



- 1 (a) (i) Algorithms may be expressed using four basic constructs. One construct is sequence.

Complete the following table for two other constructs.

| Construct | Pseudocode example                                  |
|-----------|-----------------------------------------------------|
| .....     | <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> |
| .....     | <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> |

[4]

- (ii) Simple algorithms usually consist of input, process and output.

Complete the table by placing ticks (✓) in the relevant boxes.

| Pseudocode statement                         | Input | Process | Output |
|----------------------------------------------|-------|---------|--------|
| Temp ← SensorValue * Factor                  |       |         |        |
| WRITEFILE "LogFile.txt", TextLine            |       |         |        |
| WRITEFILE "LogFile.txt", MyName & MyIDNumber |       |         |        |
| READFILE "AddressBook.txt", NextLine         |       |         |        |

[4]

(b) Program variables have values as follows:

| Variable   | Value                       |
|------------|-----------------------------|
| Title      | "101 tricks with spaghetti" |
| Version    | 'C'                         |
| Author     | "Eric Peapod"               |
| PackSize   | 4                           |
| WeightEach | 6.2                         |
| Paperback  | TRUE                        |

- (i) 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 16.

| Expression                          | Evaluates to |
|-------------------------------------|--------------|
| MID(Title, 5, 3) & RIGHT(Author, 3) |              |
| INT(WeightEach * PackSize)          |              |
| PackSize >= 4 AND WeightEach < 6.2  |              |
| LEFT(Author, ASC(Version) - 65)     |              |
| RIGHT(Title, (LENGTH(Author) - 6))  |              |

[5]

- (ii) Programming languages support different data types.

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

| Variable   | Data type |
|------------|-----------|
| Title      |           |
| Version    |           |
| PackSize   |           |
| WeightEach |           |
| Paperback  |           |

[5]

- (c) White-box and black-box are two types of testing. In white-box testing, data are chosen to test every possible path through the program.

Explain how data are chosen in black-box testing.

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

- 2 (a) One type of loop that may be found in an algorithm is a count-controlled loop.

State **one other** type **and** explain when it should be used.

Type .....

Explanation .....

.....

.....

[2]

- (b) Chris is asked to work on a program that has been coded in a language he is not familiar with.

He has identified that the program contains the constructs: sequence, iteration and selection.

Identify **three other** features of the program that he should expect to recognise.

Feature 1 .....

Feature 2 .....

Feature 3 .....

[3]

- (c) The following lines of code are taken from a program in a high-level language.

```
ON x {  
    15: Call ProcA  
    20: y := 0  
    25: y := 99  
    NONE: Call ProcError  
}
```

Identify the type of control structure **and** describe the function of the code.

Control structure .....

Description .....

.....

.....

.....

[3]

- 3 (a) A student is developing an algorithm to search through a 1D array of 100 elements. Each element of the array, `Result`, contains a REAL value.

The algorithm will output:

- the average value of all the elements
- the number of elements with a value of zero.

The structured English description of the algorithm is:

1. SET Total value to 0
2. SET Zero count to 0
3. SELECT the first element
4. ADD value of element to Total value
5. IF element value is 0 then INCREMENT Zero count
6. REPEAT from step 4 for next element, until element is last element
7. SET Average to Total / 100
8. OUTPUT a suitable message and Average
9. OUTPUT a suitable message and Zero count

Write **pseudocode** for this algorithm.

[7]

- (b) The student decides to change the algorithm and implement it as a procedure, `ScanArray()`, which will be called with three parameters.

`ScanArray(AverageValue, ZeroCount, ArrayName)`

`ScanArray()` will modify the first two parameters so that the new values are available to the calling program or module.

Write the **pseudocode** procedure header for `ScanArray()`.

.....

.....

.....

..... [4]

**Question 4 begins on the next page.**

- 4 The following pseudocode is a string handling function.

For the built-in functions list, refer to the **Appendix** on page 16.

```
FUNCTION Clean(InString : STRING) RETURNS STRING

    DECLARE NewString : STRING
    DECLARE Index : INTEGER
    DECLARE AfterSpace : BOOLEAN
    DECLARE NextChar : CHAR
    CONSTANT Space = ' '

    AfterSpace ← FALSE
    NewString ← ""

    FOR Index ← 1 TO LENGTH(InString)
        NextChar ← MID(InString, Index, 1)
        IF AfterSpace = TRUE
            THEN
                IF NextChar <> Space
                    THEN
                        NewString ← NewString & NextChar
                        AfterSpace ← FALSE
                    ENDIF
            ELSE
                NewString ← NewString & NextChar
                IF NextChar = Space
                    THEN
                        AfterSpace ← TRUE
                    ENDIF
            ENDIF
        ENDIF
    ENDFOR

    RETURN NewString

ENDFUNCTION
```

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

```
Result ← Clean("X▽▽▽Y▽and▽▽Z")
```

The symbol '∇' represents a space character. Use this symbol to represent a space character in the trace table.

[illegible]

[6]

- (ii) State the effect of the function `Clean()`.

..... [1]

- (iii) The pseudocode is changed so that the variable `AfterSpace` is initialised to `TRUE`.

Explain what will happen if the function is called as follows:

```
Result ← Clean("XZYandZ")
```

.....

.....

.....

..... [2]

- (b) The following pseudocode declares and initialises an array.

```
DECLARE Code : ARRAY[1:100] OF STRING
DECLARE Index : INTEGER

FOR Index ← 1 TO 100
    Code[Index] ← ""
ENDFOR
```

The design of the program is changed as follows:

- the array needs to be two dimensional, with 500 rows and 4 columns
- the elements of the array need to be initialised to the string "Empty"

Re-write the **pseudocode** to implement the new design.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

- (c) State the term used for changes that are made to a program in response to a specification change.

..... [1]

**Question 5 begins on the next page.**

- 5 (a) Programming languages usually contain a range of built-in functions, such as a random number generator.

State **three** advantages of using built-in functions.

- 1 .....
- 2 .....
- 3 ..... [3]

- (b) A student is learning about random number generation.

She is investigating how many times the random function needs to be called before every number in a given series is generated.

She is using **pseudocode** to develop a procedure, `TestRand()`, which will:

- use the random number function to generate an integer value in the range 1 to 50 inclusive
- count how many times the random function needs to be called before all 50 values have been generated
- output a message giving the number of times the random function was called.

For the built-in functions list, refer to the **Appendix** on page 16.

[8]

- 6 A text file, `MyCDs.txt`, stores information relating to a Compact Disc (CD) collection. Information about each CD is stored on three separate lines in the file as follows:

```
Line 1:  <Artist Name>
Line 2:  <CD Title>
Line 3:  <Storage Location>
```

Information is stored as data strings.

A section of the file is shown:

| File line | Data                    |
|-----------|-------------------------|
| 100       | "Green Floyd"           |
| 101       | "Bowlful of Cereal"     |
| 102       | "Shelf 4"               |
| 103       | "Strolling Bones"       |
| 104       | "Exile on Station Road" |
| 105       | "Box 12"                |

- (a) A program, `CDOrganiser`, will be written to manage the stored information. The program will consist of three modules: `AddCD`, `FindCD` and `RemoveCD`.

Give **three** reasons why it is good practice to construct the program using modules.

- 1 .....
- 2 .....
- 3 .....

[3]

- (b) The module, `FindCD()`, will check whether a given CD exists in the collection. The module will be implemented as a function.

The function will:

- be called with two strings as parameters, representing the artist name and CD title
- return a string that gives the storage location, or an empty string if the given CD has not been found.

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Write **program code** for the function `FindCD()`.

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

[8]

## 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

`ASC(ThisChar : CHAR)` RETURNS INTEGER  
returns the ASCII value of character `ThisChar`

Example: `ASC('A')` returns 65

`RAND(x : INTEGER)` RETURNS REAL  
returns a real number in the range 0 to `x` (`x` not inclusive).

Example: `RAND(87)` could return 35.43

### Operators (pseudocode)

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