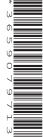


# Cambridge International AS & A Level

CANDIDATE NAME					
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COMPUTER SCIENCE

9608/23

Paper 2 Fundamental Problem-solving and Programming Skills

May/June 2021

2 hours

You must answer on the question paper.

No additional materials are needed.

#### **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.

1 (a) Algorithms usually consist of three different types of activity.

Complete the following table.

Write each example statement in **program code and** state the programming language used.

The third activity has already been given.

Example statement in program code	Programming language
	Example statement in program code

**(b)** An algorithm searches a 1D array to find the first index of an element that contains a given value. If the value is found, the index of that element is returned.

(i)	State an appropriate loop structure for this algorithm. Justify your choice.	
	Loop structure	
	Justification	
	[2	2]
(ii)	Give <b>two</b> possible reasons why the search for the value in <b>part</b> (b)(i) would end.	
	You should assume there is no error.	
	1	
	2	
	[2	2]

**(c)** 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.

Refer to the **Appendix** on pages 22 and 23 for the list of built-in pseudocode functions and operators.

Statement	Error
Code ← RIGHT("Cap" * 3, 2)	
Valid ← IS_NUM(3.14159)	
NextChar ← MID(ThisString, Index), 1	

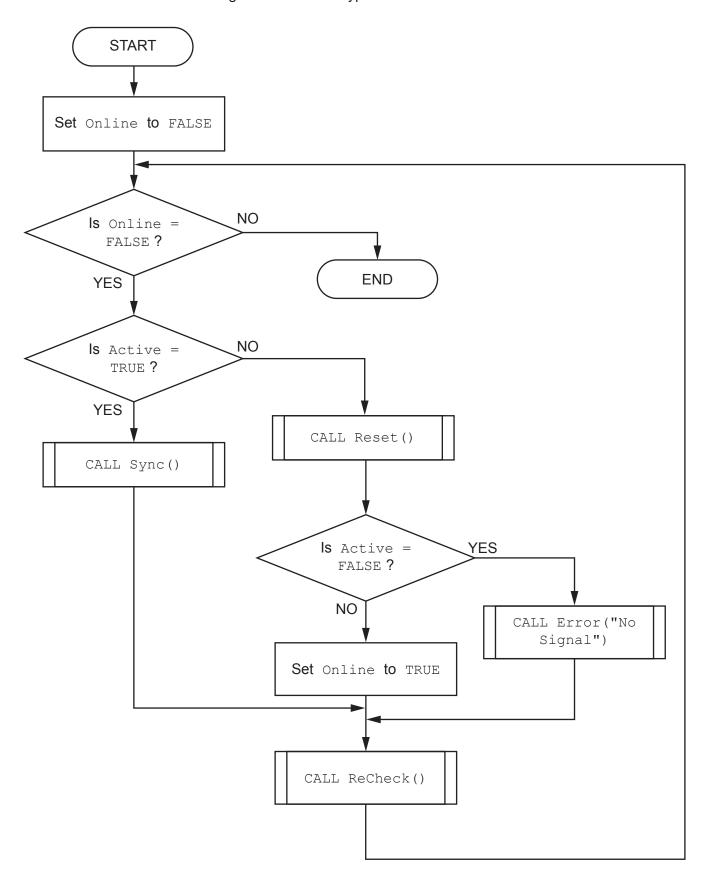
[3]

(a)	After using a program for some time, a user notices a fault in the program.	
	Describe the term program fault.	
	[	2]
(b)	Good programming practice may help to avoid faults. The use of sensible identifier names one example of good practice.	is
	(i) Explain the reason for using sensible identifier names.	
	[	1]
	(ii) State three other examples of good programming practice.	
	1	
	2	
	3	
	l	3]
(c)	A programmer chooses data to test each path through her program.	
	Identify the type of testing that the programmer has decided to perform.	
		1]

3

(a)	The process of decomposition is often applied to a programming problem.
	Describe the process of decomposition.
	[9]
(I- )	[2]
(D)	Result is a 1D array of type STRING. It contains 100 elements.
	Draw a program flowchart for an algorithm that will output each element in the array.

(c) The program flowchart for part of an algorithm from a mobile phone program is shown. Identifier Active is a global variable of type BOOLEAN.



Write <b>pseudocode</b> to implement the algorithm represented by the flowchart.					
ro.					

4 Study the following pseudocode for a string handling function Check().

Refer to the **Appendix** on pages 22 and 23 for the list of built-in pseudocode functions and operators.

```
{\tt FUNCTION~Check(InString~:~STRING)~RETURNS~INTEGER}
DECLARE Index, Result, Count : INTEGER
DECLARE NextChar : CHAR
   Result \leftarrow 0
   Count \leftarrow 1
   FOR Index ← 1 TO LENGTH(InString)
      NextChar ← MID(InString, Index, 1)
      IF (NextChar >= '0' AND NextChar <= '9') OR NextChar = '.'</pre>
          THEN
             Result \leftarrow Result + 1
          ELSE
             IF NextChar = ','
                 THEN
                    Count \leftarrow Count + 1
                 ELSE
                    Result \leftarrow -1
             ENDIF
      ENDIF
   ENDFOR
   IF Count < 3
      THEN
          RETURN -1
      ELSE
         RETURN Result
   ENDIF
```

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ENDFUNCTION

(a)	(i)	Complete the trace	table by	performing	a dry	run	of the	function	when	it is	called	as
		follows:										

Answer 
$$\leftarrow$$
 Check("74.0,4.6,3x2")

Note, there are no space characters in the string shown.

Result	Count	Index	NextChar

(ii)	State the value returned by the function when it is called as shown in part (a)(i).

[1]

(b)		imber group is a string of characters that represents an integer or decimal value. A comma arates number groups.
	For	example, "74.0" is a number group in the string "74.0,4.6,3x2".
	The	function Check() is intended to analyse the number groups in the parameter passed.
	The	function returns:
	•	a count of the number groups in the parameter passed
	or	
	•	-1 if there are less than three number groups in the string <b>or</b> if any non-numeric characters occur in the string (other than decimal point and comma).
	The	re is an error in the algorithm causing an incorrect value to be returned by the function.
	(i)	Explain why this error can occur.
		[2]
	(ii)	Describe how the algorithm could be amended to correct the error.
		[1]
(c)	A dr	y run of a pseudocode algorithm may help to locate logic errors.
	Give	e another type of program error and describe how it can occur.
	Тур	e of error
	Des	cription

[2]

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**5** A program stores a contact list of telephone numbers. Each telephone number is stored as a string of six or more numeric characters.

Before they are displayed, number strings are formatted to make them easier to read. This involves forming the characters into groups, separated by the space character.

The maximum length of a number group is five characters.

Different numbers may have different groupings. A template string is used to define the grouping.

For example:

Number string	Template string	Formatted string		
"01223553998"	"53"	"01223 553 998"		
"509700101"	"222"	"50 97 00 101"		
"4044496128"	"33"	"404 449 6128"		

For the first row, template "53" results in a formatted string comprising:

- the first five characters in the first group
- a space character
- the next three characters in the second group
- a space character
- the remaining characters from the number string.
- (a) Write pseudocode for a function <code>GroupNum()</code>, which takes a telephone number and a template as parameter strings and returns a formatted string.

You may assume that the template and telephone number are valid.

Refer to the <b>Appendix</b> on pages 22 and 23 for the list of built-in pseudocode functions and operators.

 [8]
 [0]

(b) The function GroupNum() is to be extended to include parameter checking.

State  ${\it one}$  check that could be applied to  ${\it each}$  parameter.

Give an example of test data that could be used to demonstrate that each check identifies invalid data.

The type of check must be different for each parameter.
Telephone number check
Test data
Template check
Test data
[4]

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6 A program stores data about stock items in four global 1D arrays as follows:

Array	Data type	Description	Example data value	Initial data value
StockID	STRING	the stock item ID (eight alpha-numeric characters)	"ABLK0001"	11 11
Description	STRING	a description of the item (alphabetic characters only)	"torch"	11 11
Quantity	INTEGER	the number in stock	6	0
Cost	REAL	the cost of the item	4.80	0.0

- Each array contains 10 000 elements.
- Elements with the same index relate to the same stock item. For example, StockID[5] contains the ID for the product whose description is in Description[5].
- The StockID array is not sorted and unused elements may occur at any index position.
- Unused elements are assigned the initial data value shown in the table above.
- The first four characters of the StockID represent a product group. The last four characters represent the item within the group.

The program is to be modified so that:

- data from the arrays are stored in a text file for backup purposes. Data from unused elements are not stored in the file.
- a Summary array is added. This will be a global 1D array of 500 elements of type STRING.
   Each product group will occur once in the array, for example "ABLK" for the item in the table above.

The programmer has started to define program modules as follows:

Module	Description
GetValidFilename()	<ul><li>prompts and inputs a filename</li><li>returns a valid filename as a STRING</li></ul>
CheckBackupFile()	<ul> <li>calls GetValidFilename() for a filename</li> <li>checks if the file is empty</li> <li>If the file is not empty ask the user to confirm that overwrite is intended. If not intended allow the user to re-input a different filename.</li> <li>returns the filename.</li> </ul>


**(b)** Write **program code** for a module GroupReport (), which will summarise the stock data for a given product group.

The product group will be passed to the module as a string. The total value of items is calculated by multiplying the cost by the quantity.

An example of the output for group ABLK is as follows:

Group: ABLK
Number of items in Group: 11
Total value of items in Group: 387.89

If no items are found for group ABLK, the output is as follows:

There are no items in Group: ABLK

Visual Basic and Pascal: You should include the declaration statements for variables. Python: You should show a comment statement for each variable used with its data type.

Programming language
Program code

			16

# (c) Two additional modules are required:

Module	Description
Lookup()	<ul> <li>called with a STRING representing a product group (for example, "ABLK")</li> <li>searches the Summary array for the group</li> <li>returns the index position or returns -1 if not found</li> </ul>
	• stores each product group name (found in the StockID array) into the Summary array, if not there already
GroupSummary()	• calls Lookup() to check whether the name is already in the Summary array
	returns the number of product groups added to the Summary array

#### You can assume:

- all elements of the Summary array have been initialised to the value "" before GroupSummary() is called
- there will be no more than 500 product groups.

Write program code for the module GroupSummary ().

Visual Basic and Pascal: You should include the declaration statements for variables. Python: You should show a comment statement for each variable used with its data type.

Programming language
Program code

#### **Appendix**

#### **Built-in functions (pseudocode)**

Each function returns an error if the function call is not properly formed.

MID (This String: STRING, x: INTEGER, y: INTEGER) RETURNS STRING returns a string of length y starting at position x from This String

Example: MID ("ABCDEFGH", 2, 3) returns "BCD"

LENGTH (ThisString: STRING) RETURNS INTEGER returns the integer value representing the length of ThisString

Example: LENGTH ("Happy Days") returns 10

LEFT (ThisString : STRING, x : INTEGER) RETURNS STRING returns leftmost x characters from ThisString

Example: LEFT ("ABCDEFGH", 3) returns "ABC"

RIGHT (ThisString : STRING, x : INTEGER) RETURNS STRING returns rightmost x characters from ThisString

Example: RIGHT ("ABCDEFGH", 3) returns "FGH"

INT (x : REAL) RETURNS INTEGER returns the integer part of x

Example: INT (27.5415) returns 27

NUM\_TO\_STRING(x : REAL) RETURNS STRING returns a string representation of a numeric value.

Note: This function will also work if x is of type INTEGER

Example: NUM\_TO\_STRING(87.5) returns "87.5"

STRING\_TO\_NUM(x : STRING) RETURNS REAL

returns a numeric representation of a string.

Note: This function will also work if  $\mathtt{x}$  is of type  $\mathtt{CHAR}$ 

Example: STRING\_TO\_NUM("23.45") returns 23.45

IS\_NUM(ThisString : STRING) RETURNS BOOLEAN
returns the value TRUE if ThisString contains only numeric characters ('0' to '9').

Example: IS\_NUM("123a") returns FALSE

# **Operators (pseudocode)**

Operator	Description
&	Concatenates (joins) two strings  Example: "Summer" & " " & "Pudding" produces "Summer Pudding"
AND	Performs a logical AND on two Boolean values  Example: TRUE AND FALSE produces FALSE
OR	Performs a logical OR on two Boolean values  Example: TRUE OR FALSE produces TRUE

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