8. Programming

8.1 Programming concepts

1 **Six** terms associated with programming and **six** descriptions are listed.

Draw a line to link each term with its most appropriate description.

Term	Description
Top-down design	Pre-written code to include in your own program to carry out a common task.
Structure diagram	Shows the steps representing an algorithm using various shapes of boxes.
Flowchart	Shows the hierarchy of the different components which make up a system.
Pseudocode	Shows the values of variables as you manually test your program.
Library routine	Breaks down a system into successively smaller pieces.
Trace table	Describes a program using a simplified high-level notation.

[5]

2 **Four** programming concepts and **four** descriptions are shown.
Draw a line to connect each programming concept to the most appropriate description.

Programming concept	Description
Library routine	A subroutine that does not have to return a value.
Structure diagram	A standard subroutine that is available for immediate use.
Procedure	A subroutine that always returns a value.
Function	An overview of a program or subroutine.

[3]

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3 For each of the **four** descriptions in the table, place a tick in the correct column to show whether it describes a **Structure diagram**, a **Flowchart** or **Library routines**.

Description	Structure diagram	Flowchart	Library routines
A modelling tool used to show the hierarchy of a system.			
A collection of standard programs available for immediate use.			
A graphical representation used to represent an algorithm.			
A graphical representation to show how a system is broken into sub-systems.			

[4]

4 Explain why constants, variables and arrays are used in programming.

Constants .....

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Variables .....

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Arrays .....

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[6]

5 Four statement types and four examples are shown below.

Draw a line to connect each statement type to the correct example.

Statement type	Example
Assignment	`FOR X ← 1 TO 10`
Iteration	`READ X`
Input	`PRINT X`
Output	`X ← Y + Z`

[3]

6 A programmer writes a program to store a patient's temperature every hour for a day.

State the data structure that would be most suitable to use and give the reason for your choice.

Data structure .....

Reason.....

.....[2]

7 Identify **two** different selection statements that you can use when writing pseudocode.

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2 .....

.....[2]

8 `IF ... THEN ... ELSE ... ENDIF` and `CASE ... OF ... OTHERWISE ... ENDCASE` are two different conditional statements that you can use when writing pseudocode.

Explain, using examples, why you would choose to use each conditional statement.

Example 1 .....

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Reason for choice .....

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Example 2 .....

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Reason for choice .....

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..... [6]

9 The following diagram shows **four** data structures and **four** descriptions.

Draw a line to connect each data structure to the correct description.

Data structure	Description
Constant	A collection of related data
Array	A value that can change whilst a program is running
Table	A value that never changes whilst a program is running
Variable	A series of elements of the same data type

[3]

10 `IF … THEN … ELSE … ENDIF` is one type of conditional statement used when writing pseudocode.

Identify and describe **another** type of conditional statement that you could use when writing pseudocode. Give a reason why you would use this type of conditional statement.

Conditional statement .....

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Description .....

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Reason .....

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[4]

11 A programmer has written a routine to check that prices are below $10.00. These values are used as test data.

10.00 9.99 ten

Explain why each value was chosen.

10.00 .....

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9.99 .....

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ten .....

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[3]

12 A programmer wants to test that the readings from 2000 electricity meters are greater than 400 units and less than 900 units. The programmer uses selection and repetition statements as part of the program.
Explain, using programming statements, how selection and repetition could be used in this program.

Selection .....

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Repetition .....

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[4]

13 Describe, giving an example for each, the following data types used in programming.

Integer

Description .....

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Example .....

String

Description .....

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Example .....

[4]

14 Give an example of a pseudocode statement or statements to perform each of the following functions.

A condition controlled loop .....

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A conditional statement .....

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Totalling .....

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[3]

15 Describe each of the following data types used in programming. In each case, give an example of a piece of data to illustrate your answer. Each example must be different.

Char

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String

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Boolean

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[6]

16 **(a)** Give an example of a conditional statement using pseudocode.

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..... [2]

(b) Describe the purpose of a conditional statement.

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..... [2]

17 For each of the **four** groups of statements in the table, place a tick in the correct column to show whether it is an example of **Selection** or **Repetition**.

Statements	Selection	Repetition

`FOR A ← 1 TO 100`
`  B ← B + 1`
`NEXT A`		

`CASE A OF`
`  100: B ← A`
`  200: C ← A`
`ENDCASE`		

`IF A > 100`
`THEN`
`  B ← A`
`ENDIF`		

`REPEAT`
`  A ← B * 10`
`UNTIL A > 100`		

[4]

18 Most programming languages include basic data types. Ahmad is describing the basic data types he has used.

State the data type that Ahmad is describing in each sentence.

Choose the data type from this list of programming terms.

Array **Boolean** **Char** **Constant** **Function** **Integer**

Iteration **Procedure** **Real** **String** **Variable**

A number with a fractional part that can be positive or negative and used in calculations

Data type .....

A whole number that can be positive, negative or zero and used in calculations

Data type .....

A single number, symbol or letter

Data type .....

A sequence of characters

Data type .....

A data type with two values, True or False

Data type .....

[5]

19 Explain the purpose of the library routines `DIV` and `ROUND`

`DIV` .....

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`ROUND` .....

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[4]

20 State **two** features that should be included to create a maintainable program.

Give a reason why each feature should be used.

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[4]

21 The function `LENGTH(Phrase)` calculates the length of a string `Phrase`

(a) Write the pseudocode statements to:

- store the string `"The beginning is the most important part"` in `Phrase`
- calculate and output the length of the string
- output the string in upper case.

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..... [3]

(b) Write the output your pseudocode should produce.

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..... [2]

22 The variables `P` and `Q` are used to store data in a program. `P` stores a string. `Q` stores a character.

(a) Write pseudocode statements to declare the variables `P` and `Q`, store `"The world"` in `P` and store `'W'` in `Q`

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..... [2]

(b) Write a pseudocode algorithm to:

- convert `P` to upper case
- find the position of `Q` in the string `P` (the first character in this string is in position 1)
- store the position of `Q` in the variable `Position`

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(c) Give the value of `Position` after the algorithm has been executed with the data in **question 11(a)**.

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23 Tick (✓) **one** box to complete the sentence.

A constant

A stores a value that can change at any time during the execution of a program. ☐

B stores a value that cannot change during the execution of a program. ☐

C stores values of multiple data types. ☐

D stores values that must be of the same data type. ☐

[1]

24 Explain the purpose of the library routines `MOD` and `RANDOM`

`MOD` .....

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`RANDOM` .....

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[4]

25 Describe what happens when a function is called during the execution of a program.

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..... [3]

26 The variable `Saying` is used to store string data in a program.

(a) Write the pseudocode statement to declare the variable `Saying`

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..... [1]

(b) Write the pseudocode statements to:

- allow a string to be input to the variable `Saying`
- store the content of the variable `Saying` in a text file named `"Quotations.txt"`
- make sure the text file is closed at the end of the algorithm.

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..... [5]

27 Tick (✓) **one** box to show which operator means less than or equal to.

A OR ☐

B < ☐

C <= ☐

D >= ☐

[1]

28 Tick (✓) **one** box to show how a value can be passed to a procedure.

A function ☐

B parameter ☐

C return ☐

D subroutine ☐

[1]

29 **Four** descriptions of data and **five** data types are shown.

Draw **one** line to link each description to the most appropriate data type.
Not all data types will be used.

Description	Data type
a whole number	BOOLEAN
a single letter	CHAR
a word or phrase	INTEGER
a number with two decimal places	REAL
	STRING

[4]

30 Explain why a programmer would use procedures and parameters when writing a program.

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..... [4]

31 Tick (✓) **one** box to show which library routine returns the remainder of a division.

A DIV ☐

B MOD ☐

C RANDOM ☐

D ROUND ☐

[1]

32 **Four** descriptions of programming concepts and **five** programming concepts are shown.

(a) Draw **one** line to link each description to the most appropriate programming concept.

Not all programming concepts will be used.

Description	Programming concept
a subroutine that may **not** return a value	function
a value that is declared and used within a specific procedure	procedure
a value that a procedure expects you to supply when it is called	parameter
a subroutine that will always return a value	global variable
	local variable

[4]

(b) Write the pseudocode to use a procedure named `Average` that passes the values `25` and `50` to the procedure.

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..... [2]

(c) Outline the role of procedures and functions in creating a program that is easier to maintain.

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..... [3]

33 State what is meant by the data types integer and real.
Give an example of each.

Integer .....

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Example .....

Real .....

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Example .....

[4]

34 A high-level programming language makes use of arithmetic, Boolean and logical operators.

State how each type of operator is used.
Give an example statement, in pseudocode, for each one.

Arithmetic .....

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Example .....

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Boolean .....

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Example .....

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Logical .....

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Example .....

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[6]

35 Describe the characteristics of the string and char data types and give an example of each.

String .....

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Example .....

Char .....

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Example .....

[4]

36 **(a)** The string operation `SUBSTRING(FullText, X, Y)` returns a string from `FullText` beginning at position `X` that is `Y` characters long. The first character in `FullText` is in position 1.

Write the pseudocode statements to:

- store the string "IGCSE Computer Science at Cambridge" in `FullText`
- extract and display the words "Computer Science" from the string and store it in a suitable variable
- output the original string in upper case.

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..... [4]

(b) Write the pseudocode statements to:

- store the content of the variable you created in part **(a)** to a text file named `"Subjects.txt"`
- close the text file at the end of the algorithm.

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..... [3]

37 Tick (✓) **one** box to identify which option is used to show the inputs and output of a Boolean expression.

A flowchart ☐

B trace table ☐

C truth table ☐

D variable ☐

[1]

38 **Four** operators and **three** types of operator are shown.

Draw **one or more** lines from each operator to its correct operator type.

Operator	Operator type
>=	Boolean
AND	Arithmetic
DIV	Logical
+	

[4]

39 The function `LENGTH(X)` calculates the length of a string `X`

Write the pseudocode statements to:

- allow a line of text to be input to an appropriate variable
- store this line of text in a text file called `Main.txt`
- calculate the length of the line of text and output the text in lower case along with its length
- store the lower-case line of text in a text file called `Lowercase.txt`

Make sure that any variables used are declared and that both text files are closed after they have been used.

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..... [6]

40 An incomplete algorithm has been written in pseudocode to count the number of values stored in an array and to find their average.
Values have been stored in the array starting at `A[1]`
All the values to be counted are non-zero.
A value of zero in the array indicates there are no more values stored.

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01 DECLARE A : ARRAY[1:50] OF INTEGER
02 DECLARE C : INTEGER
03 DECLARE W : INTEGER
04 DECLARE X : INTEGER
05 W ← 0
06 C ← .....
07 WHILE A[C] <> 0
08     W ← .....
09     C ← C + 1
10 ENDWHILE
11 X ← .....
```

(a) Complete the given pseudocode algorithm. [3]

(b) Write pseudocode to display, with suitable messages:

- the number of values stored in the array
- the average of those values stored.

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..... [3]

(c) Meaningful identifiers have **not** been used in this algorithm.

Suggest suitable meaningful identifiers for:

The array

A .....

The variables

C .....

X .....

W .....

[3]