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**COMPUTER SCIENCE****0478/22**

Paper 2 Algorithms, Programming and Logic

**October/November 2024****1 hour 45 minutes**

You must answer on the question paper.

No additional materials are needed.

**INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- Calculators must **not** be used in this paper.

**INFORMATION**

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **16** pages. Any blank pages are indicated.



2

1 Tick (✓) **one** box to complete this sentence.

A solution to a problem may be represented using pseudocode, flowcharts or

A procedures.

☐

B processes.

☐

C structure diagrams.

☐

D sub-systems.

☐

[1]

2 Tick (✓) **one** box to complete this sentence.

A pseudocode example of a selection statement is

A CALL Sorting(Value1, Value2)

☐

B DECLARE Count : INTEGER

☐

C IF X = 7 THEN Y ← 21 ENDIF

☐

D WHILE X <> -1 DO

☐

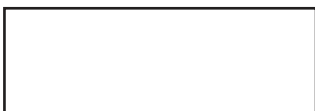
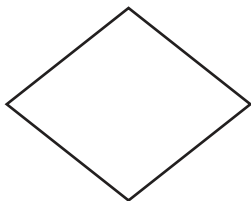
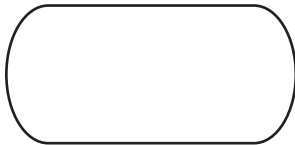
[1]

3 **Four** flowchart symbols and **five** purposes are shown.

(a) Draw **one** line to link each flowchart symbol to its correct purpose.

**Not** all purposes will be used.

**Flowchart symbol**



**Purpose**

subroutine

process

flow

decision

terminator

[4]





3



- (b) An algorithm needs to total 50 numbers between 1 and 100 inclusive.

Draw a flowchart that:

- uses a count-controlled loop from 1 to 50
- uses an appropriate prompt to ask for a number between 1 and 100
- totals the numbers as they are entered
- outputs the total after the loop has completed with an appropriate message.





- 4 This pseudocode algorithm is intended to sort a pre-populated one-dimensional (1D) array named `ItemList` into alphabetical order using a bubble sort.

```
01 DECLARE ItemList : ARRAY[1:100] OF STRING
02 DECLARE Counter : STRING
03 DECLARE Limit : INTEGER
04 DECLARE Pass : INTEGER
05 DECLARE Swapped : BOOLEAN
06 DECLARE Temp : STRING
07 Limit ← 100
08 Pass ← 1
09 Temp ← TRUE
10 WHILE Swapped = TRUE OR Pass <= Limit - 1 DO
11     Swapped ← FALSE
12     FOR Counter ← 1 TO Limit - Pass
13         IF ItemList[Counter] > ItemList[Counter + 1]
14             THEN
15                 Temp ← ItemList[Counter]
16                 ItemList[Counter] ← ItemList[Counter + 1]
17                 ItemList[Counter] ← Temp
18                 Swapped ← TRUE
19             ENDCASE
20         Pass ← Pass + 1
21     NEXT Counter
22 ENDWHILE
```

- (a) Identify the line numbers of **five** errors in the pseudocode and suggest a correction for each error.

Error 1 line number .....

Correction .....

.....

Error 2 line number .....

Correction .....

.....

Error 3 line number .....

Correction .....

.....

Error 4 line number .....

Correction .....

.....





Error 5 line number .....

Correction .....

..... [5]

(b) A bubble sort algorithm can be written to include features that make it more efficient.

Explain why the **corrected** bubble sort algorithm is efficient.

.....  
.....  
.....  
.....  
.....  
..... [3]

5 Analysis is one stage in the program development life cycle.

(a) State **one** other stage in the program development life cycle.

..... [1]

(b) Describe the analysis stage of the program development life cycle.

.....  
.....  
.....  
.....  
.....  
..... [3]

6 Outline **one** type of verification check that could be used when inputting data.

.....  
.....  
.....  
..... [2]





7 This pseudocode represents an algorithm.

An input of  $-1$  will terminate the algorithm.

```
DECLARE Count : INTEGER
DECLARE Answer : INTEGER
DECLARE Value : INTEGER
REPEAT
    INPUT Value
    IF Value <> -1
        THEN
            Answer  $\leftarrow$  Value
            FOR Count  $\leftarrow$  Value - 1 TO 1 STEP -1
                Answer  $\leftarrow$  Answer * Count
            NEXT Count
            OUTPUT Answer
        ENDIF
UNTIL Value = -1
```

(a) Complete the trace table for the input data:

5, 6,  $-1$ , 20, 9, 4

| Value | Count | Answer | OUTPUT |
|-------|-------|--------|--------|
|       |       |        |        |
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(b) State the purpose of this algorithm.

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..... [1]

(c) Describe the problem that would be caused in this algorithm if a Value of 1, 0 or less than −1 was input.

.....  
.....  
.....  
..... [2]

8 Different types of test data are used during program development to make sure a program works as intended. A program being developed takes as input whole numbers that are **not** greater than 80.

Identify **two** items of test data to test the whole number limit of 80.

Explain the reason for your choice of the data in each case.

Test data 1 .....

Reason for choice .....

.....

Test data 2 .....

Reason for choice .....

..... [4]





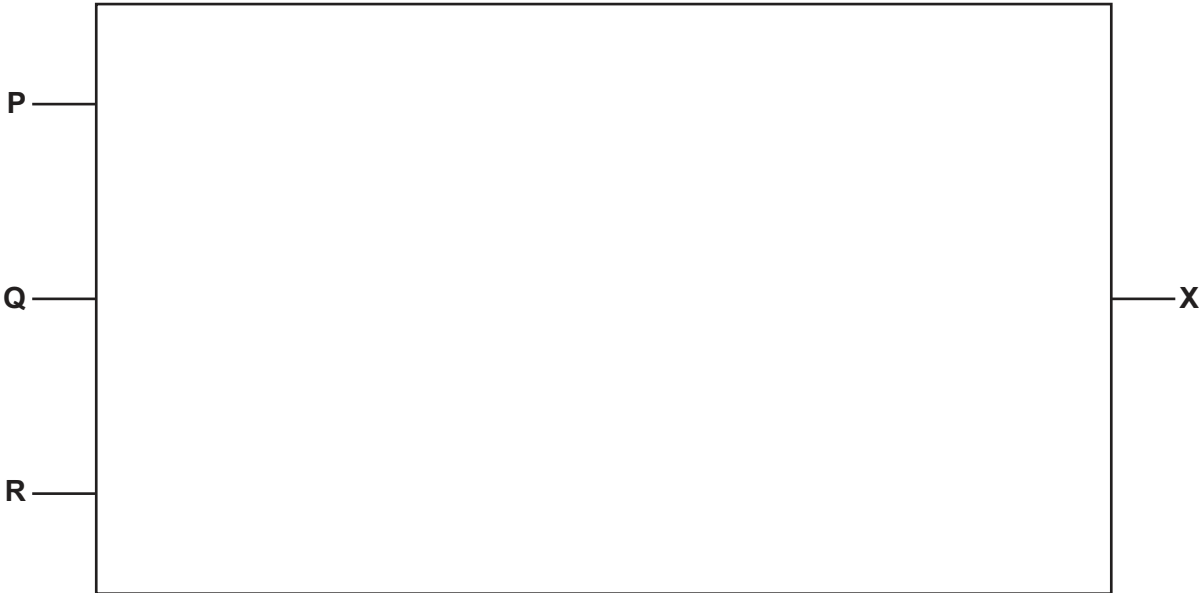
9 Consider the logic expression:

$$X = (\text{NOT } P \text{ OR } Q) \text{ NAND } (Q \text{ XOR } R)$$

(a) Draw a logic circuit for this logic expression.

Each logic gate must have a maximum of **two** inputs.

Do **not** simplify the logic expression.



[4]

(b) Complete the truth table for the given logic expression.

| P | Q | R | Working space | X |
|---|---|---|---------------|---|
| 0 | 0 | 0 |               |   |
| 0 | 0 | 1 |               |   |
| 0 | 1 | 0 |               |   |
| 0 | 1 | 1 |               |   |
| 1 | 0 | 0 |               |   |
| 1 | 0 | 1 |               |   |
| 1 | 1 | 0 |               |   |
| 1 | 1 | 1 |               |   |

[4]





[6]





- 11 A database table called `Booking28` stores details of hotel rooms and bookings for the week beginning Monday 7 July 2025.

| RoomNo | Type   | Guests | Rate\$ | Mon | Tue | Wed | Thu | Fri | Sat | Sun |
|--------|--------|--------|--------|-----|-----|-----|-----|-----|-----|-----|
| 101D   | Double | 2      | 99.99  | T   | T   | T   | T   | F   | T   | T   |
| 102D   | Double | 2      | 99.99  | T   | T   | T   | F   | T   | T   | T   |
| 103F   | Family | 4      | 150.00 | T   | T   | T   | T   | T   | T   | T   |
| 104S   | Single | 1      | 72.50  | F   | T   | T   | F   | T   | T   | T   |
| 105S   | Single | 1      | 72.50  | F   | T   | T   | F   | T   | T   | T   |
| 106T   | Twin   | 2      | 120.00 | T   | T   | T   | T   | F   | T   | T   |
| 201F   | Family | 4      | 160.00 | F   | F   | T   | T   | T   | T   | T   |
| 202D   | Double | 2      | 120.00 | T   | F   | T   | T   | T   | T   | T   |
| 203T   | Twin   | 2      | 120.00 | T   | F   | T   | T   | T   | T   | T   |
| 204T   | Twin   | 2      | 125.00 | T   | F   | T   | F   | T   | T   | T   |
| 205S   | Single | 1      | 79.99  | T   | F   | T   | T   | F   | T   | T   |
| 301D   | Double | 2      | 200.00 | F   | T   | T   | F   | F   | T   | T   |
| 302T   | Twin   | 2      | 200.00 | T   | T   | T   | T   | F   | T   | T   |
| 303P   | Suite  | 4      | 500.00 | T   | T   | T   | T   | F   | T   | T   |
| 304P   | Suite  | 6      | 700.00 | F   | F   | F   | F   | T   | T   | T   |

- (a) State the number of fields and records in this database table.

Fields .....

Records .....

[2]

- (b) State the reason why the `Type` field would **not** be suitable as a primary key.

.....

..... [1]





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(c) The database uses only the data types:

- alphanumeric
- character
- Boolean
- integer
- real
- date/time.

Complete the table to show the fields that could have the given data types.

Only **one** field name is required in each box and each field name must be different.

| Field | Data type    |
|-------|--------------|
|       | alphanumeric |
|       | Boolean      |
|       | real         |
|       | integer      |

[2]

(d) Give the output that would be produced by the structured query language (SQL) statement:

```
SELECT RoomNo, Type, Guests, Rate$  
  
FROM Booking28  
  
WHERE Mon <> T;
```

.....

.....

.....

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.....

.....

[3]





12 A one-dimensional (1D) array `Rooms[]` contains the names of up to 20 rooms in a house. A two-dimensional (2D) array `Dimensions[]` is used to store the length, width and area of each room.

The position of any room’s data is the same in both arrays. For example, the data in index 5 of `Dimensions[]` belongs to the room in index 5 of `Rooms[]`

The variable `Number` stores the number of rooms for which data is to be input. There must be at least 3 rooms but no more than 20.

Write a program that meets the following requirements:

- allows the number of rooms for which data is required to be input, stored and validated
- allows the name of the room and the length and width of the room, in metres, to be entered and stored
- allows the area of each room to be calculated as length multiplied by width and stored as square metres rounded to two decimal places
- calculates the average size of all the rooms by area, in square metres, rounded to two decimal places
- finds the largest room and smallest room by area
- outputs the names of all rooms with their dimensions and area
- outputs the names of the largest room and smallest room by area
- outputs the total area of the house and the average size of all the rooms by area.

You must use pseudocode or program code **and** add comments to explain how your code works.

You do **not** need to declare any arrays or variables; you may assume that this has already been done.

All inputs and outputs must contain suitable messages.

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