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Pre-Leaving Certificate Examination, 2024

# Computer Science

## Marking Scheme

### Higher Level

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Pre-Leaving Certificate Examination, 2024

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## Computer Science

### Higher Level

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#### Table of Contents

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#### Higher Level

Section A – Short Answer Questions	
Question 1.....	<b>4</b>
Question 2.....	<b>5</b>
Question 3.....	<b>6</b>
Question 4.....	<b>7</b>
Question 5.....	<b>7</b>
Question 6.....	<b>8</b>
Question 7.....	<b>8</b>
Question 8.....	<b>9</b>
Question 9.....	<b>9</b>
Question 10 .....	<b>10</b>
Question 11 .....	<b>10</b>
Question 12 .....	<b>11</b>

Section B – Long Questions	
Question 13 .....	<b>12</b>
Question 14 .....	<b>14</b>
Question 15 .....	<b>18</b>

Section C - Programming	
Question 16 .....	<b>21</b>

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**Pre-Leaving Certificate Examination, 2024**

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## **Computer Science**

### **Higher Level**

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### **Explanation**

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#### **Conventions Used**

1. A **dash** – before an answer indicates that the answer is a separate answer, which may be considered as independent of any other suggested answers to the question.
2. A **single forward slash** / before an answer indicates that the answer is synonymous with that which preceded it. Answers separated by a forward slash cannot therefore be taken as different answers.
3. A **double forward slash** // is used to indicate where multiple answers are given but not all are required.
4. **Round brackets** ( ) indicate material which is not considered to be essential in order to gain full marks.
5. ‘etc.’ is used in this marking scheme to indicate that other answers may be acceptable. In all other cases, only the answer given or ‘words to that effect’ may be awarded marks.
6. Marks for diagrams are shown as follows (e.g. 5m, 3m, 0m), where 5m indicates the highest possible and 0m the lowest.
7. Answers which are given in this marking scheme should not be considered as the only possible answers that may be accepted. Answers which are synonymous with or equivalent to those in this marking scheme are also acceptable.

#### **Current Marking Scheme**

Assumptions about these marking schemes on the basis of past SEC marking schemes should be avoided. While the underlying assessment principles remain the same, the exact details of the marking of a particular type of question may vary from a similar question asked by the SEC in previous years in accordance with the contribution of that question to the overall examination in the current year. In setting these marking schemes, we have strived to determine how best to ensure the fair and accurate assessment of students' work and to ensure consistency in the standard of assessment from year to year. Therefore, aspects of the structure, detail and application of the marking schemes for these examinations are subject to change from past SEC marking schemes and from one year to the next without notice.

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**Pre-Leaving Certificate Examination, 2024**

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## **Computer Science**

### **Higher Level Marking Scheme (210 marks)**

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**Section A**

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**(54 marks)**

Answer any **nine** questions.

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**Question 1**

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**(6)**

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.

Any 2: **(2 × 3m)**

**① Central Processing Unit (CPU)**

Possible points

- responsible for executing instructions and performing calculations. It consists of an arithmetic logic unit (ALU) for mathematical operations and a control unit for instruction, interpretation and execution, *etc.*

**② Control Unit (CU)**

Possible points

- coordinates the activities of the CPU, fetching instructions from memory, decoding them and executing them in a sequential manner. It manages the flow of data and control signals between the CPU, memory and other devices, *etc.*

**③ Bus**

Possible points

- serves as a communication pathway that allows data and instructions to be transferred between the CPU, memory and I/O devices. It consists of address bus (for specifying memory locations), data bus (for transferring data) and control bus (for coordinating control signals), *etc.*

**④ Memory**

Possible points

- von Neumann architecture utilises a single memory unit to store both data and instructions. This shared memory is accessed by the CPU for reading and writing instructions and data during program execution, *etc.*

**Question 1 (cont'd.)****5** I/OPossible points

- input / output devices allow for interaction with the external world. They enable the input of data and instructions into the system and provide the output of processed information. Examples of I/O devices include keyboards, displays, printers and storage devices, *etc.*
- \*\* Accept other appropriate material.

3 marks	** Very good description of role.
1 mark	** Basic description of role.

**Question 2****(6)**

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

**(a) A nibble. (2m)**

- 4 (bits)

**(b) A megabyte. (2m)**

- 8 million / 8,000,000 /  $8 \times 10^6$  (bits)

**(c) A megabit. (2m)**

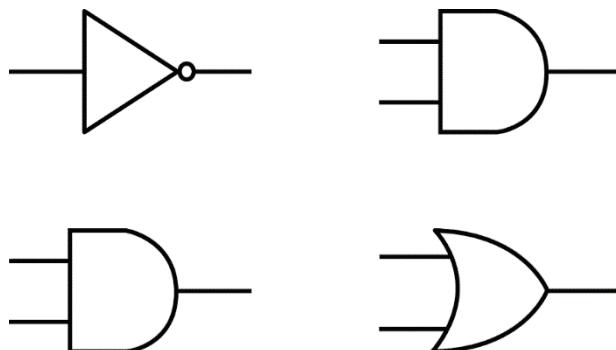
- 1 million / 1,000,000 /  $1 \times 10^6$  (bits)

**Question 3****(6)**

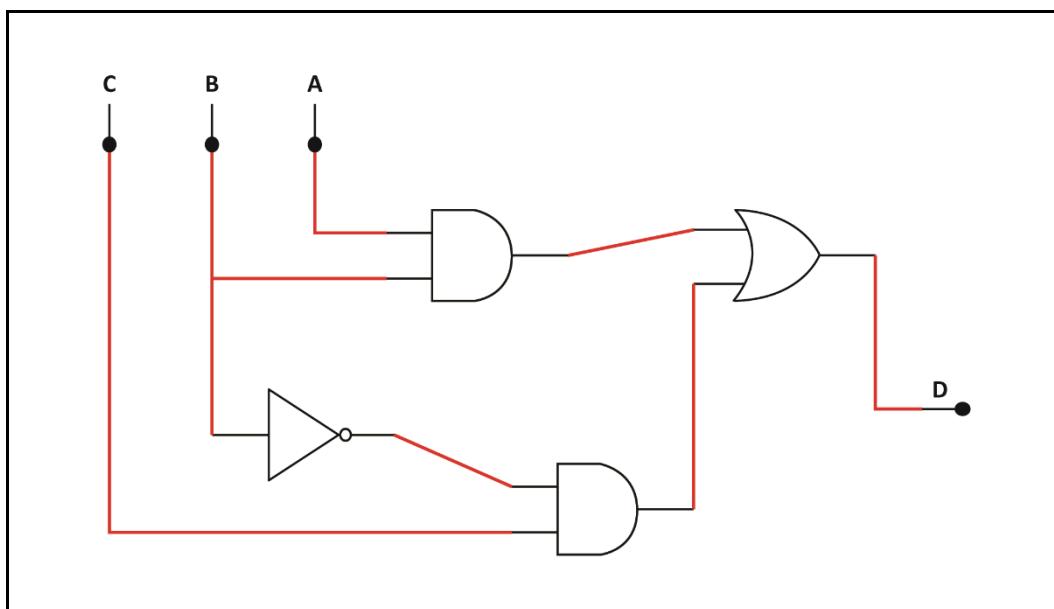
An output, **D**, is produced from three inputs, **A**, **B** and **C**.

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. **(6m)**

**Figure 1**

- \*\* Award 6m for correct circuit.
- \*\* Award 3m for any 2 logic gates in the correct position.
- \*\* Award 1m for any 1 logic gate in the correct position.



**Question 4****(6)****(a) What is cache memory? (3m)**

- a small, high-speed memory that stores frequently used data and instructions closer to the CPU for quick access, *etc.*
- \*\* Accept other appropriate material.

**(b) How does cache memory improve system performance? (3m)**

- by reducing the time taken to fetch data from main memory, which is slower than cache memory, *etc.*
- \*\* Accept other appropriate answers.

**Question 5****(6)****(a) What is the main difference between IPv4 and IPv6 protocols? (3m)**

- the number of bits used by each protocol, IPv4 (32-bit) and IPv6 (128-bit), to represent an IP address, *etc.*
- \*\* Accept other appropriate answers.

3 marks	** Very good explanation of difference.
1 mark	** Basic explanation of difference.

**(b) Explain briefly the implication of this difference for networking. (3m)**

- IPv4 (32-bit address scheme) allows for approximately 4.3 billion unique addresses. However, with the growth of the internet and the increase in the number of devices connected to it, the IPv4 address space is running out. IPv6 (128-bit address scheme) allows for approximately  $3.4 \times 10^{38}$  unique addresses, or 1,028 times more than IPv4. This means that IPv6 can accommodate a virtually unlimited number of devices on the internet, *etc.*
- \*\* Accept other appropriate answers.

3 marks	** Very good explanation of implication.
1 mark	** Basic explanation of implication.

**Question 6****(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 two cards at a time.

What is the minimum number of swaps achievable on the worst possible arrangement of cards? **(3m)**

**Figure 2**

- three / 3

Justify your answer. **(3m)**

- solution is  $(N-1)$ . For 2 cards need 1 swap, for 3 cards need 2 swaps, etc. Worst-case hand would be {4,1,2,3} or similar
- in a worst-case hand, e.g. {1,2,3,4} it is not possible to get 2 cards in their correct position using only 1 swap, hence 3 intelligent swaps are needed in the worst-case scenario, etc.

\*\* Accept other appropriate answers.

3 marks	** Very good justification - clear understanding demonstrated.
1 mark	** Basic justification - limited understanding demonstrated.

**Question 7****(6)**

Distinguish between a recursive algorithm and an iterative algorithm. **(6m)**

- recursive algorithms break down a problem into smaller sub-problems until a base case is reached and the result is reached through recursive function calls
- iterative algorithms use loops to execute a set of instructions repeatedly until a result is achieved, etc.

\*\* Accept other appropriate answers.

6 marks	** Correct answer.
3 marks	** Very good explanation - clear understanding demonstrated.
1 mark	** Fair explanation - limited understanding demonstrated.

**Question 8****(6)**

Aircraft flight recorders, or “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.

**① Advantages**

- Any 2: **(2m + 1m)**
- faster data transfer rates / speed //
- more durable (as no moving parts to wear out) //
- energy efficient //
- reduced generation of heat //
- more reliable long-term storage method // etc.

**② Disadvantages**

- Any 2: **(2m + 1m)**
- reduced capacity //
- reduced lifespan / number of read/write cycles //
- more costly per gigabyte //
- lack of support for RAID setups // etc.

\*\* Accept other appropriate answers.

**Question 9****(6)**

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. **(6m, Hit or Miss)**

<b>O(1)</b>	<b>O(n)</b>	<b>O(log n)</b>	<b>O(<math>n^2</math>)</b>	<b>O(<math>n \log n</math>)</b>
-------------	-------------	-----------------	----------------------------	---------------------------------

- $O(1)$  →  $O(\log n)$  →  $O(n)$  →  $O(n \log n)$  →  $O(n^2)$

**Question 10****(6)**

'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'.

**① Agent-based modelling (3m)**

- a type of computational model that simulates the behaviour of individual agents. It is a bottom-up approach to modelling complex systems, where the behaviour of the system emerges from the interactions of its individual parts, *etc.*

**② Emergent behaviours (3m)**

- patterns of behaviour that arise from the interactions of individual components within a system, without being explicitly designed or controlled, *etc.*

\*\* Accept other appropriate material.

**Question 11****(6)**

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.**

**Any 1: (3m)**

- simple //
- reliable // *etc.*

\*\* Accept other appropriate answers.

**(b) Convert the hexadecimal number D8<sub>16</sub> into a binary number. (3m)**

- 11011000

**Question 12****(6)**

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

- Any 2: **(2 × 3m)**
- unit testing focuses on testing individual units //
  - the purpose of unit testing is to test the functionality of a specific unit of code to ensure that it meets its requirements and specifications //
  - unit testing is typically done with the help of mock objects or other simulated dependencies that allow the unit to be tested in isolation //
  - unit testing is typically done early in the development process //
  - unit testing is generally more granular and focused on testing specific functionality within a unit // etc.
- \*\* Accept other appropriate answers.

**Section B****(76)**

Answer any **two** questions.

**Question 13****(38)**

**(a)** HTML is an important part of website design. (10)

**(i)** What do the letters HTML stand for? (4m)

– hypertext markup language

\*\* All words correct for full marks.

**(ii)** The download speed formula is: file size (bytes) ÷ (download speed ÷ 8).

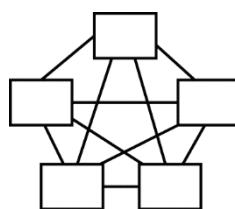
Calculate the length of time it would take a 250Mb per second (Mbps) connection to download a 1GB file, assuming a perfect connection. (6m)

$$\begin{aligned} - &= (1 \times 10^9) \div [(2.5 \times 10^8) \div 8] \\ &= (1 \times 10^9) \div (3.125 \times 10^7) \\ - &= 32 \text{ seconds} \end{aligned}$$

**(b)** James wants to set up a home office using five computers in a mesh network. (15)

**(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.) (5m)

– 10 connections



**(ii)** Derive a formula for companies to calculate the minimum number of connections to create a mesh topology in  $n$  nodes. (10m)

$$- \frac{1}{2}(n-1)n //$$

$$- \frac{n(n-1)}{2} // etc.$$

\*\* Award 7m for formula that only works with example in part **(i)**, i.e. 10 connections.

\*\* Award 5m for any attempt made to derive by example.

\*\* Award 3m for any attempt at abstraction, e.g. using ' $n$ ' or ' $x$ '.

\*\* Accept other appropriate answers.

**Question 13 (cont'd.)**

(c) (i) Distinguish between a web browser and a search engine. (13)

**① Web browser (3m)**

- a software application that allows users to access and display web pages on the internet. Some popular web browsers are Google Chrome, Mozilla Firefox, Apple Safari and Microsoft Edge, *etc.*

**② Search engine (3m)**

- a software application that allows users to search for information on the internet. Some popular search engines are Google, Bing, Yahoo, and DuckDuckGo, *etc.*

\*\* Accept other appropriate material.

(ii) Explain why internet protocols are so important in modern digital communication. (7m)

Possible points

- provide a standardised set of rules and procedures for communication between different devices and systems
- designed to be efficient, allowing data to be transmitted quickly and reliably over a network
- include security features to protect data from interception or tampering by unauthorised parties
- include error detection and correction mechanisms to ensure that data is transmitted correctly
- designed to be scalable, allowing communication to occur between large numbers of devices and systems on a network, *etc.*

\*\* Accept other appropriate answers.

7 marks	** Correct answer.
4 marks	** Very good explanation - clear understanding demonstrated.
1 mark	** Fair explanation - limited understanding demonstrated.

**Question 14****(38)**

- (a)** Patricia 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. Patricia has concerns about the storage of her 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. (9)

Any 3: (3 × 3m)

- require a password to access the database / to restrict access to data to those who know the password / authorised personnel //
- issue user IDs to identify who has accessed the data. This is for auditing who has accessed the material //
- use a firewall to limit access to particular external machines //
- use a proxy server - hardware that accesses data for external users without allowing access to the database //
- protocol-based protection like SSL to allow for an encrypted link between devices to stop third-party access //
- encryption of the data so that, even if accessed, data cannot be read //
- back-up data to provide a copy of the data in case of corruption // etc.

\*\* Accept other appropriate answers.

\*\* Award 1m for one-word answers.

**Question 14 (cont'd.)**

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

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.



(15)

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 update and **one** argument against. (15m)

**① Possible points in favour of update**

- frees up expert staff to attend to more complex matters
- accurate administration of drugs
- can be limited to operate in 'less complex' medical situations, *etc.*

**② Possible points against update**

- possible errors in drug delivery
- more impersonal than having a human administer drugs
- very limited point of expertise / possible inability to adapt to secondary medical issues that may arise
- very specialised staff required to work in ICU
- can the system be hacked / is it reliable
- is there inbuilt bias in the system, *etc.*

\*\* Accept other appropriate answers.

15 marks	** Thorough knowledge and understanding in favour of and against the update demonstrated; the material is generally accurate and detailed. Knowledge and understanding applied directly and consistently to the context provided.
10 marks	** Reasonable knowledge and understanding in favour of and against the update demonstrated; the material is generally accurate but at times underdeveloped. Line of reasoning presented with some structure. Mostly relevant information applied to the context.
5 marks	** Basic knowledge and understanding in favour of and against the update demonstrated with limited understanding shown; the material is basic and contains some inaccuracies. Limited attempt to apply acquired knowledge and understanding to the context provided.

**Question 14 (cont'd.)**

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

You have used computational thinking on 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. (5m)**

A	B	C	J	K	L
D	E	F	M	N	O
G	H	I	P	Q	R

S	U	W	Y
T	V	X	Z

(5)

**Figure 5**

>ΠΩ ΖΕΕΖ ΕΩΛΛ ΛΙΕ<> ΛΕΞΗ<>ΩΡΥ ΓΥ  
 >ΠΖ> >ΠΩ< ΖΕ ΑΠΖ> <Ε< >ΩΛΣ >ΠΩΞ  
 >Ε ΖΕ >ΠΩ ΖΕΖ ΕΩΛΛ ΓΥ >ΠΖ> >ΠΩ<  
 ΖΕ ΑΠΖ> <Ε< >ΩΛΣ >ΠΩΞ >Ε ΖΕ

**Figure 6**

- the good news about computers is that they do what you tell them to do. The bad news is that they do what you tell them to do
- \*\* Award 3m for any attempt to decipher part of the code.

**Question 14 (cont'd.)**

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

Any 3: (3 × 1m)  
 – length //  
 – character variety //  
 – avoidance of common patterns //  
 – randomness // etc.

\*\* Accept other appropriate answers.



(9)

**Figure 7**

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

Any 2: (2 × 3m)

<b>① Factor</b>	<b>② How contributes to password complexity</b>
length	– longer passwords are generally more secure than shorter ones. Increasing the length of a password makes it harder to crack through brute force or guessing attacks // etc.
character variety	– a complex password should include a mix of different character types, such as uppercase and lowercase letters, numbers and special characters. This diversification adds an extra layer of complexity and makes it more challenging for attackers to guess // etc.
avoidance of common patterns	– passwords should avoid common patterns and easily guessable sequences, such as sequential numbers, repeated characters or common words. These patterns can be exploited by attackers using dictionary-based or pattern-matching techniques // etc.
randomness	– a strong password should be generated randomly rather than using easily guessable information like names, birthdates or common words. Randomly generated passwords are harder to predict or crack through various password-cracking techniques // etc.

\*\* Accept other appropriate answers.

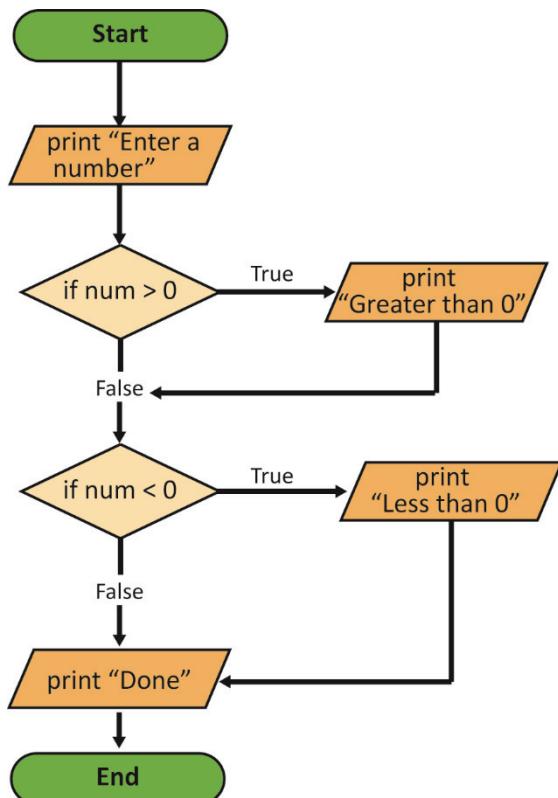
**Question 15**

(38)

- (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. (12m)  
(12)

```
# 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
```



\*\* Accept other appropriate answers.

12 marks	** Correct answer.
8 marks	** Any 3 elements in the correct position.
3 marks	** Any attempt to create a relevant flowchart.

**Question 15 (cont'd.)**

- (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. **(12m)**

(12)

**①** Waterfall design approach

Possible points

- a formal approach to software design, less flexible than agile
- a series of linear stages, with each stage being completed before moving to the next
- a project progresses in one direction
- formal documentation is produced at the end of each stage to inform the next
- work does not begin on the next stage until the previous stage has been reviewed
- each stage of a project is strictly regulated
- problems that arise are more likely to be easier and less expensive to solve by spending time dealing with them in the early stages
- documentation of each stage makes it easier for any new members who join the team to get up to speed on the status of a project
- easy to monitor the progress of a project, *etc.*

**②** Agile design approach

Possible points

- developers and users cooperate closely and frequently
- more willing to respond to any changes in user requirements, even towards the end of a project
- produces a working version of software early in the project to get feedback from users
- an emphasis on simple design
- may have a number of (self-organising) project teams
- may have issues with scalability
- training and skill required
- fixed deadlines might be missed
- may not be suited to simpler tasks or projects
- may require more planning and managerial oversight, *etc.*

\*\* Accept other appropriate material.

12 marks	** Clear and detailed recommendation, supported by a justification based on the strengths and weaknesses of the two methodologies.
8 marks	** Good explanation of the two methodologies and simple tie-in reason why good for a large-scale software project.
5 marks	** Basic explanation and basic recommendation.
3 marks	** Any relevant information on methodologies.

**Question 15 (cont'd.)**

- (c) Discuss, using examples, the potential benefits and drawbacks of using adaptive and assistive technology in education. **(14m)** (14)

**① Potential benefits**

Possible points

- increased independence - adaptive technology (AT) can enable students to perform tasks that would otherwise be difficult or impossible. For example, text-to-speech software can help students with visual impairments to access written materials independently
- improved access to information - AT can provide students with disabilities with equal access to information and learning resources. For example, closed captioning can make video content accessible to students with hearing impairments
- enhanced communication - AT can facilitate communication between students and teachers. For example, a speech recognition system can help a student with a speech impairment to communicate more effectively with their teacher
- increased engagement - AT can promote student engagement and motivation. For example, gamification tools can make learning more interactive and fun, *etc.*

**② Potential drawbacks**

Possible points

- cost - AT can be expensive, which may limit its availability to some students and schools
- training - AT may require specialised training for both students and teachers to use effectively
- over-reliance - students may become overly reliant on AT, which could hinder the development of other skills and abilities
- stigmatisation - the use of AT may make students with disabilities stand out from their peers, which could lead to social stigma and exclusion, *etc.*

\*\* Accept other appropriate material.

**③ Examples of AT in education**

Possible points

- audio players and recorders
- accessibility settings for PCs, laptops and tablets
- mousekeys / trackballs / joysticks / touchpads
- voice recognition
- touchscreens
- onscreen keyboards
- braille keyboards
- loop hearing system
- alternative and augmentative communication (AAC) for non-verbal students, *etc.*

\*\* Accept other appropriate examples.

14 marks	** Strong understanding using multiple examples of benefits and drawbacks tied to education.
10 marks	** Good explanation with examples.
5 marks	** Basic explanation and basic examples.
3 marks	** Any relevant information on benefits / drawbacks.

## Section C

# Programming

(80 marks)

Answer all question parts.

## Question 16

(80)

## **Note to Examiners and Teachers:**

Both coding solutions can be completed very quickly using Dictionaries. Possible solutions for parts (a) and (b) given in this marking scheme are compiled without the use of Dictionaries.

Students using Dictionaries may be awarded full marks only if the solution code runs correctly in each case, as a Non-Dictionary pathway to complete the code is also available.

**(a) Possible solution**

```
1 #Question 16(a)
2 #Name and School:
3
4 import random
5 player_choice=input("Please choose rock, paper or scissors:   ")
6 #print("You have chosen",player_choice)
7
8 def play_round(player_choice, computer_choice):
9     if player_choice == computer_choice:
10         return 'tie'
11     elif (player_choice == 'rock' and computer_choice == 'scissors') or \
12         (player_choice == 'paper' and computer_choice == 'rock') or \
13         (player_choice == 'scissors' and computer_choice == 'paper'):
14         return 'player'
15     else:
16         return 'computer'
17
18 def play_game(n):
19
player_score,computer_score,tie_score,p_rock,p_paper,p_scissors,c_rock,c_paper,c_scissors,t_rock,t_pape
r,t_scissors = 0,0,0,0,0,0,0,0,0,0,0,0
20
21     for i in range(n):
22         computer_choice = random.choice(['rock', 'paper', 'scissors'])
23         player_choice = random.choice(['rock', 'paper', 'scissors'])
24         result = play_round(player_choice, computer_choice)
25         if result == 'player' and player_choice=="rock":
26             player_score += 1
27             p_rock+=1
28         elif result == 'player' and player_choice=="paper":
29             player_score += 1
30             p_paper+=1
31         elif result == 'player' and player_choice=="scissors":
32             player_score += 1
33             p_scissors+=1
34         elif result == 'computer' and computer_choice=="paper":
35             computer_score += 1
36             c_paper+=1
37         elif result == 'computer' and computer_choice=="scissors":
38             computer_score += 1
39             c_scissors+=1
40         elif result=="computer" and computer_choice=="rock":
41             computer_score += 1
42             c_rock+=1
43         elif result=="tie" and computer_choice==player_choice=="rock":
44             t_rock+=1
45             tie_score+=1
46         elif result=="tie" and computer_choice==player_choice=="paper":
47             t_paper+=1
```

**Question 16 (cont'd.)**

**(a) Possible solution (cont'd.)**

**Question 16 (cont'd.)**

- (a) Open the program called **Question16\_A.py** from your device.  
The source code is shown below.

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 both players simultaneously form 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'
```

Make the following changes to the program:

**Question 16 (cont'd.)**

(a) (cont'd.)

- (i) Add a variable to the program called `player_choice` which prompts the user to choose rock, paper or scissors. **(5m)** (5)

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

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

5 marks	** Correct response. Correct implementation using solution above or similar.
3 marks	** Some use of print <u>or</u> brackets <u>or</u> input, etc.
1 mark	** Any valid attempt.

- (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: **(15m)** (15)

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

15 marks	** Correct response. Correct implementation using solution above or similar.
10 marks	** Minor errors in layout but numbers correct.
8 marks	** Use of loops and conditional <u>or</u> attempt to create a function that contains conditionals.
5 marks	** Some attempt to use conditional <u>or</u> loop <u>or</u> similar, etc.
3 marks	** Any valid attempt.

**Question 16 (cont'd.)**

(a) (cont'd.)

- (iii) In order to determine if a particular strategy is best, we need to be able to play more games, more quickly. **(5m)** (5)

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

5 marks	** Correct response. Correct implementation.
3 marks	** Makes some attempt to change loop.
1 mark	** Any valid attempt.

- (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: **(15m)** (15)

Please choose rock, paper or scissors: scissors				
You have chosen scissors				
	Outcome	Rock	Paper	Scissors
Player win	324	104	122	98
Computer win	337	101	117	119
Tie	339	119	124	96

15 marks	** Correct response. Correct implementation using solution above or similar.
10 marks	** Minor table errors <u>but</u> numbers correct.
8 marks	** Loop and table extended.
5 marks	** Evidence of extending variables to cover rock, paper, scissors, etc.
3 marks	** Any valid attempt.

**Question 16 (cont'd.)**

(a) (cont'd.)

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

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

When the program is run the output may now look as follows: **(15m)**

(15)

	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				

15 marks	** Correct response. Correct implementation using solution above or similar.
10 marks	** Performs some of the calculations on the numbers that have been correctly separated.
8 marks	** Appends numbers based on index value.
5 marks	** Any attempt at conditional or changing loop/function.
3 marks	** Any valid attempt.

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.

**Question 16 (cont'd.)**

---

(b) Possible solution

```
1 # Question 16(b)
2 # Name and School
3
4 def is_palindrome_permutation(s):
5
6     char_counts = [0] * 26
7     for char in s:
8         char_counts[ord(char) - ord('a')] += 1
9
10    odd_count = 0
11    for count in char_counts:
12        if count % 2 == 1:
13            odd_count += 1
14        if odd_count > 1:
15            print("no",s,"is not a palindrome")
16            return False
17
18
19    print("yes",s,"is a palindrome")
20
21 is_palindrome_permutation("woww")
22
23
```

**Question 16 (cont'd.)**

- (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. **(25m)**

(25)

An example output is shown below.

Yes, rotator is a palindrome

25 marks	** Correct response. Correct implementation using solution above or similar.
15 marks	** Minor issues but student looks like they understand the algorithm behind the problem.
10 marks	** Evidence of trying to determine frequency or some algorithm for determining palindrome.
8 marks	** Some evidence of counters or loops.
3 marks	** Any valid attempt.

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.

Notes:

**Notes:**

**Notes:**



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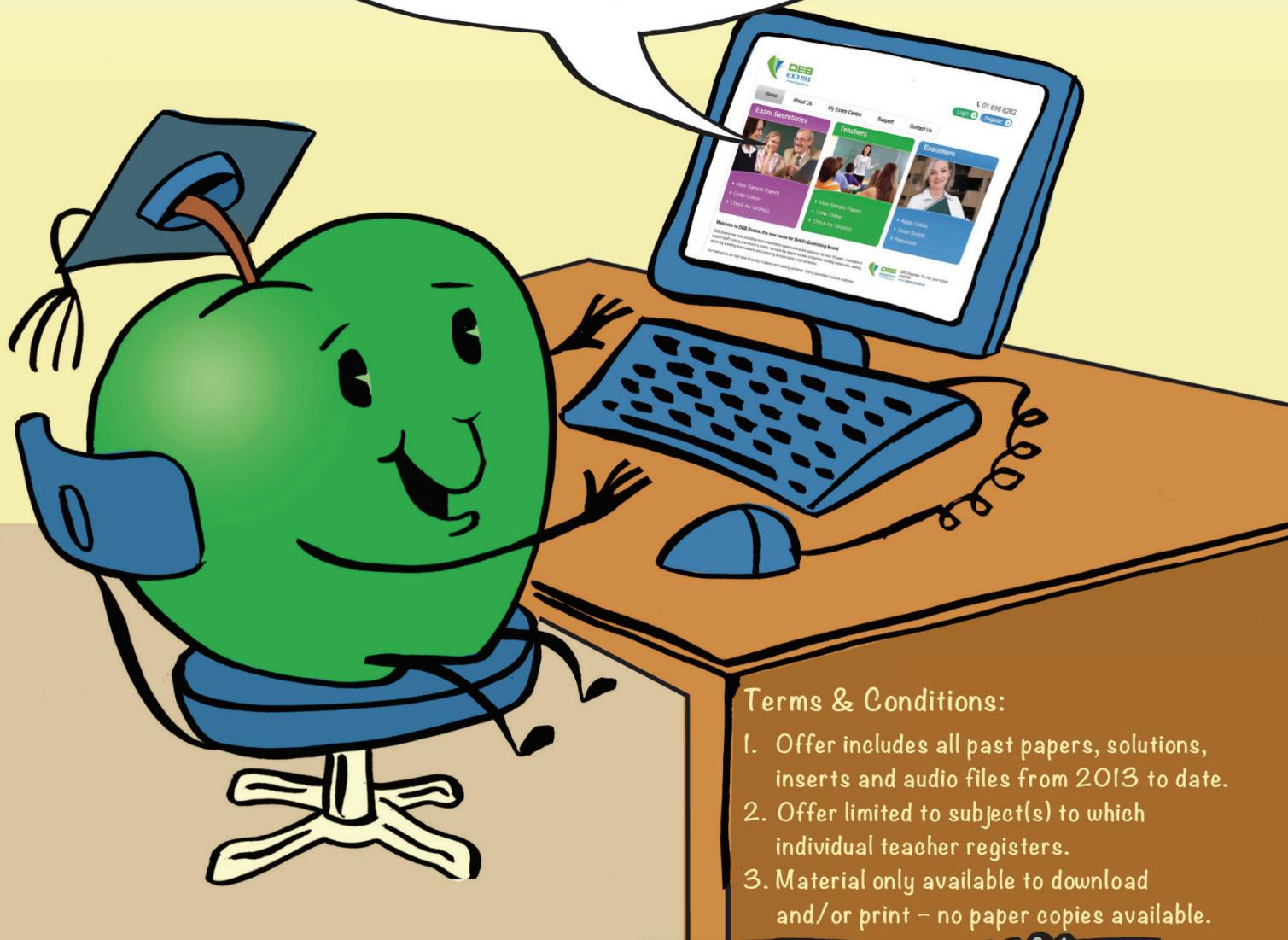
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