UNIVERSITI POLY-TECH MALAYSIA
UPTM

FINAL EXAMINATION

DIPLOMA IN COMPUTER SCIENCE

COURSE	:	**DATA STRUCTURES**
COURSE CODE	:	**SWC3684/SWC3344**
DURATION	:	**2 HOURS AND 30 MINUTES**

INSTRUCTIONS TO CANDIDATES :

1. This question paper consists of **FOUR (4)** questions.
2. Answer ALL questions in the Answer Booklet provided.
3. Please check to make sure that this examination pack consists of :
   i. The Question Paper
   ii. An Answer Booklet
4. Do not bring any material into the examination hall. An electronic calculator is allowed.
5. Please write your answer using permanent ink.

MYKAD/ PASSPORT NO. : _____

ID. NO. : _____

LECTURER : _____

SECTION : _____

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO

This question paper consists of 6 printed pages including the front page

QUESTION 1

a. An algorithm is a step-by-step method to solve a problem. The efficiency of an algorithm indicates how well it performs with the resources it uses.

List **TWO (2)** main resources used by an algorithm that affect its efficiency.

(2 marks)

b. Describe **FOUR (4)** visibility identifiers used in Object-Oriented Programming (OOP).

(8 marks)

c. Define data structure.

(2 marks)

d. State **TWO (2)** limitations of an array.

(2 marks)

e. Identify **THREE (3)** advantages of the Java Collection Framework (JCF).

(6 marks)

(Total : 20 marks)

QUESTION 2

a. State **TWO (2)** differences between an array list and a linked list.

(4 marks)

b. Give the purpose of the link stored in each node of a linked list.

(2 marks)

c. Answer the following questions based on the program below:

```
import java.util.LinkedList;

public class StudentRecordSystem {
    public static void main(String[] args) {

        LinkedList<String> students = new LinkedList<>();
        LinkedList<Integer> marks = new LinkedList<>();

        // Add students using different methods
        students.addFirst("Aina");
        marks.addFirst(85);
```

```
        students.addLast("Farid");
        marks.addLast(70);

        students.addLast("Siti");
        marks.addLast(90);

        students.addLast("Hakim");
        marks.addLast(60);

        // Question 2(c)(i)
        System.out.println("Student List: " + students);
        System.out.println("Marks List: " + marks);

        // Question 2(c)(ii)
        System.out.println("First student: " +
        students.peek());
        System.out.println("Marks of Siti: " +
        marks.get(students.indexOf("Siti")));

        marks.set(1, 75);   // Update Farid's marks

        // Remove first student
        students.removeFirst();
        marks.removeFirst();

        // Question 2(c)(iii)
        System.out.println("Is student list empty? " +
        students.isEmpty());

        // Question 2(c)(iv)
        System.out.println("Updated Student List: " +
        students);
        System.out.println("Updated Marks List: " + marks);
        System.out.println("Total Students: " +
        students.size());
    }
}
```

i. Determine the contents of the `students` and `marks` linked lists after the `addFirst()` and `addLast()` operations are executed.

(4 marks)

ii. Identify the elements returned by the `peek()` method and the expression `marks.get(students.indexOf("Siti"))` when they are executed.

(2 marks)

iii. State whether the `students` list is empty when checked using the `isEmpty()` method.

(2 marks)

iv. Illustrate the final contents of the `students` and `marks` linked lists.

(6 marks)

(Total : 20 marks)

QUESTION 3

a. Explain the definition of a stack and the principle used in stack operations.

(3 marks)

b. Determine the result of the given **postfix expression** using stack operations. Show all intermediate steps.

6 6 2 3 + 4 * 5 - 8 4 / + * +

(8 marks)

c. Assume a stack named `scoreStack` is declared as shown in **Figure 1**. Answer the following questions based on the content of the `scoreStack` object.

```
Stack <Integer> scoreStack = new Stack();
```

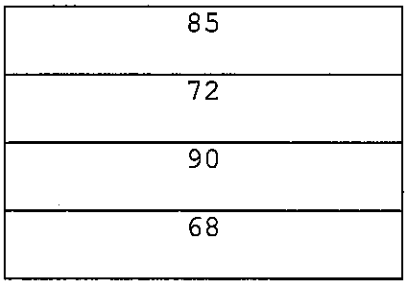

Figure 1: scoreStack

i. Redraw the contents of the `scoreStack` in **Figure 1** after the following Java program has executed.

```
scoreStack.pop();
scoreStack.push(100);
scoreStack.pop();
scoreStack.push(77);
```

(4 marks)

d. Give the output of the given Java program below:

```
import java.util.*;

public class ClinicAppointmentQueue {
    public static void main(String[] args) {

    Queue<String> appointmentQueue = new LinkedList<>();

    appointmentQueue.offer("Patient A");
    System.out.println("After offering Patient A: " +
appointmentQueue);

    appointmentQueue.add("Patient B");
    System.out.println("After adding Patient B: " +
appointmentQueue);

    String nextPatient = appointmentQueue.element();
    System.out.println("Next patient to be treated: " +
nextPatient);

    String treatedPatient1 = appointmentQueue.remove();
    System.out.println("After first removal: " +
appointmentQueue);
    System.out.println("Treated patient: " + treatedPatient1);

    appointmentQueue.add("Patient C");
    appointmentQueue.add("Patient D");
    appointmentQueue.add("Patient E");
    System.out.println("After adding patients: " +
appointmentQueue);

    String treatedPatient2 = appointmentQueue.remove();
    System.out.println("After second removal: " +
appointmentQueue);

    String frontPatient = appointmentQueue.peek();
    System.out.println("Patient at the front: " + frontPatient);

    String treatedPatient3 = appointmentQueue.poll();
    System.out.println("After polling: " + appointmentQueue);
    System.out.println("Treated patient: " + treatedPatient3);
    System.out.println("Final patients in the queue: " +
appointmentQueue);
    }
}
```

(15 marks)

(Total : 30 marks)

QUESTION 4

a. The following keys: **50, 20, 65, 10, 30, 60, 80, 25,** and **35** are inserted into an initially empty **Binary Search Tree (BST).** Illustrate the BST after each insertion.

(9 marks)

b. Based on your answer from **QUESTION 4 (a),** state the values visited in the BST for the following traversal methods.

i. Inorder traversal

(2 marks)

ii. Preorder traversal

(2 marks)

iii. Postorder traversal

(2 marks)

c. Based on your answer from **QUESTION 4 (a),** find the size of the tree and all the leaf nodes.

(3 marks)

d. Based on your answer from **QUESTION 4 (a),** delete the value **50.** Illustrate your final BST.

(2 marks)

e. List **TWO (2)** types of bubble sort algorithms.

(2 marks)

f. Illustrate the selection sort algorithm for the following numbers:

42 275 68 24 81 93 79 56 50

(8 marks)

(Total : 30 marks)

(TOTAL :100 MARKS)

END OF QUESTION PAPER