L.189

2024-L189A,B-1-EL-01/24

Pre-Leaving Certificate Examination, 2024

Computer Science

Sections A & B

Higher Level

Time: 1 hour, 30 minutes

130 marks

CANDIDATE DETAILS

DAY and MONTH of BIRTH	/ (For example, 3rd February is entered as 03/02)
NAME	
SCHOOL	
TEACHER	

For Examiner use only	
Section	**Mark**
A	
B	
C	
Total	

2024-L189A,B-1-EL-01/24

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Instructions

There are **three** sections in this examination. Sections A and B appear in this booklet. Section C is in a separate booklet that will be provided for the computer-based element.

Section A	Short Answer Questions	Attempt any nine questions All questions carry equal marks	54 marks
Section B	Long Questions	Attempt any two questions All questions carry equal marks	76 marks
Section C	Programming	Answer all question parts	80 marks

Calculators may **not** be used during this section of the examination.

The superintendent will give you a copy of page 78 (Logic gates) of the *Formulae and Tables* booklet on request. You are not allowed to bring your own copy into the examination.

Write your answers for Section A and Section B in the spaces provided in this booklet. There is space for extra work at the end of the booklet. Label any such extra work clearly with the question number and part.

Section A	Short Answer Questions	54 marks

Answer any **nine** questions.

Question 1

The five key components in von Neumann architecture are: **Central Processing Unit (CPU)**, **Control Unit (CU)**, **Bus**, **Memory** and **I/O**.

Outline briefly the role of any **two** of these components.

Component 1:
Component 2:

Question 2

State the number of bits in **each** of the following types of computer memory.

(a) A nibble.

(b) A megabyte.

(c) A megabit.

Question 3

An output, **D**, is produced from three inputs **A**, **B** and **C**.
Output **D** is required to be 1 only if inputs **A** and **B** are 1, or input **C** is 1 and input **B** is 0.

Construct the logic circuit using all of the components given in **Figure 1** below.

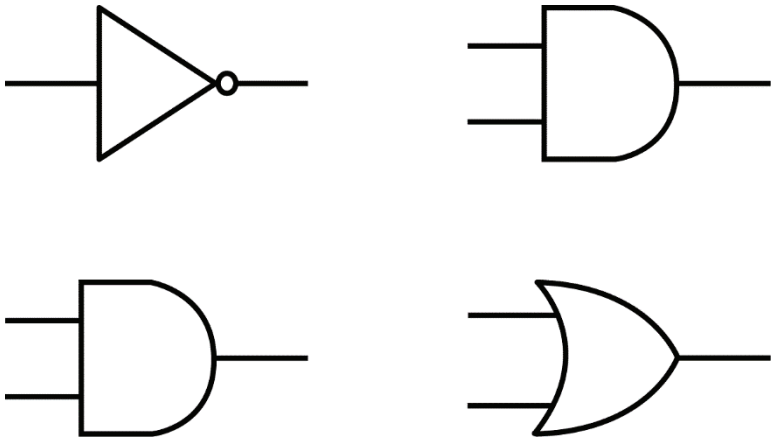
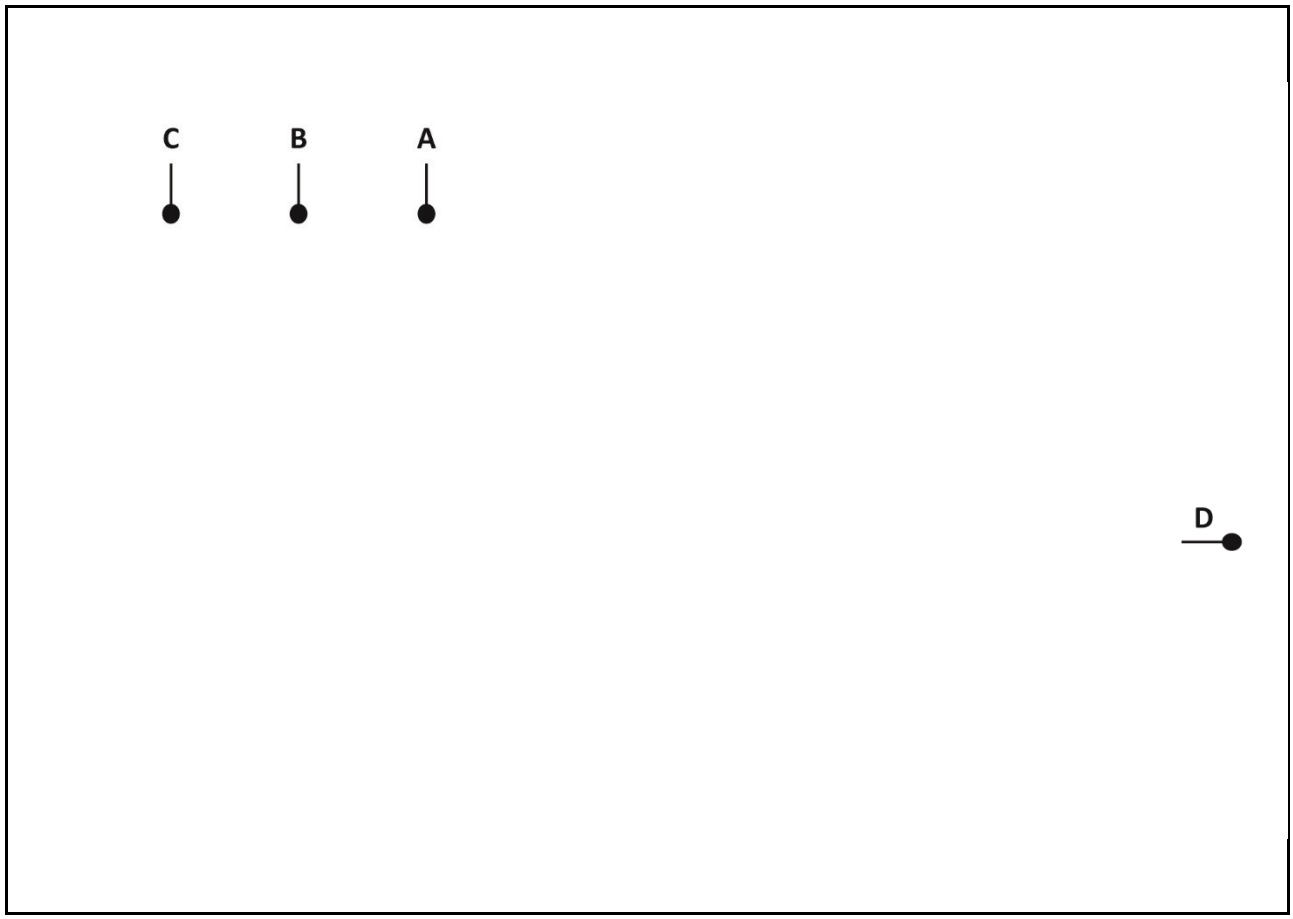


Figure 1



Question 4

(a) What is cache memory?

(b) How does cache memory improve system performance?

Question 5

(a) What is the main difference between IPv4 and IPv6 protocols?

(b) Explain briefly the implication of this difference for networking.

Question 6

Four random playing cards, each of different value, are placed face up on a table. The cards are to be sorted in ascending order of value.

The only action you can perform is to swap pairs at a time.

What is the minimal number of swaps achievable on the worst possible arrangement of cards? Justify your answer.

Figure 2

Minimal number of swaps:
Justify:

Question 7

Distinguish between a recursive algorithm and an iterative algorithm.

Question 8

Aircraft flight recorders, aka "Black Boxes" such as the one shown in **Figure 3**, use solid state memory chips to record data.

Figure 3

Explain **two** advantages and **two** disadvantages of using solid state memory to record data.

Advantage 1:
Advantage 2:
Disadvantage 1:
Disadvantage 2:

Question 9

Time complexity is the computational complexity that describes the amount of computer time it takes to run an algorithm and is commonly expressed using Big O notation.

Sort the following Big O notation in order of increasing time complexity.

O(1) **O(*n*)** **O(log *n*)** **O(n^2)** **O(*n* log *n*)**

Question 10

'An agent-based model of a traffic system might include individual drivers and their vehicles, traffic lights, road signs, and other environmental factors. By simulating the behaviour of each driver and their interactions with the other agents in the system, the model can demonstrate emergent behaviours such as traffic jams, bottlenecks, and accidents.'

Explain the terms 'agent-based modelling' and 'emergent behaviours'.

Agent-based modelling:
Emergent behaviours:

Question 11

In non-return-to-zero (NRZ) encoding, a logic 0 is represented by a low voltage level, typically 0 volts, while a logic 1 is represented by a high voltage level, often a positive voltage.
The presence or absence of voltage levels at specific points in time represents the binary data being transmitted.

(a) Explain **one** advantage of using binary numbers in computer systems.

Advantage:
Disadvantage:

(b) Convert the hexadecimal number $D8_{16}$ into a binary number.

Question 12

Unit testing is a type of testing that is commonly used in software development.
Give **two** characteristics of unit testing.

Section B	Long Questions	76 marks

Answer any **two** questions.

Question 13

(a) HTML is an important part of website design.

(i) What do the letters HTML stand for?

(ii) The download speed formula is: file size (bytes) ÷ (download speed ÷ 8). Calculate the length of time it would take a 250Mb per second (Mbps) connection to download a 1GB file, assuming a perfect connection.

(b) James wants to set up a home office using five computers in a mesh network.

(i) What is the minimum number of connections needed to connect the five computers in a mesh network? (You may draw the configuration but the connecting lines must be countable.)

This question continues on the next page.

(ii) Derive a formula for companies to calculate the minimum number of connections to create a mesh topology in *n* nodes.

(c) **(i)** Distinguish between a web browser and a search engine.

(ii) Explain why internet protocols are so important in modern digital communication.

Question 14

(a) Patrick applied for a council-funded home improvement grant via an application form on the County Council website. The County Council stores all the applications in a database on a network. Patrick has concerns about the storage of his application, which includes personal details such as home address, telephone number and PPS number.

Describe **three** methods that can be used by the County Council to protect the data held in its database.

Method 1:
Method 2:
Method 3:

This question continues on the next page.

(b) Intensive Care Units in hospitals require specialist medical staff to care for patients in need of 24-hour monitoring and support.

Figure 4

With the shortage of specialist medical staff, computerised systems can be used to monitor patients' vital signs and alert medical staff to any significant changes in a patient's condition. These systems usually run on an embedded, real-time, operating system.

One hospital would like to update the system to allow it to automatically deliver doses of certain drugs to patients based on the readings taken at the time, rather than leave the delivery of drugs to medical staff.

Consider the ethical issues that this system update might have.
Provide **one** argument in favour of this upgrade and **one** argument against.

This question continues on the next page.

(c) A Pigpen cipher is an ancient way of encrypting information. The cypher key is shown in **Figure 5**.

You have used computational thinking in your Computer Science course to decompose, abstract and look for patterns in problems.

Using those skills and the given key, decipher the code shown in **Figure 6**.

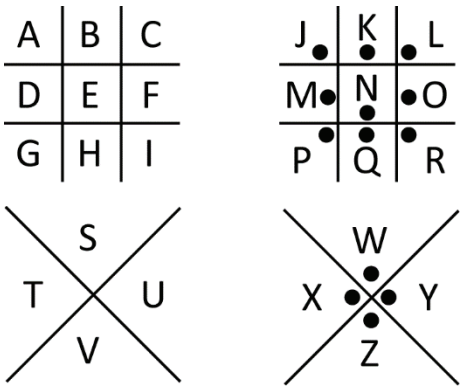


Figure 5

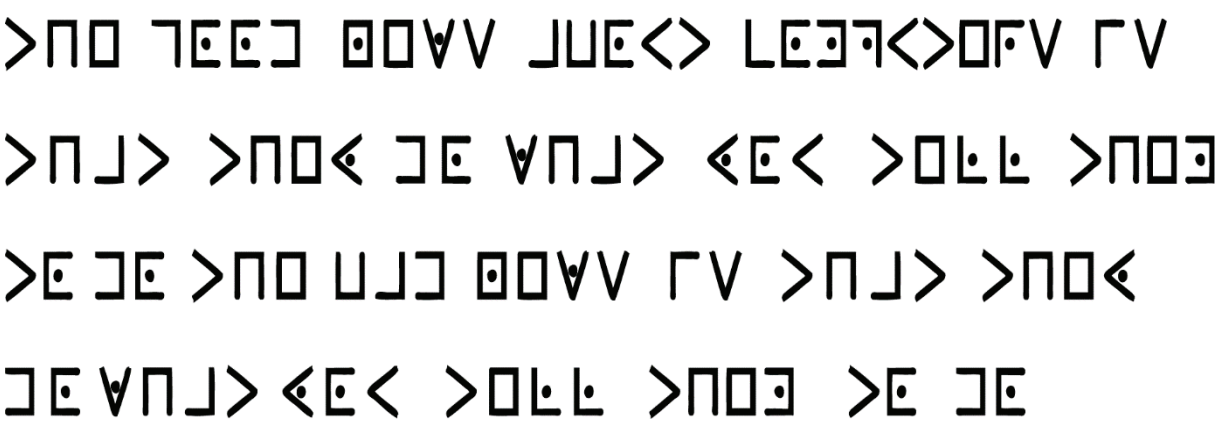


Figure 6

This question continues on the next page.

(d) **(i)** List **three** factors that contribute to the complexity of passwords.

1:
2:
3:

Figure 7

(ii) Explain how **any two** of the factors you have listed in part **(d)(i)** above contribute to the complexity of passwords.

1:
2:

Question 15

(a) Visualisation of pseudo-code is one of the key elements when beginning the design process.

Convert the following pseudo-code into a suitable flowchart using the appropriate notation.

```
# start
num = input('Enter a number:')
num = float(num)
if num>0
   print('num greater than zero')
if num<0:
   print('num less than zero')
print('Done')
   # end
```

This question continues on the next page.

(b) 'Waterfall' and 'Agile' are two design approaches used in software development.

Compare and contrast these two design approaches and state which approach you would recommend for developing a large-scale software project.

This question continues on the next page.

(c) Discuss, using examples, the potential benefits and drawbacks of using adaptive and assistive technology in education.

Pre-Leaving Certificate Examination, 2024

Computer Science

Section C

Higher Level

Time: 1 hour

80 marks

Do not hand this question paper up.
This document will not be examined
and it will not be returned to you.

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Instructions

There is one section in this paper.

Section C	Programming	One question Answer all question parts	80 marks

Answer all parts of the question on your digital device.

Calculators may be used during this section of the examination.

The *Formulae and Tables* booklet cannot be used for this section of the examination.

The superintendent will give you a copy of the *Python Reference Guide*.

Ensure that you save your work regularly.

Save your files using the naming structure described at the beginning of each question part.

If you are unable to get some code to work correctly, you can comment out the code so that you can proceed. The code that has been commented out will be reviewed by the examiner.

Rough work pages are provided at the end of this booklet. Please note that this booklet is not to be handed up and will **not** be reviewed by an examiner.

At the end of the examination it is your responsibility to ensure that you have saved all of your files onto your external media.

There is no examination material on this page

Section C	Programming	80 marks

Answer all question parts.

Question 16

(a) Open the program called **Question16_A.py** from your device.

Before making any changes, you should save your working copy of the file using the format **StudentNameQuestion16_A.py**. For example, you would save the file as **MayMurphyQuestion16_A.py** if your name was May Murphy.

Enter your Name and School in the space provided on **line 2** in your Python file.

Rock-Paper-Scissors is a hand game played between two people where each player simultaneously forms one of three shapes with their hand representing a rock, paper or scissors. The rules are as follows:

- Rock beats Scissors.
- Scissors beats Paper.
- Paper beats Rock.
- If both players choose the same shape, it's a tie, and the game is usually replayed until there is a winner.

The program defines a function called `play_round` which simulates one round of a game of Rock-Paper-Scissors.

```
1  # Question 16(a)
2  # Name and School:
3
4  import random
5
6  def play_round(player_choice, computer_choice):
7      if player_choice == computer_choice:
8          return 'tie'
9      elif (player_choice == 'rock' and computer_choice ==
   'scissors') or \
10     (player_choice == 'paper' and computer_choice == 'rock') or
   \
11     (player_choice == 'scissors' and computer_choice ==
   'paper'):
12         return 'player'
13     else:
14         return 'computer'
```

This question continues on the next page.

Make the following changes to the program:

(i) Add a variable to the program called `player_choice` which prompts the user to choose rock, paper or scissors.

When the program is run the output may now look as follows:

```
Please choose rock, paper or scissors: rock
You have chosen rock
```

(ii) You have decided on a strategy to always pick scissors.

Change the program to play the game 3 times.

Hint: use `random.choice()` to allow the computer to pick rock, paper or scissors.

When the program is run the output may now look as follows:

```
Please choose rock, paper or scissors: scissors
You have chosen scissors
               Outcome
Player win     3
Computer win   0
Tie            0
```

(iii) In order to determine if a particular strategy is best, we need to be able to play more games, more quickly.

Modify the program to play the game *n* times and instead of manually entering a choice of rock, paper, scissors, create a 'virtual' player to play against the computer using the `random.choice()` function to help you.

When the program is run the output for *n*=1000 may now look as follows:

```
               Outcome
Player win     325
Computer win   322
Tie            353
```

This question continues on the next page.

(iv) Part **(iii)** gives very little information on the strategy of your choice.

Change the program to give more information on the winning choices for the game.

When the program is run the output may now look as follows:

```
                Outcome    Rock     Paper     Scissors
Player win      324        104      122       98
Computer win    337        101      117       119
Tie             339        119      124       96
```

(v) A quick analysis of the results should show if the user won or lost and which gesture was most successful.

Amend the code in part **(iv)** to display the best gesture after each 1000 games.

When the program is run the output may now look as follows:

```
                Outcome    Rock     Paper     Scissors
Player win      339        126      108       105
Computer win    342        118      124       100
Tie             309        103      100       116
Computer best strategy was always to use paper which won
124 times
```

Save your file using the format **StudentNameQuestion16_A.py**. For example, you would save the file as **MayMurphyQuestion16_A.py** if your name was May Murphy.

This question continues on the next page.

(b) Open the program called **Question16_B.py** from your device. This file contains only two comments, on lines 1 and 2.

Before adding any code, you should save your working copy of the file using the format **StudentNameQuestion16_B.py**. For example, you would save the file as **MayMurphyQuestion16_B.py** if your name was May Murphy.

Enter your Name and School in the space provided on **line 2** in your Python file.

A palindrome is a word, phrase, number, or other sequence of characters that reads the same forward and backward, for example: mom, noon, civic, rotator, radar, kayak, wow.

Implement a program in Python that takes a string as input and determines whether it is a palindrome. The program should allow the user to enter any string and then determine if that string is a palindrome.

An example output is shown below.

```
Yes, rotator is a palindrome
```

Use the format **StudentNameQuestion16_B.py** to save your file. For example, you would save the file as **MayMurphyQuestion16_B.py** if your name was May Murphy.

Space for rough work.

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Pre-Leaving Certificate Examination, 2024 – Higher Level

Computer Science – Section C

Time: 1 hour

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Space for extra work

Indicate clearly the number and part of the question(s) you are answering.

Space for extra work

Indicate clearly the number and part of the question(s) you are answering.

Space for extra work

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Space for extra work

Indicate clearly the number and part of the question(s) you are answering.

Acknowledgements

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Pre-Leaving Certificate Examination, 2024 – Higher Level

Computer Science – Sections A & B

Time: 1 hour, 30 minutes

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2024-L189A,B-1-EL-24/24