Oxford Cambridge and RSA

Monday 19 May 2025 – Afternoon

AS Level Computer Science

H046/02 Algorithms and problem solving

Time allowed: 1 hour 15 minutes

Do not use:
- a calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink.
- Write your answer to each question in the space provided. If you need extra space use the lined page at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **16** pages.

ADVICE
- Read each question carefully before you start your answer.

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1 A gym owner would like a program for members to be able to book gym classes. Each class can have a maximum of 20 members.

Members will enter their membership ID and then the date and time of the class they want to attend. Validation rules will check these details meet set rules. If they do not meet the validation rules then an error message will be displayed. A confirmation message will be displayed if the class is not full. A bleeping sound will play if the class is full.

(a) Identify **two** inputs and **two** outputs for the program.

Input 1 .....

Input 2 .....

Output 1 .....

Output 2 .....

[4]

(b) The programmer is identifying any possible reusable components in the program design.

Explain why the programmer should create reusable program components.

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..... **[3]**

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2 Players in a computer game collect items. Each item has a name, e.g. “Fruit” and a type, e.g. “Apple”. The items for player 1 are stored in a 2D array. The array is 0-indexed.

The pseudocode declaration for the array is:

```
array p1Items[10,2]
```

The first dimension stores the item name and the second dimension stores the type.

(a) One characteristic of the array is that it has 2 dimensions.

Identify **two** other characteristics of the given array.

1 .....

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2 .....

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[2]

(b) When the game starts, the pseudocode procedure `initialiseArray` will initialise each name and type in the array to `"empty"`.

```
01   procedure initialiseArray(p1Items:byRef)
02         counter = 0
03         while counter < 10
04              p1Items[counter, 0] = "empty"
05              p1Items[counter, 1] = "empty"
06              counter = counter + 1
07         endwhile
08   endprocedure
```

(i) State why `empty` is in speech marks on lines `04` and `05`.

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..... **[1]**

(ii) Rewrite the code in lines `02` to `07` to use a for loop instead of a while loop.

Write your answer using pseudocode or program code.

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..... **[2]**

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(iii) State **one** reason why the array should be passed by reference and **not** by value.

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..... **[1]**

(c) When a user collects an item, the name and type are added to the array `p1Items`.

At the end of the game, the name of each item collected is output.

Write an algorithm, using pseudocode or program code, to:
- output the name of each item in the array
- output a suitable message if there are no items in the array.

If the item is `"empty"` it should **not** be output.

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..... **[6]**

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3 A student has written this algorithm in pseudocode:

```
for x = 1 to 4
     item = data[x]
     y = x - 1
     while (y >= 0) and (item < data[y])
          data[y + 1] = data[y]
          y = y - 1
     endwhile
     data[y + 1] = item
next x
```

Test the algorithm by completing the trace table.

The array `data` is a 1-dimensional array with 5 positions initialised with the data shown in the trace table.

You should continue your answer on the next page if you need more space.

			data				
x	**item**	**y**	**0**	**1**	**2**	**3**	**4**
			10	2	5	20	19

[6]

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Additional space for question 3 if required.

			data				
x	**item**	**y**	**0**	**1**	**2**	**3**	**4**

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4* A group of four students have decided to create a computer program to help teach younger children how to write programs in a text-based language.

(a) They intend to divide the program into sub programs that they will develop individually before combining them together to form the final solution.

The students are considering the agile methodologies or the waterfall lifecycle.

Compare the use of the agile methodologies and waterfall lifecycle for the students' project.

You should include the following in your answer:
- features of each software development methodology
- benefits of each software development methodology in this scenario
- drawbacks of each software development methodology in this scenario.

[9]

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(b) The students intend to use both black-box testing and white-box testing.

Give **one** difference between black-box testing and white-box testing.

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..... **[1]**

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5 A programmer has been given this pseudocode algorithm.

```
01  do
02     data = input("Enter the code")
03  until data.length > 20
04  first = data.substring(0,1)
05  second = data.substring(1,1)
06  first = int(first)
07  second = int(second)
08  if first > second then
09     print(str(first) + "wins")
10  elseif first == second then
11     print("It's a draw")
12  else
13     print(second + "wins")
14  endif
```

The pseudocode algorithm calls different subroutines.

(a) Identify **two** subroutines that are called in the pseudocode algorithm.

1 .....

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2 .....

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[2]

(b) Name the programming constructs that start on line `01` and line `08` in the pseudocode algorithm.

`01` .....

`08` .....

[2]

(c) State the purpose of line `06`.

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..... **[1]**

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(d) The programmer needs to extend the program.

The program will use a linear search.

(i) The linear search has been written as a pseudocode function that:

- takes an array called `array` of an unknown length as a parameter
- takes a search value called `value` to search for as a parameter
- uses a linear search to find the `value` in the array
- returns `true` if the value is found and `false` otherwise.

Complete the pseudocode function.

```
function linearSearch(array, ............................)

  counter = 0

  while counter .............  array.length

    if array[counter] == value then

      return ............................

    endif

    counter = counter ............................

  endwhile

  ............................  ............................

endfunction
```

[5]

(ii) One alternative search algorithm is a binary search.

Describe the steps in a binary search.

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..... **[4]**

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6 Two data structures are a queue and a stack.

(a) Describe **one** difference between a queue and a stack.

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(b) The current contents of a stack created from an array called `stack` and pointer called `topPointer` are shown:

index	stack
7	
6	
5	
4	
3	
2	13
1	21
0	10

The `topPointer` currently stores `2`.

(i) State the purpose of `topPointer` in the stack.

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..... **[1]**

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(ii) Describe the steps that will be followed to remove an item from the stack.

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(iii) Complete the function to insert a new data item onto the stack.

```
function push(dataItem)
  if topPointer ............................................ 7 then
    return false
  else
    topPointer = ............................................
    stack[topPointer] = ............................................
    return true
  endif
endfunction
```

[3]

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7 Write an algorithm, using program code or pseudocode to:

- take a user's date of birth as a string input in the format DD/MM/YYYY
- take a year as input from the user in the format YYYY
- output the age the user will be on their birthday in the year input in the format:
  `You will be 18 on the 1 January 2029`

You can use the function `getMonth()` to convert a 2-digit month into a string. For example:

`getMonth(02)` will return `"February"`.

You do not need to check the inputs are in the correct format.

You should assume the year entered will always be in the future.

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..... **[8]**

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8 Show each pass of a bubble sort to sort the following string data into descending order.

friend sun earth orange night time

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..... **[4]**

END OF QUESTION PAPER

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EXTRA ANSWER SPACE

If you need extra space use this lined page. You must write the question numbers clearly in the margin.

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