L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

INTERMEDIATE MATRICULATION LEVEL
2021 SECOND SESSION

SUBJECT:	**Computing**
DATE:	12th October 2021
TIME:	4:00 p.m. to 7:05 p.m.

Directions to Candidates

Answer **ALL** questions in Section A and the question in 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. Online communication would not be the same without emojis. Originally emojis were created using one or more punctuation marks within text messages to express emotional content. Nowadays emojis, like other characters, are represented using standard character codes.

   a. What is the purpose of a standardised character set? (1)

   b. ASCII and Unicode are two character-encoding systems. ASCII is an 8-bit coding system and Unicode is 16-bit. How many different patterns/codes/characters can be represented in:
      i. 8-bit ASCII; (½)
      ii. 16-bit Unicode. (½)

   c. Which of these encoding systems (mentioned in part b), is likely to include emojis in its character set? Explain your answer. (2)

   d. In standard ASCII, the letter 'A' is represented by 65 in binary, the letter 'B' by 66 in binary etc. in a collating sequence. Hence, as table 1 shows, the rightmost 5 digits of the ASCII binary pattern give the position of the letter in the alphabet.

Table 1: ASCII based binary codes for Uppercase letters A and B.

Letter	Decimal Code	Binary Pattern							
A	65	0	1	0	0	0	0	0	1
B	66	0	1	0	0	0	0	1	0
Etc.	..	..	..	..	..	..	..	..	..

Using this information, give the full binary pattern of the 19th letter in the alphabet using this coding system. Clearly show your working. (1)

Question continues on next page.

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e. When it comes to small letters, the rightmost 5 digits again represent the position of the letter in the alphabet as per the table below.

Table 2: ASCII based binary codes for lowercase letters a and b.

Letter	Binary Pattern							
a	0	1	1	0	0	0	0	1
b	0	1	1	0	0	0	1	0

i. What is the noticeable difference between the binary code for capital letters and their lower-case equivalent? (1)

ii. Using the two tables above, deduce the binary difference, on this character set between a letter and its capital letter equivalent. (1)

f. Unicode is fundamental to the architecture of the Web and operating systems, and it is supported by major web browsers and applications. Suggest **ONE** reason for this. (1)

(Total: 8 marks)

2. *Good-Food* is a company that provides daily healthy recipes to its members subscribed on their app. Although the recipes are well received, the company has been getting negative feedback about the usability of its app. Users complain that it is slow, buggy and lacking in features.

a. Suggest **ONE** reason why the company may choose to create an entirely new app rather than maintain their current one. (1)

b. The systems analysis team needs to build a good understanding of the requirements of the new system.

i. Suggest **TWO** people that they may interview during their system analysis. (1)

ii. Suggest **TWO** questions they may ask during these interviews. (1)

iii. Besides interviews, describe **ONE** other way they could collect data (1)

c. Users, once logged on to the app, can grade a recipe from 1 to 5. The system then keeps an average for the grade of each recipe and sorts recipes according to their rating. Below is part of a DFD representing this:

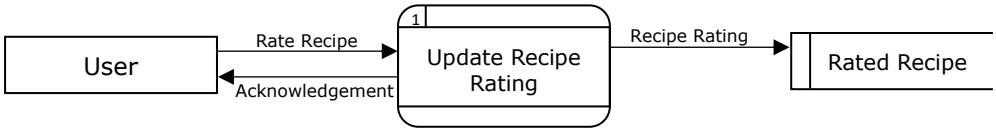


Figure 1

i. Identify a process in the above DFD and briefly explain what it is representing. (1)

ii. Identify an output flow and a data store in this DFD. (1)

iii. The following is another part DFD from the same system:

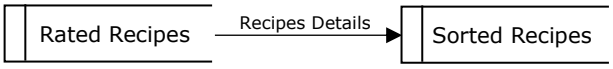


Figure 2

Explain why there's a mistake in this DFD and redraw the above part DFD correctly. (1)

d. Suggest another feature this app could provide and briefly explain its utility. (1)

(Total: 8 marks)

3. Many devices are embedded with the technology to connect and exchange data with other devices and systems over the Internet, giving us the Internet of Things (IoT). Smartwatches are used in various IoT scenarios including healthcare and fitness. Their sensor-enabled applications send data from millions of watches through the IoT cloud.

   a. One health-oriented use of a smartwatch is for measuring the rate of heart beats. What is the source of the data input required, what does the smartwatch processor do and what is the main output of this function? (2)

   b. Apps often prompt us for specific authorisation to access certain data or sensors. Suggest **ONE** type of data/service and **ONE** device the user may wish to secure access to. (1)

   c. The rise of IoT makes it increasingly imperative that our personal data is legally protected. One principle of this legislation states:

   'The processing of personal data must be carried out for explicit and specific purposes, which must be within the limits of the law.'

   Briefly explain using an example how this restriction is particularly relevant when dealing with health-monitoring apps. (1)

   d. Why would the data protection legislation need revision from time to time? (1)

   e. Home cameras are IoT devices that allow people to keep an eye on their home or pets while they're out of the house. It is highly advisable to use a long, complex password on such a device and to change that password regularly.

      i. Suggest **ONE** security issue users may have with such IoT devices. (1)
      ii. Suggest and explain another way one can increase security here. (2)

(Total: 8 marks)

4. Network topology and bandwidth can both impact user experience on a network.

   a. What is bandwidth? (1)

   b. Give **TWO** reasons why military applications are likely to opt for a mesh network. (2)

   c. Give **TWO** reasons why a Star topology is suitable for office use. (2)

   d. The OSI model is a conceptual framework used to describe the functions of a networking system. Name the layer responsible for the following:
      i. Transmitting bits from one computer to another and regulating the transmission of a stream of bits over the physical medium. (½)
      ii. Defining the route to deliver data packets from source to destination across multiple networks. (½)

   e. Explain why the Domain Name System (DNS) is an important part of the Internet, with clear reference to IP addresses. (2)

(Total: 8 marks)

Please turn the page.

5. An Operating System (OS) is the most important software on a computer.

   a. What do you understand by batch processing in the context of Operating Systems? (1)

   b. Choose **ONE** from the systems below, where batch processing would be suitable and briefly explain your choice. (1)

Table 3: Table of applications/systems

System 1	System 2	System 3
A weather monitoring system.	A fortnightly payroll system.	Office productivity application suites integrating word processing, spreadsheet, emails etc.

   c. Name a suitable operating mode for **each** of the other two systems (mentioned in part b), clearly explaining your answer. Clearly identify which of the above systems you are referring to in **each** case. (2)

   d. A newly-released gaming console runs a new version of its OS.
      i. Give **ONE** reason why this OS is **not** likely to be batch-processing. (1)
      ii. Suggest **ONE** way in which the new version of the OS may be an improvement on the previous one. (1)
      iii. Clearly explain the reason how this improvement may impact user experience. (1)

   e. Briefly explain how an Operating System's memory management can impact system efficiency.

(1)

(Total: 8 marks)

6. A lot of water is wasted when using traditional irrigation as different crops and different areas require specific irrigation patterns. An automated irrigation system using a single board computer system is being proposed. The system will monitor soil moisture and irrigate accordingly.

   a. Suggest **ONE** reason why the automated system may solve the problem of water wastage. (1)

   b. The system comes with the following specifications sheet.

QuadCore 64-bit Processor @1.5GHz
8GB DRAM
Gigabit Ethernet
2 × micro-HDMI ports
2 USB 3.0 ports; 2 USB 2.0 ports
MicroSD card slot

Figure 3

      i. Suggest **ONE** other hardware element the system will require. Clearly state whether this is an input, output or storage component. (1)
      ii. Which device in the above system is likely to be used to store the Operating System (OS)? (1)
      iii. An older model of this single-board computer used a 32-bit processor. Explain why this system could **not** have used 8GB of RAM. (1)
      iv. This system uses DRAM. Name another type of RAM and briefly mention **ONE** way how this differs from DRAM. (2)

c. The application is coded using a High-Level Language called Python. Suggest **TWO** ways this code is likely to differ from Assembly code. (2)

(Total: 8 marks)

7. A logic circuit is designed to accept a 3-bit binary number A as input. The circuit produces an output of 1 if the binary number A is either 2, 3 or 6, otherwise it should output 0.

a. Draw the truth table for this circuit. (3)

b. Draw the Karnaugh Map for this circuit and extract the minimised logic formula. (2)

c. Using only **ONE** AND gate and **ONE** NAND gate, draw the circuit that performs this logic function. Show all your workings. (3)

(Total: 8 marks)

8. a. Distinguish between source code and object code as used in high level programming languages. (2)

b. Both a compiler and an interpreter are used to translate computer languages.

i. Distinguish between a compiler and an interpreter. (1)

ii. Mention **ONE** advantage of a compiler over an interpreter. (1)

iii. Mention **ONE** advantage of an interpreter over a compiler. (1)

c. Assembly language on the other hand is a low-level language. List in order the **THREE** steps involved in the assembly process. (3)

(Total: 8 marks)

9. a. State **ONE** advantage of a list over an array. (1)

b. State **ONE** disadvantage of a list when compared to an array. (1)

c. Consider the following Stack structure:

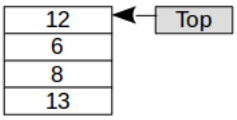


Figure 4

i. Redraw the stack to show how it looks after the number 5 is pushed to the stack. (2)

ii. Redraw the original stack (as shown in figure 4) after two items are consecutively popped from the stack. (2)

d. Consider the following queue:

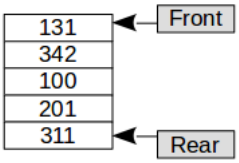


Figure 5

Redraw the above queue, shown in figure 5, to show its state after the number 433 is added and the number 311 removed. (2)

(Total: 8 marks)

Please turn the page.

10. A particular Appliances Repair company would like to implement a database to keep track of servicing and repair jobs. Currently, the company keeps track of their repairs on a manual ledger as shown below:

Table 4: Sample of records of repairs entered in manual ledger.

Emp ID	Name	Surname	Job No	Job Description	Date Started	Date Finished
121	Mark	Sammut	761	Changed motor chain	03/08/2021	07/08/2021
120	James	Ciantar	800	Oiling of rails	01/09/2020	11/09/2020
121	Mark	Sammut	400	Changed motor gears	01/07/2021	10/07/2021
100	Martina	Vella	403	Changed Filters	01/01/2020	03/01/2020
120	James	Ciantar	383	Changing Sliding Rails	07/07/2021	14/07/2021
121	Mark	Sammut	833	Changed air filter	20/10/2021	27/10/2021

a. It was decided that the database should contain two tables. Write down the names of the tables and select the appropriate fields for **each** table. (2)

b. Select a primary key for **each** table. (2)

c. What is the type of the relationship that should link the two tables? (1)

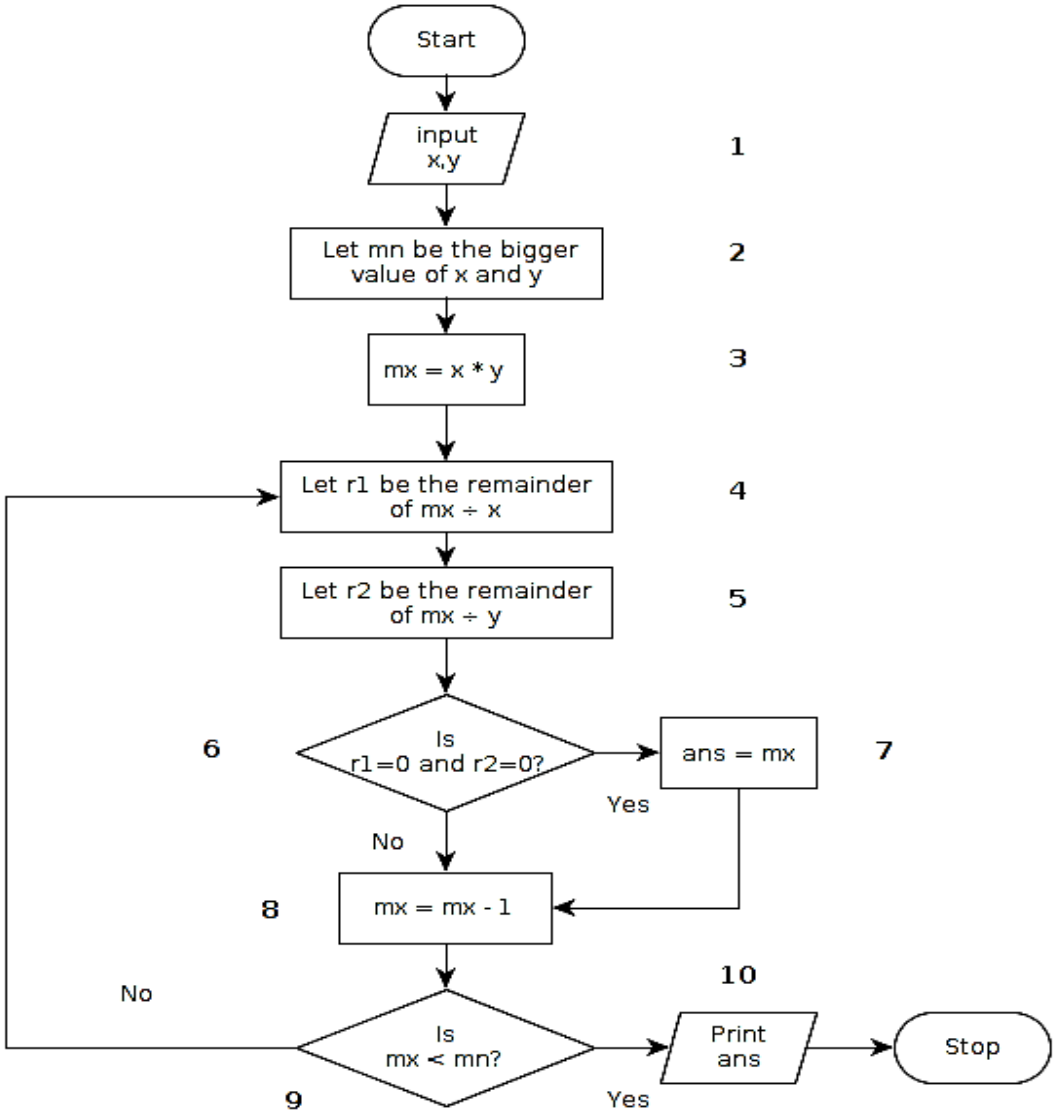
d. What field should be added to create the relationship and in which table? (2)

e. What is the type of field that connects the two tables together called? (1)

(Total: 8 marks)

Section B – This question is compulsory

1. a. For the first part of this question, consider the following flowchart, the steps have been numbered for reference.



i. Write down Java statements to implement step 2 to store the bigger value of x and y in variable mn. (3)

ii. Write down the the values of the variables r1 and r2 as they change with every iteration of the algorithm (steps 4-9) and the output produced by the algorithm (step 10) if:
- x = 3 and y = 4; (3)
- x = 3 and y = 6. (3)

iii. What is the purpose of this algorithm? (1)

iv. The algorithm works fine if neither x nor y are zero. What would happen if one of them is zero? (1)

Question continues on next page.

b. For the second part of this question consider the following Java Classes – one called Employee, the other called Deliveryman:

```
public class Employee {
      private String id;
      private float hours;

      public void setID (String id) {
      this.id = id;
      }

      public String getID () {
      return id;
      }

      public void setHours (float hours) {
      if (hours > 0) {
            this.hours = hours;
      }
      }

      public float getHours () {
      return hours;
      }

}

public class Deliveryman extends Employee {
      public Deliveryman (String ID, float hours) {
      setID (ID);
      setHours(hours);
      }

      public float getSalary () {
      return getHours() * 12.5f;
      }
}
```

i. Briefly explain how the concept of encapsulation is achieved in the class Employee. (2)

ii. Which important Object Oriented Programming (OOP) concept is implemented through the use of the keyword extends in the class Deliveryman? Mention **ONE** important advantage of this concept. (2)

iii. Using the statement:

Deliveryman joe = new Deliveryman ("213422M", 43);

Give **ONE** example of **each** of the following:

- an Object; (1)
- a Parameter or argument; (1)
- a Class; (1)
- a Keyword; (1)
- call to a Constructor. (1)

(Total: 20 marks)