



GCE A LEVEL

A500U10-1



WEDNESDAY, 11 JUNE 2025 – MORNING

COMPUTER SCIENCE – A level component 1
Programming and System Development

2 hours 45 minutes

A500U101
01

ADDITIONAL MATERIALS

A WJEC pink 16-page answer booklet.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Write your answers in the separate answer booklet provided.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question; you are advised to divide your time accordingly.

The total number of marks available is 100.

You are reminded of the need for good English and orderly, clear presentation in your answers.

Answer **all** questions.

1. A binary tree structure is designed to contain strings and uses the following rules:
 - The left pointer indicates the condition “earlier or at the same position in the alphabet”.
 - The right pointer indicates the condition “later in the alphabet”.
- (a) (i) Construct a binary tree using these rules and the data entered in the following order:

Halifax, Leeds, Bradford, Doncaster, Chelmsford, Birmingham, Sheffield, York, Cambridge

You may use letter abbreviations if you wish. [3]

(ii) Carry out an in-order traversal of the tree. [1]

(iii) Carry out a pre-order traversal of the tree. [1]

(iv) Carry out a post-order traversal of the tree. [1]

- (b) Describe **two** situations in which a binary tree would be the preferred method of data storage over a linked list. [4]

2. An online international e-commerce company produces a unique order code with each customer order. The order code comprises a two-letter country code of the customer's location, the date of purchase followed by a unique reference and the customer's surname.
 - The country code can only contain two UPPERCASE letters.
 - The date is stored in the format DDMMYYYY.
 - The unique reference is made up of one capital letter and 4 digits.
 - The surname can only contain UPPERCASE letters.

Example: UK12032024G2376JONES.

Produce a Backus-Naur Form (BNF) definition for the order code. [6]

3. The algorithm below shows a sort procedure.

```
counter = 0
swapped = TRUE
swaps = 0
length = list.length

while swapped = TRUE
    while counter < length - 1
        if list(counter) > list(counter + 1) then
            temp = list(counter)
            list(counter) = list(counter + 1)
            list(counter + 1) = temp
            swaps = swaps + 1
        endif
        counter = counter + 1
    endwhile
    if swaps = 0 then
        swapped = FALSE
    else:
        swaps = 0
        counter = 0
    endif
endwhile
```

(a) Name the sort method used in the algorithm.

[1]

- (b) Dry run the algorithm using the trace table with the given integers:

[6]

54, 45, 13, 26

list	counter	swapped	swaps
54, 45, 13, 26	0	TRUE	0

4. (a) Draw a truth table to demonstrate the value of Q:

$$Q = (\text{NOT } A \text{ OR } B) \text{ XOR } (A \text{ AND } C)$$

[5]

- (b) Draw a truth table to prove the following:

$$\text{NOT } (A \text{ AND } B) = \text{NOT } A \text{ OR } \text{NOT } B$$

[4]

5. Simplify the following Boolean expressions using Boolean algebra identities and De Morgan's law where appropriate. Clearly show each step.

(a) $B \cdot (\bar{A} + C) \cdot A \cdot (B + C) \cdot \bar{A} \cdot B$

[5]

(b) $\overline{\bar{A} \cdot (\bar{B} + C)}$

[4]

6. (a) Describe **one** example where a shortest-path algorithm is appropriate. [2]

(b) The routing costs for a network of 7 nodes are stored in a two-dimensional array, as shown below (0 indicates there is no route between the nodes).

	A	B	C	D	E	F	G
A	0	4	6	0	0	0	0
B	4	0	1	0	0	8	0
C	6	1	0	4	6	0	0
D	0	0	4	0	1	0	4
E	0	0	6	1	0	3	0
F	0	8	0	0	3	0	5
G	0	0	0	4	0	5	0

(i) Draw a labelled diagram of the network. [3]

(ii) State the shortest path from node A to node G and calculate its cost. [2]

7. The following people are in a queue for an online chat facility:

David, Amy, Justin, Kacper, Ali, James, Siobhan

(a) Draw a clearly labelled diagram to show how the above queue can be represented using a one-dimensional array and necessary pointers. [3]

(b) Give another example of when a queue data structure might be used. [1]

8. Below is an algorithm that searches for a data item in a one-dimensional array. You can assume that the data in the array is in ascending order and that the data item being searched is present.

```

1  Function binarySearch(dataList)
2  input searchItem
3  set low = 0
4  set high = length(dataList) - 1
5
6  repeat while low <= high:
7      set midpoint = low + (high + low) DIV 2
8
9      if dataList(midpoint) = searchItem then
10         return True
11     else if searchItem < dataList(midpoint) then
12         set high = midpoint - 1
13     else
14         set low = midpoint + 1
15     endif
16 end repeat
17
18 output dataList(midpoint)
19 end

```

- (a) Evaluate the efficiency of the search algorithm and, using Big O notation, determine the growth rate for time performance. [5]
- (b) Draw a graph to illustrate the order of time performance. [2]

9. (a) Discuss the different methods of investigation during the system analysis process, describing the benefits and drawbacks for each method. [6]
- (b) Describe the differences between parallel and phased changeover methods. Suggest situations where each would be the most suitable changeover method. [6]
10. (a) Write an algorithm to search an unsorted one-dimensional array of integers. [5]
- (b) Give **two** advantages of a linear search algorithm. [2]
11. (a) Describe the role of codes of conduct in promoting professional behaviour. [2]
- (b) Discuss the possible effects that computers have on employees. [8]
12. Describe the principal stages involved in the compilation process. [12]

END OF PAPER

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