and `J`.	`joinString("Join", "Test")` returns `"JoinTest"`

(a) The following section of pseudocode represents an algorithm that is intended to perform validation to check if the length of the string entered is between 10 and 25, inclusive. The algorithm is incorrect and contains **two** errors.

```
input X
loop while (lenString(X) < 10) AND (lenString(X) > 25)
    output "The string's length is out of range, please try again"
    output X
end loop
```

Construct the correct pseudocode that removes the two errors. [2]

(This question continues on the following page)

(Question 16 continued)

(b) The following algorithm performs a task using the string sub-programs:

```
J = ""
loop C from 1 to 4
    input X
    input Y
    input Z
    R = subString(X, Y, Z)
    S = revString(R)
    J = joinString(S, J)
end loop
output J
```

Copy and complete the trace table for the algorithm using the input data:

ADONUS, 3, 2, FERGUS, 0, 3, NASREEN, 1, 4, TUPPENCE, 0, 3, DAMOCLES, 2, 3

The values for columns J, C, X, Y and Z for the first row have been done for you.

J	C	X	Y	Z	R	S
	1	ADONUS	3	2		

[5]

(This question continues on the following page)

(Question 16 continued)

An algorithm is required to set new passwords. The new passwords must be at least eight characters in length and there must be no two consecutive repeated characters.

For example, the password “fEedBack” would be accepted, but the password “FEEDBACK” would fail because of the two consecutive repeated ‘E’ characters.

Following these checks, the password must be entered a second time to check that the user has entered the password they intended.

If any of the tests fail, the password is rejected and the whole procedure is repeated to allow a new password to be re-entered.

An appropriate message must be output to the user at each stage of the algorithm.

For example:

```
Please enter a password that is at least 8 characters long
with no consecutive repeated characters
AAbcDefg

Password has repeated characters, try again

Please enter a password that is at least 8 characters long
with no consecutive repeated characters
AbcdEfGH

Please re-enter your password
AbcdEfGH

Your password is accepted
```

(c) Construct this algorithm in pseudocode, making use of the given string manipulation sub-programs. [8]