L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

INTERMEDIATE MATRICULATION LEVEL
2026 FIRST SESSION

SUBJECT:	**Computing**
DATE:	29th May 2026
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 software company is developing a mobile app for a café that stores customer orders and prices. The program needs to handle both numbers and text data efficiently.

   a. The programmer enters the price of a coffee as 5.25 in binary fixed-point representation using 4 bits for the integer part and 4 bits for the fractional part. Write the binary equivalent of 5.25 in this format. (2)
   b. The program must also store customer initials, such as 'A' and 'B'. State how characters like these are represented inside the computer, naming **ONE** standard code used. (2)
   c. The app stores some numbers using two's complement representation in 8 bits. State the range of values that can be represented using this system. (1)
   d. Another part of the program stores numbers using Sign and Magnitude representation instead. Explain how the sign bit is used in this method. (1)

(Total: 6 marks)

2. A home alarm system uses three sensors. Sensor **A** = 1 if it detects motion inside the house; Sensor **B** = 1 if it detects a door being opened; and Sensor **C** detects that the alarm system is disarmed (1 = disarmed, 0 = armed).

   The system designer writes the Boolean expression as:

$$X = (A.B.\overline{C}) + (A.\overline{C}) + (A.B.C)$$

   a. Simplify the Boolean expression above, stating the Boolean laws used. (4)
   b. From the simplified expression derived, state when the alarm (X) should activate. (2)

(Total: 6 marks)

3. A small travel agency called Gozo Getaways wants to create a website to promote its holiday packages. The manager hires a web developer to design and upload the site.

   a. Explain the role of an Internet Service Provider (ISP) in helping Gozo Getaways make their website accessible to the public. (2)
   b. The developer would like to upload high-quality images and videos to the website. Explain how the choice between ADSL and ISDN could affect the speed of uploading these files. (2)
   c. The manager accesses the site by typing a URL into a web browser. State **ONE** reason why the use of standard protocols such as HTTP is important in this process. (2)

(Total: 6 marks)

Please turn the page.

4. A school has commissioned a new attendance-tracking system. During development, the team first carried out alpha testing on an internal prototype. Later, selected teachers began beta testing to report any remaining issues. The school also prepared normal, extreme, and erroneous data to perform input and output checks. Finally, the development team reviewed the system using both black-box testing and white-box testing.

   Outline the following in terms of the context above:

   a. alpha testing; (1)
   b. beta testing; (1)
   c. extreme data; (1)
   d. erroneous data; (1)
   e. black-box testing; (1)
   f. white-box testing. (1)

(Total: 6 marks)

5. Sorting algorithms are commonly used to organise data.

   a. Define a sorting algorithm. (1)
   b. State **ONE** reason why sorting data is useful in computing. (1)
   c. Compare bubble sort and insertion sort algorithms in terms of:
      i. how they work; (2)
      ii. their efficiency on nearly sorted data. (2)

(Total: 6 marks)

6. A company running Artificial Intelligence (AI) software requires a high-end CPU to allow efficient parallel processing of complex computations and handling of large datasets. They are opting for a CPU with 64 cores, a clock speed of 5.0 GHz, 144 MB cache, and a 64-bit word length.

   a. Explain how the wider address bus of 64-bit CPUs provides an advantage over 32-bit CPUs for AI workloads. (1)
   b. For each of the following, indicate whether or not they correctly describe cache memory:
      i. typically built using Dynamic RAM;
      ii. typically built using Static RAM;
      iii. volatile;
      iv. faster than RAM. (2)
   c. The stack is a region of RAM used for temporary data storage, while the stack pointer is a CPU register that tracks and manages its top location.
      i. Name **TWO** things that may be stored in the stack. (2)
      ii. State what happens to the value of the stack pointer when a data item is 'pushed'. (1)

(Total: 6 marks)

7. The Internet connects millions of computers worldwide through various signals and network topologies.

   a. Identify a medium used to transmit data across large geographical distances. (1)
   b. Outline noise in the context of Internet and data communication. (2)
   c. At a more localised level, the Internet is supported by Local Area Networks (LANs), which link computers within a confined space.
      i. State **TWO** reasons why LANs today are more likely to use a star topology than a ring topology. (2)
      ii. State **ONE** disadvantage of a star network. (1)

(Total: 6 marks)

8. Operating systems (OS) provide a range of features that allow them to manage hardware devices and support software applications effectively.

   a. Describe the role of OS interrupts in managing hardware and software tasks. (1)
   b. An OS allocates different priorities to different devices. Name **ONE** device that is likely to be assigned a low priority. (1)
   c. Describe a factor considered when allocating device priorities. (1)
   d. Contrast polling with interrupt-handling. (2)
   e. Briefly describe **ONE** other role of the OS, (apart from scheduling and file management). (1)

(Total: 6 marks)

9. An equipment rental database stores information to help staff manage bookings and track availability efficiently.

   a. The database includes a Rentals table. Identify **TWO** other tables that one expects to find in this database. (1)
   b. The RentalsID field in the Transaction files will be the primary key. Explain the role of the primary key. (1)
   c. Identify the foreign key used to link the Rentals table to either of the files mentioned in your answer to part (a). Clearly state the table you are linking to. (1)
   d. Explain the advantages of using a relational database instead of a traditional file-based system in this context. (1)
   e. Identify **TWO** roles of the Database Administrator. (2)

(Total: 6 marks)

10. A country is commissioning a disaster alert app to warn citizens about natural hazards such as floods, earthquakes, or storms. The app will be able to send real-time notifications, provide safety instructions, and help coordinate emergency response efforts.

    a. Justify **TWO** ways the Systems Analyst can get information relevant to the requirements of this app. (2)
    b. During system analysis, why is it important to understand what the system should do? (1)
    c. During testing, testers create test data to validate inputs and outputs (e.g., only valid location/phone values are accepted and the correct alert message is produced). Name this form of testing. (1)
    d. A phased transition is used before the system is launched nationwide. State **ONE** advantage of this approach. (1)
    e. After the system is launched, it is found to occasionally give errors and needs to be maintained. Name this type of maintenance. (1)

(Total: 6 marks)

Please turn the page.

SECTION B

Answer ONE question in this section.

1. A small company called SmartPark is developing an automated car park management system.

   Each parking bay is equipped with sensors that detect whether the bay is occupied (1) or free (0).

   The system stores vehicle and parking information in a database and provides a Java interface for users to check for available spaces and register their vehicles.

   Each parking bay has three sensors — A (front wheels), B (rear wheels), and C (middle/chassis area).

   To reduce false positives from the middle sensor, the system defines availability as follows:

   A bay is available (OUT = 1) when A = 0 and B = 0, regardless of C.

A	B	C	OUT
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

   a. From the truth table above and using a Karnaugh Map, derive and simplify the Boolean expression for OUT. (3)

   b. Draw the logic circuit for your simplified expression using NOR gates only. (3)

   c. The system stores parking information in two tables:

      VEHICLE(VehicleID, RegNumber, OwnerName)
      PARKING(ParkingID, VehicleID, EntryTime, ExitTime, Level)

      i. Identify the primary key in each table. (2)
      ii. State the foreign key in the Parking table and explain its purpose. (2)

   d. The database designer wants to ensure that the design avoids redundancy and update anomalies.
      i. Explain what is meant by data redundancy. (1)
      ii. Explain normalisation and how it helps reduce redundancy. (2)

e. Refer to the following Java program:

```
public class ParkingBay {
    boolean sensorA;
    boolean sensorB;
    boolean sensorC;

    public ParkingBay(boolean a, boolean b, boolean c) {
        sensorA = a;
        sensorB = b;
        sensorC = c;
    }

    public boolean isAvailable() {
        // complete this method
    }

    public static void main(String[] args) {
        ParkingBay bay1 = new ParkingBay(false, false, false);
        System.out.println("Bay available: " + bay1.isAvailable());
    }
}
```

i. Complete the `isAvailable()` method so that it returns true only if A and B detect no car (ignore C for availability). (3)

ii. Explain what the `main()` method does. (2)

iii. What is the output when the program runs? (2)

(Total: 20 marks)

2. A supermarket membership and sales tracking system is being developed in Java, which is an object-oriented programming language. The system manages information about products, staff, and client members. There are two types of client members: Premium and Regular Members.

Some of the classes involved are described below.

Product Class
- **Attributes:** productID, name, price, stockQuantity
- **Methods:** updateStock(), applyDiscount()

Staff Class
- **Attributes:** staffID, name, role, salary
- **Methods:** processSale(), generateReceipt()

Member Class
- **Attributes:** memberID, name, email, loyaltyPoints
- **Methods:** addPoints(), redeemPoints()

a. Object-orientism is one of many programming paradigms. Briefly describe **ONE** other programming paradigm. (2)

b. Briefly explain how inheritance can be implemented in the above scenario. (2)

c. Outline **TWO** benefits of inheritance. (2)

Question continues on the next page.

d. The base class Staff has two subclasses: `Cashier` and `Supervisor`.
The class `Staff` defines a general `generateReceipt()` method that produces a basic sales receipt. The subclasses implement this differently: the `Cashier` class generates a printed receipt whilst the `Supervisor` class generates a detailed receipt including discount approvals.

In this context, state whether each of the following statements is true or false:

i. This is an example of encapsulation. (1)
ii. This is an example of polymorphism. (1)
iii. These subclasses could override `generateReceipt()` to tailor the receipt format accordingly. (1)

e. Given the following class attributes for class Product, complete its constructor.

```
private String productID;

private String name;

private double price;

private int stockQuantity;
```

(2)

f. Product details are kept private and accessed through getter and setter methods. What object-oriented programming concept does this illustrate? (1)

g. Write a getter method for `stockQuantity` in class Product. (2)

h. The following is the incomplete code for method `updateStock()`:

```
01    // Method to update stock after a sale or restock
02    public void updateStock(int quantity, ____________ isRestock) {
03    if (isRestock == false) {
04      stockQuantity += quantity;
05      System.out.println(quantity + " items added to stock.");
06    } else {
07      if (quantity <= stockQuantity) {
08        stockQuantity _________________;
09        System.out.println(quantity + " items sold. Stock updated.");
10      } else {
11        System.out.println("Error: Not enough stock available!");
12      }
13    }
14    System.out.println("Current stock: " + stockQuantity);
15  }
```

i. Complete the blank code in lines 2 and 8. (2)
ii. When executed, this code gives the wrong result. Identify the type of error involved and explain how it can be fixed. (2)

i. Consider the code below and answer the following questions in the context of the above scenario:

```
01 public class Main {
02   public static void main(String[] args) {
03     Product apple = new Product("P101", "Apple", 0.50, 100);
04     _____________________________;  // Sell 20 apples
05     _____________________________; // Restock 50 apples
06   }
07 }
```

i. Explain the function of line 3. (1)
ii. Complete lines 4 and 5. (1)

(Total: 20 marks)