KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE

COURSE CODE: COMP 123

COURSE TITLE: DATA STRUCTURES

STREAM: Y1S2

DAY: THURSDAY

TIME: 9.00 – 11.00 AM.

DATE: 06/08/2009

INSTRUCTIONS:

Answer <u>The First Question</u> and any <u>Other Two Questions</u>.

PLEASE TURN OVER

QUESTION 1(30 MARKS)

(a). Assume an array **a[b]** for storing **b** float numbers. Write an algorithm to input the array and then display

- § Those array elements which are positive.
- § The largest value in the array. **(5 Marks)**

(b). Briefly describe the structure of the following data structures. Also give the various operations involved in each.
(i). Binary Tree (ii). Linked list **(6 Marks)**

(c). Explain three applications of stacks in computer science. **(3 Marks)**

(d). (i). Briefly describe what a linear queue is. **(2 Mark)**

(ii). Explain how a circular queue improves a linear queue. **(2 Marks)**

(e). (i). What is a linear list? List the various operations of a linear list. **(2 Marks)**

(ii). Assume that you want to insert an element **a** into position **b** of a linear list. List the steps needed to achieve this. **(2 Marks)**

(f). (i). Briefly describe how a binary search is done. **(2.5 Marks)**

(ii). Assume you are carrying out a binary search of value **70** in the following list: **20, 50, 55, 60, 65, 70**. List the sequence of elements that will be compared with the search value (70). **(1.5 marks)**

(g). (i). Briefly describe how a bubble sort is done. **(2.5 Marks)**

(ii). Show the steps of sorting the following elements (into ascending order) using the **bubble sort** method (i.e. list the elements after each step): **9, 6, 4. (1.5 Marks)**

QUESTION 2 (20 MARKS)

(a). Explain the main advantage and the main disadvantage of linked lists over linear lists. **(2 Mark)**

(b). Assume a linear list represented by the array **a[b]** – for storing **b** integers, but currently having **c** values (where **c<=b**).

(i). Write an algorithm to insert an element **d** into position **e** of the list. **(6 Marks)**

(ii). Write an algorithm to receive a position **d** and then remove and return the element in that position. **(3 Marks)**

(c). Assume an array named **a[b]** - of size **b** for storing floats. Assume also that the array currently has **c** numbers. Write the following algorithms.

(i). To sum the array and display this sum. **(3 Marks)**

(ii). To compute and display the number of occurrences of value **5.0** in the array. **(3 Marks)**

(iii). To shift each of the array's elements one position to the right. **(3 Marks)**

QUESTION 3 (20 MARKS)

(a). Assume an array declared and initialized in C language as follows.

int a[7]={20, 17, 12, 14, 10, 7, 3};

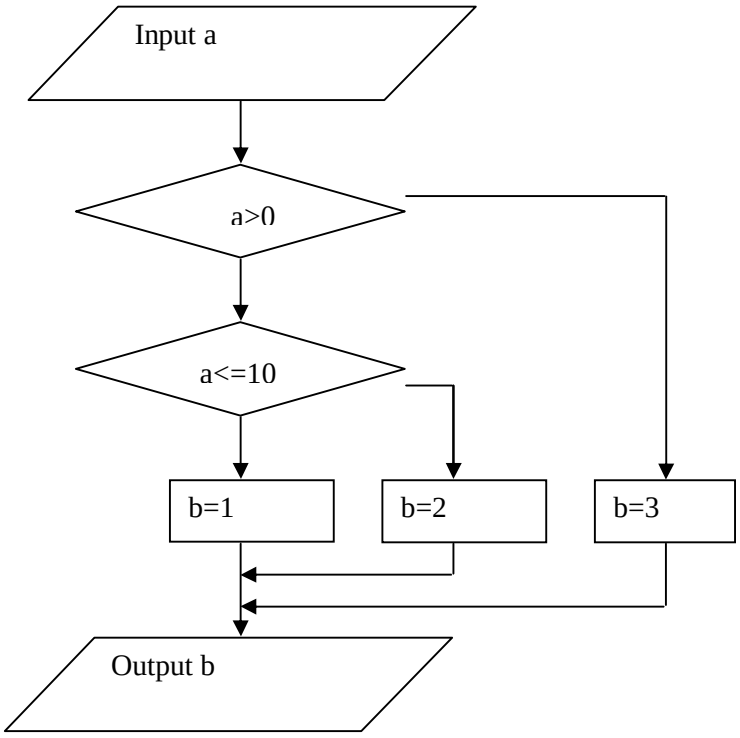
Required

(i). Write down an algorithm to carry out a selection sort (ascending order) of the array**.** **(5 marks)**

(ii). Show the contents of the new list after every pass of sorting the list (into ascending order) using the selection sort. **(3 marks)**

(iii). Repeat the above sorting (in part a(ii) above) using the insertion sort method. **(3 Marks)**

(b). (i). Consider the following flowchart and answer the questions below it.



(I). Fill in the following test table for the flowcharts. **(2 Mark)**

TEST TABLE	
Input	**Output**
0	
-5	
10	
15	

(II). Write pseudo codes for the flowcharts. **(3 Marks)**

(ii). Assume two arrays of integers named **a[50]** and **b[50]**. Write an algorithm to
(I). Output the indices whose corresponding elements in **a** are the same as in **b**.
(II). Copy **b** into **a**. **(4 marks)**

QUESTION 4 (20 MARKS)

(a). Write an algorithm to receive a base ten number and convert it into its binary equivalent using a stack. **(5 Marks)**

(b). Write an algorithm to convert an expression into its equivalent RPN form using a stack. **(6 Marks)**

(c). Apply the above algorithm (in part (b)) to convert the following infix expression into its postfix (RPN) equivalent using a stack (show the contents of the output as well as the stack after each step using the format shown below the expression). **(6 marks)**
(9 - 2 * 3) / (5 + 1)

FORMAT

Step	Operation	Stack Contents	Outputs

(d). Write the RPN equivalent of the following expression. **(3 Marks)**
(A + B * C) - (D * E - F) / (G + H)

QUESTION 5 (20 MARKS)

(a). (i). Write algorithms for inserting an element **x** into a linear queue and removing and returning an element from the queue using the method of keeping Rear constant 0. Assume that the queue is initialized appropriately i.e. Rear=0, Front=0. Also assume other functions **empty()** and **full().** Use **m[]** as the name of the queue. **(4 Marks)**

(ii). Repeat a(i) above using the method of keeping Front constant 0. **(4 Marks)**

(b). (i). Write down the (I). LPR (II). PLR and (III). LRP traversals of the following binary tree.

(3 Marks)

(ii). Construct binary search tree of the following expression.

(A - (B + C) / (D - E * F)) + (G * H) **(3 Marks)**

(c). (i). State a strength and a limitation of the binary search method over the linear search method. (**1 Marks)**

(ii). Assume you are carrying out a binary search of value **10** in the following list: **5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100**. List the sequence of elements that will be compared with the search value (**10**).

(3 marks)

(d). Assume you have a linked list storing the following elements: 1, 3, 5, 8, 10. List the steps of doing the following.

(i). Removing element 8 from the list.

(ii). Inserting element 4 between elements 3 and 5. **(2 Marks)**