Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3013807674

COMPUTER SCIENCE **9618/22**

Paper 2 Fundamental Problem-solving and Programming Skills **May/June 2021**

2 hours

You must answer on the question paper.

You will need: Insert (enclosed)

INSTRUCTIONS

- Answer **all** questions
- Use a black or dark blue pen.
- 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.
- You may use an HB pencil for any diagrams, graphs or rough working.
- 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.
- The insert contains all the resources referred to in the questions.

This document has **16** pages. Any blank pages are indicated.

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Refer to the **insert** for the list of pseudocode functions and operators.

1 (a) (i) Complete the following table by giving the appropriate data type in each case.

Variable	Example data value	Data type
`Name`	`"Catherine"`	
`Index`	`100`	
`Modified`	`FALSE`	
`Holiday`	`25/12/2020`	

[4]

(ii) Evaluate each expression in the following table by using the initial data values shown in **part (a)(i)**.

Expression	Evaluates to
`Modified OR Index > 100`	
`LENGTH("Student: " & Name)`	
`INT(Index + 2.9)`	
`MID(Name, 1, 3)`	

[4]

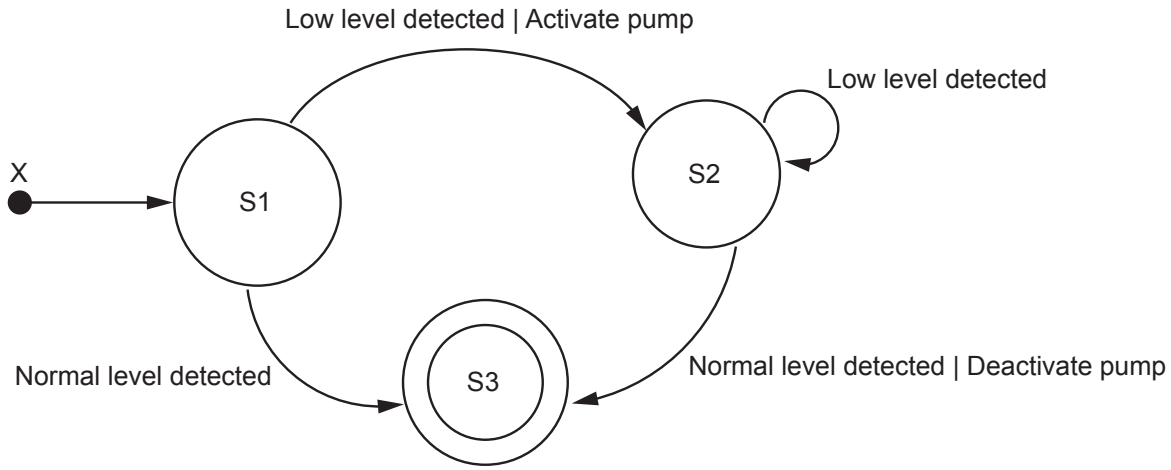
(b) Each pseudocode statement in the following table contains an example of selection, assignment or iteration.

Put **one** tick (‘✓’) in the appropriate column for each statement.

Statement	Selection	Assignment	Iteration
`Index ← Index + 1`			
`IF Modified = TRUE THEN`			
`ENDWHILE`			

[3]

2 **(a)** Examine the following state-transition diagram.



(i) Complete the table with reference to the diagram.

	Answer
The number of transitions that result in a different state	
The number of transitions with associated outputs	
The label that should replace 'X'	
The final or halting state	

[4]

(ii) The current state is S1. The following inputs occur.

1. Low level detected
2. Low level detected
3. Low level detected
4. Low level detected

Give the number of outputs and the current state.

Number of outputs .....

Current state .....

[2]

(b) A system is being developed to help manage book loans in a library.

Registered users may borrow books from the library for a period of time.

(i) State **three** items of data that must be stored for each loan.

1 .....

2 .....

3 .....
[2]

(ii) State **one** item of data that will be required in the library system but does not need to be stored for each loan.

..... [1]

(iii) One operation that manipulates the data stored for each loan, would produce a list of all overdue books.

Identify **two other** operations.

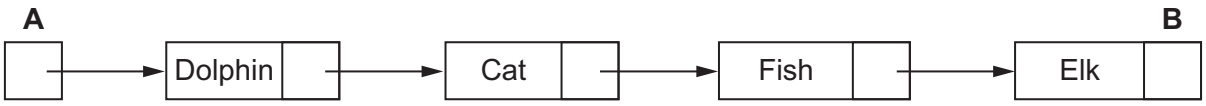
Operation 1 .....

.....

Operation 2 .....

.....
[2]

3 The following diagram represents an Abstract Data Type (ADT).



(a) Identify this type of ADT.

..... [1]

(b) Give the technical term for the item labelled **A** in the diagram.

..... [1]

(c) Give the technical term for the item labelled **B** in the diagram.

Explain the meaning of the value given to this item.

Term .....

Meaning .....

.....

.....

[2]

(d) Complete the diagram to show the ADT after the data has been sorted in alphabetical order.



[2]

4 A teacher uses a paper-based system to store marks for a class test. The teacher requires a program to assign grades based on these results.

The program will output the grades together with the average mark.

Write a detailed description of the algorithm that will be needed.

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5 **(a)** A student is learning about arrays.

She wants to write a program to:

- declare a 1D array `RNum` of 100 elements of type `INTEGER`
- assign each element a random value in the range 1 to 200 inclusive
- count and output how many numbers generated were between 66 and 173 inclusive.

(i) Write pseudocode to represent the algorithm.

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(ii) The student decides to modify the algorithm so that each element of the array will contain a unique value.

Describe the changes that the student needs to make to the algorithm.

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..... [3]

(b) The following is a pseudocode function.

Line numbers are given for reference only.

```
01  FUNCTION StringClean(InString : STRING) RETURNS STRING
02
03     DECLARE NextChar : CHAR
04     DECLARE OutString : STRING
05     DECLARE Counter : INTEGER
06
07     OutString ← ""
08
09     FOR Counter ← 1 TO LENGTH(InString)
10        NextChar ← MID(InString, Counter, 1)
11        NextChar ← LCASE(NextChar)
12        IF NOT((NextChar < 'a') OR (NextChar > 'z')) THEN
13           OutString ← OutString & NextChar
14        ENDIF
15     NEXT Counter
16
17     RETURN OutString
18
19  ENDFUNCTION
```

(i) Examine the pseudocode and complete the following table.

	Answer
Give a line number containing an example of an initialisation statement.	
Give a line number containing the start of a repeating block of code.	
Give a line number containing a logic operation.	
Give the number of parameters to the function `MID()`.	

[4]

(ii) Write a simplified version of the statement in line `12`.

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..... [2]

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6 A procedure `CountVowels()` will:

- be called with a string containing alphanumeric characters as its parameter
- count and output the number of occurrences of each vowel (a, e, i, o, u) in the string
- count and output the number of occurrences of the other alphabetic characters (as a single total).

The string may contain both upper and lower case characters.

Each count value will be stored in a unique element of a global 1D array `CharCount` of type `INTEGER`. The array will contain six elements.

Write pseudocode for the procedure `CountVowels()`.

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..... [8]

7 A procedure, `FormatName()`:

- is called with a string containing words and spaces as its parameter. In this context, a word is any sequence of characters that does not contain a space character.
- creates a new formatted string from this string with the following requirements:
    1. Any leading spaces removed (spaces before the first word).
    2. Any trailing spaces removed (spaces after the last word).
    3. Any multiple spaces between words converted to a single space.
    4. All characters converted to lower case.

The `FormatName()` procedure has been written in a programming language and is to be tested using the black-box method.

(a) Give a test string that could be used to show that all **four** formatting requirements have been applied correctly.

Use the symbol '∇' to represent a space character.

..... [3]

(b) The `FormatName()` procedure should assign a value to the global variable `FString`.

There is a fault in the program, which means that the assignment does not always take place.

Explain **two** ways of exposing the fault.

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..... [2]

8 A program is needed to take a string containing a full name and to produce a new string of initials.

Some words in the full name will be ignored. For example, “the”, “and”, “of”, “for” and “to” may all be ignored.

Each letter of the new string must be upper case.

For example:

Full name	Initials
Integrated Development Environment	IDE
The American Standard Code for Information Interchange	ASCII

The programmer has decided to use the following global variables:

- a ten element 1D array `IgnoreList` of type `STRING` to store the ignored words
- a string `FNString` to store the full name string.

Assume that:

- each alphabetic character in the full name string may be either upper or lower case
- the full name string contains at least one word.

The programmer has started to define program modules as follows:

Module	Description
`GetStart()`	• Called with an `INTEGER` as its parameter, representing the number of a word in `FNString` • Returns the character start position of that word in `FNString` or returns `-1` if that word does not exist • For example: `GetStart(3)` applied to `"hot and cold"` returns `9`
`GetWord()`	• Called with the position of the first character of a word in `FNString` as its parameter • Returns the word from `FNString` • For example: if `FNString` contains the string `"hot and cold"`, `GetWord(9)` returns `"cold"`
`IgnoreWord()`	• Called with a `STRING` parameter representing a word • Searches for the word in the `IgnoreList` array • Returns `TRUE` if the word is found, otherwise returns `FALSE`
`GetInitials()`	• Processes the sequence of words in the full name one word at a time • Calls `GetStart()`, `GetWord()` and `IgnoreWord()` to process each word to form the new string • Outputs the new string

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(a) Write pseudocode for the module `IgnoreWord()`.

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(b) Write pseudocode for the module `GetInitials()`.

[8]

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