Answer the following - 25 marks each

1. Write a program that does the following: It reads a number from stdin and uses a Switch-case set of statements to decide the following: **5 marks each**
   a. If the value is '1' it simply prints "Hello World" on stdin.
   b. If the value is '2', it reads another integer value and computes the factorial of the 2nd number using a do-while loop.
   c. If the value is '3', it reads two more numbers and computes the gcd of these two numbers recursively.
   d. If the value is '4' it reads a string and reverses it before printing it out.
   e. Else it declares an array of length 5 and prints out the address of each array index using a for loop.

2. Define the data structures in C for each of the following and illustrate using diagrams. In each case label relevant nodes using standard convention. **5 marks each**
   a. Doubly linked list with integer data in each node
   b. Stack with the following values 2, 7, 8, 3, 0, 9
   c. Circular queue with the following values 4, 2, 0, 5, 8, 1, 9, 3, 7, 6
   d. A 2x 3 matrix initialised to 1,2,3,4,5,6,7,8,9. Also show its inverse.
   e. A max heap with values 45, 23 90, 87, 12, 56, 34, 3, 78, 84, 20, 6. Show the array representation for the heap. What is the height of the heap? For any index i, where is its left and right child placed?

3. Do the following: **10 + 10 + 5**
   a. Write the pseudocode for the infix-postfix algorithm.
   b. Using the above algorithm, convert the following expression 39 - 2*6 + (8 /4 +3) ^ 2 + 1 into postfix form. Show the step-wise stack values and output string values.
   c. Evaluate the postfix expression and show the intermediate operands.

4. Do the following: **10 + 10 + 5**
   a. Show the step-wise sorting of the numbers 5, 7, 9, 0, 1, 6, 8, 2 using Insertion Sort.
   b. Show in steps the process of inserting a value 85 into a MAX heap 100, 90, 80, 70,60, 50, 20, 45, 17, 18, 30, 26.
   c. Show the step-wise sorting of the numbers 45, 5, 90, 25, 67, 12, 7, 56, 38 using Merge Sort.