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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.

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[Turn over

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` ☐

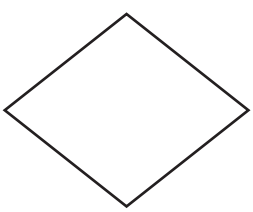
D `WHILE X <> -1 DO` ☐

[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]

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(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.

[6]

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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 .....

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Error 2 line number .....

Correction .....

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Error 3 line number .....

Correction .....

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Error 4 line number .....

Correction .....

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Error 5 line number .....

Correction .....

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[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.

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..... [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.

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..... [3]

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

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..... [2]

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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 ← Value
        FOR Count ← Value - 1 TO 1 STEP -1
            Answer ← 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

[5]

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(b) State the purpose of this algorithm.

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

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..... [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 .....

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Test data 2 .....

Reason for choice .....

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[4]

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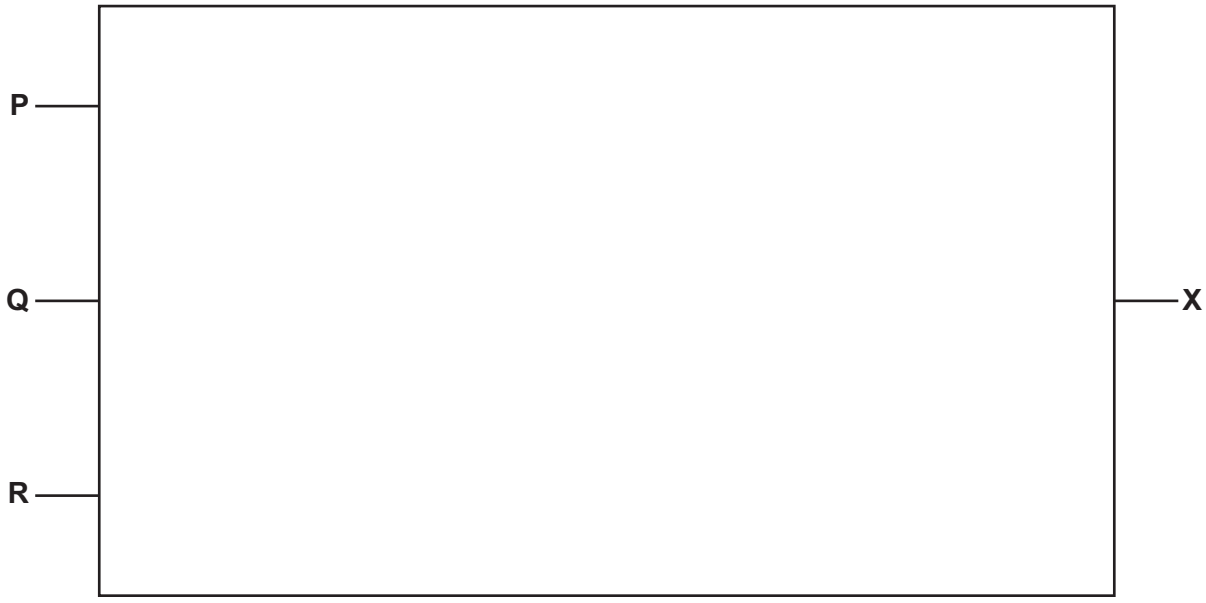
9 Consider the logic expression:

X = (NOT **P** OR **Q**) NAND (**Q** 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		

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10 The function `LENGTH(X)` calculates the length of a string `X`

Write the pseudocode statements to:

- allow a line of text to be input to an appropriate variable
- store this line of text in a text file called `Main.txt`
- calculate the length of the line of text and output the text in lower case along with its length
- store the lower-case line of text in a text file called `Lowercase.txt`

Make sure that any variables used are declared and that both text files are closed after they have been used.

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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.

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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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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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