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COMPUTER SCIENCE **0478/22**

Paper 2 Algorithms, Programming and Logic **May/June 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 identify a method used to design and construct a solution to a computing problem.

A analysis ☐

B coding ☐

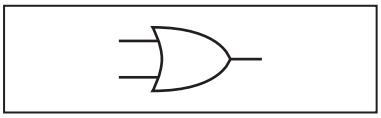
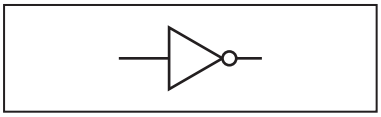
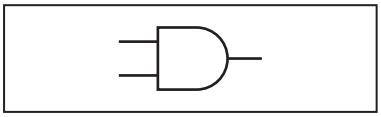
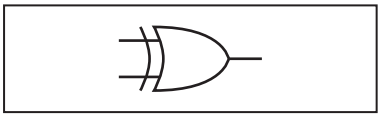
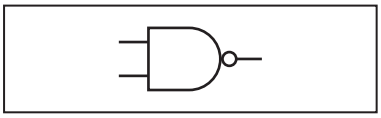
C flowchart ☐

D testing ☐

[1]

2 **Four** logic functions and **five** standard symbols for logic gates are shown.

Draw **one** line to link each logic function to its standard symbol. **Not** all standard symbols will be used.

Logic function	Standard symbol
AND	
XOR	
NAND	
OR	
	

[4]

3 Identify **three** different tasks in the analysis stage of the program development life cycle.

1 .....

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2 .....

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3 .....

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[3]

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4 A program needs to make sure the characters input for a product code meet these rules:

- The product code is six characters in length.
- The first two characters must be "PD".
- The last four characters must be a number in the range 1000 to 9999 inclusive.

(a) Identify **three** validation checks and state how each check would make sure the product code met one of these rules.

Check 1 .....

.....

.....

Check 2 .....

.....

.....

Check 3 .....

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..... [6]

(b) The program design will include a pseudocode algorithm. Assume that the product code is stored in the variable `Product`

(i) Write the pseudocode to make sure that the product code is six characters in length.

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..... [2]

(ii) Write the pseudocode to make sure that the first two characters of the product code are "PD".

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..... [2]

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5 A high-level programming language makes use of arithmetic, Boolean and logical operators.

State how each type of operator is used.
Give an example statement, in pseudocode, for each one.

Arithmetic .....

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Example .....

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Boolean .....

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Example .....

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Logical .....

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Example .....

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[6]

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6 Totalling and counting are standard methods of solution.

Numbers are input. The number 9999.9 is the last number to be input and is ignored.

(a) Write an algorithm in pseudocode to total the numbers input and to output the total. You do **not** need to validate the input.

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..... [4]

(b) Write an algorithm in pseudocode to count and output the number of input values that are greater than 100. You do **not** need to validate the input.

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7 An algorithm has been written in pseudocode to find and display the maximum and minimum values in an array of 1000 positive numbers. The array `List[]` starts at index `1`

```
01 Max ← List[1]
02 Min ← List[1]
03 FOR Counter ← 2 TO 1000
04     IF List[Counter] < Max
05       THEN
06         Max ← List[Counter]
07     ENDIF
08     IF List[Count] < Min
09       THEN
10         Min ← List[Counter]
11     ENDWHILE
12 NEXT Counter
13 OUTPUT "Maximum value is ", Max
14 OUTPUT "Minimum value is ", Min
```

(a) Give a line number for each of these types of statement:

Assignment statement .....

Selection statement .....

Iteration statement .....

[3]

(b) Identify the line numbers of the **three** 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 .....

.....

[3]

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8 A logic circuit is to be built to control the opening of a safe used to store money. There are two keys, **A** and **B**, and a time switch **C**. The safe can only open if both keys are used and the time switch is off.

key **A**	not used	0
	used	1
key **B**	not used	0
	used	1
time switch **C**	switch off	0
	switch on	1
safe **X**	safe cannot open	0
	safe can open	1

(a) Write the logic expression for this problem.

..... [3]

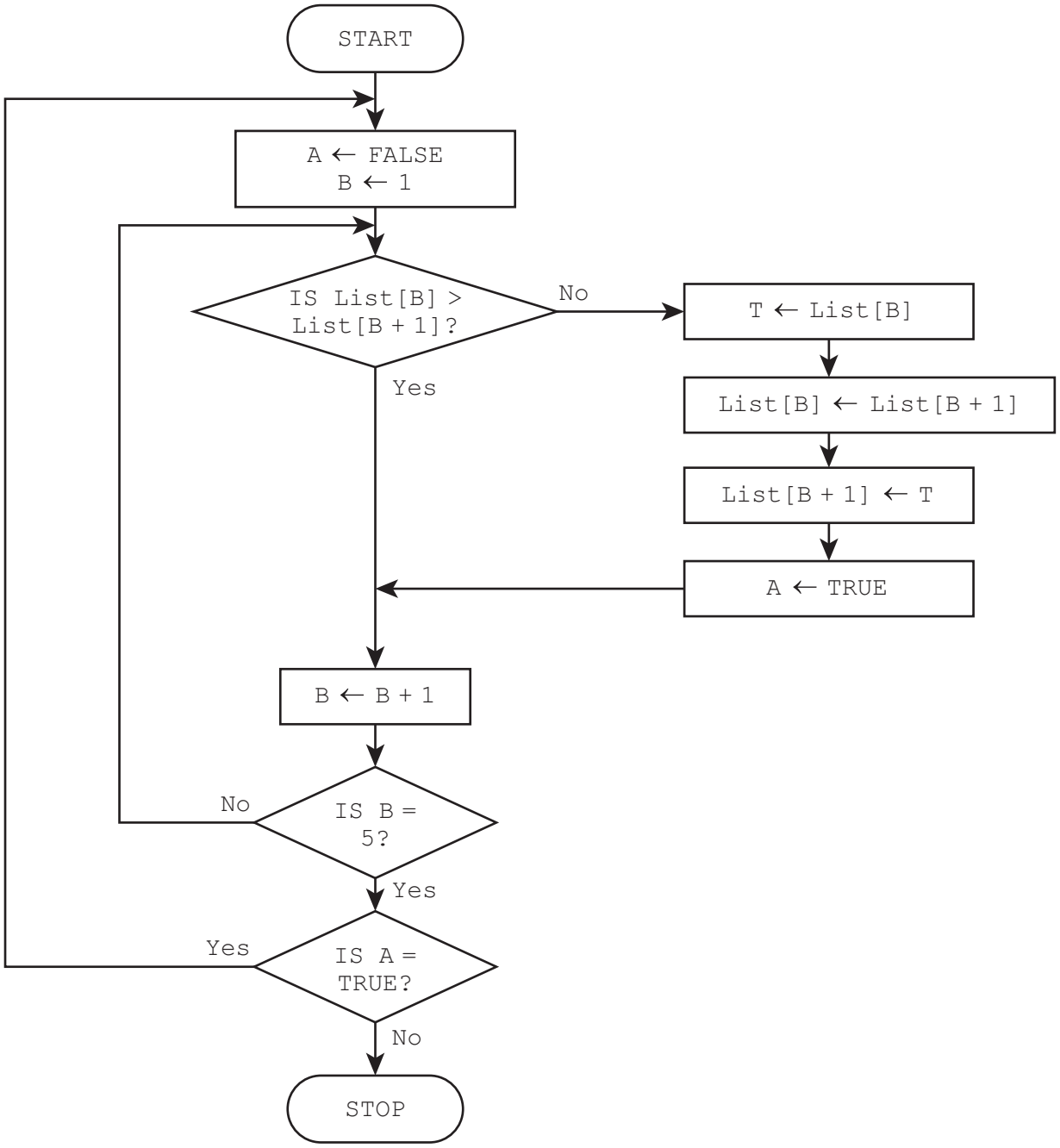
(b) Complete the truth table for this problem.

A	B	C	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]

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9 This flowchart represents an algorithm.



(a) The array `List[1:5]` used in the flowchart contains this data:

List[1]	List[2]	List[3]	List[4]	List[5]
15	17	20	5	9

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Complete the trace table using the data given in the array.

A	B	List[1]	List[2]	List[3]	List[4]	List[5]	T
		15	17	20	5	9	

[5]

(b) Describe what the algorithm represented by the flowchart is doing.

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10 A television subscription service has a new database table named `Contract` to store details of their subscribers' contracts. The table contains these fields:

- `ContractNumber` – the contract number, for example CT567
- `Months` – the length of the contract in months, for example 6
- `EndDate` – the date the contract finishes, for example 30 November 2024
- `News` – the news service, yes or no
- `Movie` – the movie service, yes or no
- `Sport` – the sports service, yes or no
- `Junior` – the children's service, yes or no.

(a) Identify the field that will be the most appropriate primary key for this table.

..... [1]

(b) Complete the table to identify the most appropriate data type for these fields in `Contract`

Field	Data type
`ContractNumber`	
`Months`	
`EndDate`	
`Sport`	

[2]

(c) Explain the purpose of these structured query language (SQL) statements.

Statement 1: `SELECT SUM (Months) FROM Contract;`

Statement 2: `SELECT COUNT (News) FROM Contract WHERE News;`

Statement 1 .....

.....

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Statement 2 .....

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[3]

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(d) Complete this SQL statement to find the contract numbers of the subscribers that take both the news and sports services.

```
SELECT .....

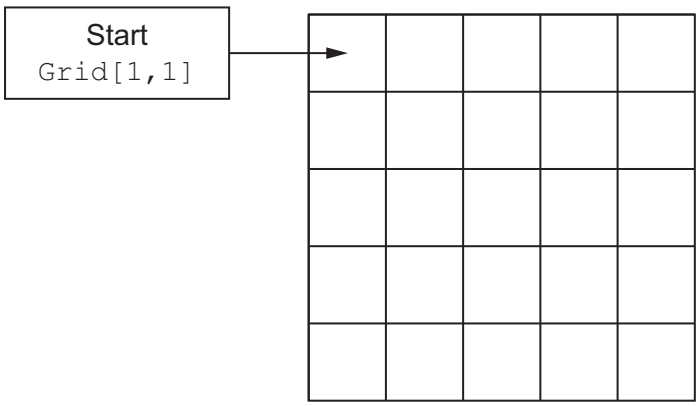
FROM Contract

WHERE ..... AND ..... ;
```

[2]

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11 A one-player game uses the two-dimensional (2D) array `Grid[]` to store the location of a secret cell to be found by the player in 10 moves. Each row and column has 5 cells.



At the start of the game:

- The program places an 'X' in a random cell (**not** in `Grid[1,1]`) and empties all the other cells in the grid.
- The player starts at the top left of the grid.
- The player has 10 moves.

During the game:

- The player can move left, right, up or down by one cell and the move must be within the grid.
- "You Win" is displayed if the player moves to the cell with 'X' and has played 10 moves or less.
- "You Lose" is displayed if the player has made 10 moves without finding the 'X'.

Write a program that meets these requirements.

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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[15]

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