

061306T4CSC

COMPUTER SCIENCE LEVEL 6

ICT/OS/CS/CR/09/6

Understand Algorithms and Data Structures

March/April 2026



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION
COUNCIL (TVET CDACC)**

WRITTEN ASSESSMENT

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATE

1. The paper consists of **TWO** sections: **A** and **B**
2. Answer **ALL** questions in section A and **ANY THREE** (3) questions from section B
3. Marks for each question are indicated in the brackets
4. Candidates are provided with a separate answer booklet
5. Do not write on the question paper

This paper consists of FOUR (4) printed pages

Candidate should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A: (40 MARKS)*Answer ALL questions in this section*

1. Using an appropriate illustration, explain how arrays differ from linked lists in terms of memory allocation and access. (4 marks)
2. Given the data elements 23, 1, 10, 5, 2, demonstrate all stages of Bubble Sort using diagrams. (4 marks)
3. When developing a computer program to solve a real-world problem, it is important to evaluate the algorithm before implementation. Explain TWO reasons why algorithm analysis is important in solving computing problems. (4 marks)
4. With the aid of a diagram, explain how enqueue and dequeue operations are performed in a queue. (4 Marks)
5. Write an algorithm in pseudocode that calculates the average of five numbers entered by a user. (4 marks)
6. Using diagrams, demonstrate how divide-and-conquer strategy can be applied to sort the list: 40, 12, 9, 25. (4 marks)
7. In a school database system, a teacher needs to find a student's admission number from a list of records using different linear searching methods. Explain how linear search differs from binary search when locating the record, using a simple example. (4 marks)
8. In a transport booking system where stops are stored as connected nodes, data is organized using linked lists. Using clearly labelled diagrams, differentiate between a singly linked list and a circular linked list as used in managing the stops. (4 marks)
9. When developing a software application such as an online student results system, different algorithms can be used to process data. Explain why time complexity and space complexity are critical factors when evaluating the performance of such algorithms. (4 marks)
10. In a computer application that processes numerical data in tabular form, values are stored using matrices. Write C++ statements to declare appropriate data structures and store the following values: (4 marks)
 - (i) $\begin{bmatrix} 12 & 45 & 78 \end{bmatrix}$
 - (ii) $\begin{bmatrix} 5 & 9 \\ 14 & 20 \end{bmatrix}$

SECTION B: (60 MARKS)***Answer THREE questions in this section***

11. a) Develop a C++ program that creates a stack capable of storing the names of five programming languages (Python, Java, C++, JavaScript, Ruby). The program should display all elements in the stack and then demonstrate the POP operation twice. (8 marks)
- b) Given two numbers p and q, write an algorithm using pseudocode that computes and displays their product. (4 marks)
- c) Apply the selection sort algorithm to arrange the following list in ascending order, showing all passes: (8 marks)

45 12 8 30 17 25

12. a) Using relevant examples, differentiate between static and dynamic data structures. (4 marks)
- b) A software development team needs to implement operations on doubly linked lists. Describe any FOUR fundamental operations that can be performed on doubly linked lists. (8 marks)
- c) Write a C++ program that implements the bubble sort algorithm to sort the array $y = [78, 23, 45, 12, 67, 34]$ in descending order. (8 marks)
13. a) Consider the following array and use it to answer the questions below:

[22, 45, 18, 56, 33, 71, 9]

- (i) Develop an algorithm to search for element $Y = 56$ using binary search technique. (5 marks)
- (ii) Write a C++ program to implement the binary search algorithm from part (i). (7 marks)
- b) Create a C++ program that reads six integer values into an array named scores. The program should compute the average of these values and display both the average and the original array elements. (8 marks)
14. a) An algorithm is a step-by-step procedure for solving a problem or performing a computation. Well-designed algorithms share several fundamental characteristics

that make them effective and practical. Explain FOUR essential characteristics that every well-designed algorithm must possess. (8 marks)

- b) Queues are fundamental data structures that follow the First-In-First-Out (FIFO) principle. This mirrors many real-world scenarios where order matters. Discuss THREE real-world applications where queue data structures are effectively utilized. (6 marks)
- c) Given the initial array [9, 5, 16, 8, 13, 6], write a C++ program that implements the quick sort algorithm to sort the elements in ascending order. (6 marks)