GradeMax

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0015260821

COMPUTER SCIENCE **9608/21**

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.

This document has **24** pages. Any blank pages are indicated.

DC (RW/FC) 205023/2
© UCLES 2021

[Turn over

PapaCambridge

GradeMax

1 **(a)** **(i)** State how characters are represented using the ASCII character set.

.....

.....

.....

..... [2]

(ii) String values may be represented by a sequence of ASCII characters.

The following table shows consecutive memory locations.

Complete the table by adding the values to show how the string `"FADED"` may be stored in memory using the ASCII character set.

Refer to the **Appendix** on pages 22–23 for the list of built-in pseudocode functions and operators, which includes a reference to the `ASC()` function.

Memory location	ASCII character value
100	
101	
102	
103	
104	

[2]

(b) Individual elements in a 1D array are referenced using an integer value.

In the pseudocode expression `StockID[n]`, the integer value is represented by the variable `n`.

(i) Give the technical terms for the minimum and maximum values for the variable `n`.

Minimum value .....

Maximum value .....

[1]

(ii) Give the correct term for the variable `n` in the pseudocode expression `StockID[n]`.

..... [1]

© UCLES 2021

PapaCambridge

GradeMax

(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 22–23 for the list of built-in pseudocode functions and operators.

Statement	Error
`Code ← LEFT("Cat", 4)`	
`Status ← MID("Aardvark", 0, 5)`	
`Size ← LENGTH("Password)`	
`Stock[n] ← Stock[n+1]`	
`Result ← 3 OR 4`	

[5]

© UCLES 2021

[Turn over

PapaCambridge

GradeMax

2 **(a)** The following pseudocode algorithm counts the number of each alphabetic character in the string `Msg`. The character count values are stored in an array `CharCount`.

Variable declarations are not shown.

```
FOR Index ← 1 TO 26
   CharCount[Index] ← 0
ENDFOR

FOR Index ← 1 TO LENGTH(Msg)
   ThisChar ← MID(Msg, Index, 1)
   ThisChar ← LCASE(ThisChar)
   IF ThisChar >= 'a' AND ThisChar <= 'z'
      THEN
         ThisIndex ← ASC(ThisChar) - 96 // value from 1 to 26
         CharCount[ThisIndex] ← CharCount[ThisIndex] + 1
   ENDIF
ENDFOR
```

© UCLES 2021

PapaCambridge

5

Draw a program flowchart to represent the algorithm.

Variable declarations are not required in program flowcharts.

[5]

PapaCambridge

GradeMax

(b) The character count values have been assigned to the array in **part (a)**.

Use **structured English** to describe an algorithm to:

- search the array
- output the alphabetic character that occurs most often (the highest character count value)
- output a suitable message if more than one alphabetic character has the same highest count value.

.....

.....

.....

GradeMax

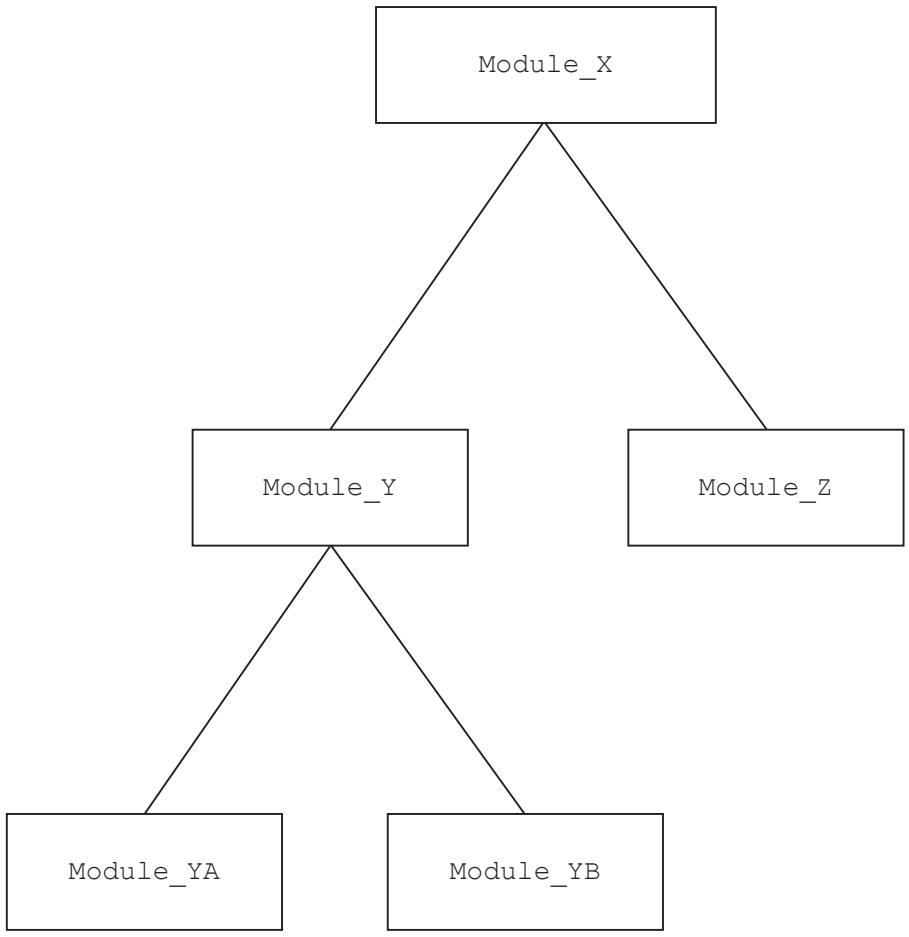
BLANK PAGE

PapaCambridge

3 **(a)** The following table contains information about five modules in a program. It describes the calls made and the parameters passed.

Module	Description
`Module_X`	• repeatedly calls `Module_Y` then `Module_Z` • passes a parameter of type `REAL` to `Module_Y` • passes two parameters of type `INTEGER` to `Module_Z`
`Module_Y`	calls either `Module_YA` or `Module_YB`
`Module_Z`	called with two parameters of type `INTEGER`
`Module_YA`	• called with a parameter of type `REAL` • parameter is passed by reference
`Module_YB`	• called with a parameter of type `INTEGER` • returns a `BOOLEAN` value

Complete the structure chart to include the information given about the five modules.

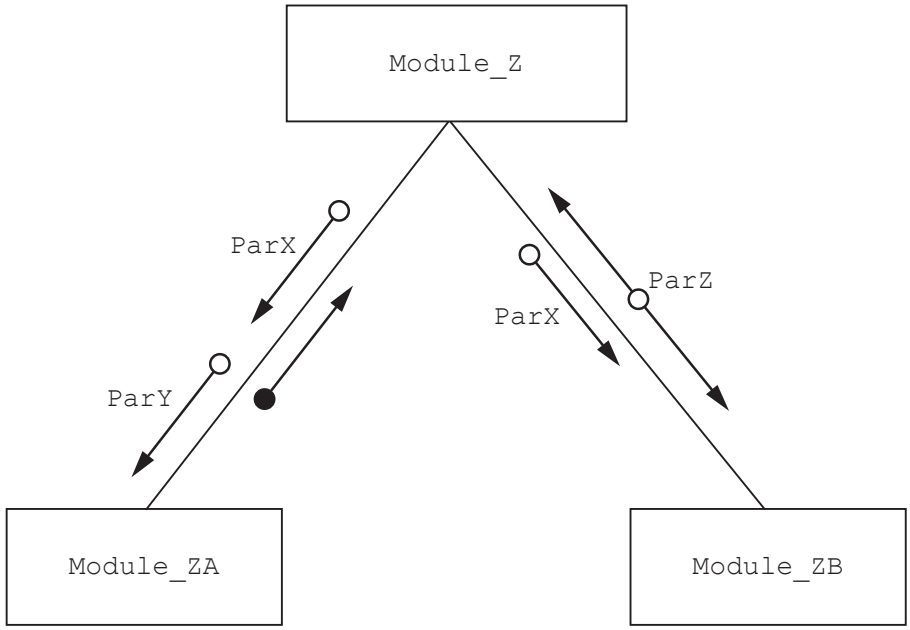


[5]

© UCLES 2021

PapaCambridge

(b) Two more modules are added to the chart below `Module_Z` as shown:



Parameter data types are:

```
ParX   : REAL
ParY   : INTEGER
ParZ   : STRING
```

(i) State whether `Module_ZA()` is a function or a procedure **and** justify your choice.

.....

.....

..... [2]

(ii) Write the **pseudocode** header for `Module_ZB()`.

.....

.....

..... [3]

PapaCambridge

4 The following is part of a program written in pseudocode:

```
DECLARE ThisArray : ARRAY[1:1000] OF STRING
DECLARE ArrayResult : INTEGER

PROCEDURE ScanArray(SearchString : STRING)

  DECLARE Index, Total : INTEGER
  DECLARE Error : BOOLEAN

  Index ← 1
  Total ← 0
  Error ← FALSE

  WHILE Index <= 1000 AND Error <> TRUE
     IF LENGTH(ThisArray[Index]) > 5
        THEN
           IF ThisArray[Index] = SearchString
              THEN
                 Total ← Total + LENGTH(ThisArray[Index])
           ENDIF
           Index ← Index + 1
        ELSE
           Error ← TRUE
     ENDIF
  ENDWHILE

  ArrayResult ← INT(Total / (Index - 1))

ENDPROCEDURE
```

The procedure `ScanArray()` is amended as follows:

- `SearchString` is compared with just the first **four** characters of each array element.
- The total ignores the first **five** characters of each array element.
- When calculating `ArrayResult`, prevent any possible division by zero.

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

© UCLES 2021

PapaCambridge

GradeMax

(a) Write **program code** to implement this **amended** procedure `ScanArray()`.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

PapaCambridge

GradeMax

(b) Context-sensitive prompts are a feature of a typical Integrated Development Environment (IDE).

Explain the term **context-sensitive prompt**.

.....

.....

.....

..... [2]

(c) **(i)** Identify the first stage in the program development cycle.

State the tasks that are completed during this stage.

First stage .....

Tasks .....

.....

.....

.....

.....

[3]

(ii) A program will be translated using a compiler.

Identify the stage of the program development cycle where a syntax error may occur.

..... [1]

© UCLES 2021

PapaCambridge

GradeMax

BLANK PAGE

PapaCambridge

GradeMax

5 Alice is developing an algorithm for a game. The game will count the number of attempts by a player to guess the secret number generated by the built-in random number function.

She will use pseudocode to develop a procedure, `GuessNum()`, that will:

1. generate a secret number that is a random integer in the range 1 to 20 inclusive
2. prompt and input the player's guess
3. output a message if the guess is not the same as the secret number and repeat from step 2
4. count the number of attempts it takes to guess the secret number
5. output a message when the secret number has been guessed correctly, giving the number of attempts.

(a) (i) Write **pseudocode** for the procedure `GuessNum()`.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

© UCLES 2021

PapaCambridge

GradeMax

(ii) Suggest **two** different validation checks that could be applied to the input of the procedure `GuessNum()` to ensure invalid guesses are not counted.

1 .....

.....

.....

2 .....

.....

.....

[2]

(b) Alice is converting her pseudocode into a high-level language for use in a larger modular program.

She wants to start testing the program before all the subroutines (procedures and functions) have been implemented.

(i) Identify this type of testing.

..... [1]

(ii) Her program contains a function `Status()` that she has not yet written, but will be called from several places within the program.

Explain what Alice needs to do to allow the program to be tested.

.....

.....

.....

.....

..... [2]

(iii) Alice compiles her program.

Explain the function of the compiler.

.....

..... [1]

© UCLES 2021

[Turn over

PapaCambridge

6 A program stores stock data in four global arrays as follows:

Array	Data type	Description	Example data value	Initial data value
`StockID`	`STRING`	The stock item ID (Eight alpha-numeric characters)	`"HWDM0001"`	`""`
`Description`	`STRING`	A description of the item (Alphabetic characters only)	`"Candle"`	`""`
`Quantity`	`INTEGER`	The number in stock	`4`	`0`
`Cost`	`REAL`	The cost of the item	`2.75`	`0`

- Each array contains 10 000 elements.
- Elements with the same index relate to the same stock item. For example, `StockID[4]` contains the ID for the product whose description is in `Description[4]`.
- 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 program is to be modified so that the data from the arrays can be stored in a text file for backup.

The programmer has started to define program modules as follows:

Module	Description
`GetValidFilename()`	• prompts, inputs and returns a valid filename
`Check()`	• called with an array index as a parameter • checks that the data values for the stock item with the given index are valid • returns `TRUE` if the values are valid, otherwise returns `FALSE`
`Backup()`	• calls `GetValidFilename()` to get the name of the backup file • combines the data values for each stock item to form a single string. Inserts an asterisk character '*' as a separator between data values • writes the string to the backup file • calls `Check()` to validate the data values. If there is an error then also writes the string to the file `"ERRORLOG.TXT"` • repeats for all stock items • returns `TRUE` if nothing was written to `"ERRORLOG.TXT"`, otherwise returns `FALSE`

`Unpack()`	• called with two parameters:
	  ○ an array index
	  ○ a string value read from one line of the backup file
	• extracts the four data values from the string and assigns each to the appropriate array

© UCLES 2021

PapaCambridge

GradeMax

(a) Write **program code** for the module `Check()`.

Data values relating to an individual stock item are valid if:

- the `StockID` element is of length 8
- the `Description` is not an empty string
- the `Quantity` is zero or above.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

PapaCambridge

(b) Write **pseudocode** for the module `Backup()`.

PapaCambridge

GradeMax

.....

.....

.....

.....

.....

..... [8]

© UCLES 2021

[Turn over

PapaCambridge

GradeMax

(c) The module description of `Unpack()` is repeated here for reference.

Module	Description
`Unpack()`	• called with two parameters: o an array index o a string value read from one line of the backup file • extracts the four data values from the string and assigns each to the appropriate array

Write **program code** for the module `Unpack()`. You may assume that the backup file contains only valid stock information.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

© UCLES 2021

PapaCambridge

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [8]

© UCLES 2021

PapaCambridge

GradeMax

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`

`LCASE(ThisChar : CHAR) RETURNS CHAR`
returns the character value representing the lower case equivalent of `ThisChar`
If `ThisChar` is not an upper case alphabetic character, it is returned unchanged.

Example: `LCASE('W')` returns `'w'`

`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` (not inclusive of `x`).

Example: `RAND(87)` could return `35.43`

`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"`

© UCLES 2021

PapaCambridge

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`

© UCLES 2021

PapaCambridge

GradeMax

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.

© UCLES 2021

PapaCambridge