

**B. Math III Year**  
**2008-09 Final Examination – CS III Algorithms and Data Structures**  
**(Max. marks & weightage: 50) – Good Luck!**

**Q1 [5 Marks: 1 Mark for each part]** Give very very short answers

- a. State True or False: If  $f(n)$  is  $O(n^3)$  and  $g(n)$  is  $O(n^3)$  then  $f(n)/g(n)$  is  $O(1)$
- b. State True or False: Prim's and Kruskal's algorithms will always give the same minimum spanning tree for a given connected graph
- c. Retain the correct words from the brackets: With Merge Sort, the data comparisons are all done (before/after) the recursive calls complete, whereas with Quick Sort the data comparisons are all done (before/after) the recursive calls are made.
- d. State True or False: I have two BSTs. If I want to determine if they are identical, I can perform an inorder tree walk on both and compare the output lists.
- e. Which of the two is a significantly higher order?  $O(\log_2 n)$  and  $O(\log_{10} n)$

**Q2 [6 Marks]** Answer very briefly

1. Data types are important for a number of reasons. We discussed four reasons in the class. State these four reasons (use one word to describe each reason).
2. What is the **main reason** for recursive algorithms for functions such as Fibonacci numbers to be slow?
3. The decision to use recursive vs non-recursive methods usually lead to which trade-off?

**Q3 [4 Marks]** What is being performed by the following C program?

```
int Something (int m, int n) {  
    int t, r;  
    if (m < n) { t = m; m = n; n = t; }  
    r = m % n;  
    if (r == 0) { return n; }  
    else { return Something(n, r); }  
}
```

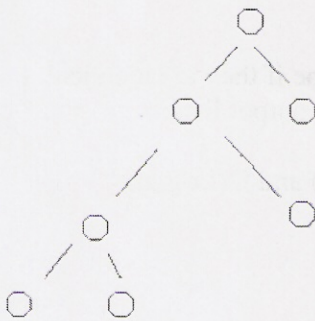
What is the output from the above program for 1.  $m = 28$  &  $n = 76$  2.  $m = 41$  &  $n = 233$  [10]

**Q4. [5 Marks]** Write an algorithm to determine if a linked list contains a cycle in it, and, at what node the cycle starts. State the order of your algorithm (Marks will be awarded for the correct data structure declaration, correct logic, order of the algorithm, and a proper pseudo-code convention.)

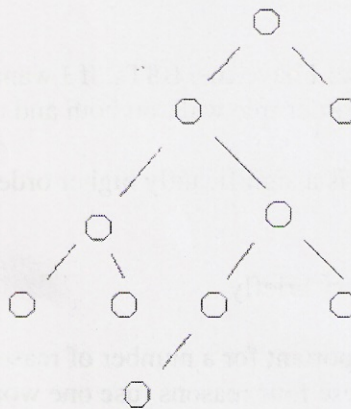
**B. Math III Year**  
**2008-09 Final Examination – CS III Algorithms and Data Structures**  
**(Max. marks & weightage: 50) – Good Luck!**

**Q5 [5 Marks]** In the following two trees, label the nodes as either Red or Black if it is possible to do so. If not then clearly (and briefly) state the reason

Tree A



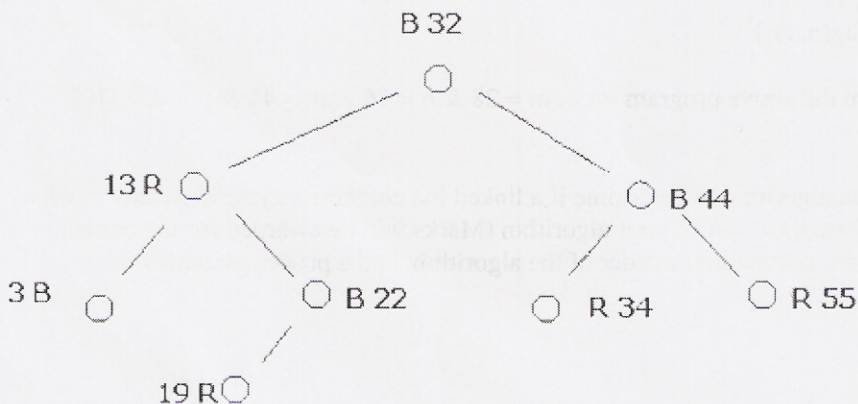
Tree B



**Q6 [10 Marks]** Solve only **ONE** of the two: (If you make any assumption about the algorithm then state them clearly)

1. Prove that the Merge Sort runs in  $O(n \log_2 n)$  time
2. Obtain a closed form expression for the order of the average time taken for a Quick sort algorithm.

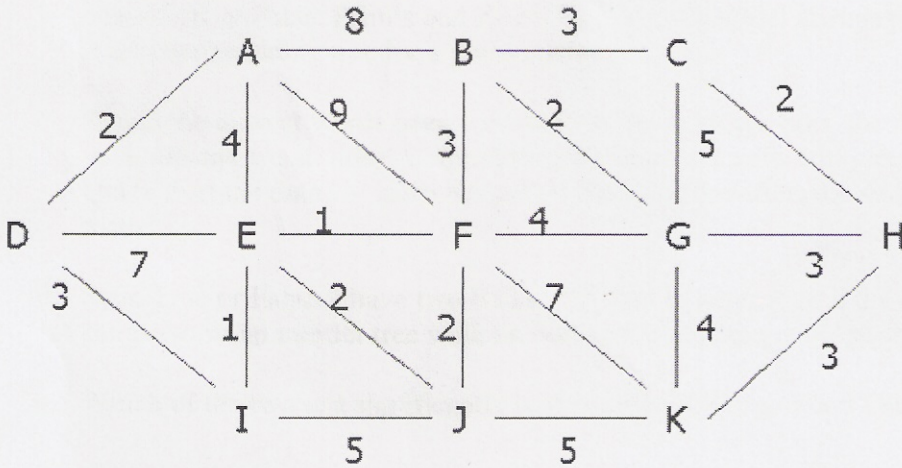
**Q7 [5 Marks]** Redraw the following tree after adding the node 15





**(Max. marks & weightage: 50) – Good Luck!**

**Q8 [5 Marks]** Use Prim's and Kruskal's algorithms to find a minimum spanning tree (MST) in the following graph. Show your reasoning and if you make any assumptions then state them clearly.



**Q9. [5 Marks]** Given the adjacency matrix in (a) draw the directed graph and given the graph in (b) write the adjacency list

(a)

	A	B	C	D	E	F
A	0	0	1	1	0	0
B	0	0	1	0	0	1
C	0	0	0	0	0	0
D	1	0	1	0	0	0
E	1	1	0	0	0	1
F	0	0	0	0	1	0

