L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

INTERMEDIATE MATRICULATION LEVEL
2018 SECOND SESSION

SUBJECT:	**Computing**
DATE:	6th September 2018
TIME:	4:00 p.m. to 7:05 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. A team of accountants work together in the same building. Each accountant has his own workstation and it is connected to a central server.

   a. Identify and explain the topology being used in this scenario. (2)

   b. Outline the concept of the Open System Interconnection (OSI) model in communication across the network mentioned. Your answer should also include a description of the OSI model. (2)

   c. Outline, with an example, the function of protocols. (2)

   (Total: 6 marks)

2. A farmer grows fruit and vegetables in several greenhouses. The temperature, humidity, light levels and automatic watering in the greenhouses are centrally monitored and controlled through various sensors.

   a. Outline the role of the operating system in this scenario. (2)

   b. Describe the difference between polling and interrupt in the event that a sensor malfunctions. (2)

   c. When a sensor detects a value outside an acceptable range, a message is sent and an interrupt occurs. Why is an interrupt appropriate for this situation? Give **TWO** reasons. (2)

   (Total: 6 marks)

3. A machine is used to cut jigsaw puzzle pieces. The machine has two sensors, one (S1) if the blade gets hot and another one (S2) if the blade becomes blunt. The machine stops if the blade becomes both hot and blunt. In order for the blade to remain cool, a container with water is used. A sensor (S3) is used to monitor the water level. If S3 detects that the water is lower than a certain level, the machine stops irrespective of the other sensors. A logic circuit is required to control the machine.

   a. Copy and complete the following truth table. (2)

S1	S2	S3	Stop
0	0	0	0
0			
0			
0			
1			
1			
1			
1			

   b. Construct a simplified Boolean expression for output Stop using Karnaugh maps. (3)

   c. Draw the logic circuit that corresponds to the expression in part (b). (1)

(Total: 6 marks)

4. The following shows a code snippet in Assembly Language and the relative description.

Assembly Language Instructions	Description
MOV AX, 0005H	Copy 5 hex to register AX
MOV AX, CX	Copy contents of register CX into register AX
MOV AX, [CX]	Copy contents of memory location addressed by contents of register CX to register AX

   a. Identify the mnemonic and operand in the assembly language instructions. (3)

   b. Identify the different addressing modes used in the above code. (3)

(Total: 6 marks)

5. a. Identify **TWO** security measures that should be implemented when one is connected to a Local Area Network (LAN). (2)

   b. Identify and explain the importance of **ONE** additional security measure needed if the LAN is connected to a Wide Area Network (WAN). (2)

   c. Explain why encryption is important when using Wi-Fi. (2)

(Total: 6 marks)

6. One of the roles of a supermarket's database is to keep track of stock items and their suppliers. The database includes a table for stock items named StockItem and another for suppliers named Supplier. Each stock item is sourced from only one supplier.

Table **StockItem**

Field Name	**Field Type**
Item ID	Autonumber
Item name	Text
Brand	Text
Supplier ID	Number
Items in stock	Number
Re-order limit	Number

Table **Supplier**

Field Name	**Field Type**
Supplier ID	
Supplier name	

a. Name **TWO** other fields you expect to see in the Supplier table, clearly stating the type in each case. (1)

b. What is a flat database? (1)

c. There is a relationship between the StockItem and Supplier tables.
   i. In the context of a relational database, what is a foreign key? Exemplify your answer by suggesting a suitable foreign key in the StockItem table. (1)
   ii. What type of relationship exists between the StockItem and Supplier tables? (1)

d. Name and briefly explain **TWO** advantages of a relational database. (2)

(Total: 6 marks)

7. Technology continues to ensure the increasing availability of online services everywhere and, technically, for all.

a. Name and briefly explain **ONE** way that remote access has positively impacted the business world. (2)

b. Explain **ONE** security issue one may have with remote access and suggest **TWO** ways of trying to overcome it. (2)

c. It is often noted that we have an ageing population. Suggest an issue that technology needs to address in view of this and briefly describe **TWO** ways of addressing such an issue. (2)

(Total: 6 marks)

Please turn the page.

8. Complementation is a technique used to subtract one number from another using only addition of positive numbers.

   a. Show how this is done in two's complementation by subtracting 45_{10} from 63_{10}. (3)

   b. What is the range of two's complement numbers that can be stored in an 8-bit register? (1)

   c. Why is Binary Coded Decimal (BCD) often used in electronic systems where a numeric value is to be displayed? (1)

   d. Express 63_{10} in BCD. (1)

   (Total: 6 marks)

9. Main Memory is one of the most important components determining computer speed.

   a. Distinguish between RAM and ROM. (2)

   b. Explain why, despite having sufficient RAM and ROM, we need cache memory on our PCs. (1)

   c. Suggest **ONE** application of EEPROM. Give a reason for your answer. (1)

   d. Briefly explain why SRAM is much faster than DRAM. (1)

   e. Name **ONE** other factor, besides the speed and size of RAM that impacts our computer's performance and briefly explain your answer. (1)

   (Total: 6 marks)

10. Java is an Object Oriented programming language.

   a. Briefly explain why Java is both an imperative and Object Oriented language. (1)

   b. An application dealing with a school system handles student and teacher attendance among other things. Class Student and Class Teacher both inherit class Person.
      i. Write a line of code to declare class Student. (1)
      ii. Name **TWO** properties you expect class Person to include. (1)
      iii. Give **ONE** advantage of implementing inheritance in OOP. (1)

   c. Explain the advantage of implementing encapsulation in our code. (1)

   d. Name **ONE** other key feature of OOP besides inheritance and encapsulation. (1)

   (Total: 6 marks)

SECTION B

Answer ONE question from this section.

1. a. The method `logicGate1()` below is used to perform a particular Boolean function. It has two inputs, a and b and one output.

```
public boolean logicGate1 (int a, int b)
{
            if ((a==1) && (b==1))
                return false;
            else
                 return true;
}
```

i. Identify the logic gate represented by the method above. (1)

ii. Construct the method `logicGate2()` to represent a XOR gate. (3)

iii. Express the logic gates mentioned in parts (a) and (b) using a truth table. (2)

iv. Two circuits are equivalent if their respective truth tables are the same. The method `compareLogicCircuits()` makes use of nested loops to generate and pass inputs to methods logicGate1() and logicGate2(). The outputs produced by these methods are compared and return true if the circuits are the same and false otherwise. Construct the method `compareLogicCircuits()`. (5)

b. Simplify the Boolean expression below. (2)

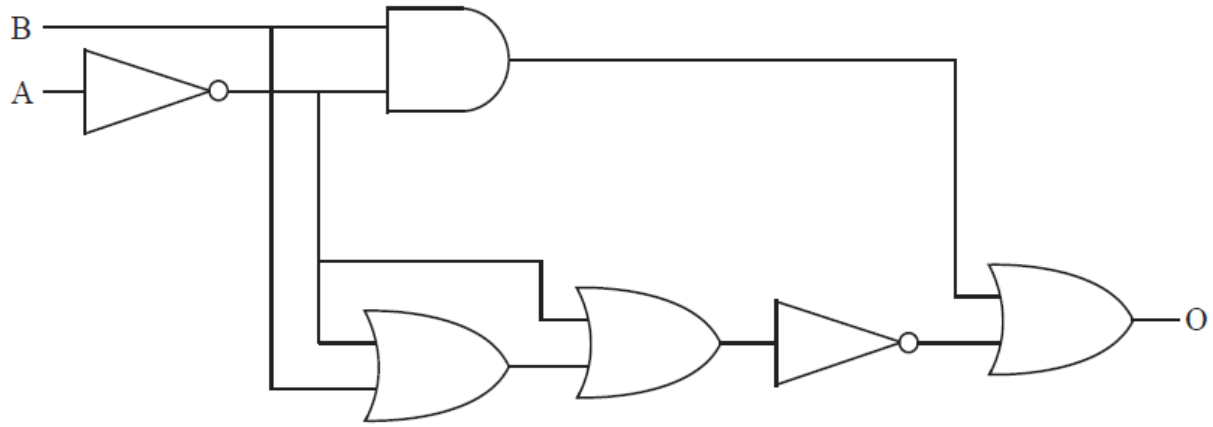
$$\bar{A}.\bar{B} + \bar{A}.B + A.\bar{B}$$

c. Consider the following logic circuit.

i. State, without doing any simplification, the Boolean expression for output O. (2)

ii. Simplify the Boolean expression produced in part (i) in order to minimise the number of logic gates. List down the laws used. (3)

iii. Suggest a way to prove that the given circuit is equivalent to A XOR B. (2)



(Total: 20 marks)

2. A college is developing a new Book Tracker App aimed to motivate students to read more books from its library and engage in a community of readers.

   The development of the new system involves a number of stages including:

   System Testing
   Feasibility Study
   Implementation
   System Design

   a. Put the above developmental stages in order. (2)

   b. Name **TWO** activities likely to be done in the Control and Review stage. (2)

   c. After the new system is up and running, system maintenance may be in order. Give **TWO** reasons why the system may need maintenance. (2)

   d. In order for it to be able to handle all books available in the library, the new system will involve a class called Book. How would you declare an array called bookArray of 1000 objects of class Book? (2)

   e. When students borrow a book, the app will allow them to scan its barcode to create an entry for the book in that app. The class `Book` has the following four variables:

      `ID, name, numOfPages and percentProgress.`

      When selected, this entry will display the book title, the total pages in the book and the user's reading progress in page numbers and as a percentage of the whole book.

      When the user wants to update his progress in a given book, the book's ID is input, and passed to a method `updateBookEntry(IdToFind)`.

      This method locates and outputs the book name and total number of pages. It then prompts the user to input his progress to date, in terms of pages read, such that it can then calculate the user's percentage progress by calling method `getPercentageProgress(pagesRead,numOfPages)` and updates the array.

Complete the code below to:

i. loop through the list of books to find the entry to match the ID input; (3)

ii. once this entry is found, allow the user to input the number of pages read; (1)

iii. calculate the percentage progress by calling the method `getPercentageProgress(pagesRead, numberOfPages);` (1)

iv. update the array element with the `percentageProgress`. (2)

```
public void updateBookEntry(int IDtoFind){
                                // loop through array
                                // find entry to match ID input
   int currentPage = 0;
   int percentageProgress = 0;
   System.out.println (bookArray[i].name);
   System.out.println (bookArray[i].numberOfPages); //outputs number of pages
   System.out.println ("Enter progress to date");
                                // input pages read so far
                                // calculate percentage progress
                                // update array with percentage progress
   System.out.println (bookArray[i]. percentageProgress); //outputs percentage



}
```

f. Write method `getPercentageProgress()` which takes `currentPage` and `numberOfPages` as input parameters and returns an integer value for the user's percentage progress through the book. (5)

(Total: 20 marks)