

Candidate Name

Candidate Number

Centre Name

Centre Number

Paper 2: Problem-solving and Programming

For Examination December 2023

(1 hour 15 minutes)

It is necessary to respond on the answer sheets provided alongside this question paper. Additionally, you must have a soft pencil (preferably of type B or HB), a clean eraser and a dark blue or black pen.

INSTRUCTIONS:

- You must write your name, candidate number, centre name and centre number on the answer sheets in the designated spaces.
- Attempt all the questions from the subjective section using a dark blue or black pen.
- It is important to follow the instructions provided on the answer sheets.
- Do not use correction fluid.
- Avoid writing on any bar codes.
- **Maximum mark: 50**

Use the pre-release material and your experience from attempting the tasks before the examination to answer Question 1.

The Pre-release Material

Imagine you're tasked with creating a program for managing a digital library. The library contains a vast collection of e-books, and your program should handle various tasks related to book management. Your preparation for this project should include implementing the following practical tasks:

Task 1 – Adding Books to the Library:

Write a program that allows librarians to input information about books into the library's digital catalog. The program should:

- Prompt the librarian to enter the book's title, author, publication year, and genre.
- Validate the entered data to ensure accuracy.
- Display clear and understandable error messages for any input validation issues.
- Store the book information in a suitable data structure.

Task 2 – Managing Library Users:

Extend Task 1 to manage library users. Implement features to:

- Allow library users to register by providing their name, email, and a unique library card number.
- Check if a user with the same library card number is already registered.
- Store user information in a data structure and handle any registration errors appropriately.

Task 3 – Borrowing and Returning Books:

Develop a system that enables library users to borrow and return books. Your program should:

- Allow users to search for books by title, author, or genre.
- Check if a book is available for borrowing and display its availability status.
- Allow users to borrow available books by providing their library card number.

- Update the book's availability status and user borrowing records accordingly.
- Implement a due date system and notify users when their borrowed books are due for return.
- Handle return requests by users and update the book's availability status and user records accordingly.

Task 4 – Generating Library Statistics:

Extend your program to provide library statistics and reporting features. Your program should:

- Calculate and display the total number of books in the library.
- Show the number of books borrowed and the number available.
- Display a list of the most borrowed books and their borrowing counts.
- Generate reports on the most popular genres and authors based on user borrowing patterns.

Task 5 – Handling Book Requests:

Implement a feature that allows users to request books not currently available in the library.

The program should:

- Allow users to submit book requests, including title, author, and reason for the request.
- Store these requests in a data structure.
- Notify librarians of new book requests and provide a mechanism for librarians to review and process them.

Your program should be **thoroughly tested** to ensure its functionality and robustness in managing the digital library efficiently.

1. (a). It is imperative to assign meaningful names to all variables, constants, and other identifiers.

(i) Identify one constant you could have used for Task 1 - Adding books to the library, give the value that would be assigned to it, and explain its purpose. [3]

Constant Name:

Value:

Use:

(ii). In Task 1, specify one variable and one list/array that you could have been utilized. Explain the purpose of each in the context of the task. [4]

Variable Name:

Use:

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Array/List Name:

Use:

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b. How can you enhance **Task 1** of the library system to allow a librarian to enter details for up to **eight different authors** and **their respective books** in the library's collection? [4]

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c. Provide an algorithm, pseudocode, programming statements, or a flowchart to illustrate how your program accomplishes the following aspects of Task 2:

- Develop a feature that allows students to enter their unique library card number as part of the registration process.
- Implement a system to verify whether the student's library card number is already registered in the system.
- If the card number is already registered, provide an appropriate message and prevent them from registering again.
- If the card number is not found in the system, establish a process for storing the unique library card number without duplicating it in a suitable data structure. [6]

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1 (d). How does your program accomplish the following aspects of Task 3:

- determine the availability status of library books, allowing users to borrow or return them.
- update the availability status of books after they have been borrowed or returned.
- provide user feedback by confirming book transactions (borrowing or returning).

Provide **detailed programming statements** to explain your approach.

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[Q1 Total: 18]

Q2. Mr. Elijah wants to migrate his firm to be technology-complaint. His IT department advised that he approves and implements the system development lifecycle.

- a. Describe what takes place during the analysis stage of the system development lifecycle for Mr. Elijah. [4]

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- b. A system lifecycle may include a feedback stage. This is sometimes described as both the end and the start of the cycle. Briefly explain the reason(s) for this description. [2]

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- c. The agile and waterfall methods are often used for developing new systems. Briefly explain **when testing** takes place in these two methods.

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- d. Three sorts of data are used when testing a program. Briefly explain the purpose of each. [3]

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- e. With examples, briefly describe data validation. [2]

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[Q2 TOTAL: 13]

Q3. One type of operating system is known as a real-time operating system (RTOS).

a(i). Describe a characteristic that distinguishes a real-time operating system (RTOS) from other types of operating systems. [2]

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a(ii). **Identify** a specific use case where RTOS is essential and **provide** the rationale for its necessity. [2]

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b. What is the reason for the absence of a graphical user interface (GUI) in many server-operating systems?

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c. A database is employed to store data gathered from a survey conducted among school students. Fill in the table provided with **appropriate data types** for each field.

[4]

Filename	Data type
Surname	
Travels by bus?	
Height in metres	
Student number	

d. An internet search engine permits you to input queries in natural language. Provide a brief explanation of the actions the computer system needs to perform on the text you input to generate relevant search results.

[2]

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[Q3 TOTAL: 13]

Q4. Read the Python program below:

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1  def an_algorithm(items):
2      num_items = len(items)
3      i = 1
4      while i < num_items:
5          for current in range(num_items - 1):
6              if items[current] > items[current+1]:
7                  temp = items[current]
8                  items[current] = items[current+1]
9                  items[current+1] = temp
10         i = i + 1
```

4 (a). Complete the trace table below only for lines 7-9 of the algorithm. The first line in the trace table contains the values for the current variable and the items list. [5]

Line	current	temp	items			
			[0]	[1]	[2]	[3]
	0	-	Pakistan	China	Greece	Chad
7						
8						
9						

4 (b). What algorithm is this? [1]

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[Q4 TOTAL: 6]