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COMPUTER SCIENCE **0478/21**

Paper 2 Algorithms, Programming and Logic **May/June 2025**

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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1 Tick (✓) **one** box to identify the type of test to only check for the largest or smallest acceptable value.

A normal test data ☐

B abnormal test data ☐

C extreme test data ☐

D boundary test data ☐

[1]

2 **Four** requirements for validating inputs and **five** types of validation check are given.

(a) Draw **one** line from each requirement to the most appropriate validation check.
Not all validation checks will be used.

Requirement	Validation check
Date of birth must be between 01/01/1900 and 01/01/2010.	length check
Name has been entered.	format check
Password has exactly 12 characters.	range check
Student ID must contain 2 letters followed by a 4-digit number.	check digit
	presence check

[4]

(b) Identify and describe **one** verification check that could be applied when a new password is input into a system.

Verification check .....

Description .....

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[3]

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3 The following pseudocode algorithm uses a count-controlled loop to read in 10 names and store them in the array `Names[]`

```
FOR Count ← 1 TO 10
    OUTPUT "Please enter a name"
    INPUT Name
    Names[Count] ← Name
NEXT Count
```

Rewrite the algorithm in pseudocode, using a condition-controlled loop instead of a count-controlled loop.

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4 A telephone number with 13 characters is input. The first character is a '+', followed by a 2-digit country code, for example:

+20xxxxxxxxx where 20 is the country code and x is a digit between 0 and 9 inclusive.

The algorithm includes checks for the country codes: 44 for the UK and 20 for Egypt.

(a) Write an algorithm using pseudocode to:

- input the telephone number
- extract the 2-digit country code
- output the matching country
- output 'Unknown' if there is no matching country.

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(b) Explain how you could change the algorithm to repeatedly prompt for the telephone number until the number entered is 13 characters in length.

Any code used must be fully explained.

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..... [3]

5 Two library routines used in programming are MOD and DIV.

State the purpose of each of the library routines.
Give **one** example pseudocode statement for each of the library routines.

MOD purpose .....

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Example pseudocode .....

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DIV purpose .....

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Example pseudocode .....

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[4]

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6 An algorithm has been written in pseudocode to generate a random integer between 1 and 100 inclusive and store the value in `N`. The user enters a guess for the number and the algorithm indicates whether the guess is higher or lower than the random number. The algorithm outputs the number of guesses when the user has correctly guessed the random number.

```
01 Counter ← 0
02 N ← ROUND(RANDOM() * 99, 1) + 1
03 REPEAT
04     OUTPUT "Please enter a guess"
05     INPUT G
06     IF G > N
07       THEN
08         OUTPUT "The number is lower than your guess"
09       ELSE
10         IF G < N
11           THEN
12             OUTPUT "The number is lower than your guess"
13         ENDIF
14       Counter ← Counter + 1
15     ENDIF
16 UNTIL G = N
17 OUTPUT "Well done, you took ", Guess, " attempts"
```

(a) Identify the line numbers of the **four** 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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[4]

(b) Identify **one** method to make the algorithm maintainable.
Give an example.

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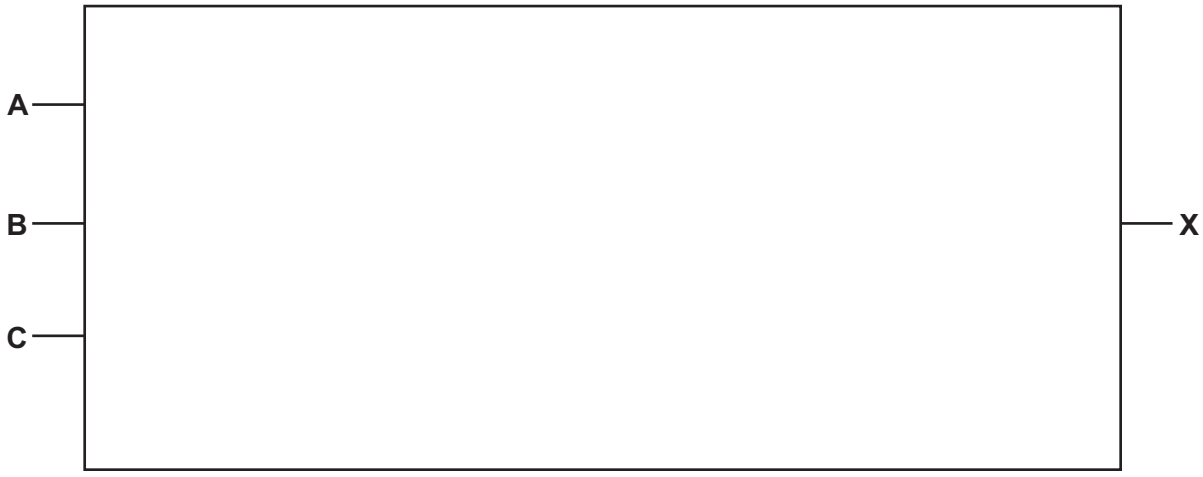
7 Consider the logic expression:

X = (**A** AND **B**) XOR (**B** OR NOT **C**)

(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.

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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8 A bus company has set up a new database table called `BUS` to store details of the buses leaving the main bus terminal.

RouteID	Destination	Stops	Driver	Time	Return
BC01	Town Centre	10	B Smith	9:00	Yes
BC02	The Fountain	5	A Patel	9:10	Yes
BC03	The Palace	9	B Hayes	9:28	No
BC04	City Park	12	W Gao	9:55	Yes
BC05	City Mall	9	R Hussein	10:10	No
BC06	Swan Lake	14	S Clarke	10:33	No
BC07	Guildhall Square	7	J Page	11:34	No
BC08	Sunset Quay	6	A Patel	12:01	Yes
BC10	Fort Worthington	15	E Carr	12:01	Yes
BC12	The Observatory	18	B Smith	13:27	No
BC14	East Seaport	11	B Scott	14:07	No
BC15	The Football Ground	12	J Page	14:46	Yes
BC19	The Cricket Ground	11	B Hayes	15:14	No
BC23	Temple Ruins	14	W Gao	16:16	No
BC27	The University	9	A Patel	16:45	No

(a) (i) Identify **one** appropriate data type for the field `Return`

..... [1]

(ii) State the reason for the data type chosen.

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..... [1]

(b) Write the output from the structured query language (SQL) statement:

```
SELECT RouteID, Destination, Time
FROM BUS
WHERE Driver = "A Patel";
```

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..... [2]

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(c) Complete the SQL statement to display only the destination of the buses that have a return.

```
SELECT .....
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..... [3]
```

9 The variables `A` and `B` are used in a program. `A` holds a whole number and `B` holds text.

(a) Write pseudocode statements to declare the variables `A` and `B`

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..... [2]

(b) The function `Odds(X)` returns 'Odd' if the value of `X` is an odd number and returns 'Even' if the value of `X` is an even number.

Write pseudocode statements to:

- define the function
- call the function using parameter `A` and store the return item in variable `B`

Function definition .....

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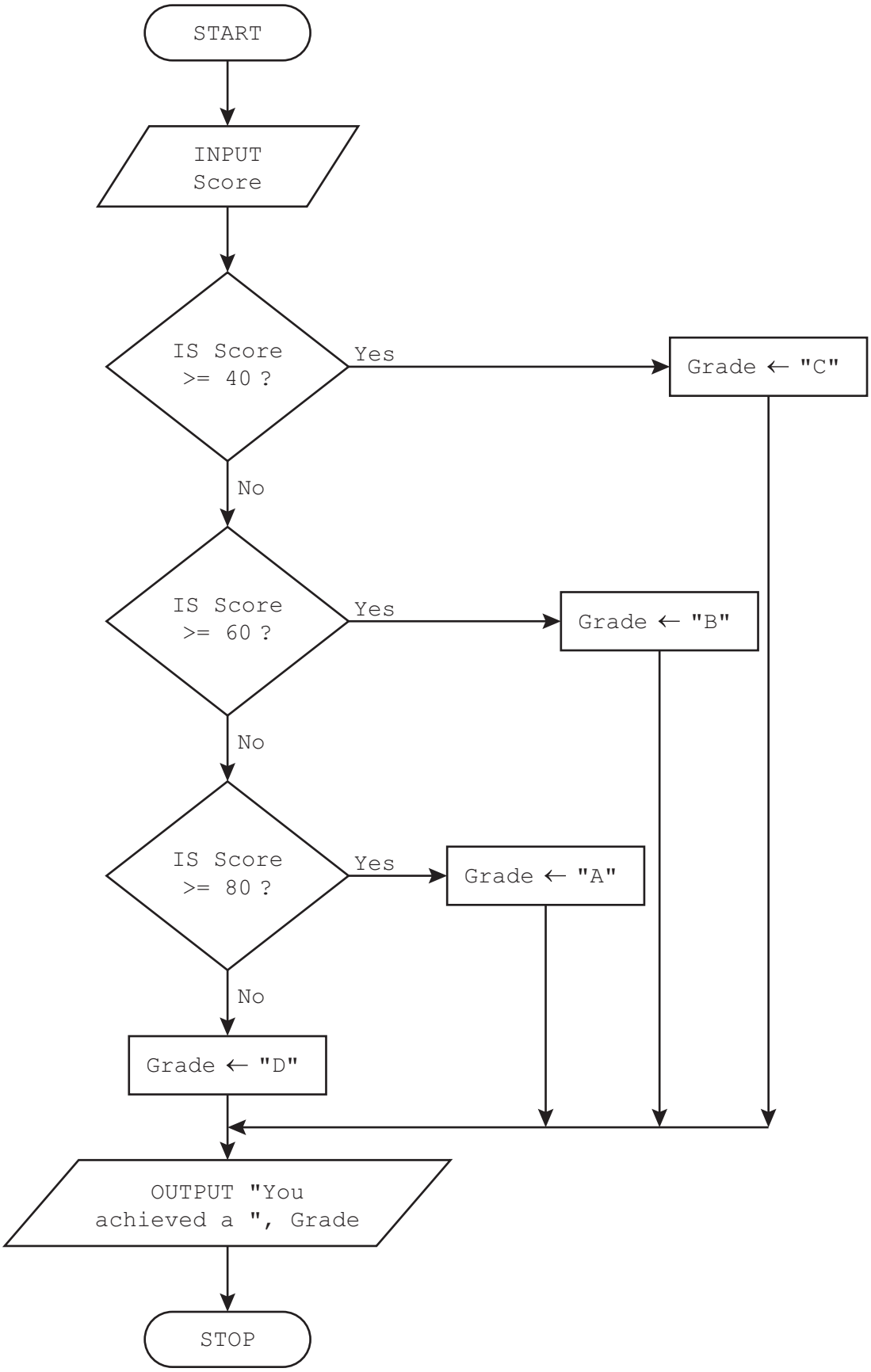
Function call .....

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[6]

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10 The flowchart represents an algorithm to calculate grades.



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(a) Complete the trace table for the algorithm, using the input data:

21, 46, 63, 91, 12

Score	Grade	OUTPUT

[3]

(b) Explain how the flowchart can be changed to produce the correct output.

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11 The one-dimensional (1D) array `CompetitorName[]` contains the names of 25 competitors in a tournament that includes five events.

Another two-dimensional (2D) array `CompetitorScore[]` contains the points scored by each competitor in the five events. The first dimension of this array contains the index of the competitor from `CompetitorName[]` and the second dimension contains their scores.

Each competitor receives a score out of 100 for each event. These scores are manually entered into `CompetitorScore[]`

Medals are awarded to the competitor or the competitors who have:

- the highest points scored in each of the five events
- the highest total points scored for all five events.

The one-dimensional (1D) array `Points[]` stores the total number of points scored for each competitor.

Write a program that meets the following requirements:

- takes as input, valid scores (between 0 and 100), for each competitor in each of the five events
- calculates the highest points scored for each event
- outputs the names of the competitors who receive a medal for the highest points scored
- calculates the highest total points scored for the five events
- outputs the names of the competitors with the highest total points scored for the five events.

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.

All inputs and outputs must contain suitable messages.

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