



Oxford Cambridge and RSA

AS Level Computer Science

H046/02 Algorithms and problem solving

Friday 9 June 2017 – Morning

Time allowed: 1 hour 15 minutes



Do not use:

- a calculator



First name										
Last name										
Centre number						Candidate number				

INSTRUCTIONS

- Use black ink.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.

INFORMATION

- The total mark for this paper is **70**.
- The marks for each question are shown in brackets [].
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **12** pages.

2

- 1 A 2-dimensional (2D) array, `data`, holds numeric data that Karl has entered. The declaration for the array is:

```
array data[16,11]
```

The array `data`, has 16 'rows' and 11 'columns'.

Fig. 1.1 shows an extract from `data`.

	0	1	2	3	...	10
0	1	5	7	12	...	36
1	3	4	15	16	...	48
2	0	0	1	3	...	10
3	12	16	18	23	...	100
...
15	6	10	15	25	...	96

Fig. 1.1

The data in each 'row' is in ascending numerical order.

Karl needs to analyse the data.

- (a) Karl needs to find out if a number he enters appears in a given row of the array. He is going to use a search algorithm to do this.

- (i) State the name of **two** different search algorithms that Karl could consider using.

1

2

[2]

2 A group of A-level students are working together to program a computer game.

In the game, the player controls a character who moves through a virtual world. The game starts with a load-up screen. The player can select which area to move to on an on-screen map, and then they control the movements of their character using a keyboard to solve puzzles on the screen.

(a) Identify **two** inputs that the user could enter to control the character and describe each input's function.

Input 1

Use

Input 2

Use

[4]

(b) The game is to be created using sub-procedures. The following table identifies and describes one sub-procedure the students could use.

Complete the table below, identifying **three** additional sub-procedures that the students could create from the description at the start of question 2.

Describe the purpose of each sub-procedure you have identified.

	Sub-procedure	Purpose
e.g.	characterMovement	Takes the key the player pressed and moves the character in that direction
1		
2		
3		

[6]

(c) The following pseudocode algorithm is for the sub-procedure `characterMovement`.

```
procedure characterMovement(inputKey:byVal, characterx:byRef,  
characterY:byRef)  
    if inputKey == 37 then  
        characterx = characterx + 1  
    elseif inputKey == 38 then  
        characterY = characterY + 1  
    elseif inputKey == 39 then  
        characterx = characterx - 1  
    elseif inputKey == 40 then  
        characterY = characterY - 1  
    endif  
endprocedure
```

(i) Identify the **three** parameters in the procedure `characterMovement`.

- 1
- 2
- 3 **[3]**

(ii) Describe the decision that is made in this procedure and how the decision affects the flow through the procedure.

-
-
-
-
-
- **[3]**

(iii) Explain why `characterx` and `characterY` are passed `byRef` and not `byVal`.

-
-
-
-
-
- **[3]**

- 3 A procedure takes as input a number between 1 and 100. It calculates and outputs the square of each number starting from 1, to the number input. The square of a number is the result of multiplying a number by itself.

```

procedure squares()
  do
    number = int(input("Enter a number between 1 and 100"))
  until number >= 1 AND number <= 100

  for x = 1 to number
    print(x * x)
  next x
endprocedure

```

- (a) The procedure uses one programming construct twice.

State whether the construct that is used twice, is iteration or branching.

..... [1]

- (b) State why the algorithm is a procedure and not a function.

.....
 [1]

- (c) The procedure needs to be tested.

- (i) Describe how black box testing can be used to test a program.

.....

 [3]

- (ii) For each type of test given in the table, identify **two** examples of test data that can be used to test the program.

Test Type	Test Data 1	Test Data 2
Normal		
Extreme		
Invalid		

[3]

- 4 A program stores a queue of mathematical questions to be asked to a user. The questions are asked in the order they are added. Once a question has been asked it cannot be asked again. New questions are continually added to the end of the queue.

The program will use a non-circular queue, `questions`, (implemented using an array) to store the questions.

The pointer, `head`, stores the index of the first element in the queue.

The pointer, `tail`, stores the index of the last element in the queue.

- (a) Describe why a queue is a suitable structure for this program.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

- (b) Fig. 4.1 shows an example of the data in the queue. `head` is currently 0, `tail` is currently 4.

"2*3"	"1+4"	"3-1"	"10/2"	"3+6"			
-------	-------	-------	--------	-------	--	--	--

Fig. 4.1

- (i) Show the contents of the queue shown in Fig. 4.1, after the following code is run.

```
add("6+1")
```

--	--	--	--	--	--	--	--

[2]

- (ii) State the values stored in `head` and `tail` after the code in **part (i)** has run.

`head`

`tail`

[2]

(c) Complete the following algorithm, to remove, and output, the first element in the queue.

```
procedure remove()
```

.....

.....

.....

.....

.....

.....

.....

.....

```
endprocedure
```

[4]

(d) Complete the following algorithm, to ask the user to input a new question and then either add it to the queue, or report that the queue is full.

```
procedure add()  
    maxElements = 10
```

.....

.....

.....

.....

.....

.....

.....

.....

```
endprocedure
```

[4]

END OF QUESTION PAPER

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