OCR A-Level Computer Science

Practice Examination

Component 01: Computer Systems

Section 1.4: Data types, data structures and algorithms

Centre Number	**Candidate Number**
Candidate Forename(s)	**Candidate Surname**

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above.
- Answer ALL questions.
- Write your answers in the spaces provided.
- Additional paper may be used if required.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question.
- The total number of marks for this paper is 40.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of 6 pages.

TIME ALLOWED: 50 minutes

GRADE BOUNDARIES:

A*: 36-40 marks
A: 32-35 marks
B: 28-31 marks
C: 24-27 marks
D: 20-23 marks

Question 1

a. Define the term 'primitive data type' and give two examples. [3 marks]

b. Explain the difference between a stack and a queue data structure. [4 marks]

c. A binary tree has the following properties:

- Each node can have at most two children
- Each node contains a single integer value
- For any node, all values in its left subtree are less than the node's value
- For any node, all values in its right subtree are greater than the node's value

What is this specific type of binary tree called? [1 mark]

Question 2

a. Complete the following table by indicating whether each data structure is linear or non-linear, and whether it is static or dynamic. [4 marks]

Data Structure	**Linear/Non-linear**	**Static/Dynamic**
Array		
Linked List		
Binary Tree		
Hash Table		

b. Describe how a hash function is used in a hash table data structure. [3 marks]

c. Explain what a collision is in the context of hash tables and describe two methods to resolve collisions. [5 marks]

Question 3

Consider the following pseudocode for a bubble sort algorithm:

```
PROCEDURE BubbleSort(A: array of comparable items)
    n = length(A)
    FOR i = 0 TO n-1
        swapped = FALSE
        FOR j = 0 TO n-i-2
            IF A[j] > A[j+1] THEN
                swap(A[j], A[j+1])
                swapped = TRUE
            END IF
        END FOR
        IF swapped = FALSE THEN
            BREAK
        END IF
    END FOR
END PROCEDURE
```

a. Trace through the first pass (i=0) of the bubble sort algorithm for the array [5, 3, 8, 1, 2], showing the state of the array after each comparison and swap. [4 marks]

b. What is the purpose of the 'swapped' variable in the algorithm? [2 marks]

c. State the best-case and worst-case time complexities of the bubble sort algorithm. [2 marks]

Question 4

a. *Explain how a binary search algorithm works and why it is more efficient than a linear search for sorted data. Your answer should include a description of the algorithm, its time complexity, and a comparison with linear search. [8 marks]

b. Write pseudocode for a recursive function that implements binary search on a sorted array. [4 marks]