Computer Science Paper 2
Problem Solving and Programming
Model Paper 2025

Time Allowed: 1 hour 40 minutes
Total Marks: 60

You must answer on the question paper.

You must bring a soft pencil (preferably type B or HB), a clean eraser, and a dark blue or black pen. You may use a simple calculator if needed.

Before attempting the paper, write your name, candidate number, centre name, and centre number clearly in the designated spaces.

Instructions for Candidates

- Answer all questions.
- Write your answer to each question in the space provided.
- You must show all necessary working clearly.
- Do not use an erasable pen or correction fluid.
- Avoid writing over any bar codes printed on the paper.

Information for Candidates

- This paper consists of a total of **60 marks**.
- The number of marks assigned for every question or its parts is indicated within brackets [ ].

Please read all questions carefully and follow the instructions exactly to ensure your responses are properly evaluated.

Q1. Use the pre-release material and your experience from attempting the tasks before the examination to answer Question 1.

Pre-release Material

Imagine you're tasked with creating a program to manage a Smart Vending Machine System. The program will manage inventory, handle customer purchases, track sales, and support admin functionalities like restocking and generating reports.

Task 1 – Managing Items in the Machine:

- Add new products with name, code, price, and stock_quantity
- Validate input (e.g., price must be a positive real number, stock must be ≥ 0)
- Store all items in a suitable data structure

Task 2 – Customer Purchase Functionality:

- Display available products
- Allow customers to input a product code and quantity
- Check stock availability
- Deduct quantity if available and show total cost
- Handle invalid selections or insufficient stock with appropriate messages

Task 3 – Inventory and Sales Reporting:

- Show the most sold product
- Show total revenue generated
- Calculate and display average price of items sold
- Generate a list of out-of-stock items for restocking

Task 4 – Admin Login and Logical Controls:

- Include a login mechanism for the admin using a username and password
- Allow a maximum of 3 login attempts (use control structures)
- Use Boolean logic to determine whether the login is successful
- Apply truth tables or gate logic to explain authentication conditions

Task 5 – Database Storage:

- Store product and transaction details in a single-table database
- Include fields such as ProductCode, ProductName, Price, SoldQuantity
- Use SQL to display products below stock threshold, total quantity sold, and sort by highest sales

Q1.

a. Identify one constant and one variable that would be useful in Task 1. Explain their purpose. [3]

Constant: _____

Variable: _____

Use: _____

b. Write pseudo code or a flowchart to represent the admin login system from Task 4, ensuring only 3 attempts are allowed. [4]

_____

_____

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c. Provide an algorithm or programming code that allows a customer to: [3]

- Enter product code and quantity
- Check availability
- Display total cost or error if not available

d. Explain how you would use arrays and loops to store and display up to 20 products. Provide sample pseudo code or code. [4]

e. Write an SQL query to retrieve: [4]

(i) All products with stock less than 5

(ii) The total revenue from all products

Q1 TOTAL MARKS: 18

Q2. Ms. Ayesha is planning to launch an online appointment system for her dental clinic.
Her IT consultant recommended following the System Development Life Cycle (SDLC) to ensure the system is reliable and user-friendly.

a. Analyse two key design decisions that must be made when developing the system (for example: choice of user interface, authentication method, or data storage). For each decision, discuss the advantages and disadvantages of possible options and justify the best choice. [4]

b. The SDLC is often viewed as a cycle. Explain how the completion of one project can influence the start of another. [2]

c. Both the Agile and Waterfall models are used to manage software projects.
State one difference in how changes are handled in each model. [2]

d. Briefly describe valid data, invalid data, and boundary data with one example of each. [3]

e. State two common validation checks used in programming. Give one example for each. [2]

Q2 TOTAL MARKS: 13

Q3. A research company processes large volumes of data from weather stations every night.
Their IT department uses a batch processing system controlled via a command line interface (CLI), and stores results in a simple database.

a. Describe one feature of a batch processing system and explain why it is suitable for this company. [2]

b. Evaluate the suitability of using a command line interface (CLI) instead of a graphical user interface (GUI) for this company. [2]

c. The company uses a database to store weather data. Define the following terms as used in database design: [3]

- Field
- Record
- Primary key

d. Complete the table below with a suitable data type for each field in the weather database. [4]

Field Name	Suggested Data Type
StationID	
TemperatureCelsius	
IsRaining	
RecordedDate	

e. Explain how inaccurate or inconsistent data types (e.g., text stored where numbers are expected) can affect the reliability of reports generated from the database. [2]

Q3 TOTAL MARKS: 13

Q4. Read the Python program below:

```
1.  def sort_list(numbers):
2.      for i in range(1, len(numbers)):
3.          key = numbers[i]
4.          j = i – 1
5.          while j >= 0 and numbers[j] > key:
6.              numbers[j + 1] = numbers[j]
7.              j = j – 1
8.              numbers[j + 1] = key
```

a. Complete the trace table for the first two iterations (i = 1 and i = 2) using the list: [4, 2, 7] [4]

i	key	j	numbers list after update

b. What sorting algorithm does this code implement? [1]

c. Briefly explain when this sorting method might be more efficient than bubble sort. [1]

Q4 TOTAL MARKS: 6

Q5. You are given the following truth table for three inputs (A, B, C) and one output (X):

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

a. Write the Boolean expression for X using logical operators. [1]

b. Draw the corresponding logic gate diagram. [3]

c. Explain the difference between the following programming constructs. [3]

i. Sequence

ii. Selection

iii. Iteration (loop)

d. The following SQL query has several errors. Identify and correct each mistake: [3]

SELECT Product_Name WHERE stock > 50 FROM ProductTable ORDERY BY stock DESC;

i. Rewrite the corrected query.

ii. Explain the purpose of each clause used in your corrected version.

Q5 TOTAL MARKS: 10

Computer Science Paper 2
Marking Scheme and Answer key
Problem Solving and Programming
Model Paper 2025

Q1. Use the pre-release material and your experience from attempting the tasks before the examination to answer Question 1.

Pre-release Material

Imagine you're tasked with creating a program to manage a Smart Vending Machine System. The program will manage inventory, handle customer purchases, track sales, and support admin functionalities like restocking and generating reports.

Task 1 – Managing Items in the Machine:

- Add new products with name, code, price, and stock_quantity
- Validate input (e.g., price must be a positive real number, stock must be ≥ 0)
- Store all items in a suitable data structure

Task 2 – Customer Purchase Functionality:

- Display available products
- Allow customers to input a product code and quantity
- Check stock availability
- Deduct quantity if available and show total cost
- Handle invalid selections or insufficient stock with appropriate messages

Task 3 – Inventory and Sales Reporting:

- Show the most sold product
- Show total revenue generated
- Calculate and display average price of items sold
- Generate a list of out-of-stock items for restocking

Task 4 – Admin Login and Logical Controls:

- Include a login mechanism for the admin using a username and password
- Allow a maximum of 3 login attempts (use control structures)
- Use Boolean logic to determine whether the login is successful
- Apply truth tables or gate logic to explain authentication conditions

Task 5 – Database Storage:

- Store product and transaction details in a single-table database
- Include fields such as ProductCode, ProductName, Price, SoldQuantity
- Use SQL to display products below stock threshold, total quantity sold, and sort by highest sales

a. Identify one constant and one variable that would be useful in Task 1. Explain their purpose. [3]

Answer:

Constant: MAX_STOCK – sets the maximum number of items allowed for any product.

Variable: stock_quantity – stores the current number of units available for a product.

Use: The constant ensures stock does not exceed machine capacity, while the variable keeps track of items as they are sold or restocked.

Marking scheme:

1 mark for identifying a relevant constant.

1 mark for identifying a relevant variable.

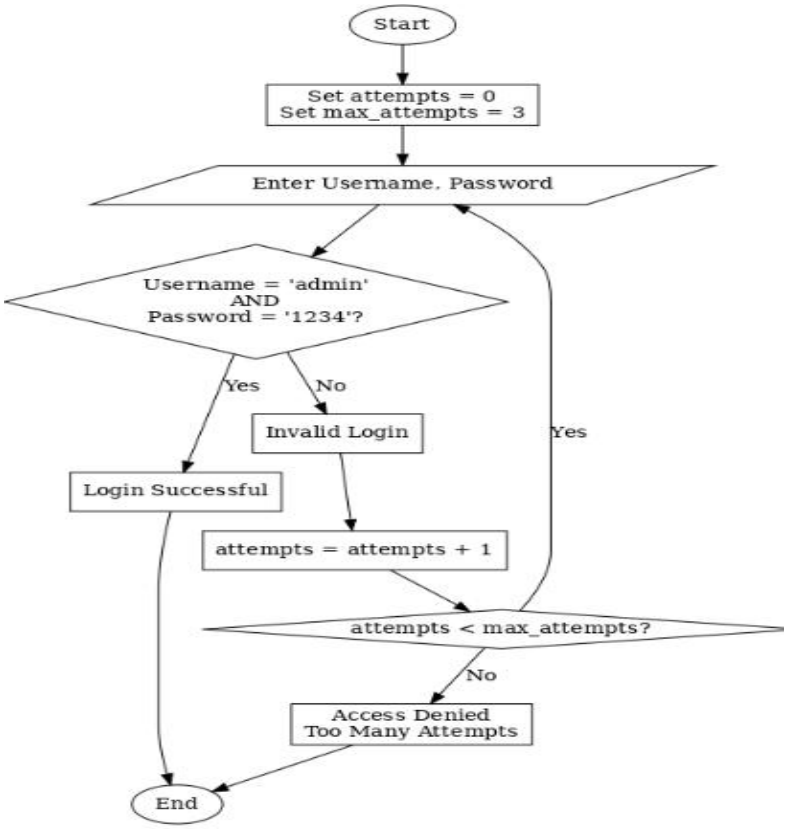
1 mark for explaining their purpose/use.

b. Write pseudo code or a flowchart to represent the admin login system from Task 4, ensuring only 3 attempts are allowed. [4]

Answer:

```
SET attempts = 0
SET max_attempts = 3
WHILE attempts < max_attempts
   INPUT username, password
   IF username = "admin" AND password = "1234" THEN
      OUTPUT "Login Successful"
      EXIT LOOP
   ELSE
      OUTPUT "Invalid Login"
```

```
    attempts = attempts + 1
  ENDIF
ENDWHILE
IF attempts = max_attempts THEN
    OUTPUT "Access Denied – Too Many Attempts"
ENDIF
```



Marking scheme:

1 mark for initializing attempts and max_attempts.
1 mark for loop/control structure limiting attempts.
1 mark for correct Boolean check for username AND password.
1 mark for handling success and failure (including lockout after 3 tries).

c. Provide an algorithm or programming code that allows a customer to: **[3]**

- **Enter product code and quantity**
- **Check availability**
- **Display total cost or error if not available**

Answer:

```
INPUT product_code, quantity
IF product_code exists AND stock_quantity >= quantity THEN
   total_cost = price * quantity
   stock_quantity = stock_quantity - quantity
   OUTPUT "Total Cost = ", total_cost
ELSE
   OUTPUT "Error: Invalid code or insufficient stock"
ENDIF
```

Marking scheme:

1 mark for taking input for product code and quantity.
1 mark for checking validity and stock availability.
1 mark for correct output (total cost if valid, error if not).

d. Explain how would you use arrays and loops to store and display up to 20 products. Provide sample pseudo code or code. [4]

Answer:

```
DECLARE ProductName[20], ProductCode[20], Price[20]
FOR i = 0 TO 19
   INPUT ProductName[i], ProductCode[i], Price[i]
NEXT i
OUTPUT "Product List:"
FOR i = 0 TO 19
   OUTPUT ProductCode[i], ProductName[i], Price[i]
NEXT i
```

Marking scheme:

1 mark for declaring arrays for product details.
1 mark for using a loop to store (input) product information.
1 mark for using a loop to display products.
1 mark for correct syntax/logic for handling up to 20 items.

e. Write an SQL query to retrieve: [4]

Answer:

(i) All products with stock less than 5

```
SELECT *
FROM Products
WHERE StockQuantity < 5;
```

(ii) The total revenue from all products

```
SELECT SUM (Price * SoldQuantity) AS TotalRevenue
FROM Products;
```

Marking scheme:

1 mark for correct SELECT * with WHERE StockQuantity < 5.
1 mark for correct use of SUM ().
1 mark for correct multiplication of Price * SoldQuantity.
1 mark for use of alias/clarity in total revenue output.

Q1 TOTAL MARKS: 18

Q2. Ms. Ayesha is planning to launch an online appointment system for her dental clinic.
Her IT consultant recommended following the System Development Life Cycle (SDLC) to ensure the system is reliable and user-friendly.

a. Analyse two key design decisions that must be made when developing the system (for example: choice of user interface, authentication method, or data storage). For each decision, discuss the advantages and disadvantages of possible options and justify the best choice . [4]

Answer:

User Interface:
Web-based system → easy access, low cost, but needs internet.
Mobile app → convenient, but expensive to develop.
Best: Web-based (more affordable and accessible for all patients).
Data Storage:
Cloud database → secure, backed up, remote access, but has ongoing costs.
Local server → full control, but high maintenance and less reliable remotely.
Best: Cloud database (reliable, secure, easy to scale).

Marking scheme:

2 marks for two design decisions with pros/cons.
2 marks for justification of best choice for each.

b. The SDLC is often viewed as a cycle. Explain how the completion of one project can influence the start of another. [2]

Answer:

When one project is completed, its evaluation phase identifies successes and problems. These lessons help improve planning and design of the next project, making it more efficient and avoiding past mistakes.

Marking scheme:

1 mark for stating that evaluation of a finished project informs future projects.
1 mark for explaining how (e.g., learning from strengths/weaknesses, improving planning/design).

c. Both the Agile and Waterfall models are used to manage software projects.
State one difference in how changes are handled in each model. [2]

Answer:

Waterfall: Changes are difficult once a stage is completed.
Agile: Changes can be made at any stage through iterations.

Marking Scheme:

1 mark for correct point about Waterfall.
1 mark for correct point about Agile.

d. Briefly describe valid data, invalid data, and boundary data with one example of each. [3]

Answer:

Valid data: Acceptable input within rules (e.g., age = 25).
Invalid data: Input outside rules (e.g., age = -5).
Boundary data: Values at the edge of valid range (e.g., if age must be 0–120, test with 0 or 120).

Marking Scheme:

1 mark for valid data + example.
1 mark for invalid data + example.
1 mark for boundary data + example.

e. State two common validation checks used in programming. Give one example for each. [2]

Answer:

Range check: Ensures a value falls within a set range (e.g., age between 0 and 120).
Type check: Ensures data is of the correct type (e.g., input must be a number, not text).

Marking Scheme:

1 mark for correct validation check + example.
1 mark for correct second validation check + example.

Q2 TOTAL MARKS: 13

Q3. A research company processes large volumes of data from weather stations every night. Their IT department uses a batch processing system controlled via a command line interface (CLI), and stores results in a simple database.

a. Describe one feature of a batch processing system and explain why it is suitable for this company. [2]

Answer:

Feature: Processes large volumes of data automatically without user interaction.
Suitability: Ideal for the company because weather data is collected continuously and can be processed overnight in batches, saving time and reducing manual work.

Marking Scheme:

1 mark for describing a correct feature of batch processing.
1 mark for explaining why it is suitable for the scenario.

b. Evaluate the suitability of using a command line interface (CLI) instead of a graphical user interface (GUI) for this company. [2]

Answer:

CLI: Faster and more efficient for experienced users, uses fewer system resources.
GUI: Easier for beginners but slower and heavier on resources.
Evaluation: CLI is suitable because IT staff can efficiently run batch processes and scripts without unnecessary overhead.

Marking Scheme:

1 mark for describing CLI vs GUI.
1 mark for evaluating suitability in the given scenario.

c. The company uses a database to store weather data. Define the following terms as used in database design: [3]

Answer:

Field: A single piece of information in a database (e.g., Temperature).
Record: A complete set of related fields representing one entry (e.g., Date, Time, Temperature, Humidity).
Primary key: A unique field that identifies each record (e.g., StationID).

Marking Scheme:

1 mark for correct definition of Field.
1 mark for correct definition of Record.
1 mark for correct definition of Primary key.

d. Complete the table below with a suitable data type for each field in the weather database. [4]

Answer:

Field Name	Suggested Data Type
StationID	Integer
TemperatureCelsius	Float/ Real
IsRaining	Boolean
RecordedDate	Date

Marking Scheme:

1 mark for each correct data type corresponding to the field. (All four required)

e. Explain how inaccurate or inconsistent data types (e.g., text stored where numbers are expected) can affect the reliability of reports generated from the database. [2]

Answer:

Inaccurate or inconsistent data types can cause calculation errors, incorrect summaries, or system crashes. This makes reports unreliable because totals, averages, or trends may be wrong.

Marking Scheme:

1 mark for identifying the effect on calculations or data processing.
1 mark for explaining how it reduces reliability of reports.

Q3 TOTAL MARKS: 13

Q4. Read the Python program below:

```
1. def sort_list(numbers):
2.     for i in range(1, len(numbers)):
3.         key = numbers[i]
4.         j = i – 1
```

```
5.      while j >= 0 and numbers[j] > key:
6.          numbers[j + 1] = numbers[j]
7.          j = j – 1
8.          numbers[j + 1] = key
```

Answer:

a. Complete the trace table for the first two iterations (i = 1 and i = 2) using the list: [4, 2, 7] [4]

i	key	j	numbers list after update
1	2	-1	[2,4,7]
2	7	1	[2,4,7]

Marking Scheme:

1 mark for correct key and j values for i = 1.
1 mark for correct updated list after i = 1.
1 mark for correct key and j values for i = 2.
1 mark for correct updated list after i = 2.

b. What sorting algorithm does this code implement? [1]

Answer:

Insertion Sort

Marking Scheme:

1 mark for correctly identifying the sorting algorithm.

c. Briefly explain when this sorting method might be more efficient than bubble sort. [1]

Answer:

Insertion sort is more efficient than bubble sort when the list is already nearly sorted, because it only shifts elements that are out of order rather than repeatedly swapping all adjacent elements.

Marking Scheme:

1 mark for correctly explaining a scenario where insertion sort outperforms bubble sort.

Q4 TOTAL MARKS: 6

Q5. You are given the following truth table for three inputs (A, B, C) and one output (X):

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

a. Write the Boolean expression for X using logical operators. [1]

Answer:

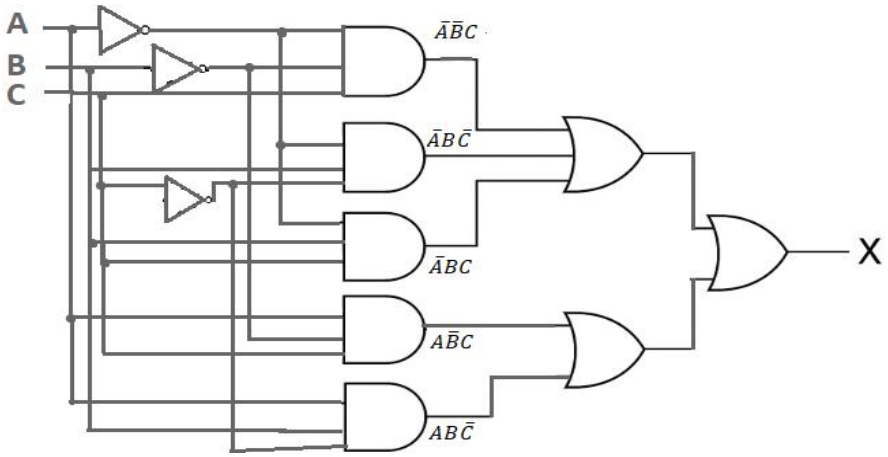
$X = \overline{A}\overline{B}C + \overline{A}B\overline{C} + \overline{A}BC + A\overline{B}C + AB\overline{C}$

Marking Scheme:

1 mark for correctly expressing X using AND, OR, and NOT (with bars).

b. Draw the corresponding logic gate diagram. [3]

Answer:



Marking Scheme:
1 mark for correct use of NOT gates for A, B, C.
1 mark for correct AND gates for each minterm.
1 mark for correct OR gates combining all AND outputs.

c. Explain the difference between the following programming constructs. [3]
Answer:
i. Sequence – Instructions are carried out in order, one after another, without branching.
ii. Selection – A decision is made, and different instructions are executed depending on a condition (e.g., IF…ELSE).
iii. Iteration (loop) – A set of instructions is repeated until a condition is met or for a fixed number of times (e.g., FOR, WHILE loops).
Marking Scheme:
1 mark for correct explanation of Sequence.
1 mark for correct explanation of Selection.
1 mark for correct explanation of Iteration (loop).

d. The following SQL query has several errors. Identify and correct each mistake: [3]
SELECT Product_Name WHERE stock > 50 FROM ProductTable ORDERY BY stock DESC;
Answer:
i. Rewrite the corrected query.
SELECT Product_Name FROM ProductTable WHERE stock > 50ORDER BY stock DESC;
ii. Explain the purpose of each clause used in your corrected version.
SELECT Product_Name → Chooses which column(s) to display in the result.
FROM ProductTable → Specifies the table containing the data.
WHERE stock > 50 → Filters to only include products with stock greater than 50.
ORDER BY stock DESC → Sorts results in descending order of stock.
Marking Scheme:
1 mark for correctly writing SQL query.
2 marks for explaining all four clauses clearly.

Q5 TOTAL MARKS: 10

Ziauddin Examination Board SSC (Advanced Level)

Computer Science Paper 2

Table of Specification (ToS)

No.	TOPICS	Question No. in model paper	AO	Total Marks
1	SYSTEMS ARCHITECTURE	3a	AO3	2
		3b	AO3	2
2	ALGORITHMS, PROGRAMMING AND LOGIC	1a	AO1	3
		1b	AO3	4
		1c	AO3	3
		1d	AO3	4
		1e	AO2	4
		2a	AO3	4
		2b	AO2	2
		2c	AO1	2
		3c	AO1	3
		3d	AO3	4
		3e	AO3	2
		4a	AO3	4
		4b	AO1	1
		4c	AO3	1
		5a	AO2	1
		5b	AO2	3
		5c	AO1	3
		5d	AO2	3
3	Data Representation	2d	AO1	3
		2e	AO1	2
Total Marks				**55**

ZUEB Criteria (Revised)			
AO	**Assessment Objectives**	**%**	**Marks**
AO1	Knowledge & Understanding	30%	18
AO2	Application	20%	12
AO3	Analysis & Evaluation	50%	30
Total			**60**

Model paper evaluation	
AO1	17
AO2	13
AO3	30
Total	**60**