OCR
Oxford Cambridge and RSA

Friday 9 June 2017 – Morning

GCE COMPUTING

F452/01   Programming Techniques and Logical Methods

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

*   Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
*   Use black ink. HB pencil may be used for graphs and diagrams only.
*   Answer **all** the questions.
*   Read each question carefully. Make sure you know what you have to do before starting your answer.
*   Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
*   Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

*   The number of marks is given in brackets **[ ]** at the end of each question or part question.
*   The total number of marks for this paper is **100**, the quality of written communication will be assessed where an answer requires a piece of extended writing.
*   This document consists of **24** pages. Any blank pages are indicated.

Turn over

1 A mountain walking club is setting up a database of mountains located within the United Kingdom (UK). The database will contain:

- the mountain's name (e.g. Scafell Pike).
- height in metres (e.g. 633).
- map reference made up of two grid letters (e.g. SK) and 6 digit co-ordinates (e.g. 079871).

(a) Design an input screen to gather the required information to add a mountain to the database.

[5]

(b) (i) Complete the table below to show the most appropriate data type for each variable in the record.

	Data type	**Size in bytes**
Mountain Name		
Height of Mountain		
Grid Letters		
Co-ordinates		

[4]

(ii) The mountain records are to be held in a serial file. The maximum number of records to be stored is 2000. Calculate the maximum size of the file in Kilobytes (KB). Show your working.

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(c) The database is stored in a serial file. Explain how the program could ensure duplicate records for mountains are not added to the database.

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(d) In the context of records, state what a field is.

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.... **[1]**

(e) When a file is opened in a procedural programming language, the access mode is usually stated. State the name of **two** access modes.

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2 ....

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 [2]

(f) The database is going to be expanded to include all mountains in Europe. This will mean that additional data will need to be added (i.e. Country), and also there will be many more records. The developer is looking at changing the file type from serial to either index sequential or random access.

Evaluate the use of an index sequential or random access file to hold the mountain details.

The quality of written communication will be assessed in your answer to this question. **[8]**

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Turn over

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2 A company is going to transfer sensitive data between offices around the world. They have decided to encrypt the data using a bespoke system.

(a) The software company producing the encryption software are going to produce a top down design. Explain the advantages of using a top down design.

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.... **[2]**

(b) The encryption will work by using a key of 4 or more standard ASCII characters (0–127) and applying this to the standard ASCII text of the document.

The following function is used to enter the encryption key.

```
FUNCTION EnterKey(): STRING

    STRING key

    REPEAT
       OUTPUT "Enter Key"
       INPUT key
       IF LENGTH(key) <4 THEN
          OUTPUT "Key must be at least 4 characters long"
       END IF
    UNTIL LENGTH(key)>=4

    RETURN key

END FUNCTION
```

(i) Using the code of function `EnterKey` give examples of selection and sequence.

Selection ....

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Sequence ....

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[2]

(ii) During alpha testing it was found that the longer the key, the greater the chance of mistyping it. It was decided to limit the key to 128 characters. Rewrite the function `EnterKey` to include the key length limit of 128 characters.

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(c) The key is held in an array and the sensitive data in a file. The data is encrypted by taking the ASCII value of the next character in the key and adding it to the ASCII value of the next character in the data, to give the encrypted extended ASCII character (0–255). This continues until end of file (EOF).

For example if the data was "Computers" and the key was "Slip".

Data	C	o	m	p	u	t	e	r	s
ASCII Decimal Value	67	111	109	112	117	116	101	114	115
Key	S	l	i	p	S	l	i	p	S
ASCII Decimal Value	83	108	105	112	83	108	105	112	83
Extended ASCII Value	150	219	214	224	200	224	206	226	198
Extended ASCII Character	û	█	Í	Ó	╚	Ó	╫	Ô	ã

Write an algorithm for a procedure that reads the data from a file, applies the key and then writes the encrypted data back to another file, as extended ASCII characters.

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(d) When running the software an error occurs. State the name of, and describe **three** features of debugging tools that would help locate the error(s).

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Description ....

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Name ....

Description ....

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Name ....

Description ....

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[9]

3 A software company is going to produce a game where each player's hero competes against other player's heroes for dominance. Each hero starts with the same number of points for defence, attack and health, which are all stored using the integer data type.

(a) For each round of the contest, when one hero attacks another, the following happens:

- The attacker's attack points are multiplied by a random integer number between 1 and 8.
- The defender's defence points are multiplied by a random integer number between 1 and 8.
- The new total of the attack points is compared to the new total defence points. Whoever has the highest value wins that round. The winner has half the difference in values added to their attack (attacker wins) or defence (defender wins) points, with the remainder added to their health points.
- Each hero's attack/defence/health points are stored as global variables (e.g. Attacker_AttackPoints, Defender_DefencePoints, Defender_HealthPoints etc.).

Write an algorithm for a procedure that will perform **one** round of the contest.

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Turn over

(b) There are three main types of programming error. State the name of, and using examples, explain **two** programming errors.

Name ....

Explanation ....

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Name ....

Explanation ....

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[6]

(c) To improve the maintainability of software, code can be written to be self-documenting. Give **three** ways the code can be made self-documenting.

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[3]

(d) In the context of source code, explain the terms constant and reserved word.

Constant ....

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Reserved word ....

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[4]

(e) Complete the following expressions.

45 / 2 = ...

35 DIV 6 = ...

38 MOD 6 = ...

42 + 35 DIV 6 = ...

[4]

Turn over

4 The following algorithm has been produced to quickly change human readable text to an encrypted form.

```
01  PROCEDURE Encrypt(inText:String) / Elements are numbered 1 to n
02      i = 0
03      k = 0
04      REPEAT
05          i = i + 1
06          k = i + 1
07          IF i <> LENGTH(inText) THEN
08              PRINT MID(inText,k,1)
09          END IF
10          PRINT MID(inText,i,1)
11      UNTIL i = LENGTH(inText)
12  END PROCEDURE
```

(a) Complete the trace table for PROCEDURE Encrypt if the string "mat" is passed.

Line No	inText	i	k	Print	Comment

[4]

Turn over

(b) Produce a flowchart for `PROCEDURE Encrypt.`

[5]

(c) A programming language has a `LOCATE` function which returns the start position of a substring in a larger string. State the value that would be returned in the following cases, if string elements are numbered 1 to n.

`LOCATE("is","Hard disk")` returns ....

`LOCATE("ri","processor Prints")` returns ....

`LOCATE("ab","source code")` returns ....

[3]

5 The following recursive function has been produced to total the number of odd values in the range of 0 to n.

```
01  FUNCTION Sum_Odd(INTEGER n)
02      IF n<2 THEN
03          RETURN 1
04      ELSE IF n MOD 2 = 0 THEN
05          RETURN Sum_Odd(n-1)
06      ELSE
07          RETURN n + Sum_Odd(n-2)
08      END IF
09  END FUNCTION
```

(a) Trace the execution of this recursive call when called as `Sum_Odd(5)`.

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(b) Rewrite the `Function Sum_Odd(n)` to change it from a recursive function to a function that uses iteration to produce the same outcome.

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END OF QUESTION PAPER

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