Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMPUTER SCIENCE **2210/22**

Paper 2 Algorithms, Programming and Logic **October/November 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.

[Turn over

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

The result of the arithmetic operation 4 ^ 2 is

A 2 ☐

B 8 ☐

C 16 ☐

D 42 ☐

[1]

2 This pseudocode algorithm is intended to input a first name from a user and search for it in a two-dimensional (2D) array. If the name is found, the algorithm outputs all the remaining details for that name. The algorithm will continue to allow other names to be entered for searching, until the user input stops it.

```
01 DECLARE Contacts : ARRAY[1:500, 1:4] OF REAL
02 DECLARE Row : INTEGER
03 DECLARE Column : INTEGER
04 DECLARE Continue : BOOLEAN
05 DECLARE Stop : BOOLEAN
06 DECLARE FirstName : STRING
07 Continue ← TRUE
08 Stop ← FALSE
09 WHILE Continue
10     Row ← 1
11     OUTPUT "Enter a first name "
12     OUTPUT FirstName
13     REPEAT
14         IF Contacts[Row, 1] = FirstName
15           THEN
16             FOR Column ← 1 TO 4
17                 OUTPUT Contacts[Row, 1]
18             NEXT Column
19             Stop ← TRUE
20           ELSE
21             Row ← Row + 1
22         ENDIF
23     NEXT Stop OR Row > 500
24     OUTPUT "Search for another name? (Y or N)"
25     INPUT Answer
26     IF Answer = 'N' OR Answer = 'n'
27       THEN
28         Continue ← TRUE
29     ENDIF
30 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 procedure `NewData` allows data for new contacts to be entered and stored in the 2D array `Contacts[]`. A parameter, `Number`, is used to pass values from the main algorithm to the procedure for the number of new contacts. Next, four pieces of contact data for each new contact are entered and stored at the start of the array.

(i) Complete the pseudocode for `PROCEDURE NewData`

```
PROCEDURE NewData(.....)
    FOR Row ← 1 TO .....
        FOR Column ← 1 TO 4
            INPUT .....
            .....
        .....
ENDPROCEDURE
```

[4]

(ii) Write the pseudocode to input the number of new contacts and to use procedure `NewData`. A variable declaration is **not** required.

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..... [2]

(c) A first name is used as the search key in the algorithm on page 2. If the name is found, all the data for that name is output and the algorithm stops searching.

(i) Explain why the given algorithm may **not** always give the expected results.

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..... [2]

(ii) Explain how you could improve the algorithm so that the search is more likely to find the required results.

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..... [2]

3 A program is written that will only accept values between –99.99 and +99.99, inclusive.
The program is to be tested.

The table, when completed, shows appropriate test data that matches the type of test data and purpose of the test data.

Complete the table by inserting the missing information.

Test data	Type of test data	Purpose of test data
0		....
	boundary	....
		to make sure that the program rejects data that is outside acceptable limits

[6]

4 **(a)** A length check is a type of validation check.

State the purpose of a length check.

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..... [1]

(b) An email address can be validated by checking that it contains an @ symbol.

Write the pseudocode for an algorithm that will allow an email address to be input and check whether or not it contains an @ symbol.

Output a suitable message with the result.

Use the string function `SUBSTRING(EmailAddress, Start, 1)` in your solution to return a string of length 1 character, starting at position `Start`, where `EmailAddress` is the identifier representing your input.

You do **not** need to declare any variables for this algorithm, but variables must be initialised as necessary. Assume there will **not** be more than **one** @ symbol in the email address input.

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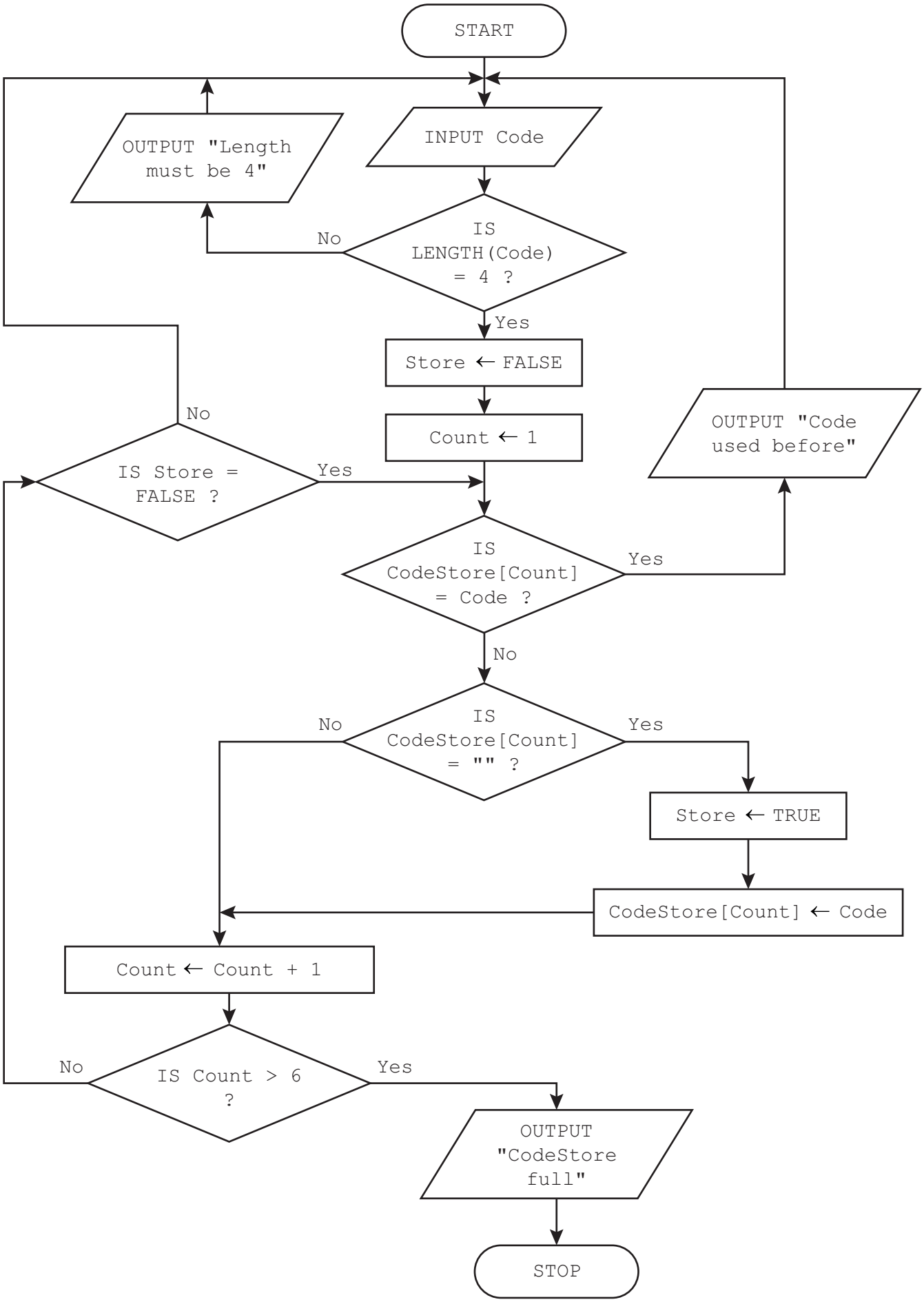
..... [6]

5 This flowchart represents an algorithm.



(a) The first data row of the trace table shows the values currently stored in `CodeStore[]`

Complete the trace table for the algorithm, using the input data:

7686, Face, Speed, 432U, Yp79

			CodeStore[]						
Code	**Store**	**Count**	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**OUTPUT**
			aBcd	1532	Face	63q8			

[6]

(b) Describe the processes in the algorithm on page 6.

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..... [3]

(c) The algorithm on page 6 requires the array `CodeStore[]` to be declared as a one-dimensional (1D) string array with six elements that are initially set to the null string `""`.

Write the pseudocode required to declare and initialise the array `CodeStore[]`
You do need to declare any variables used.

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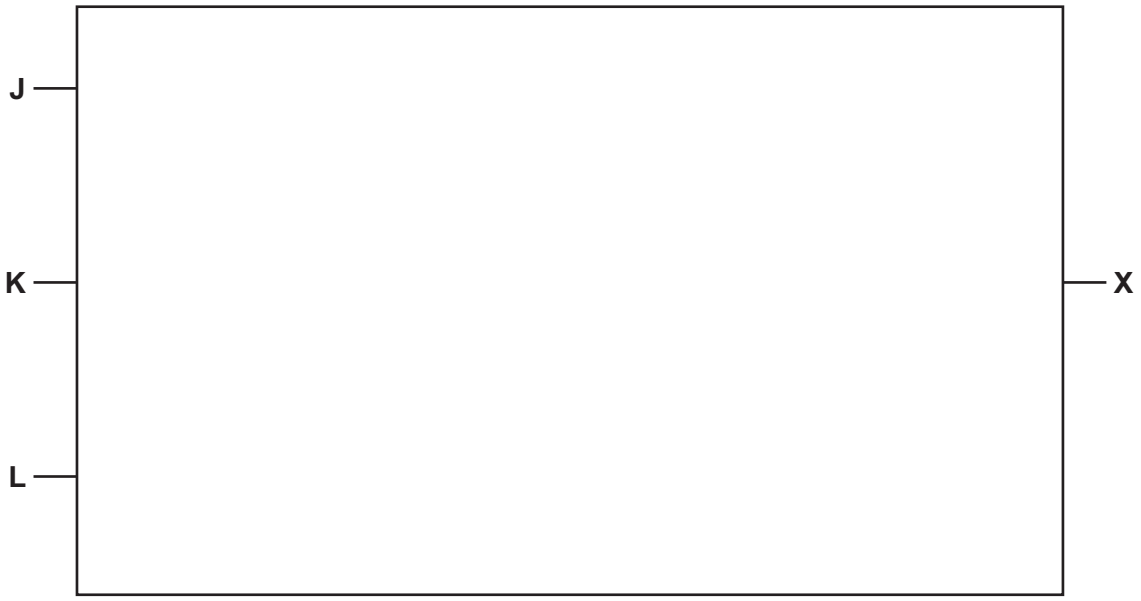
..... [4]

6 Consider the logic expression:

X = (**J** XOR NOT **K**) NAND NOT **L**

(a) Draw a logic circuit for the 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.

J	K	L	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]

7 A database table `WATERFOWL` stores some details of a range of birds found in the UK that live on or near water. The length and wingspan dimensions are in centimetres and the typical lifespan is in years.

Species	Family	Length	Wingspan	CoastalHabitat	Lifespan
Barnacle goose	Goose	63.5	130.0	FALSE	14
Bewick's swan	Swan	120.2	190.5	TRUE	8
Brent goose	Goose	58.0	94.3	TRUE	11
Canada goose	Goose	78.5	160.0	FALSE	6
Eider	Duck	58.0	94.5	TRUE	8
Goldeneye	Duck	44.5	72.1	TRUE	6
Goosander	Duck	63.3	90.0	TRUE	7
Long-tailed duck	Duck	44.0	76.6	TRUE	5
Mallard	Duck	59.7	90.8	FALSE	3
Mute swan	Swan	150.0	220.2	FALSE	10
Pink-footed goose	Goose	69.6	150.0	TRUE	8
Pintail	Duck	60.0	88.6	TRUE	3
Smew	Duck	41.5	62.1	FALSE	7
White-fronted goose	Goose	71.5	140.0	FALSE	6
Whooper swan	Swan	150.0	230.0	TRUE	9

(a) State the purpose of a primary key in a database table.

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..... [1]

(b) Complete the table for each of the given data types, to identify **one** field from the table `WATERFOWL` that is most likely to use it.

Each field must be different.

Data type	Field
Boolean	
Integer	
Real	
Text	

[2]

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

```
SELECT Species, Length, Wingspan
FROM WATERFOWL
WHERE Family = "Swan"
ORDER BY Lifespan;
```

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..... [3]

(d) Complete the SQL statement to list only the species, family and lifespan of all waterfowl whose typical lifespan is at least 10 years, sorted in order of species.

SELECT .....

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..... [4]

8 A program is required to test the fairness of the random number generator.

The one-dimensional (1D) array `RandomNumber[]` is used to store 100 000 random integers.

The two-dimensional (2D) array `CountedNumber[]` is used to store the integers 1 to 10, inclusive, and the frequency of each integer (the number of times each integer was generated).

Write a program that meets the following requirements:

- Generate 100 000 random integers between 1 and 10, inclusive.
- Store each integer in the appropriate array.
- Calculate the frequency of each of the integers 1 to 10 and store these values in the appropriate array.
- Sort the contents of the counted number array in **descending order** of frequency.
- Calculate the chance of generating each of the integers 1 to 10, rounded to four decimal places.
  Use the formula: chance = frequency / 100000
- Output each of the integers 1 to 10 in the order they are stored in the counted number array, along with the chance of generating them.

The following is an example of an algorithm that sorts a 2D array in an ascending order:

```
F ← TRUE
WHILE F DO
    F ← FALSE
    FOR I ← 1 TO 9
        IF A[I, 2] > A[I + 1, 2]
          THEN
            T1 ← A[I, 1]
            T2 ← A[I, 2]
            A[I, 1] ← A[I + 1, 1]
            A[I, 2] ← A[I + 1, 2]
            A[I + 1, 1] ← T1
            A[I + 1, 2] ← T2
            F ← TRUE
        ENDIF
    NEXT I
ENDWHILE
```

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

All arrays, variables or constants used must be declared for this algorithm.

All inputs and outputs must contain suitable messages.

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[15]

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