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Computer science Higher level Paper 1

2 May 2025

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].

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Section A

Answer **all** questions.

1.	lden	tify two features of an application interface.	[2]
2.	(a)	Outline the purpose of secondary memory.	[2]
	(b)	Describe a situation when secondary memory would be used as an extension of primary memory.	[2]
3.	Outl	ine two possible hardware upgrades to improve a desktop computer's performance.	[4]
4.		cribe two advantages of using surveys to determine user requirements for updating mputer system.	[4]
5.	Con	struct a truth table for the following expression:	
		X = NOT A OR B AND C OR NOT B	[4]
6.	Iden	tify two methods of implementing a new computer system.	[2]
7.	Des	cribe the role of a DNS server.	[2]
8.	Exp	ain one reason why a virtual private network (VPN) might be used.	[3]

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Section B

Answer **all** questions.

9.	An architect uses a single computer for her business. She uses hand-drawn sketches to present her ideas to clients and computer-aided design (CAD) software to create construction projects, alterations, and redevelopments.							
	(a)	(i)	State what is meant by CAD software.	[1]				
		(ii)	Outline two benefits for the architect of using CAD software.	[4]				
	The	archit	ect often creates large graphic files that are sent via the internet.					
	(b)	•	ain the need for data compression software in storing and transferring these graphic files.	[3]				
	Data	loss	can cause downtime, which can force the architect to pause business operations.					
			t on productivity depends on the amount of data lost as well as the time it takes covery.					
	(c)	(i)	Describe how the architect could minimize downtime if the disk system on her computer fails.	[3]				
		(ii)	Outline two causes of data loss other than hardware failure.	[4]				
10.	A school has a local area network (LAN) with a central server that stores many files containing personal, health, and financial information.							
	The LAN is used by the following types of user: network administrators, teachers, students and guests.							
	(a) Explain how the different levels of access for the users of this LAN could be implemented							
	(b)	(i)	Suggest one communications link that would provide high-speed internet access for the school.	[2]				
		(ii)	Suggest two measures to protect the school's LAN from external network security threats.	[4]				
	The	The school gives students and teachers their own school email account.						
	(c) List three problems that might result from providing email access to all students and teachers.							

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- **11.** Each set of traffic lights in a city is controlled by a separate embedded system.
 - (a) (i) Describe what is meant by an embedded system.

[2]

(ii) State **two** other examples of embedded systems in daily life.

[2]

It has been proposed that all the traffic lights in the city should be controlled from a central computer.

(b) Discuss the advantages **and** disadvantages of using one central computer to manage the city's traffic light system.

[4]

Vehicle counts provide the city's traffic control centre with information regarding the number of vehicles on the city's roads.

- (c) List **two** types of sensor that could be used to collect data on the number of vehicles.
- (d) Describe **one** difference between interrupts and polling.

[2]

[2]

The data about traffic and road conditions will be shared with application (app) developers. Their apps can provide real-time information about traffic conditions.

(e) Explain the benefit for drivers of having access to real-time information about traffic and road conditions.

[3]

12. (a) Consider the following recursive function:

```
recfn(N)
    if N <= 0
        then
            return 0
    else
        if N mod 2 = 0
            then
            return recfn(N-1) - N
        else
            return recfn(N-1) + N
        endif
    endif
end recfn</pre>
```

Determine the value of variable x after execution of the following program statement:

X = recfn(5)

Show all your working.

[5]

(This question continues on the following page)

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(Question 12 continued)

(b) Describe **two** basic stack operations.

[4]

The NUMBERS stack stores real numbers. An algorithm should be constructed that will find the smallest number and the largest number stored in the NUMBERS stack. After execution of the algorithm, only these two numbers should be stored in the NUMBERS stack (see Figure 1).

Figure 1: Example data stored in the NUMBERS stack before and after execution of the requested algorithm

The content in the NUMBERS stack before execution of the algorithm.

The content in the NUMBERS stack after execution of the algorithm.

The number **23.0** is on the top of the NUMBERS stack.

The smallest number, **-54.9**, is on the top of the NUMBERS stack.

23.0
-54.9
-12.4
67.0
15.2

-54.9	
67.0	

(c) Construct this algorithm in pseudocode.

You may assume that the NUMBERS stack already contains real numbers.

You must use the access methods of a stack.

[6]

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13. A team of four high-school students decided to create a computer program for younger students to help them learn to count and recognize whole numbers from 1 to 25.

A table partially completed with numbers from 1 to 25 is given to a younger student. The table consists of five rows and five columns (see **Figure 2**). The younger student must enter the remaining numbers. Each number from 1 to 25 should be entered only once.

Figure 2: Example table partially filled with numbers

	24	1		
		7	14	
4	6			22
10			21	3
11		25		9

Each of the four students is responsible for creating several sub-programs that will be included in the program.

(a) List **three** advantages of using sub-programs in this situation.

(This question continues on the following page)

[3]

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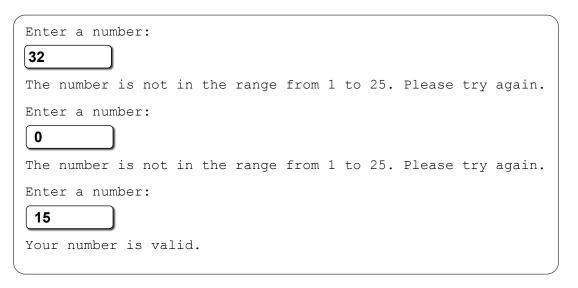
(Question 13 continued)

The sub-program inputInRange() should return a valid input number.

This will ensure that the younger student's input is a number in the range 1–25 inclusive. If the input number is not in this range, an appropriate message is output. The process will be repeated until a valid number is input.

For example:

For the sub-program call N = inputInRange(), if the following appears on the screen:



Then the value of $\ensuremath{\mathtt{N}}$ would be 15 after execution.

(b) Construct an algorithm in pseudocode for the sub-program inputInRange().

(This question continues on the following page)

[4]

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(Question 13 continued)

In the program, the table is stored as a static two-dimensional array.

Figure 3: Two examples of data

Figure 3a: The two-dimensional array is correctly completed because each of the numbers from 1 to 25 appears only once.

	[0]	[1]	[2]	[3]	[4]
[0]	2	24	1	8	15
[1]	23	5	7	14	16
[2]	4	6	13	20	22
[3]	10	12	19	21	3
[4]	11	18	25	17	9

Figure 3b: The two-dimensional array is not correctly completed because the number 17 is missing and the number 12 appears twice.

	[0]	[1]	[2]	[3]	[4]
[0]	12	24	1	8	15
[1]	23	5	7	14	16
[2]	4	6	13	20	22
[3]	10	12	19	21	3
[4]	11	18	25	2	9

The sub-program <code>isCorrectlyCompleted(MAT)</code> accepts the two-dimensional array <code>MAT</code> and outputs an appropriate message to indicate if it has been correctly filled.

For example:

If MAT is the two-dimensional array shown in Figure 3a, then isCorrectlyCompleted(MAT) should output that the table has been correctly completed.

If MAT is the two-dimensional array shown in Figure 3b then isCorrectlyCompleted(MAT) should output that the table has **not** been correctly completed.

(This question continues on the following page)

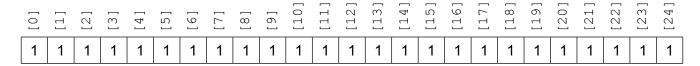
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(Question 13 continued)

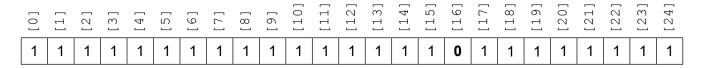
The description of the algorithm for the <code>isCorrectlyCompleted(MAT)</code> sub-program is as follows:

- Initialize a one-dimensional array, FLAGS, with zero (0) values.
- Visit all elements of the MAT array.
 - Use the number stored in the MAT array to match up the index in the FLAGS array.
 - Assign one (1) to the FLAGS array at that index.
- Inspect elements of the FLAGS array.
 - If all the elements in the FLAGS array are one (1), output a message saying that the table has been completed correctly; otherwise, output a message saying that the table has not been completed correctly.

For example, the FLAGS array for the MAT array shown in Figure 3a is:



And the FLAGS array for the MAT array shown in Figure 3b is:



(c) Construct the algorithm in pseudocode for the <code>isCorrectlyCompleted(MAT)</code> sub-program as described.

[8]