

Examiners' report

AS LEVEL

COMPUTER SCIENCE

**OCR Level 3 Advanced Subsidiary GCE
in Computer Science**

H046

For first teaching in 2015

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from [Teach Cambridge](#).

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Paper 2 series overview

Paper 2 focuses on algorithms and problem solving. It tests candidates' computational thinking ability to analyse and solve problems. Candidates are expected to be able to write algorithms fluently in either pseudocode or program code and to be able to trace algorithms.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• demonstrated good factual knowledge of terms on the specification • demonstrated an ability to trace algorithms accurately • demonstrated an ability to complete algorithms and to describe standard algorithms such as binary search • demonstrated an ability to write well-structured and logical pseudocode to solve problems.	• showed some factual knowledge but were less able to show depth of knowledge • showed a limited knowledge of standard sorting and searching algorithms such as bubble sort and binary search • found algorithms challenging to complete • showed a limited ability to write pseudocode or program code.

Question 1 (a)

- 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]

Most candidates were given full marks by identifying relevant inputs and outputs from the question stem.

Question 1 (b)

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

Explain why the programmer should create reusable program components.

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

[3]

Most candidates were given at least 1 mark, often for quantifying that programming time would be saved. Fewer candidates were able to expand with a full range of additional points. Where they did so, reasons related to readability, efficiency and testing were the most common responses.

Question 2 (a)

- 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 plItems[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

.....

2

.....

[2]

Many candidates gave generic characteristics of arrays rather than relating their responses to the specific array in the question. Responses such as 'arrays contain a single data type' were not accepted, whereas a response that stated this array held string data only were accepted.

Question 2 (b) (i)

- (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.

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

Most candidates correctly identified that speech marks were required to denote string data. Incorrect responses often talked about initialising the value but omitted the role of the speech marks.

Question 2 (b) (ii)

- (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.

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

Many candidates were unable to convert the *while loop* to a *for loop*. Common errors included trying to include a condition in a for loop, incrementing the loop counter variable inside the for loop, and not iterating through the correct sequence of values. Where candidates responded with solutions that were clearly written in Python, they were not given for loops in *range* (9) since this would only iterate between 0 and 8.

Exemplar 1

```
for x in range(0, 9):  
    p1items[counter, 0] = "empty"  
    p1items[counter, 1] = "empty"  
    counter = counter + 1  
end for
```

[2]

This response exemplifies many of the typical programming errors and misconceptions that some candidates have. The loop index variable does not match the identifier being used to index the item in *p1items*. The *counter* increment from the *while* loop has been erroneously copied into the candidate's *for* loop. The candidate has also clearly used a Pythonic syntax that would need to be *range(0, 10)* to yield the correct values.

Question 2 (b) (iii)

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

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

Many responses displayed a clearer understanding of this topic than in previous series, with many candidates successfully identifying that passing by reference would maintain changes made to the array after the procedure had completed.

Question 2 (c)

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

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.

.....

.....

.....

.....

.....

..... [6]

A range of solutions to the question were observed and some efficient solutions were seen. It was clear that some candidates found 2D array indexing challenging and so could not access elements of the structure correctly. Candidates found the first part of the problem to output the names of items in the array more accessible than devising a mechanism to determine if there were no items in the array.

Question 3

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]

Tracing the code for an insertion sort was found to be challenging by many candidates. Few candidates were given full marks. Many candidates could trace the state change for the *x*, *item* and *y* variables, but far fewer were able to show the swaps/updates to the values in the *data* array.

Question 4* (a)

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]

Nearly all candidates were able to make some valid points about either the agile or the waterfall methodology. Level 1 responses frequently listed a few facts about the methodologies. Level 2 responses were able to compare some relative advantages and/or disadvantages. There were few Level 3 responses that were able to make detailed evaluative analysis with reference to the specific context of the problem. The 9-mark levels of response question on this paper always requires candidates to apply relevant knowledge to the specific context and to make evaluative judgements.

Question 4 (b)

(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.

.....

 **[1]**

Most candidates identified a difference between black-box and white-box testing. Where candidates did not achieve the mark, it was often because they made a statement about one form of testing only and did not draw out the difference for the other type of testing.

Question 5 (a)

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
-
- 2
-

[2]

Many candidates identified at least one subroutine. Length was classed as an attribute and was not given as an acceptable response. Responses that listed whole lines of code without identifying the specific subroutine were also discounted. Some candidates gave the names of variable identifiers rather than subroutines.

Question 5 (b)

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

01.....

08.....

[2]

Most candidates correctly identified iteration and selection, but some gave these structures in reverse order.

Question 5 (c)

(c) State the purpose of line 06.

.....

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

Most candidates identified casting to an integer.

Question 5 (d) (i)

(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]

Most candidates were given some marks, but far fewer achieved full marks.

Question 5 (d) (ii)

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

Describe the steps in a binary search.

.....

.....

.....

.....

.....

..... [4]

Most candidates knew how a binary search operated and there were relatively few candidates who confused a binary search with a linear search or who gave responses related to sorting algorithms. Where candidates did not get full credit, it was either for not clearly articulating that the midpoint needed to be calculated, or for descriptions where the half of the list to discard did not match with the comparison being made.

Question 6 (a)

6 Two data structures are a queue and a stack.

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

.....

.....

.....

..... [2]

Nearly all candidates identified that a stack is a LIFO structure whereas a queue is a FIFO structure. Few of the other potential responses on the mark scheme were seen.

Question 6 (b) (i)

- (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.

.....
 [1]

While many candidates identified that `topPointer` was a pointer to the index where that last item was inserted into the stack, some candidates confused this by saying that it actually held the last value, implying or stating that it held the value 13.

Misconception



Some candidates think that a pointer holds the actual value that it points towards, rather than holding the location that contains the value.

Question 6 (b) (ii)

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

.....

.....

.....

.....

.....

..... [3]

Many candidates achieved some of the marks, but far fewer were given full marks. The most omitted part of the required response was checking whether the stack was empty or not before trying to pop the value at the top of the stack.

Question 6 (b) (iii)

(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]

Many candidates produced accurate solutions. The most common error was an incorrect relational operator in the first gap with `<=` often given as an incorrect response instead of `<`.

Question 7

- 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.

.....

.....

.....

.....

.....

..... [8]

Most candidates achieved some marks for taking the relevant inputs and there were relatively few candidates who did not attempt the question. A range of different approaches were then taken regarding extracting parts of the date string. A variety of interpretations for substrings and string slicing were seen, and where responses were logically consistent, marks were given for the logic and syntax was not penalised.

Assessment for learning



Candidates would benefit from being set programming challenges. This 8-mark question can be set as a programming challenge where solutions can be tested using the test data in the question. Candidates can be asked to write the code for the `getMonth()` function to take a two character string 'mm' and return the associated month.

Question 8

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

friend sun earth orange night time

.....

.....

.....

.....

.....

..... [4]

Some candidates did not read the question carefully and sorted the list into ascending order. Those that did this were still able to achieve 3 marks for a correct ascending sort. Few candidates confused bubble sort with insertion sort or other sorting algorithms. Some candidates sorted by the total number of letters in each word rather than by alphabetical order.

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