

Cambridge
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AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

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NAME

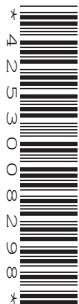
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COMPUTER SCIENCE

9608/22

Paper 2 Fundamental Problem-solving and Programming Skills

October/November 2017

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

No calculators allowed.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

No marks will be awarded for using brand names of software packages or hardware.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The maximum number of marks is 75.

This document consists of **14** printed pages and **2** blank pages.

1 (a) (i) Procedural high-level languages usually support different data types.

Give an appropriate data type for each data value in the following table:

| Data value | Data type |
|------------|-----------|
| FALSE | |
| 03/03/2013 | |
| 35 | |
| "INTEGER" | |
| 3.5 | |
| "35" | |

[6]

(ii) The following is a declaration in a high-level language:

```
DEFINE MyGrade[1 to 100]
```

State the data structure of variable `MyGrade`.

..... [1]

(iii) An experienced programmer is presented with program code in an unfamiliar high-level language.

State **two** features of the code that the programmer should be able to recognise.

1

.....

2

.....

[2]

- (b) (i) In the ASCII character set 'A' is represented by the value 65. The values representing the other characters of the alphabet follow in sequence, so 'B' is represented by 66, 'C' by 67 and so on.

The following table represents consecutive memory locations. Each memory location stores one byte.

Complete the table to show how the string "CAGE" may be stored in memory using the ASCII set.

| Address | Data |
|---------|------|
| 100 | |
| 101 | |
| 102 | |
| 103 | |
| 104 | |
| 105 | |

[2]

- (ii) In a high-level language, a LENGTH function is used to return the number of characters in a string.

Explain what is stored in addition to the string characters to allow this function to determine this number.

.....

.....

.....

..... [2]

- (c) Functions and procedures are subroutines.

Explain why parameters are used with subroutines.

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.....

..... [3]

Question 2 begins on the next page.

2 A 1D array, `ClassName`, of type `STRING` contains 100 elements.

The following pseudocode represents a simple algorithm to process the array.

```
DECLARE SearchValue : STRING
DECLARE FoundFlag : BOOLEAN
DECLARE Index : INTEGER

INPUT SearchValue
FoundFlag ← FALSE
Index ← 1

WHILE Index < 101 AND FoundFlag = False
  IF ClassName[Index] = SearchValue
    THEN
      OUTPUT Index
      FoundFlag ← TRUE
    ENDIF
  Index ← Index + 1
ENDWHILE

IF FoundFlag = FALSE
  THEN
    OUTPUT "Not found"
  ENDIF
```

(a) Describe the purpose of the algorithm.

.....

.....

.....

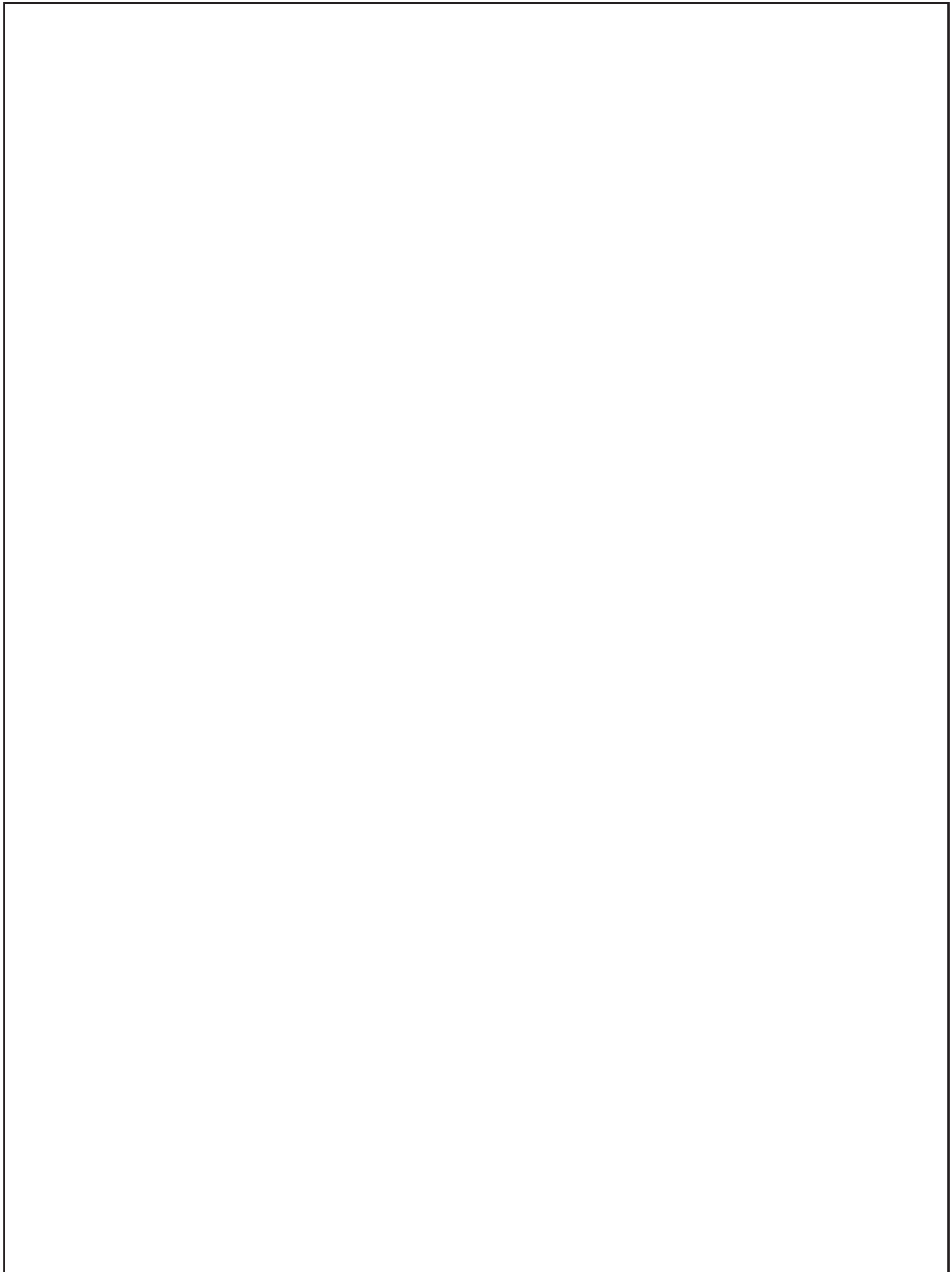
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..... [2]

(b) Draw a program flowchart to represent this algorithm.

Note that variable declarations are not required in program flowcharts.



[9]

- 3** A 1D array, `Product`, of type `STRING` is used to store information about a range of products in a shop. There are 100 elements in the array. Each element stores one data item.

The format of each data item is as follows:

<ProductID><ProductName>

- `ProductID` is a four-character string of numerals
- `ProductName` is a variable-length string

The following pseudocode is an initial attempt at defining a procedure, `ArraySort`, which will perform a bubble sort on `Product`. The array is to be sorted in ascending order of `ProductID`. Line numbers have been added for identification purposes only.

```
01  PROCEDURE SortArray
02      DECLARE Temp : CHAR
03      DECLARE FirstID, SecondID : INTEGER
04      FOR I ← 1 TO 100
05          FOR J ← 2 TO 99
06              FirstID ← MODULUS(LEFT(Product[J], 6))
07              SecondID ← MODULUS(LEFT(Product[J + 1], 6))
08              IF FirstID > SecondID
09                  THEN
10                      Temp ← Product[I]
11                      Product[I] ← Product[J + 1]
12                      Product[J + 1] ← Temp
13          ENDFOR
14      ENDIF
15  ENDFOR
16  ENDPROCEDURE
```


The pseudocode on page 8 contains a number of errors. Complete the following table to show:

- the line number of the error
- the error itself
- the correction that is required.

Note:

- If the same error occurs on more than one line, you should only refer to it ONCE.
- Lack of optimisation should not be regarded as an error.

| Line number | Error | Correction |
|-------------|------------------------------------|---------------------|
| 01 | Wrong procedure name – “SortArray” | PROCEDURE ArraySort |
| | | |
| | | |
| | | |
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| | | |
| | | |

[8]

- 4 Programming languages provide built-in functions to generate random numbers. To be truly random, the frequency of each number generated should be the same.

You are required to write program code to test the random number generator of your chosen language.

The test should:

- generate a given number of random numbers between 1 and 10 inclusive
- keep a count of the number of times each number is generated
- calculate the expected frequency of each number 1 to 10
- output the actual frequency of each number 1 to 10
- output the difference between the actual frequency and the expected frequency.

The program code should be written as a procedure. In pseudocode, the procedure heading will be:

```
PROCEDURE TestRandom(Repetitions AS INTEGER)
```

The parameter, *Repetitions*, contains a value representing the total number of random numbers that should be generated.

The following example shows the expected output for the procedure call, `TestRandom(200)`.

The expected frequency is 20.

| Number | Frequency | Difference |
|--------|-----------|------------|
| 1 | 17 | -3 |
| 2 | 21 | 1 |
| 3 | 12 | -8 |
| 4 | 28 | 8 |
| 5 | 20 | 0 |
| 6 | 19 | -1 |
| 7 | 21 | 1 |
| 8 | 16 | -4 |
| 9 | 24 | 4 |
| 10 | 22 | 2 |

(b) Name **three** features of a typical IDE that would help a programmer to debug a program.

Explain how each of these could be used in the debugging of the `TestRandom` procedure from **part (a)**.

Feature 1

Explanation

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.....

.....

Feature 2

Explanation

.....

.....

.....

Feature 3

Explanation

.....

.....

.....

[6]

(c) The procedure is developed and run using the call `TestRandom(200)`. No system errors are produced.

To ensure that the procedure works correctly, you need to check the output.

Describe **two** checks you should make to suggest the program works correctly.

1

.....

.....

2

.....

.....

[2]

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Appendix

Built-in functions (pseudocode)

In each function, if the function call is not properly formed, the function returns an error.

MODULUS (x : INTEGER, y : INTEGER) RETURNS INTEGER

returns the remainder when x is divided by y using integer arithmetic.

Example: MODULUS (5, 2) will return 1

INT (x : REAL) RETURNS INTEGER

returns the integer part of x .

Example: INT (27.5415) returns 27

LENGTH (ThisString : STRING) RETURNS INTEGER

returns the integer value representing the length of string 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 string "ABC"

RIGHT (ThisString : STRING, x : INTEGER) RETURNS STRING

returns rightmost x characters from ThisString.

Example: RIGHT ("ABCDEFGH", 3) returns string "FGH"

TONUM (ThisString : STRING) RETURNS INTEGER

returns a numeric value equivalent to ThisString.

Example: TONUM ("1201") returns integer value 1201

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 |

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