L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

INTERMEDIATE MATRICULATION LEVEL
2026 SECOND SESSION

SUBJECT:	**Computing**
DATE:	4th September 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. Convert the binary number **00101101** to decimal. (1)

   b. Convert the binary number **00101101** to hexadecimal. (2)

   c. State **ONE** advantage of using hexadecimal instead of binary when representing data. (1)

   d. The system stores student names using ASCII and Unicode. Give **TWO** reasons why Unicode is more suitable than ASCII for storing student names in an international school. (2)

(Total: 6 marks)

2. A smart classroom uses three inputs to control an automatic projector system:

   - A = Teacher present (1 = Yes, 0 = No)
   - B = Computer switched on (1 = Yes, 0 = No)
   - C = Projector button pressed (1 = Yes, 0 = No)

   The projector output is given by the expression $Y = AB + AC + A\overline{B}C$

   a. Simplify the Boolean expression for Y using Boolean algebra. State clearly the laws used in every step. (5)

   b. Using the expression derived in part (a), determine the conditions under which the projector will "turn on". (1)

(Total: 6 marks)

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3. A school is setting up a computer network for different systems. During testing, the network administrator notices some problems during transmission between computers. To detect errors, the system uses parity checking. The school also uses different communication modes for various devices.

   a. Explain what is meant by a transmission error and describe how parity checking (single parity and block parity) can be used to detect such errors. (3)

   b. For **each** of the following devices used in the school network, state whether the communication mode is simplex, half-duplex, or full-duplex, and justify your answer.
      i. A walkie-talkie communication system used by staff; (1)
      ii. A digital projector that only receives signals from a computer; (1)
      iii. A video call system used for online lessons. (1)

(Total: 6 marks)

4. A local cinema is introducing an online ticket booking system. Customers use the system to select a movie and book tickets. The system sends booking confirmations to customers. The cinema staff use the system to update movie schedules and receive booking reports.

   a. Identify the following in the above scenario:
      i. the main process; (1)
      ii. the external entities interacting with the system; (1)
      iii. the likely data stores required by the system. (1)

   b. Draw a Level 0 Data Flow Diagram (Context Diagram) for the Online Cinema Booking System. Clearly label **all** data flows between the system and **each** external entity. (3)

(Total: 6 marks)

5. A small school is developing a Java program to store students' test results. The school has 5 students, each of which has marks for 3 subjects. The program must:

   - Store the students' names in a single-dimensional array.
   - Store the students' marks in a two-dimensional array.
   - Fill both arrays with sample data.
   - Display all students' names together with their marks.

   a. Identify **ONE** difference between a single-dimensional array and a two-dimensional array. (1)

   b. Write Java statements to declare:
      i. a one-dimensional array to hold the students' names; (1)
      ii. a two-dimensional array to hold the students' marks (5 rows, 3 columns). (1)

   c. The system uses a stack to store recently accessed student names.
      i. State what is a stack. (1)
      ii. Name the **TWO** main operations performed on a stack. (2)

(Total: 6 marks)

6. A desktop computer such as a typical Windows PC relies on an operating system (OS) to manage all of its hardware and software resources.

   a. Give **ONE** advantage of using interrupts rather than polling in this context. (1)

   b. The OS is responsible for handling memory. Describe the difference between logical and physical address spaces. (2)

   c. Describe memory fragmentation and memory compaction in the context of memory allocation. (2)

   d. Explain the purpose of memory store protection. (1)

(Total: 6 marks)

7. A local Internet Service Provider (ISP) is upgrading its network infrastructure. Although some parts of the network still use coaxial cables, the company has started installing fibre optic cables between major distribution points. However, the final connection from the street cabinet to customers' homes is still delivered using twisted-pair cabling.

   a. Give **ONE** reason why fibre optic cable is preferable to coaxial cable. (1)

   b. Explain why the ISP still delivers the last mile using twisted-pair cabling. (1)

   c. In older systems, analogue signals were commonly used, but modern broadband networks transmit digital data. Explain **ONE** reason why digital signals are preferred. (2)

   d. When transmitting data over twisted-pair cabling, a high-frequency carrier signal is modulated so that it can carry digital information across the network. Distinguish between amplitude and frequency modulation. (1)

   e. Give **ONE** advantage of frequency modulation over amplitude modulation. (1)

(Total: 6 marks)

8. The Central Processing Unit (CPU) forms the core of a computer system and utilises a variety of registers to perform its operations.

   a. Explain the role of each of the following registers:
      i. Instruction Pointer; (1)
      ii. Current Instruction Register. (1)

   b. Compilers are High Level Language translators and they produce object code. Explain why object code is platform-dependent. (1)

   c. Name **ONE** other translator that translates High Level language to machine code and outline how this translator differs from a compiler. (2)

   d. Assembly code is translated using an assembler. Identify the utility responsible for combining the object code into a single executable program. (1)

(Total: 6 marks)

Please turn the page.

9. A retail company is upgrading its existing computerised inventory system to a more advanced version.

   a. Outline why defining a problem is important before designing a new system. (1)

   b. Name **TWO** ways the analyst may gain the necessary information to understand the problem completely. (2)

   c. Describe **ONE** risk of a direct changeover in this context. (1)

   d. Outline how the risk identified in part (c) can be mitigated. (1)

   e. Outline **ONE** reason why the company might opt for a parallel changeover despite higher costs. (1)

(Total: 6 marks)

10. The database for an online bookstore tracks customers, their orders, and the books they purchase.

    a. Explain the importance of a field called `OrderId` in the `Orders` table. (1)

    b. List **TWO** other fields that would be needed in the `Orders` table and state their types. (2)

    c. The `Customers` table includes the fields `customerID`, `first_name`, `second_name` and `email`. Identify the field which would be used to link to the `Orders` table. (1)

    d. The database designer needs to create the `Orders` table by defining its field names and data types. Name the type of database language used for this task. (1)

    e. The shop manager wants to find all orders made by a particular customer. Explain how a query language would be used in this situation. (1)

(Total: 6 marks)

SECTION B
Answer ONE question in this section.

1. A small delivery company is installing an automatic gate at the entrance of its warehouse.

   The gate should open only when:
   - a valid access card is detected (**C = 1**), and
   - the driver enters the correct PIN (**P = 1**),

   unless the emergency override button is pressed (**E = 1**), in which case the gate must open regardless of the card or PIN.

   Let the output **G** represent whether the gate opens (1 = open, 0 = closed).

   a. Construct the truth table for the system. (3)

   b. From the truth table derived in part (a) above, obtain the Boolean expression using a Karnaugh Map. (3)

   c. Draw a logic circuit for the simplified expression using NAND gates only. (2)

d. The company also stores information about drivers who are authorised to access the warehouse in a database.

Each driver is issued with:

- a unique `DriverID`;
- `Name`;
- `VehicleRegistration`;
- `AccessCardNumber`;
- and a flag `IsActive` indicating whether the driver is currently authorised to enter.

Design a relational table named Driver to store this information by:

i. listing **all** suitable attributes with their data types; (3)

ii. identifying the primary key; and (1)

iii. stating **ONE** validation rule that should be applied to the data. (1)

Consider the following Java code fragment. Assume that this code is written inside a valid Java class:

```
1.  public static int computeGate(int C, int P, int E) {
2.    E = 0; // modification inside the method
3.    if (E == 1 || (C == 1 && P == 1)) {
4.    return 1;
5.  }
6.  return 0;
7.  }
8.  public static void main(String[] args) {
9.    int C = 1;
10.   int P = 0;
11.   int E = 1;
12.   int result = computeGate(C, P, E);
13.   System.out.println("Gate status: " + result);
14.   System.out.println("E after method call: " + E);
15. }
```

e. What would be printed by line 13? (1)

f. What would be printed by line 14? (1)

g. Explain why the value of E printed in line 14 is not changed by the assignment made in line 2. (2)

h. The code does not correctly follow the required gate behaviour described at the start of the question. Explain why. (1)

i. What should be done to line 2 so that the method uses the value of E passed to it? (1)

j. Write the Boolean expression represented by the condition in line 3. (1)

(Total: 20 marks)

Please turn the page.

2. a. Programming paradigms are fundamental styles or approaches to programming that shape how developers structure, organize, and think about code to solve problems effectively.

   i. Explain how the imperative programming paradigm solves problems. (1)
   ii. State **ONE** key feature of object-oriented programming and briefly explain its purpose. (1)
   iii. A programmer wants to use mathematical rules and logical reasoning to help prove that a program is correct. Identify the programming paradigm being described. (1)

   b. Java is an Object-Oriented language. Explain how encapsulation can help a programmer implement security features in an application. (1)

   c. Briefly explain **TWO** ways how inheritance in OOP can increase productivity. (2)

   A company is developing a program called 'The Shopping Basket'. This program will provide functionality such as allowing customers to add products to a basket, calculating bill totals, detecting duplicate items in an order, and so on.

   The program is to be developed in OOP and includes the following two classes: `Product` and `Order`.

   d. The `Order` class includes a method `calculateTotal()`. Explain how this method would use `Product` objects to calculate the total cost of the order. (1)

   The following code includes part of the class `Product`:

```
public class Product {
  private String name;
  private double price;

  public Product(String name, double price) {
    this.name = name;
    this.price = price;
  }
}
```

   e. What type of method is `Product()` in the above code? (1)

   f. Explain the function of the '`this`' keyword. (1)

   g. Explain the function of the line: `this.name = name;` (1)

   h. If the method declaration of `Product()` is changed to:

```
public Product(String name, double itemPrice)
```

   rewrite the following line so that it correctly assigns the value of the parameter to the instance variable:

```
this.price = price
```

   (1)

i. To prevent a single product from being added multiple times to an order, the following code snippet was designed. Its purpose is to verify if a specific item already exists within the current order list before proceeding with the addition.

```
for (_____________________________) {
    if (products[____].getName().equals(newProduct.getName())) {
        System.out.println("Product already in order: " +
          newProduct.getName());
        return;
    }
}

if (count < products.length) {
    products[count] = newProduct;
    count++;
    System.out.println("Product added: " + newProduct.getName());
} else {
    System.out.println("Order is full. Cannot add more products.");
}
```

Note that:
- `products` is an array of `Product` objects
- `count` keeps track of how many products are already in the order
- this snippet would form part of a method such as `addProduct(Product newProduct)`

i. Complete the for-loop declaration. (3)
ii. Complete the line:
`if (products[___].getName().equals(newProduct.getName())) {` (1)
iii. Explain the function of this line: `products[count] = newProduct;` (1)
iv. What happens if the line `count++` is removed? (1)

j. Give **TWO** differences between an array and a stack. (2)

Products are being sorted alphabetically by name as outlined in the following pseudo code:

```
procedure sort(products)
n = length of products
for i from 0 to n - 2
   for j from 0 to n - 2 - i
       if products[j].name > products[j + 1].name // compare
           temp = products[j]
       products[j] = products[j + 1]
      products[j + 1] = temp
   end if
end for
    end for
end procedure
```

k. Name the sorting algorithm implemented in the algorithm above. (1)

(Total: 20 marks)