



SUBJECT: **Computing**
DATE: 2nd May 2023
TIME: 9:00 a.m. to 12:05 p.m.

Directions to Candidates

Answer **ALL** questions in Section A and **ONE** question from Section B.

- Good English and orderly presentation are important.
- All answers are to be written on the booklet provided.
- The use of flowchart templates is permitted but calculators may **not** be used.

SECTION A

Answer ALL questions in this section.

1. Microsoft's Windows powers the majority of laptop and desktop computers worldwide. Windows 11 is installed on around 23 % of PCs and Windows 10 is installed on around 75 % of them.
 - a. Suggest a reason why **not** all users may have updated to Windows 11 even though the update is free. (1)
 - b. Is Windows a batch processing operating system? Explain your answer. (2)
 - c. Windows puts running threads in a circular queue and when a thread's allocated CPU time expires, the thread is put to the end of the queue and the new task is taken from the front of the queue. This is an example of:
 - Round - Robin Scheduling;
 - First-Come-First-Served Scheduling;
 - Shortest Job First Scheduling. (1)
 - d. Briefly explain how a multithreading OS can be caught in a deadlock. (1)
 - e. Operating systems are also responsible for memory management. Briefly explain the role an Operating System plays in memory store protection. (1)

(Total: 6 marks)
2. In analog telephone services users are connected through coaxial copper wire subscriber loop which runs from a central switch office to many homes and businesses.
 - a. Distinguish between analog and digital communication. (1)
 - b. Name **ONE** type of cabling which transmits data as electrical signals. (1)
 - c. Briefly explain what measures can be taken to minimise noise in this type of cable. (1)
 - d. Many customers will likely have optical fibre most of the way between their house and the rest of the network, but the last mile to their home will be made over coaxial cable.
 - i. Suggest why optical fibre is preferable to coaxial cable. (1)
 - ii. Outline why the last mile is coaxial cabling. (1)
 - e. A carrier signal can be modulated to transmit information. Distinguish between amplitude and frequency modulation. (1)

(Total: 6 marks)

Please turn the page.

3. The portal `servizz.gov.mt` provides health-related services, including the registration for organ donation. Organ donation registration requires the specification of which organ/s a user wishes to donate. The code below implements part of the `showDonor()` method, which allows registered users to view their data once they enter their ID card number (e.g. 123456L).

```
void showDonor (String idNumber){
String[] organs = { "kidneys", "small bowel", "pancreas", "liver",
"lungs", " heart"};
System.out.println ("ID number: " + idNumber);
for(int i = 0; i<6; i++){
    System.out.print(organs[i] + ":");
    if (donateOrgan[i])
        System.out.println ("Yes");
    else
        System.out.println("No");
    }
}
```

- a. Which of the following is a valid way of calling the `showDonor` method? Briefly explain your answer.

- i. `showDonor();`
- ii. `showDonor(number);` //where number is an integer
- iii. `showDonor(idNum);` //where idNum is a String
- iv. `showDonor(idNumber);` //where id Number is a Boolean (1)

- b. Organ donation registration requires users to specify whether they wish to donate (True or False) from the following organs: kidneys, small bowel, pancreas, liver, lungs and heart. Declare an array called `donateOrgan` to store this data. (1)

- c. Java is an Object-Oriented Programming (OOP) language. Briefly explain how encapsulation can help a programmer implement security features in his application. (1)

- d. Briefly explain how inheritance in OOP can increase productivity. (1)

- e. Apart from government related services, the Internet is also used for carrying out e-Commerce. Mention **TWO** activities related to e-Commerce that benefit suppliers and briefly explain how the Internet helps in each case. (2)

(Total: 6 marks)

4. A computer game called 'Snowball' is being developed. In this game the user navigates a snowball to win points. The game rules are as follows:

- A snowball starts with 5 lives.
- The snowball is thrown and may hit one of two types of objects - a snowman or a tree.
- If it hits a snowman the program displays '**Snowman Hit**' and a life is gained.
- If it hits a tree the program displays '**Tree Hit**' and a life is lost.
- If the snowball's lives become 0, '**Game Over**' is displayed on the screen and the game ends.
- If the snowball's lives become 10, '**You win**' is displayed on the screen and the game ends.
- If the game has not ended, the new number of lives is flashed on the screen and the gameplay continues with another throw.

- a. Draw a flowchart to represent what happens when a ball is thrown according to the above rules. (3)

- b. A student is creating an application for the above game and includes the methods shown below:

```

..... lines of code before
Line 34 public void hitSnowman(){
Line 35     System.out.println ("Snowman was hit!");
Line 36     this.lifePoints++;
Line 37 }
Line 38 public void hitTree(){
Line 39     System.out.println ("Tree was hit!");
Line 40     this.lifePoints____;
Line 41 }
Line 42 public void checkLives(){
Line 43     if (this.lifePoints == __){
Line 44         System.out.println ("Game Over!!");
Line 45     }
Line 46     if (this.lifePoints == 10) {
Line 47         System.out.println ("You Win!!");
Line 48     }
Line 49     if ((this.lifePoints >0) __ (this.lifePoints <10)){
Line 50         System.out.println ("Life points: " + _____);
Line 51     }
Line 52 }
..... lines of code after

```

- i. The `hitTree()` and `checkLives()` methods are incomplete as indicated by the underlined spaces. Write down the text required for **each** of the **FOUR** underlined spaces in order to complete these methods. (2)
- ii. After which of the above line or lines would you insert a statement to call `checkLives()` so that the rules described at the start of question 4 are followed fully? (1)

(Total: 6 marks)

5. a. A new supermarket was implementing a computer network to link all of its ten cashier point terminals to the central office system. One of the main concerns was to minimise disruption in case of a broken line. The choice for the type of Local Area Network (LAN) was between a star-based one and a bus type of network. Which type would you recommend? Briefly explain the reason for your choice. (2)
- b. A Personal Area Network (PAN) can also be used to connect different computers and devices.
- i. Contrast a Personal Area Network (PAN) with a LAN. (1)
- ii. Name **TWO** devices that can form part of a PAN. (1)
- c. Portable devices collect a lot of biometric data which is often stored on company servers. Outline, with reference to data protection legislation, **TWO** responsibilities of these companies. (2)

(Total: 6 marks)

6. a. The digital economy surged during the COVID-19 crisis. As people had to respect social distancing, they turned more and more to online shopping and remote working.
- i. Give **TWO** reasons why nowadays, even though restrictions on COVID-19 are on the decline, consumers are still inclined towards e-Commerce. (2)
- ii. Even with all its benefits, remote working still offers its disadvantages. Explain **TWO** such disadvantages. (2)
- b. State the appropriate switching protocol you would use for each one of the following scenarios:
- i. A dedicated path is established between sender and receiver. (1)
- ii. Each node stores the entire message and then forwards it to the next node. (1)

(Total: 6 marks)

Please turn the page.

7. a. Simplify the following expression using Boolean algebra.

$$\mathbf{A(B+AB) + AC} \quad (2)$$

b. Draw a logic circuit for the simplified expression resulting from part (a). (1)

c. Boolean algebra is subject to the laws of commutation, association, and distribution. For each of the following Boolean expressions, write the corresponding Boolean law. (3)

	BOOLEAN EXPRESSION	LAW
i.	AB = BA	
ii.	(A + C)B = AB + CB	
iii.	(A + B) + C = A + (B + C)	

(Total: 6 marks)

8. Read through the following assembly language program snippet and answer the questions set.

```

1   MOV AX,03h      ; move value 3 hex into register AX
2   MOV 2000H,AX    ; move value in register AX to memory
                    ; location 2000H
3   ADD AX,2000H    ; add the contents of memory location
                    ; 2000H to the contents of register AX
    
```

a. Write down **ONE** operand and **ONE** opcode. (2)

b. Write down **ONE** instruction in which the addressing mode is direct and another **ONE** in which the addressing mode is immediate. (2)

c. Name **ONE** other type of addressing mode, apart from the ones mentioned in part (b) above. (1)

d. What would be the value in AX after the third statement is executed? (1)

(Total: 6 marks)

9. MyFood is a small fast-food restaurant which caters mainly for students, since it is situated near a university. However, the owners have realised that to keep up with competition they need to provide an online food ordering system which would provide convenience for the students as well as other paying customers.

Customers can choose one or more food item to place an order. The order is then entered in the database and retrieved in real-time. This allows the restaurant employees to quickly go through the orders as they are received.

a. Draw a context diagram (Level 0) to represent this system. (3)

b. Once the new system is in operation, on-going maintenance is required. Suggest **ONE** type of maintenance that would be required for the above system. Justify your answer. (2)

c. Apart from Data Flow Diagrams, Unified Modeling Language (UML) diagrams are also used. Name **ONE** UML diagram that can be used for the above system. (1)

(Total: 6 marks)

- 10. a. Briefly explain why an array is considered to be a data structure. (1)
- b. Outline **ONE** advantage and **ONE** disadvantage of the array data structure when compared with a list. (2)
- c. Briefly describe how one can access the values stored in the elements of an array. (1)
- d. The table STUDENTS below, consists of a class of five students. The class needs to publish the results of each of these five students in three subjects, in a manner which is similar to the table below.

SUBJECT	STUDENT1	STUDENT2	STUDENT3	STUDENT4	STUDENT5
ENGLISH	10	55	90	70	60
MATHEMATICS	95	75	55	85	95
COMPUTING	88	60	79	90	85

- i. Which type of array would be ideal to store the above data? (1)
- ii. Write a line of code in Java that declares an array which would be suitable for the above requirement. (1)

(Total: 6 marks)

Section B

Answer ONE question from this section.

- 1. a. **WXYZ** is a 4-bit binary word. Bit Z is an even parity bit, such that if the number of ones in the inputs W, X, and Y, is odd, the parity bit value is set to one to make the total number of ones in the word an even number.

- i. Copy and complete the truth table below. (2)

W	X	Y	Z
0	0	0	0
0	1	0	1

- ii. Draw the Karnaugh map (KM) for bit Z. (2)
- iii. From the KM in (ii) above, obtain a minimised logic expression for the parity bit Z. (2)

- b. Draw the circuit for the Boolean expression **Y = AB + CD** using NAND gates **ONLY**. (2)

Please turn the page.

- c. The organisers of the next WORLD CUP tournament wish to set up a database to record the main aspects of the games. The database is to carry the following information on each match of the tournament: the scheduled day and start time, the referee who is refereeing, the stadium where it will be held, the names of the two teams involved, the stage of the tournament, the total duration, and the final score of the match. The system is also expected to keep the names of all the referees, the country they come from, their age and the years of professional experience. It will also include information about all the stadiums: the name of each stadium, the country and city of the stadium and its maximum capacity.

Specify **ONE** table using the format shown below, for match data and **ONE** other table which could be included in the above relational database. For each table, identify at least **FOUR** of the required fields and their respective data types. For each table, also identify its primary key. Identify the foreign key/s, if any, which could be used to relate them to other tables. (6)

Name of Table			
	Name of field	Datatype and Suggested field size (for text only)	Is it a Primary Key or Foreign Key
Field 1			
Field 2			
Field 3			
Field 4			

- d. Outline **TWO** benefits that a relational database could provide if used for the requirement described in part (c) above. (2)
- e. Define what a data dictionary is in the context of a DBMS. (1)
- f. The Database Administrator is one of the most important professions in any organization with an information system. Briefly describe **TWO** roles of a Database Administrator. (2)
- g. Define a query language. Give **ONE** example of how a query language could be used in the system described in part (c) in this question. (1)

(Total: 20 marks)

2. a. The table below compares the processor on the Raspberry Pi Pico with two other processors on the market.

	Raspberry Pi Pico	Processor A	Processor B
Wordlength	32-bit	64-bit	64-bit
Address Bus	32-bit	64-bit	64-bit
CPU Cache	16 KB	12 MB	16 MB
CPU Speed	133 MHz	2.4 GHz	3.5 GHz
Cores	2	6	8

- i. Briefly explain how wordlength contributes to a difference in processor performance of the Raspberry Pi Pico relative to other two processors whilst referring to the specifications shown above. (1)
- ii. The Raspberry Pi Pico also shows a difference in the size of the address bus, compared to that of both Processor A and B. How can this difference impact system performance? (1)

- b. Memory Management is handled by the Operating System.
- i. Define memory management. (1)
 - ii. Distinguish between logical and physical addresses. (1)
- c. The CPU makes use of registers. Briefly explain the role of the following registers:
- i. Memory Data Register. (1)
 - ii. Memory Address Register. (1)
- d. i. Briefly explain why programming code that is written in a High-Level Language cannot be executed directly by a CPU. (1)
- ii. Compilers are one type of High-Level Language translators. Explain why object code is platform dependent. (1)
 - iii. Name **ONE** other translator that translates High Level language to machine code. Outline how this translator differs from a compiler. (1)
- e. Assembly code is translated using an assembler. Identify the utility responsible for:
- i. combining the object code into a single executable program; (1)
 - ii. loading programs into memory and preparing them for execution. (1)
- f. Below is a snippet of code in Assembly language.

```

1          MOV BX, 1    ; move the decimal number 1 to register BX
2          MOV AX, 3    ; move the decimal number 3 to the accumulator
3          MOV CX, AX   ; move the accumulator content to register CX
4  LAB1    MOV AX, BX   ; move contents of register BX to accumulator
5          MUL AX, 2    ; multiply the contents of accumulator by 2
6          MOV BX, AX   ; store accumulator contents to register BX
7          MOV AX, CX   ; move contents of register CX to accumulator
8          DEC AX      ; decrement the accumulator content by 1
9          MOV CX, AX   ; store accumulator contents to register CX
10         JNZ LAB1    ; jump to LAB1 if accumulator is not zero
11         HLT         ; halt

```

- i. From the above code:
- Identify a mnemonic. (1)
 - Identify the line number where a label is declared. (1)
 - Identify the line number where an instruction refers to a label. (1)
 - Write down the contents of AX, BX and CX as they change when this code is being executed. (2)
- ii. What is the function of the above assembly program? (2)
- iii. Write the equivalent of the above code in Java. (2)

(Total: 20 marks)