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4816020701

COMPUTER SCIENCE **0478/21**

Paper 2 Algorithms, Programming and Logic **May/June 2023**

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 **(a)** **Four** descriptions of stages in the program development life cycle are shown.

Draw **one** line to link each description to its most appropriate program development life cycle stage.

Not all program development life cycle stages will be used.

Program development life cycle description	Program development life cycle stage
develop an algorithm to solve the problem by using structure diagrams, flowcharts or pseudocode	analysis
detect and fix the errors in the program	coding
identify the problem and its requirements	design
write and implement the instructions to solve the problem	evaluation
	testing

[4]

(b) Identify **three** of the component parts after a problem has been decomposed.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

2 Tick (✓) **one** box to show the name of the data structure used to store a collection of data of the same data type.

A Array ☐

B Constant ☐

C Function ☐

D Variable ☐

[1]

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3 **(a)** Describe what is meant by data validation.

.....

.....

.....

..... [2]

(b) A validation check is used to make sure that any value that is input is an integer between 30 and 200 inclusive.

Give **one** example of each type of test data to check that the validation check is working as intended. Each example of test data must be different.

Give a reason for each of your choices of test data.

Normal test data .....

Reason .....

.....

Abnormal test data .....

Reason .....

.....

Extreme test data .....

Reason .....

.....

[6]

4 Explain the purpose of the library routines `DIV` and `ROUND`

`DIV` .....

.....

.....

.....

`ROUND` .....

.....

.....

.....

[4]

5 An algorithm has been written in pseudocode to allow some numbers to be input. All the positive numbers that are input are totalled and this total is output at the end.
An input of `0` stops the algorithm.

```
01 Exit ← 1
02 WHILE Exit <> 0 DO
03     INPUT Number
04     IF Number < 0
05       THEN
06         Total ← Total + Number
07       ELSE
08         IF Number = 0
09           THEN
10             Exit ← 1
11         ENDIF
12     ENDIF
13 ENDIF
14 OUTPUT "The total value of your numbers is ", Number
```

(a) Identify the **four** errors in the pseudocode and suggest a correction for each error.

Error 1 .....

Correction .....

.....

Error 2 .....

Correction .....

.....

Error 3 .....

Correction .....

.....

Error 4 .....

Correction .....

.....

[4]

(b) Describe how you could change the corrected algorithm to record and output how many positive numbers have been included in the final total.

You do **not** need to rewrite the algorithm.

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..... [4]

6 State **two** features that should be included to create a maintainable program.

Give a reason why each feature should be used.

1 .....

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2 .....

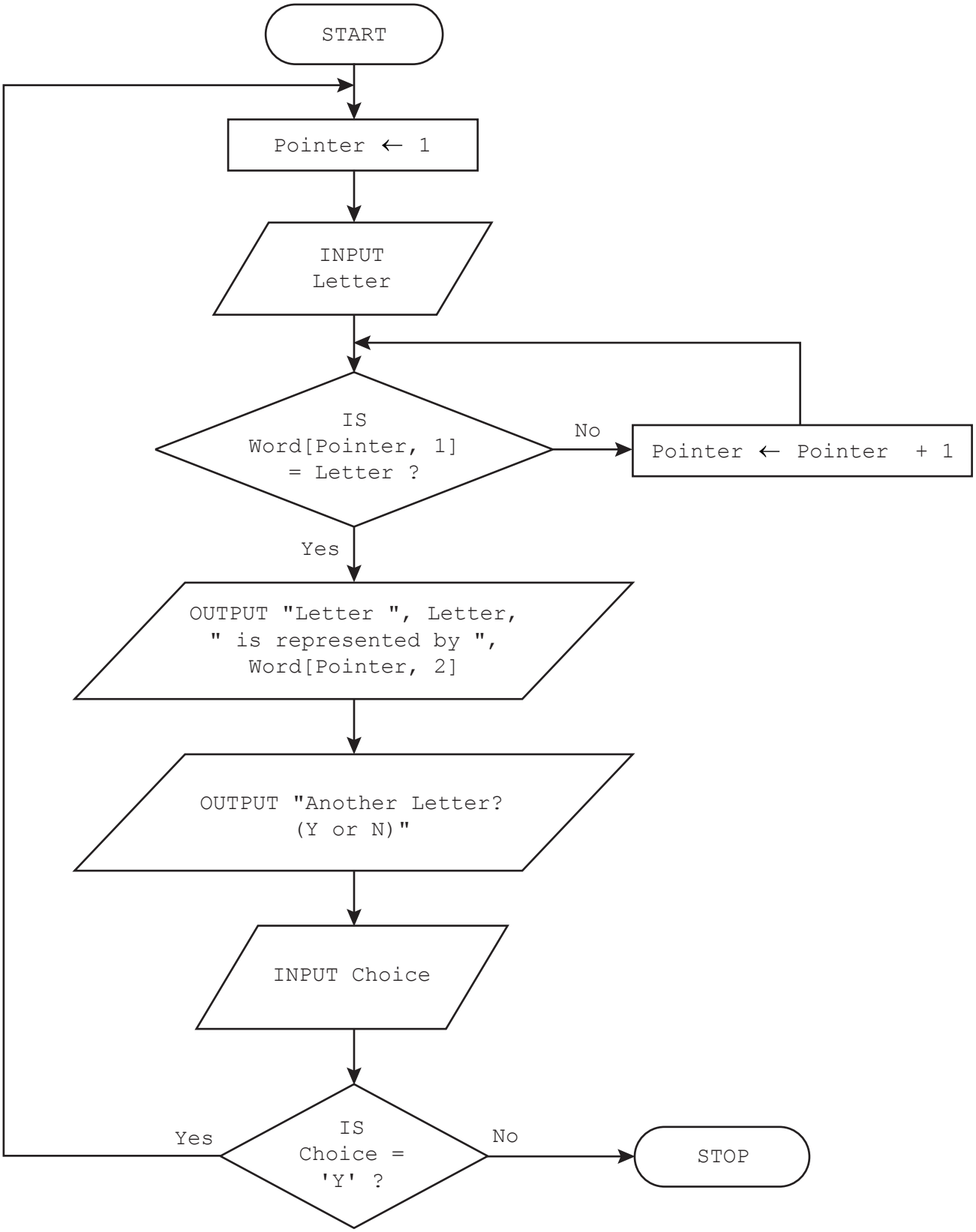
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[4]

7 The flowchart represents an algorithm.



The table represents the two-dimensional (2D) array `Word[]` which stores the first half of the phonetic alphabet used for radio transmission. For example, `Word[10,1]` is 'J'.

Index	1	2
1	A	Alpha
2	B	Bravo
3	C	Charlie
4	D	Delta
5	E	Echo
6	F	Foxtrot
7	G	Golf
8	H	Hotel
9	I	India
10	J	Juliet
11	K	Kilo
12	L	Lima
13	M	Mike

(a) Complete the trace table for the algorithm by using the input data: F, Y, D, N

Pointer	Letter	Choice	OUTPUT

[4]

(b) Identify the type of algorithm used.

.....

..... [1]

(c) Describe **one** problem that could occur with this algorithm if an invalid character was input.

.....

.....

.....

..... [2]

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8 The function `LENGTH(Phrase)` calculates the length of a string `Phrase`

(a) Write the pseudocode statements to:

- store the string `"The beginning is the most important part"` in `Phrase`
- calculate and output the length of the string
- output the string in upper case.

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..... [3]

(b) Write the output your pseudocode should produce.

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..... [2]

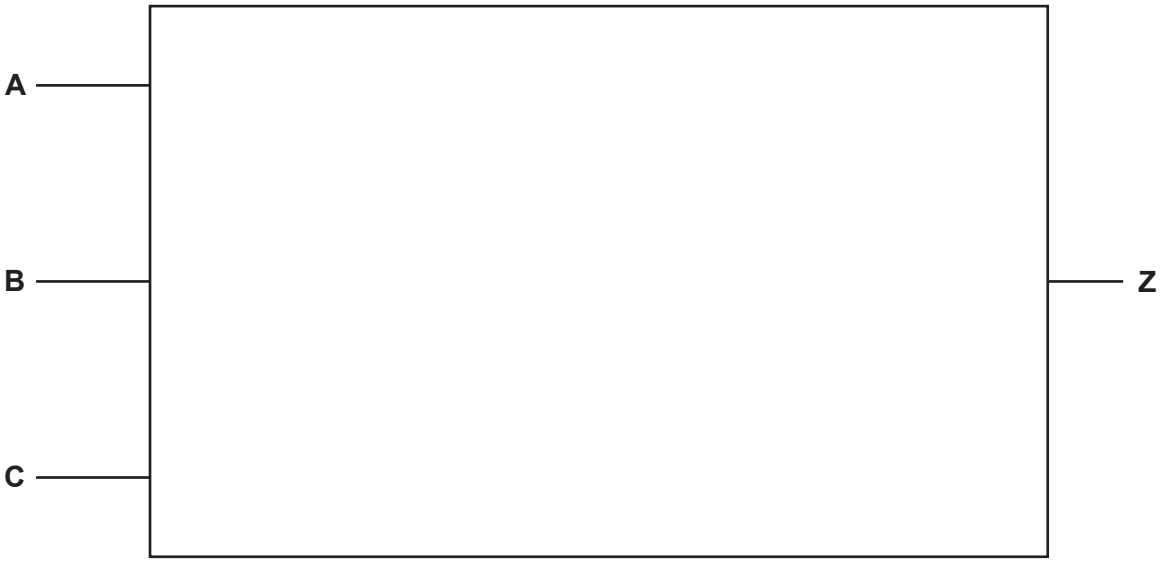
9 Consider this logic expression.

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

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

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

Do **not** simplify this logic expression.



[4]

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

A	B	C	Working space	Z
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]

10 A database table called `TVRange` shows the main features and prices of a range of televisions.

TVCode	ScreenSize	Satellite	SmartTV	SoundBar	Price$
TV90SaSmSd	90	YES	YES	YES	9750.00
TV75SaSmSd	75	YES	YES	YES	8500.00
TV75SaSd	75	YES	NO	YES	8000.00
TV65SaSmSd	65	YES	YES	YES	6000.00
TV65SmSd	65	NO	YES	YES	5000.00
TV65SaSd	65	YES	NO	YES	5000.00
TV55SaSmSd	55	YES	YES	YES	4000.00
TV55SaSd	55	YES	NO	YES	3500.00
TV55SmSd	55	NO	YES	YES	3500.00
TV50SaSmSd	50	YES	YES	YES	2500.00
TV50Sa	50	YES	NO	NO	1750.00
TV50Sm	50	NO	YES	NO	1750.00
TV40Sa	40	YES	NO	NO	1200.00
TV40	40	NO	NO	NO	950.00
TV32	32	NO	NO	NO	650.00

(a) Give the name of the field that is most suitable to be the primary key.

State the reason for this choice.

Field .....

Reason .....

.....

[2]

(b) The database uses the data types:

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

Complete the table to show the most appropriate data type for each field.
Each data type must be different.

Field	Data type
TVCode	
ScreenSize	
SmartTV	
Price$	

[2]

(c) Complete the structured query language (SQL) query to return the television (TV) code, screen size and price of all Smart TVs in the database table.

```
SELECT TVCode, ....., .....

..... TVRange

WHERE SmartTV = .....;
```

[4]

11 A one-dimensional (1D) array `Days[]` contains the names of the days of the week. A two-dimensional (2D) array `Readings[]` is used to store 24 temperature readings, taken once an hour, for each of the seven days of the week. A 1D array `AverageTemp[]` is used to store the average temperature for each day of the week.

The position of any day's data is the same in all three arrays. For example, if Wednesday is in index 4 of `Days[]`, Wednesday's temperature readings are in index 4 of `Readings[]` and Wednesday's average temperature is in index 4 of `AverageTemp[]`

The temperature readings are in Celsius to one decimal place. Temperatures can only be from –20.0 °C to +50.0 °C inclusive.

Write a program that meets the following requirements:

- input and validate the hourly temperatures for one week
- calculate and store the average temperature for each day of the week
- calculate the average temperature for the whole week
- convert all the average temperatures from Celsius to Fahrenheit by using the formula Fahrenheit = Celsius * 9 / 5 + 32
- output the average temperature in Celsius and in Fahrenheit for each day
- output the overall average temperature in Celsius and in Fahrenheit for the whole week.

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

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

All inputs and outputs must contain suitable messages.

All data output must be rounded to one decimal place.

You will need to initialise and populate the array `Days[]` at the start of the program.

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