UNIVERSITI TEKNOLOGI MARA
FINAL EXAMINATION

COURSE	:	**FUNDAMENTALS OF DATA STRUCTURES**
COURSE CODE	:	**CSC248**
EXAMINATION	:	**OCTOBER 2016**
TIME	:	**3 HOURS**

INSTRUCTIONS TO CANDIDATES

1. This question paper consists of two (2) parts: Part A (10 Questions) Part B (7 Questions)
2. Answer ALL questions in the Answer Booklet. Start each answer on a new page.
3. Do not bring any material into the examination room unless permission is given by the invigilator.
4. Please check to make sure that this examination pack consists of:
   i) the Question Paper
   ii) an Answer Booklet – provided by the Faculty
5. Answer ALL questions in English.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

This examination paper consists of 12 printed pages

PART A (20 MARKS)

1. Which of the following is **FALSE** about data abstraction?

   A. Separation of what a method provides to users from how the class is defined.
   B. A user's code should not access the implementation details of the class used.
   C. About how class operations are implemented.
   D. About the desired results returned by the methods are accomplished.

2. In the `java.util.ArrayList` class, the method that returns the number of data in the list is _____.

   A. `size()`
   B. `length()`
   C. `numData()`
   D. `numberOfData()`

3. The data is stored in contiguous memory locations. This data structure refers to _____.

   A. Linked List
   B. Sequential List
   C. Linear List
   D. Contiguous List

4. Which of the following is **TRUE** about queue?

   A. Insertion is allowed only at the front of the queue.
   B. Removal is allowed only the front of the queue.
   C. The method `enqueue()` is used to insert an element at the front of the queue.
   D. The method `dequeue()` is used to delete an element at the back of the queue.

5. The method `pop()` in the Stack data structure is used to _____.

   A. retrieve the top element of a stack
   B. delete the top element of a stack
   C. insert the top element of a stack
   D. retrieve the last element of a stack

6. Choose the **CORRECT** description of Binary Trees.

A. Each node of a tree has maximum of two child nodes.
B. Height of a tree refers to the number of branches between the root and the farthest leaf.
C. It is a complex form of a tree data structure.
D. A leaf is a node in a tree with one or two branches going down from it.

7. To print data in sorted order, a Binary Search Tree should be traversed using _____.

A. preorder traversal
B. inorder traversal
C. postorder traversal
D. All of the above.

8. Which statements best to retrieve the first element in a queue name `QStudent`?

A. `QStudent.enqueue();`
B. `Student A = QStudent.dequeue();`
C. `Student A = QStudent.dequeue(i);`
D. `Student A = QStudent.getEnd();`

9. A data structure could be defined as _____.

A. an organisation of data in memory location during run time which have insertion and deletion algorithm.
B. a process of collecting and clustering the data according to its size.
C. an organisation of class without regards to its implementation.
D. a collection of super classes and its sub classes.

10. A _____ is a linked list in which every node has a reference to the next and previous node.

A. single list
B. doubly linked list
C. circular linked list
D. None of the above

PART B (80 MARKS)

QUESTION 1

The following is a JAVA application using the `ArrayList` ADTs.

```
public static void main(String[] args) {

      ArrayList <Integer> list = new ArrayList();
      int data = 2;

      for(int x=0; x<3; x++){
            data = data * 3;
            if (data % 2 == 0) {
                  list.add(data);
                  data++;
            }
            else
                  list.add(x,data);

            System.out.print(data + " ");
      }
}
```

a) Show the output of the program.

(3 marks)

b) Draw a diagram of the sequential list after the loop is executed.

(4 marks)

c) Write JAVA codes segment to display data at the last index.

(1 mark)

QUESTION 2

Given the following ADTs:

```
public class Car {
      private String RegistrationNo;
      private string OwnerName;
      private String ManufactureName;
      private double CarPrice;
      public Car(String, String, String, double){…}
      public String getRegistrationNo(){…}
      public String getOwnerName(){…}
      public String getManufactureName (){…}
      public String getCarPrice(){…}
      public String toString() {…}
}

public class ArrayList {
      public ArrayList()
      public boolean add(Car item)
      public Car remove (int index)
      public int size();
      public Car get(int);
 }
```

Assumed that a number of cars object have been inserted into an ArrayList named `carList`. Write a program segment to:

a) Find and remove all the *"Honda"* cars.

(3 marks)

b) Find and display the information of a car based on the `RegistrationNo` given by the user. If the information does not exist, display an appropriate message.

(5 marks)

QUESTION 3

A Go-Kart Operator uses a Linked List to store the data of Go-Kart customers. The following classes are used for this purpose.

```
public class GoKart {
      private String name;                  //customer name
      private String typeOfCar;             //couple or single seat
      private String strokeEngine;          //200cc or 150cc
      private int option;                   //1 - quick experience
                                            //2 - race adventure
      private int numberOfLaps;
      private boolean safetySet;            //true if choose safety set

      public GoKart(String name, String type,
                  String stroke, int option){...}
      public String getName(){...}
      public String getType(){...}
      public String getEngineStroke(){...}
      public int getOption(){...}
      public int getNumOfLaps(){...}
      public boolean getSafetySet(){...}
      public String toString(){...}
}

public class LinkedList {
            public void insertAtBack(GoKart item){...}
            public GoKart removeFromFront(){...}
            public boolean isEmpty(){...}
            public GoKart getFirst(){...}
            public GoKart getNext(){...}
}
```

Assume that the data has been inserted into a `LinkedList` named `goKartList`. Write a Java program segment to solve the following problems:

a) Calculate and display the total charges received from all customers. One customer will be charged RM30 for each lap and extra RM20 if they use a safety set.

(4.5 marks)

b) Copy all customers who choose race adventure option to another linked list named `raceAdventureList`.

(5.5 marks)

QUESTION 4

The following are the ADTs of `Node` and `LinkedList`.

```
public class Node {
      int data;
      Node next;
      public Node(int x) { data = x; }
}

public class LinkedList {
      private Node head;
      private Node current;
      public LinkedList(){…}
      public void insertAtSecond(int data) {…}
      public int deleteAtFront(){…}
}
```

a) Write method `insertAtSecond()` to insert a data after the first node.

(3.5 marks)

b) Write method `deleteAtFront()` to delete and return data at the front of the LinkedList.

(3.5 marks)

QUESTION 5

Given the following `Printer` and `Queue` ADTs

```
public class Printer {
      private int documentIDNo;
      private String docType;     //word, excel, ppt
      private int numberOfPages;
      private int timeTaken;      //time taken to print document in
                                  //seconds
      public Printer() { }
      public Printer(int, String, int, int) { }
      public void setPrinter(int, String, int, int) { }
      public int getDocIDNo(){…}
      public String getDocType(){…}
      public int getNumPages() {…}
      public int getTimeTaken(){…}
      public String toString(){…}
}

public class Queue {
      public Queue() {…}
      public void enqueue(Printer element){…}
      public Printer dequeue(){…}
      public boolean isEmpty(){…}
}
```

Assume that all information on printers have been stored in a queue named `PrinterQ`. Write a JAVA program segment to do the following:

a) Copy all the documents from `PrinterQ` into 3 different queues according to their type:

- `wordQ` for word document,
- `excelQ` for excel document
- `pptQ` for power point document

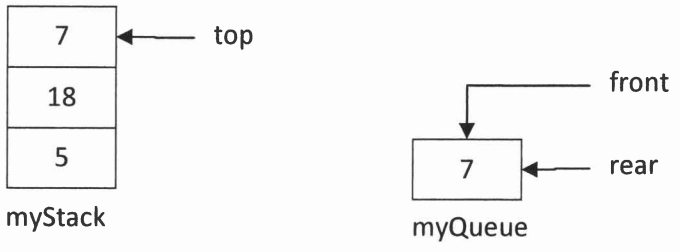
(5 marks)

b) Determine the average time taken to print a page of a word document.

(3 marks)

QUESTION 6

The following diagram shows `myStack` object of stack and `myQueue` object of Queue.



a) Draw the diagram of `myStack` and `myQueue` after the execution of the following code fragment.

```
for (int i=0; i<2; i++) {
      myQueue.enqueue(myStack.pop())
}
```

(3 marks)

b) Given are the attributes and methods for a class named `Car` as follows:

```
Class: Car
Attributes:
      String carRegNumber     //registration number
      String carBrand
      double carPrice
      String carOwnerName
      int carYearPurchase

Methods:
      public Car()
      public Car(String, String, double, String, int)
      public void setCar(String, String, double, String, int)
      public void setRegNumber(String)
      public void setBrand(String)
      public void setPrice(double)
      public void setOwnerName(String)
      public void setYearPurchase(int)
      public String getRegNumber()
      public String getBrand()
      public double getPrice()
      public String getOwnerName()
      public int getYearPurchase()
```


The following is the ADT of Queue and Stack data structure.

```
Class: Queue
Methods:    public void enqueue(Car obj)
            public Car dequeue()
            public boolean isEmpty()

Class: Stack
Methods:    public void push (Car obj)
            public Car pop()
            public boolean isEmpty()
```

Based on the above information, assume that 100 cars object have been inserted into a stack named `carStack`. Count the number of 'Hyundai' cars and copy all data from the `carStack` and store into two objects of type Queue. The first object will store all cars from `'Perlis'` and the second object will store cars from `'Pulau Pinang'` which are identified from the first character of the car registration number, `'R'` and `'P'` respectively.

At the end of processes, make sure the stack contains the original records in an original order.

(11 marks)

QUESTION 7

a) Given is an infix arithmetic expression as follows:

```
A = (35 - 3 * (3 + 2)) / 4
```

Based on the expression, answer the following questions:

i. Draw the expression tree.

(3 marks)

ii. What is the depth of the tree?

(1 mark)

iii. Traverse the expression tree using preorder and postorder traversals, and show the order in which the nodes are visited.

(3 marks)

b) A Binary Search Tree is used to store the data of books using the ADTs.

```
public class Book {
      private int BookNo;
      private String title;
      private String publisher;
      private int year;
      private double price;
      public Book(){…}
      public Book(int no, String t,
                  String p, int y, double p){…}
      public int getBookNo() {…}
      public String getTitle() {…}
      public String getPublisher() {…}
      public int getYear() {…}
      public double getPrice() {…}
      public String toString(){..}
}

public class TreeNode{
      TreeNode left;
      TreeNode right;
      Book item;
}

public class BSTBook {
      public BSTBook(){…}
      public void countBook(){…}
      public void searchBook(String title){…}
      public double calcTotalPrice() {…}
}
```

The following tables shows the detailed information of the items.

Book No.	Title	Publisher	Year Published	Price
78	Java	Addison Wesley	2014	169.00
81	C++	Thomson	2009	127.00
80	Fortran	Prentice hall	1988	39.00
65	Pascal	Longman	2005	78.00
67	Cobol	Addison Wesley	1999	45.00
50	HTML	Thomson	2005	119.00
9	PHP	Prentice hall	2006	178.00

i. Draw the diagram of a Binary Search Tree (BST) according to Book No.
(3 marks)

ii. Write the definition of method `CountBook()` and its recursive method to count and display the number of book published in the year of 2005.
(5 marks)

iii. Write the definition of method `SearchBook()` and its recursive method to display the information of the book.
(5 marks)

iv. Write the definition of method *`CalcTotalPrice()`* and its recursive method to calculate the total price of all books.
(5 marks)

END OF QUESTION PAPER