

- 1 The following pseudocode searches for the longest run of identical characters in the array Message.

```
DECLARE Message : ARRAY[1:100] OF CHAR
```

```
PROCEDURE Search()
```

```
    DECLARE Index : INTEGER  
    DECLARE ThisChar : CHAR  
    DECLARE ThisRun : INTEGER  
    DECLARE LongRun : INTEGER
```

```
    ThisChar ← Message[1]  
    ThisRun ← 1  
    LongRun ← 1
```

```
    FOR Index ← 2 TO 100
```

```
        IF Message[Index] = ThisChar  
            THEN  
                ThisRun ← ThisRun + 1  
            ELSE  
                ThisChar ← Message[Index]  
                IF ThisRun > LongRun  
                    THEN  
                        LongRun ← ThisRun  
                ENDIF  
                ThisRun ← 1  
            ENDIF  
    ENDIF
```

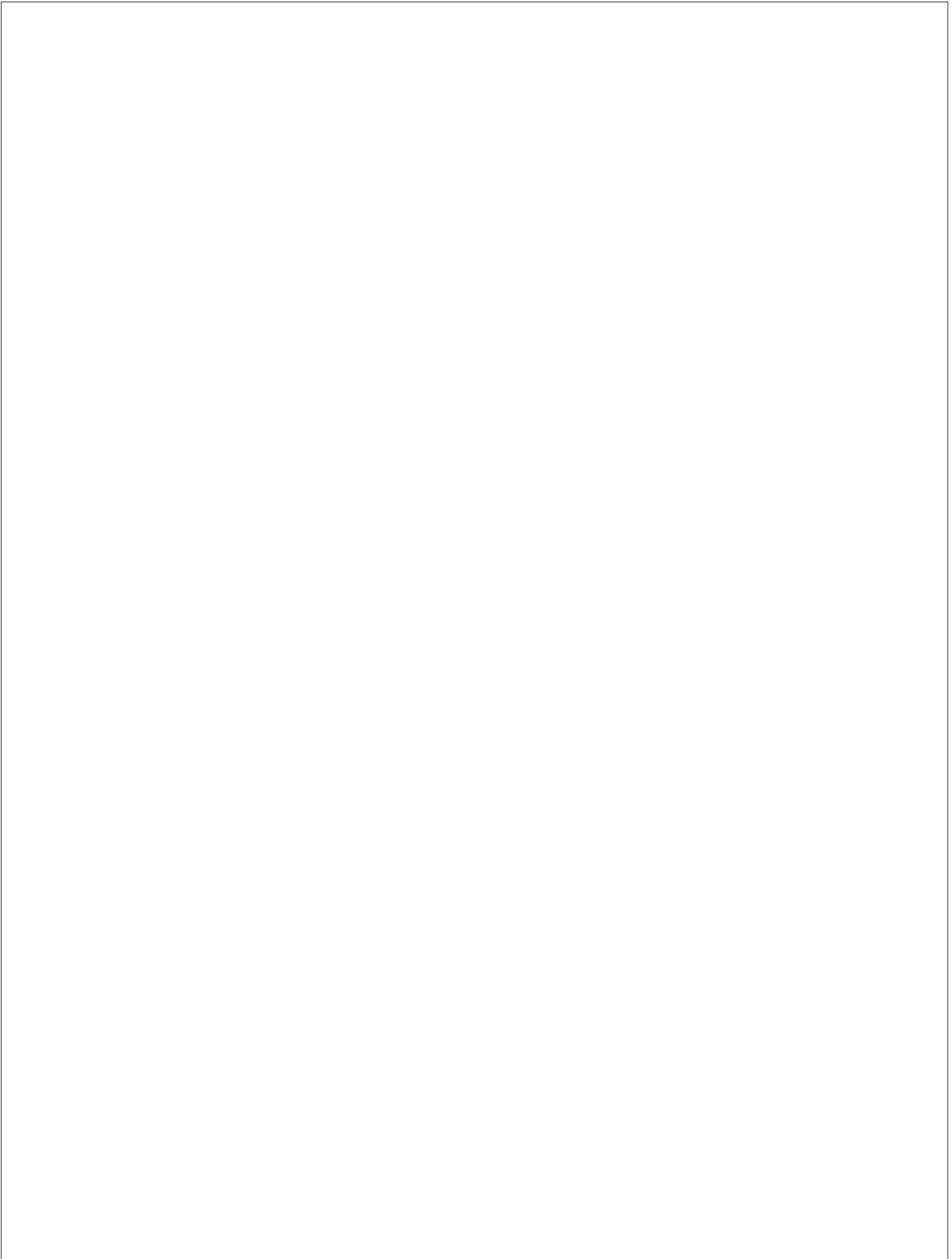
```
    ENDFOR
```

```
    OUTPUT "The longest run was " , LongRun
```

```
ENDPROCEDURE
```

(a) Draw a program flowchart to represent the procedure `Search()`.

Variable and array declarations are not required in program flowcharts.



[6]

(b) (i) Program variables have values as follows:

Variable	Value
MeltingPoint	180.5
Soluble	FALSE
Attempt	3
ProductName	"Mushroom Compost"
Version	'A'
ProductID	"BZ27-4"

Evaluate each expression in the following table.

If an expression is invalid, write ERROR.

For the built-in functions list, refer to the **Appendix** on page 18.

Expression	Evaluates to
STRING_TO_NUM(MID(ProductID, 3, 2)) + 4	
INT(MeltingPoint / 2)	
Soluble AND Attempt > 3	
LENGTH(ProductID & NUM_TO_STRING(MeltingPoint))	
RIGHT(ProductName, 4) & MID(ProductName, 5, 4)	

[5]

(ii) Programming languages support different data types.

Give an appropriate data type for the following variables from **part (b)(i)**.

Variable	Data type
MeltingPoint	
Soluble	
Attempt	
Version	
ProductID	

[5]

(c) The student is learning about file handling.

She has been told that there are different file modes that can be used when opening a text file. She wants to make sure that the existing contents are not deleted when the file is opened.

Identify **two** file modes she could use **and** describe their use.

Mode

Description

.....

.....

Mode

Description

.....

.....

[4]

(d) The student has completed the design of her program and is ready to use an Integrated Development Environment (IDE).

Describe the features of an IDE that she can use to write, translate and test her program.

.....

.....

.....

.....

.....

..... [3]

Question 3 begins on the next page.

- 3 The following pseudocode represents three separate modules from an algorithm design. The module contents are not shown.

```
FUNCTION Search(AA : INTEGER, BB : STRING) RETURNS INTEGER
```

```
{
```

```
ENDFUNCTION
```

```
FUNCTION Allocate() RETURNS BOOLEAN
```

```
{
```

```
ENDFUNCTION
```

```
PROCEDURE Enable(CC : INTEGER, BYREF DD : INTEGER)
```

```
{
```

```
ENDPROCEDURE
```

A fourth module, `Setup()`, refers to the previous three modules as follows:

```
PROCEDURE Setup()
```

```
{
```

```
  WHILE Authorised = TRUE
```

```
  {
```

```
    ThisValue ← Search(27, "Thursday")
```

```
  {
```

```
    Authorised ← Allocate()
```

```
  {
```

```
    CALL Enable(ThisValue, 4)
```

```
  {
```

```
  ENDWHILE
```

```
{
```

```
ENDPROCEDURE
```


- (a) Draw a structure chart to show the four modules and the parameters that these pass between them.



[6]

- (b) The algorithm is implemented in a high-level language. Changes are required and the program is given to Albert, who is an experienced programmer. He is not familiar with the language that has been used.

Explain why Albert would be able to understand the program.

.....

.....

.....

..... [2]

Question 5 begins on the next page.

- 5 Nigel is learning about string handling. He wants to write code to count the number of words in a given string. A word is defined as a sequence of alphabetic characters that is separated by one or more space characters.

His first attempt at writing an algorithm in pseudocode is as follows:

```

PROCEDURE CountWords (Message : STRING)

    DECLARE NumWords : INTEGER
    DECLARE Index : INTEGER
    CONSTANT Space = ' '

    NumWords ← 0

    FOR Index ← 1 TO LENGTH(Message)
        IF MID(Message, Index, 1) = Space
            THEN
                NumWords ← NumWords + 1
            ENDIF
        ENDFOR

    OUTPUT "Number of words : " , NumWords

ENDPROCEDURE

```

For the built-in functions list, refer to the **Appendix** on page 18.

His first attempt is incorrect. He will use white-box testing to help him to identify the problem.

- (a) (i) State the purpose of white-box testing.

.....
 [1]

- (ii) Dry running the code is often used in white-box testing. In this method, the programmer records the values of variables as they change.

Identify what the programmer would normally use to record the changes.

..... [1]

(b) (i) Write a test string containing two words that gives the output:

Number of words : 2

Use the symbol '∇' to represent each space character in your test string.

Explain why the algorithm gives the output shown above.

String

Explanation

.....
.....
.....
.....

[3]

(ii) Nigel tested the procedure with the strings:

String 1: "Red∇and∇Yellow"

String 2: "Green∇∇and∇∇Pink∇"

Give the output that is produced for each of the strings.

Describe the changes that would need to be made to the algorithm to give the correct output in each case.

Do **not** write pseudocode **or** program code.

String 1

Description

.....
.....
.....

String 2

Description

.....
.....
.....

[6]

- 6 A text file, `StudentContact.txt`, contains a list of names and telephone numbers of students in a school. Not all students in the school have provided a contact telephone number. In this case, their name will not be in the file.

Each line of the file is stored as a string that contains a name and telephone number, separated by the asterisk character ('*') as follows:

`<Name>' * '<TelNumber>`, for example:

`"Bill Smith*081234567"`

A 1D array, `ClassList`, contains the names of students in a particular class. The array consists of 40 elements of string data type. You can assume that student names are unique. Unused elements contain the empty string "".

A program is to be written to produce a **new** text file, `ClassContact.txt`, containing student names and numbers for all students in a particular class.

For each name contained in the `ClassList` array, the program will:

- search the `StudentContact.txt` file
- copy the matching string into `ClassContact.txt` if the name is found
- write the name together with “*No number” into `ClassContact.txt` if the name is not found.

The program will be implemented as three modules. The description of these is as follows:

Module	Description
<code>ProcessArray()</code>	<ul style="list-style-type: none"> • Check each element of the array: <ul style="list-style-type: none"> ○ Read the student name from the array ○ Ignore unused elements ○ Call <code>SearchFile()</code> with the student name ○ If the student name is found, call <code>AddToFile()</code> to write the student details to the class file ○ If the student name is not found, call <code>AddToFile()</code> to write a new string to the class file, formed as follows: <p style="text-align: center;"><code><Name>“*No number”</code></p> • Return the number of students who have not provided a telephone number
<code>SearchFile()</code>	<ul style="list-style-type: none"> • Search for a given student name at the start of each line in the file <code>StudentContact.txt</code>: <ul style="list-style-type: none"> ○ If the search string is found, return the text line from <code>StudentContact.txt</code> ○ If the search string is not found, return an empty string
<code>AddToFile()</code>	<ul style="list-style-type: none"> • Append the given string to a specified file, for example, <code>AddToFile(StringName, FileName)</code>

(c) `ProcessArray()` is modified to make it general purpose. It will now be called with two parameters as follows:

- an array
- a string representing the name of a class contact file

It will still return the number of students who have not provided a contact telephone number.

Write **program code** for the header (declaration) of the modified `ProcessArray()`.

Programming language

Program code

.....

.....

.....

..... [3]

Appendix

Built-in functions (pseudocode)

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

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

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.

Example: NUM_TO_STRING(x) returns "87.5" if x has the value 87.5

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

STRING_TO_NUM(x : STRING) RETURNS REAL
returns a numeric representation of a string.

Example: STRING_TO_NUM(x) returns 23.45 if x has the value "23.45"

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

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

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.