



# Cambridge International AS & A Level

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## COMPUTER SCIENCE

9618/21

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 **24** pages. Any blank pages are indicated.

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

- 1 (a) A program is being developed to help manage the membership of a football club.

Complete the following identifier table.

Example value	Explanation	Variable name	Data type
"Wong"	The preferred name of the member joining the football club		
FALSE	A value to indicate whether an existing member of the club lives at the same address		
19/02/1983	When the member joined the football club		
1345	The number of points a member has earned. Members of the club earn points for different activities.		

[4]

- (b) Each pseudocode statement in the following table may contain an error due to the incorrect use of the function or operator.

Describe the error in each case, or write 'NO ERROR' if the statement contains no error.

You can assume that none of the variables referenced are of an incorrect type.

Statement	Error
Result ← 2 & 4	
SubString ← MID("pseudocode", 4, 1)	
IF x = 3 OR 4 THEN	
Result ← Status AND INT(x/2)	
Message ← "Done" + LENGTH(MyString)	

[5]

(c) The following data items need to be stored for each student in a group:

- student name (a string)
- test score (an integer).

State a suitable data structure and justify your answer.

Structure .....

Justification .....

.....

.....

[3]

2 (a) Four program modules form part of a program for a library.

A description of the relationship between the modules is summarised as follows:

Module name	Description
UpdateLoan()	<ul style="list-style-type: none"> <li>• Calls either LoanExtend() or LoanReturn()</li> </ul>
LoanExtend()	<ul style="list-style-type: none"> <li>• Called with parameters LoanID and BookID</li> <li>• Calls CheckReserve() to see whether the book has been reserved for another library user</li> <li>• Returns TRUE if the loan has been extended, otherwise returns FALSE</li> </ul>
CheckReserve()	<ul style="list-style-type: none"> <li>• Called with BookID</li> <li>• Returns TRUE if the book has been reserved, otherwise returns FALSE</li> </ul>
LoanReturn()	<ul style="list-style-type: none"> <li>• Called with parameters LoanID and BookID</li> <li>• Returns a REAL (which is the value of the fine to be paid in the case of an overdue loan)</li> </ul>

Draw a structure chart to show the relationship between the four modules and the parameters passed between them.

[5]

(b) The definition for module `LoanReturn()` is amended as follows:

Module name	Description
<code>LoanReturn()</code>	Called with parameters <code>LoanID</code> , <code>BookID</code> and <code>Fine</code> The module code checks whether the book has been returned on time and then assigns a new value to <code>Fine</code>

- `LoanID` and `BookID` are of type `STRING`
- `Fine` is of type `REAL`

Write the pseudocode header for the **amended** module `LoanReturn()`.

.....  
..... [2]

(c) A program will:

- input 50 unique integer values
- output the largest value
- output the average of the values **excluding** the largest value.

Draw a program flowchart to represent the algorithm.

Variable declarations are **not** required.

It is not necessary to check that each input value is unique.





- 3 (a) A concert venue uses a program to calculate admission prices and store information about ticket sales.

A number of arrays are used to store data. The computer is switched off overnight and data has to be input again at the start of each day before any tickets can be sold. This process is very time consuming.

- (i) Explain how the program could use text files to speed up the process.

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..... [2]

- (ii) State the characteristic of text files that allow them to be used as explained in **part (a)(i)**.

.....  
..... [1]

- (iii) Information about ticket sales will be stored as a booking. The booking requires the following data:

- name of person booking
- number of people in the group (for example a family ticket or a school party)
- event type.

Suggest how data relating to each booking may be stored in a text file.

.....  
.....  
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..... [2]





**4** Study the following pseudocode. Line numbers are for reference only.

```
10 FUNCTION Convert(Name : STRING) RETURNS STRING
11
12   DECLARE Flag: BOOLEAN
13   DECLARE Index : INTEGER
14   DECLARE ThisChar : CHAR
15   DECLARE NewName : STRING
16
17   CONSTANT SPACECHAR = ' '
18
19   Flag ← TRUE
20   Index ← 1
21   NewName ← ""           // formatted name string
22
23   WHILE Index <= LENGTH(Name)
24     ThisChar ← MID(Name, Index, 1)
25     IF Flag = TRUE THEN
26       NewName ← NewName & UCASE(ThisChar)
27       IF ThisChar <> SPACECHAR THEN
28         Flag ← FALSE
29       ENDIF
30     ELSE
31       NewName ← NewName & ThisChar
32     ENDIF
33     IF ThisChar = SPACECHAR THEN
34       Flag ← TRUE
35     ENDIF
36     Index ← Index + 1
37   ENDWHILE
38
39   RETURN NewName
40
41 ENDFUNCTION
```

(a) Complete the trace table below by dry running the function when it is called as follows:

```
Result ← Convert("∇in∇a∇∇Cup")
```

Note: The symbol '∇' has been used to represent a space character.  
Use this symbol for any space characters in the trace table.

The first row has been completed for you.

Name	Flag	Index	NewName	ThisChar
"∇in∇a∇∇Cup"				

[5]

(b) The pseudocode for `Convert()` contains a conditional loop.

State a more appropriate loop structure.

Justify your answer.

Loop structure .....

.....

Justification .....

.....

.....

[2]

(c) Two changes need to be made to the algorithm.

Change 1: Convert to lower case any character that is not the first character after a space.

Change 2: Replace multiple spaces with a single space.

(i) Change 1 may be implemented by modifying one line of the pseudocode.

Write the modified line.

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.....[1]

(ii) Change 2 may be implemented by moving one line of the pseudocode.

Write the number of the line to be moved and state its new position.

Line number .....

New position .....

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[2]

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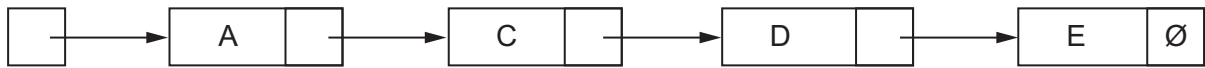
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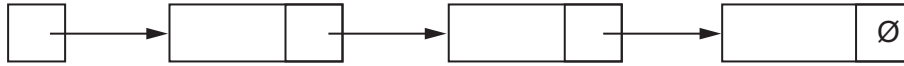
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..... [8]

6 The following diagram represents an Abstract Data Type (ADT) for a linked list.



The free list is as follows:



(a) Explain how a node containing data value B is added to the list in alphabetic sequence.

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..... [4]

(b) Describe how the linked list in **part (a)** may be implemented using variables and arrays.

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- 7 A program is needed to take a string containing a full name and 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 abbreviated 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 a global variable `FNString` of type `STRING` to store the full name.

It is assumed that:

- words in the full name string are separated by a single space character
- space characters will not occur at the beginning or the end of the full name string
- the full name string contains at least one word.

The programmer has started to define program modules as follows:

Module	Description
<code>GetStart()</code>	<ul style="list-style-type: none"> <li>• Called with an <code>INTEGER</code> as a parameter, representing the number of a word in <code>FNString</code>.</li> <li>• Returns the character start position of that word in <code>FNString</code> or returns <code>-1</code> if that word does not exist</li> <li>• For example: if <code>FNString</code> contains the string "hot and cold", <code>GetStart(3)</code> returns 9</li> </ul>
<code>GetWord()</code>	<ul style="list-style-type: none"> <li>• Called with a parameter representing the position of the first character of a word in <code>FNString</code></li> <li>• Returns the word from <code>FNString</code></li> <li>• For example: if <code>FNString</code> contains the string "hot and cold", <code>GetWord(9)</code> returns "cold"</li> </ul>



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(b) The programmer has decided to use a global ten-element 1D array `IgnoreList` of type `STRING` to store the ignored words. Unused elements contain the empty string ("") and may occur anywhere in the array.

A new module `AddWord()` is needed as follows:

Module	Description
<code>AddWord()</code>	<ul style="list-style-type: none"> <li>• Called with a parameter representing a word</li> <li>• Stores the word in an unused element of the <code>IgnoreList</code> array and returns <code>TRUE</code></li> <li>• Returns <code>FALSE</code> if the array was already full or if the word was already in the array</li> </ul>

Write a detailed description of the algorithm for `AddWord()`. Do **not** include pseudocode statements in your answer.

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