8 Algorithms & Programming
QUESTIONS

8 – Programming

8.1 Programming concepts				
1	Declare and use variables and constants			
2	Understand and use the basic data types			
3	Understand and use input and output			
4	(a) Understand and use the concept of sequence			
4	(b) Understand and use the concept of selection			
4	(c) Understand and use the concept of iteration			
4	(d) Understand and use the concepts of totalling and counting			
4	(e) Understand and use the concept of string handling			
4	(f) Understand and use arithmetic, logical and Boolean operators			
5	Understand and use nested statements			
6	(a) Understand what is meant by procedures, functions and parameters			
6	(b) Define and use procedures and functions, with or without parameters			
6	(c) Understand and use local and global variables			
7	Understand and use library routines			
8	Understand how to create a maintainable program			

More Guidance:

8.1 Programming concepts

Candidates should be able to:	Notes and guidance
1 Declare and use variables and constants	
2 Understand and use the basic data types	• Including: – integer – real – char – string – Boolean
3 Understand and use input and output	
4 (a) Understand and use the concept of sequence	
(b) Understand and use the concept of selection	• Including: – `IF` statements – `CASE` statements
(c) Understand and use the concept of iteration	• Including: – count-controlled loops – pre-condition loops – post-condition loops
(d) Understand and use the concepts of totalling and counting	
(e) Understand and use the concept of string handling	• Including: – length – substring – upper – lower • The first character of the string can be position zero or one

(f) Understand and use arithmetic, logical and Boolean operators	• Arithmetic, limited to: – + – − – / – * – ^ (raised to power of) – MOD – DIV • Logical, limited to: – = – < – <= – >> – >= – <> (not equal to) • Boolean, limited to: – AND – OR – NOT
5 Understand and use nested statements	• Including nested selection and iteration • Candidates will **not** be required to write more than three levels of nested statements
6 (a) Understand what is meant by procedures, functions and parameters (b) Define and use procedures and functions, with or without parameters (c) Understand and use local and global variables	• Procedures and functions may have up to two parameters
7 Understand and use library routines	• Including: – MOD – DIV – ROUND – RANDOM
8 Understand how to create a maintainable program	• Including appropriate use of: – meaningful identifiers – the commenting feature provided by the programming language – procedures and functions – relevant and appropriate commenting of syntax • Use meaningful identifiers for: – variables – constants – arrays – procedures and functions

8 Algorithms & Programming
QUESTIONS

8.2 Arrays				
1	Declare and use one-dimensional (1D) and two-dimensional (2D) arrays			
2	Understand the use of arrays			
3	Write values into and read values from an array using iteration			

More Guidance:

8.2 Arrays

Candidates should be able to:	Notes and guidance
1 Declare and use one-dimensional (1D) and two-dimensional (2D) arrays	
2 Understand the use of arrays	• Including the use of variables as indexes in arrays • The first index can be zero or one
3 Write values into and read values from an array using iteration	• Including nested iteration

8.3 File handling				
1	Understand the purpose of storing data in a file to be used by a program			
2	Open, close and use a file for reading and writing			

More Guidance:

8.3 File handling

Candidates should be able to:	Notes and guidance
1 Understand the purpose of storing data in a file to be used by a program	
2 Open, close and use a file for reading and writing	• Including: – read and write single items of data – read and write a line of text

8 Algorithms & Programming
QUESTIONS

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

A OR ☐

B < ☐

C <= ☐

D >= ☐

[1]

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

A function ☐

B parameter ☐

C return ☐

D subroutine ☐

[1]

3 **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]

4 Circle the **three** words representing places where data may be stored.

array constant dimension input

output procedure variable

[3]

4 Five data types and five data samples are shown below.

Draw a line to link each data type to the correct data sample.

Data type	Data sample
Integer	'a'
Real	2
Char	2.0
String	True
Boolean	"Twelve"

[4]

4 Four programming concepts and four examples of programming code are shown below.

Draw a line to link each programming concept to the correct example of programming code.

Programming concept	Example of programming code
Counting	`Sum = Sum + Value[n]`
Repetition	`IF Value = 10 THEN PRINT 'X'`
Selection	`FOR Counter = 1 TO 10`
Totalling	`Amount = Amount + 1`
	`Sum = Num1 + Num2`

[4]

3 A program will be written to store information about members of a swimming club.

The following membership details will be recorded:

- Name
- Gender
- Status:
  - Senior
  - Junior
- Fee
- Team member (Yes or No)

(i) Choose a suitable data type for each of the membership details to be recorded.

Membership details	Data type
Name	
Gender	
Status	
Fee	
Team member	

[5]

(ii) The swimming club has 50 members.

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

Data structure.....

Reason.....

.....[2]

5 `REPEAT ... UNTIL` is one type of loop structure.

Identify and describe **two** other types of loop structure that you could use when writing pseudocode.

Loop structure 1.....

Description.....

.....

Loop structure 2.....

Description.....

.....[4]

4 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]

4 **(a)** **Four** pseudocode descriptions and **five** pseudocode statements are shown. Draw one line to link each pseudocode description to the correct pseudocode statement. Not all pseudocode statements will be used.

Pseudocode description	Pseudocode statement
A loop that will iterate at least once.	FOR...TO...NEXT
A conditional statement to deal with many possible outcomes.	IF...THEN...ELSE...ENDIF
A loop that will iterate a set number of times.	WHILE...DO...ENDWHILE
A conditional statement with different outcomes for true and false.	CASE...OF...OTHERWISE...ENDCASE
	REPEAT...UNTIL

[4]

3 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]

4 A routine checks the weight of melons to be sold in a supermarket. Melons weighing under 0.5 kilograms are rejected and melons weighing over 2 kilograms are also rejected.

Give an example of each type of test data for this routine.

Normal .....

Extreme .....

Abnormal .....[3]

5 Identify **two** different conditional statements that you can use when writing pseudocode.

1 .....

2 .....[2]

4 A routine checks the age and height of children who are allowed to enter a play area. The children must be less than 5 years of age and under 1 metre in height.

(a) The first set of test data used is age 3 and height 0.82 metres.

State what type of test data this is.

.....

Give a reason for using this test data.

.....

.....[2]

(b) Provide **two** additional sets of test data. For each, give

- the type of each set of test data
- the reason why it is used

Each type of test data and reason for use must be different.

Set 1 .....

Type .....

Reason .....

.....

.....

Set 2 .....

Type .....

Reason .....

.....

.....[6]

5 **(a)** Rewrite the following pseudocode algorithm using a `WHILE … DO … ENDWHILE` loop.

```
INPUT Num
FOR Counter ← 1 TO 12
      Num ← Num * Counter
      A[Counter] ← Num
NEXT
```

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.....[4]

(b) Explain the differences between a `WHILE … DO … ENDWHILE` and a `REPEAT … UNTIL` loop.

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.....[4]

4 `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]

6 An algorithm has been written in pseudocode.

```
01 DECLARE A[1:10] : STRING
02 DECLARE T : STRING
03 DECLARE C, L : INTEGER
04 L ← 10
05 FOR C ← 1 TO L
06     OUTPUT "Please enter name "
07     INPUT A[C]
08 NEXT C
09 FOR C ← 1 TO L
10     FOR L ← 1 TO 9
11         IF A[L] > A[L + 1]
12           THEN
13             T ← A[L]
14             A[L] ← A[L + 1]
15             A[L + 1] ← T
16         ENDIF
17     NEXT L
18 NEXT C
19 FOR C ← 1 TO L
20     OUTPUT "Name ", C, " is ", A[C]
21 NEXT C
```

(a) State the purpose of this pseudocode algorithm.

.....

..... [1]

(b) State **four** processes in this algorithm.

1 .....

.....

2 .....

.....

3 .....

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4 .....

.....

[4]

(c) Meaningful identifiers have **not** been used in this algorithm.
Suggest suitable meaningful identifiers for:

The array:

`A` .....

The variables:

`T` .....

`C` .....

`L` .....

[3]

(d) State **two** other ways the algorithm can be made easier to understand and maintain.

1 .....

.....

2 .....

.....

[2]

8 A programmer is designing an algorithm to calculate the cost of a length of rope.
The program requirements are:

- input two values: the length of rope in metres `Length` and the cost of one metre `Cost`
- perform a validation check on the length to ensure that the value is between `0.5` and `6.0` inclusive
- calculate the price `Price`
- output the price rounded to two decimal places.

Use the variable names given.

(a) State the name of the validation check.

..... [1]

(b) Complete the flowchart for this algorithm.

[6]

(c) Give **two** different sets of test data for this algorithm and state the purpose of each set.

Set 1 .....

Purpose .....

.....

.....

Set 2 .....

Purpose .....

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.....

[4]

(d) Complete the headings for the trace table to show a dry-run for this algorithm.
You do **not** need to trace the algorithm.

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[3]

(e) Describe an improvement that should be made to the requirements for this algorithm.

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..... [2]

8 Algorithms & Programming
QUESTIONS

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

Verification is used to make sure that a value entered

A has **not** changed during input. ☐

B is an integer. ☐

C is correct. ☐

D is **not** a string. ☐

[1]

2 A type of validation check is a length check. Another type of validation check is used to make sure that any date entered is in the dd/mm/yyyy style:
dd means day, mm means month and yyyy means year.

(a) State the type of validation check used.

..... [1]

(b) Give **one** example of normal test data and **one** example of abnormal test data you should use to make sure the check **in part (a)** is working properly.

State a reason for each of your choices of test data.

Normal .....

Reason .....

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Abnormal .....

Reason .....

.....
[4]

(c) Describe how a length check could be used with the date entered.

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..... [2]

3 **Four** pseudocode statements and **five** pseudocode uses are shown.

(a) Draw **one** line to link each pseudocode statement to the most appropriate pseudocode use.

Not all pseudocode uses will be required.

Pseudocode statement	Pseudocode use
`CALL Colour(NewColour)`	counting
`Value ← (A1 + A2 + A3) / 3`	finding an average
`Loop1 ← Loop1 + 1`	totalling
`IF Count > 7 THEN X1 ← 0`	using a conditional statement
	using a procedure

[4]

(b) A one-dimensional (1D) array called `Temperatures[]` has 25 elements beginning at index 1. It holds values that range between –20 and 100 inclusive.

Write a pseudocode algorithm using a single loop to find the lowest value in this array and output the result only once.

You do **not** need to declare or populate this array.

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..... [4]

5 Explain how variables and constants should be used when creating and running a program.

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..... [3]

7 The string operation `SUBSTRING(Quote, Start, Number)` returns a string from `Quote` beginning at position `Start` that is `Number` characters long. The first character in `Quote` is in position 1.

Write pseudocode statements to:

- store the string `"Learning Never Exhausts The Mind"` in `Quote`
- extract and display the words `"The Mind"` from the string
- output the original string in lower case.

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..... [5]

8 Algorithms & Programming
QUESTIONS

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

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..... [4]

1 Tick (✓) **one** box to show which term is an example of a verification check.

A Double entry check ☐

B Format check ☐

C Length check ☐

D Presence check ☐

[1]

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

A DIV ☐

B MOD ☐

C RANDOM ☐

D ROUND ☐

[1]

3 **(a)** **Four** pseudocode descriptions and **five** pseudocode keywords are shown.

Draw **one** line to link each pseudocode description to the most appropriate pseudocode keyword. **Not** all pseudocode keywords will be used.

Pseudocode description	Pseudocode keyword
stores data in a file	OUTPUT
retrieves data from a file	WRITE
displays data on a screen	READ
enters data from a keyboard	OPEN
	INPUT

[4]

(b) Give **two** reasons for storing data in a file.

1 .....

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2 .....

.....

[2]

4 A programmer is writing a data entry program for booking theatre seats.
The programmer needs the program to accept only whole numbers that are greater than or equal to one and less than or equal to six.

(a) Give the names of **two** validation checks that are required for this program.

1 .....

2 .....
[2]

(b) Complete this pseudocode to perform your **two** validation checks, using your answers given in **(a)**:

```
OUTPUT "Please enter the number of seats you want to book "

INPUT Seats
```

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[5]

(c) Give **one** item of test data to use when testing this program.
State the reason for your choice of test data.

Test data .....

Reason for choice .....

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[2]

8 Algorithms & Programming
QUESTIONS

7 A program uses both local variables and global variables.

Describe **two** differences between local variables and global variables.

Difference 1 .....

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Difference 2 .....

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.....

[4]

2 Tick (✓) **one** box to show the name of the data structure used to store a collection of data of the same data type.

A Array ☐

B Constant ☐

C Function ☐

D Variable ☐

[1]

3 **(a)** Describe what is meant by data validation.

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.....

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..... [2]

(b) A validation check is used to make sure that any value that is input is an integer between 30 and 200 inclusive.

Give **one** example of each type of test data to check that the validation check is working as intended. Each example of test data must be different.

Give a reason for each of your choices of test data.

Normal test data .....

Reason .....

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Abnormal test data .....

Reason .....

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Extreme test data .....

Reason .....

.....

[6]

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

`DIV` .....

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`ROUND` .....

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[4]

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

Give a reason why each feature should be used.

1 .....

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2 .....

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[4]

8 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]

4 A program needs to make sure the value input for a measurement meets the following rules:

- the value is a positive number
- a value is always input
- the value is less than 1000.

(a) Describe the validation checks that the programmer would need to use.

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..... [3]

(b) The program needs editing to include a double entry check for the value input.

(i) State why this check needs to be included.

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..... [1]

(ii) The input value needs to be stored in the variable `Measurement`
Write pseudocode to perform the double entry check until a successful input is made.

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..... [3]

6 State **three** different features of a high-level programming language that a programmer could use to make sure that their program will be easier to understand by another programmer.
Give an example for each feature.

Feature 1 .....

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Example .....

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Feature 2 .....

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Example .....

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Feature 3 .....

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Example .....

.....

[6]

11 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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..... [4]

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

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..... [1]

8 Algorithms & Programming
QUESTIONS

1 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]

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

`MOD` .....

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`RANDOM` .....

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[4]

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

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..... [3]

4 **(a)** Explain why verification checks are used when data is input.

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..... [2]

(b) Give **two** types of verification check and state how each one can be used.

Verification check 1 .....

Use .....

.....

Verification check 2 .....

Use .....

.....

[4]

5 **(a)** **Four** descriptions of validation checks are shown.

Draw **one** line to link each description to the most appropriate check.

Not all checks will be used.

Description	Check
to check that the data entered is an integer	check digit
to check that some data has been entered	format check
to check that the data entered has an appropriate number of characters	length check
to check that an identification number contains no errors	presence check
	type check

[4]

(b) Write an algorithm in pseudocode to make sure that an input for the variable `Length` is between 15 and 35 inclusive. The code must iterate until a valid input has been made and the code must include appropriate messages.

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..... [3]

9 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]

8 Algorithms & Programming
QUESTIONS

1 Tick (✓) **one** box to show which word accurately describes the scope of a variable declared in a procedure.

A Function ☐

B Global ☐

C Local ☐

D Subroutine ☐

[1]

2 **(a)** **Four** descriptions and **five** pseudocode statements are shown.

Draw **one** line to link each description to its most appropriate pseudocode statement. **Not** all pseudocode statements will be used.

Description	Pseudocode statement
a statement to count	`FOR Count ← 1 TO 10`
a statement to total	`Value ← Value + NewValue`
a statement to start a pre-condition loop	`WHILE Value > 10 DO`
a statement to start a post-condition loop	`Value ← Value + 1`
	`REPEAT`

[4]

(b) Write an algorithm in pseudocode, using a single loop, to output the average of 50 numbers that have been stored in the array `Number[]`

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..... [5]

3 Describe the purpose of test data. Include an example of a type of test data in your answer.

Description .....

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Example .....

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[3]

4 Describe how variables and constants are used in programming.

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..... [3]

10 The variables `X`, `Y` and `Z` are used in a program: `X` stores a whole number, `Y` stores a decimal number and `Z` stores a flag that can be set to `TRUE` or `FALSE`

(a) Write pseudocode statements to declare the variables `X`, `Y` and `Z`

.....

.....

..... [3]

(b) The function `Same(A,B)` returns `TRUE` if the value of `A` is the same as the value of `B` when `B` is rounded to the nearest whole number and `FALSE` otherwise.

Write pseudocode statements to:
- define the function
- call the function with `X` and `Y` and store the return value in `Z`

Function definition .....

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Function call .....

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[6]

(c) State the difference between defining and calling a function.

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..... [1]