Full Name: _____ NetID: _____

OAKLAND UNIVERSITY, School of Engineering and Computer Science
Object Oriented Computing II
CSE 231 002/CSE 506 002

Please write and/or mark your answers clearly and neatly; answers that are not readable are not considered. Please answer in appropriate details if needed and you may get partial points for the intermediate steps even if a final answer is not correct.

Chapter 1, 2, 3, 4 and 5 (30 points):

1. What is the order of magnitude of the following function, using Big-O notation: $3N^8 + 100*N^4 + 17N^2$? (2 point) _____ $O(N^8)$ _____

2. What are the three perspectives, or levels, with which we deal with ADTs? Explain each level(5 points)
   App , Logical , implem

3. Which are the two approaches are we mostly used for implementing an ADT
   Array based , Link-based

4. Show what is written by the following segment of code, given that item1, item2, and item3 are int variables, and stack is an object that fits our abstract description of a stack. Assume that you can store and retrieve variables of type int on stack. (7 points)

```
item1 = 14;
item2 = 10;
item3 = 5;
stack.push(item2);
stack.push(item1);
stack.push(item1 + item3);
stack.push(item3);
item2 = stack.top();
stack.push (item3*item3);
stack.push(item2);
stack.push(3);
stack.push(10*item2);
item1 = stack.top();
stack.pop();
System.out.println(item1 + " " + item2 + " " + item3);
```

```
while (!stack.isEmpty())
{
 item1 = stack.top();
 stack.pop();
 System.out.println(item1);
}
```

5. What the three questions we need to answer to verify a recursive algorithms or functions? (3 points). Given the following function, explain how the three questions are used to verify the recursion of this function. (4 points)

```
1. int factorial (int n)
2. {
3. if (n > 0) return (n * factorial (n – 1));
4. else if (n == 0) return 1;
5. }
```

Answer: base
Smaller - caller
General - case

6. Show what will be written by running following segment of code, given that item1, item2, and item3 are int variables, and queue is an object that fits our abstract description of a queue. Assume that you can store and retrieve variables of type int on queue. (7 points)

```
item1 = 9;
item2 = 12;
item3 = 21;
queue.enqueue(item2);
queue.enqueue(item1);
queue.enqueue(item3);
queue.enqueue(item1 + item3);
item3 = queue.dequeue();
queue.enqueue (item3*item3);
queue.enqueue(7);
item2 = queue.dequeue();
queue.enqueue(item2);
item1 = queue.dequeue();
System.out.println(item1 + " " + item2 + " " + item3);
while (!queue.isEmpty())
{
 item1 = queue.dequeue();
 System.out.println(item1);
```

Chapter 6 and 7 List ADT and More List (20 points):

7. What is binary search algorithm. What is the difference between binary search algorithm and linear search algorithm? (6 points)

explain binary search

Binary

$O(\log_2 N)$

Sorted

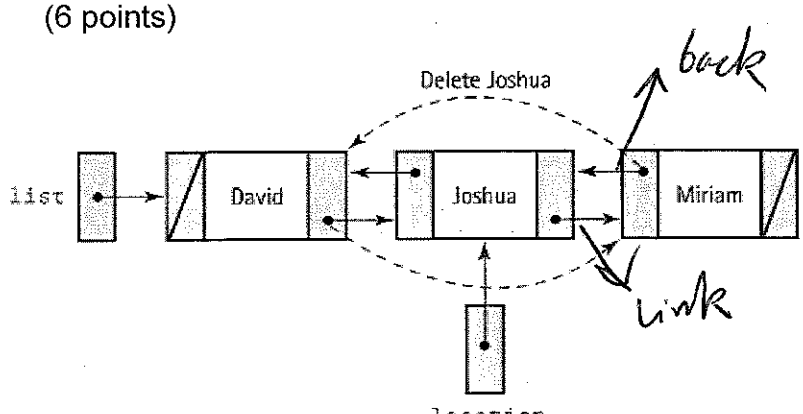
Linear

$O(N)$

unsorted

Difference

8. Considering removing a node from a doubly linked list as show in the following figure, please add the two missing statements to finish the removing operation: (6 points)



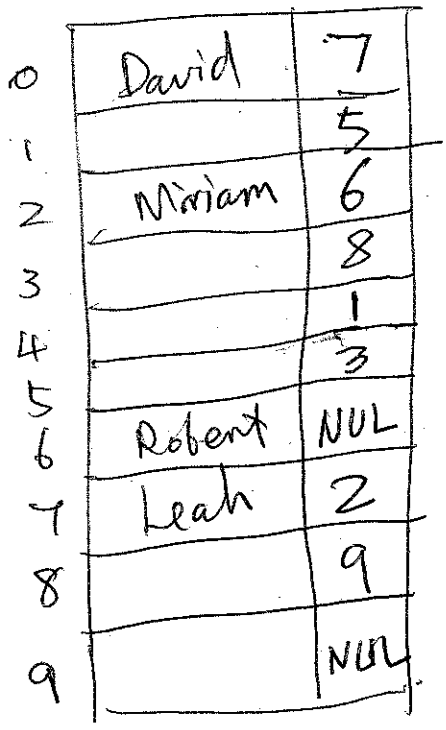
location.back.link = location.link

location.link.back = location.back

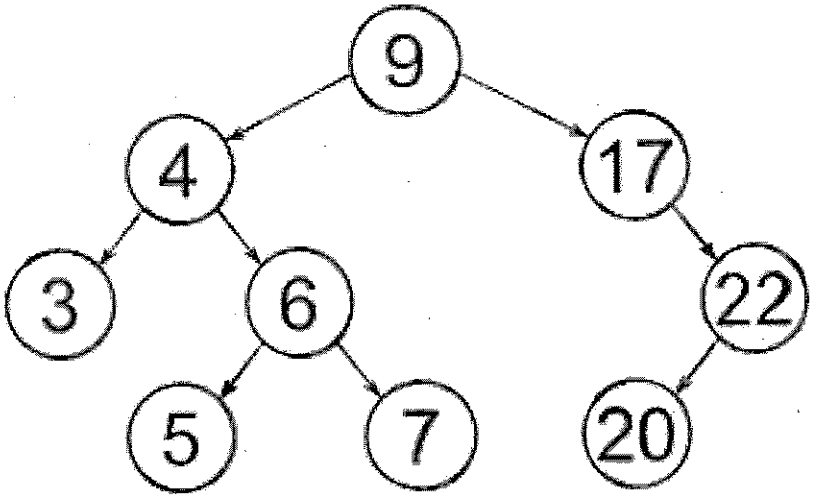
9. The following diagram shows the current state of a linked list using an array of nodes; please draw a new diagram showing the state of the list after removing element "Joshua" (put the freed node to the front of the free list). (8 points)

nodes	.info	.next
[0]	David	4
[1]		5
[2]	Miriam	6
[3]		8
[4]	Joshua	7
[5]		3
[6]	Robert	NUL
[7]	Leah	2
[8]		9
[9]		NUL

list	0
free	1



Chapter 8 Binary Search Tree (20 points):



10. What is the order in which the nodes are visited by a preorder traversal (using comma to separate each element, e.g. 1, 2, 3, ...) (3 points)?

9, 4, 3, 6, 5, 7, 17, 22, 20

11. What is the order in which the nodes are visited by a postorder traversal (using comma to separate each element, e.g. 1, 2, 3, ...) (3 points)?

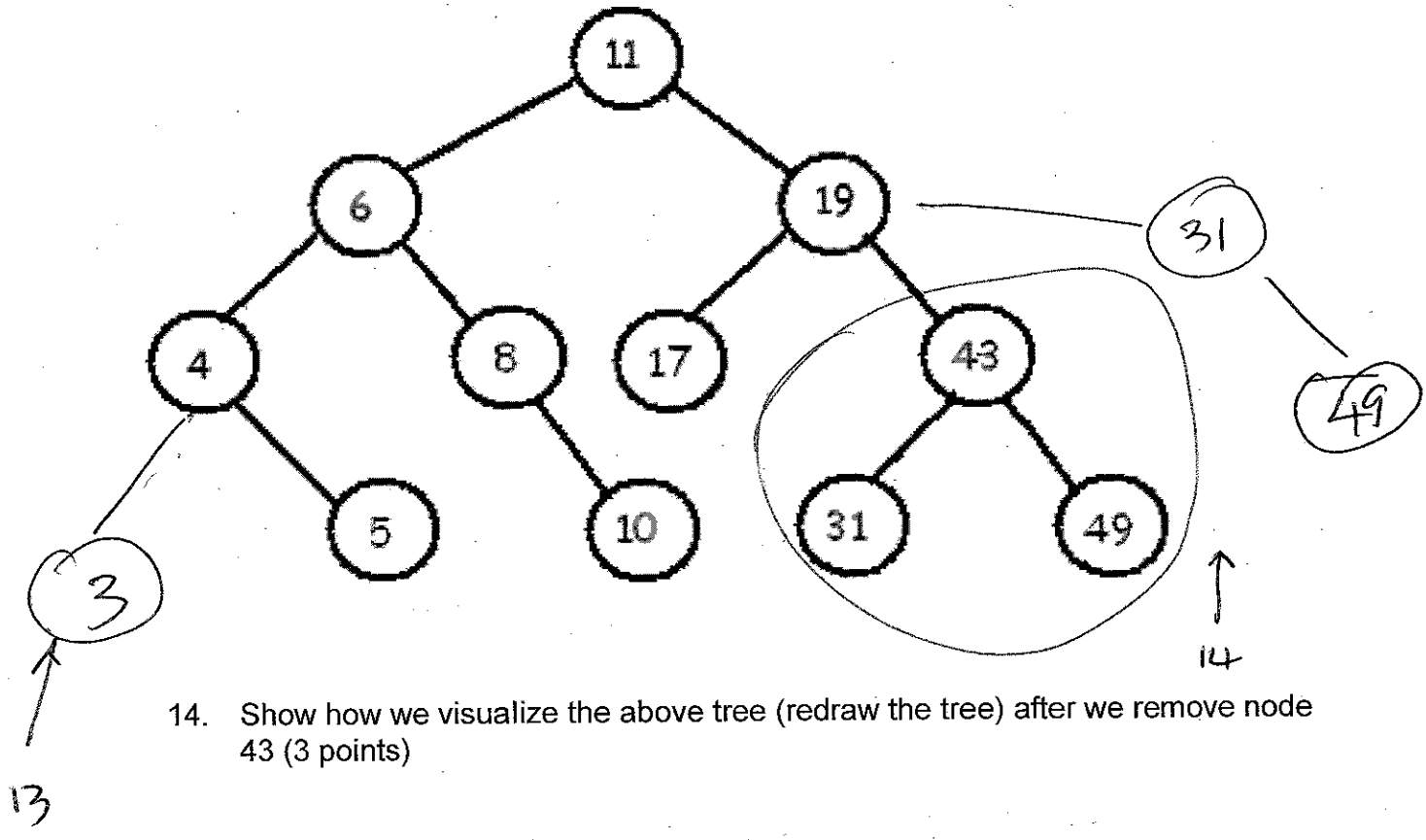
3, 5, 7, 6, 4, 20, 22, 17, 9

12. Why lots of algorithms involving processing a tree can be implemented using recursive methods? (3 points)

the child of each node could also be considered as the root of a subtree

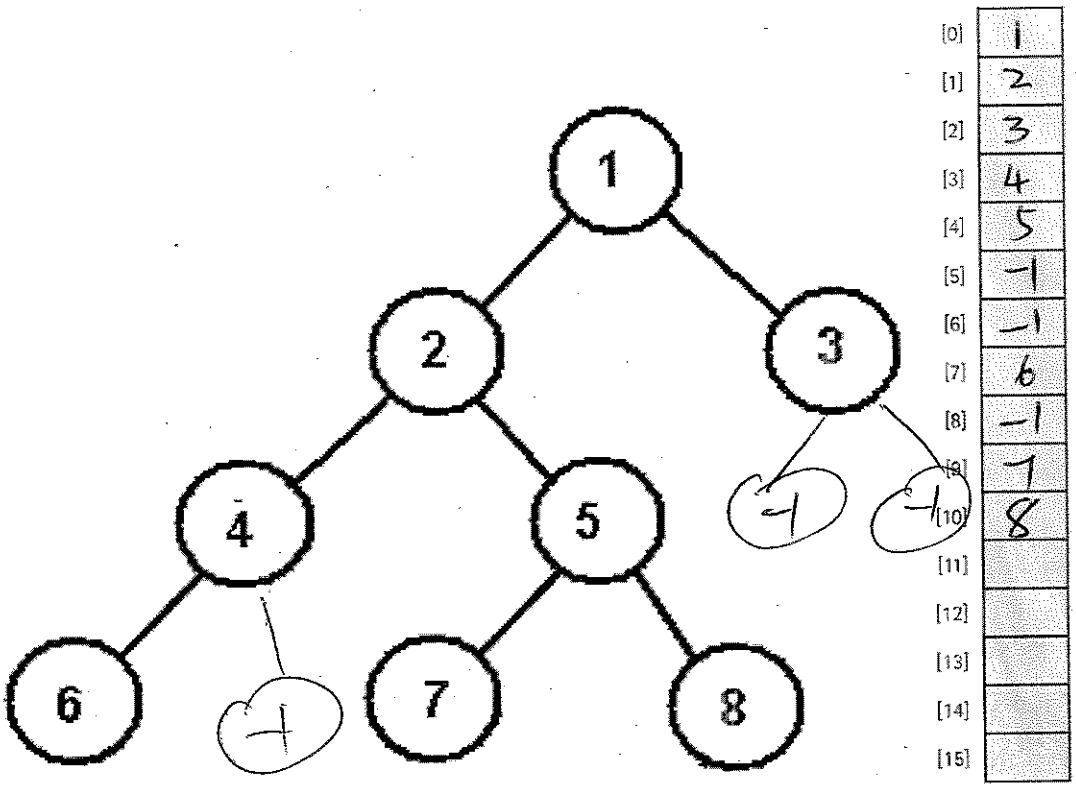
Questions 13 and 14 assume access to the following binary search tree:

13. Show how we visualize the above tree (redraw the tree) after we add node 3. (3 points)



14. Show how we visualize the above tree (redraw the tree) after we remove node 43 (3 points)

15. Create nonlink representation of the following binary tree in an array, using -1 as dummy value (5 points)



Chapter 9 Priority Queues, Heaps and Graph (12 points):

16. What is the difference between a heap and a binary search tree? (3 points):

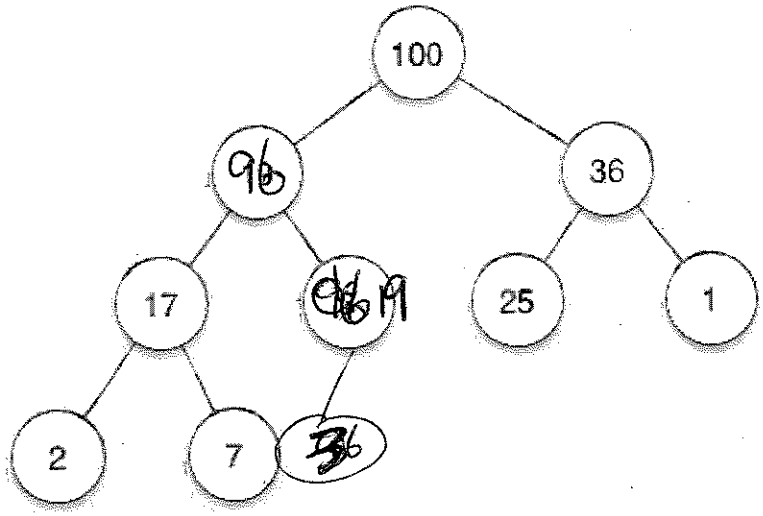
① Heap must be a complete binary tree
BST doesnot need to be

② Heap Root ≥ Left, Root ≥ Right
BST Left ≤ Root < Right

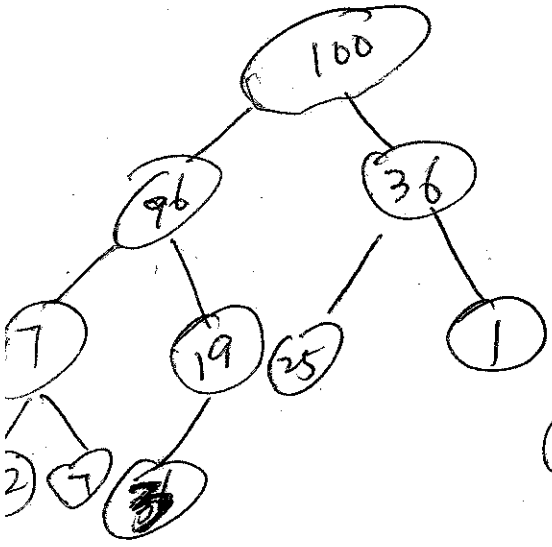
17. Given a heap as follows and a sequence of operations applied to the heap, draw the intermediate heaps after each of the following steps operations (4 points). What is the results for x and y (2 points)

a) enqueue (96);

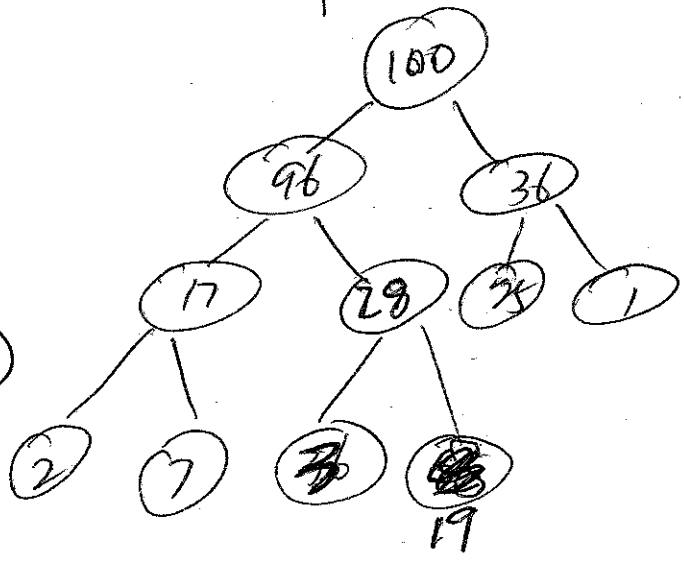
b) enqueue (28);
c) x = dequeue();
d) x = dequeue();
e) y = dequeue();



a) enqueue (96)



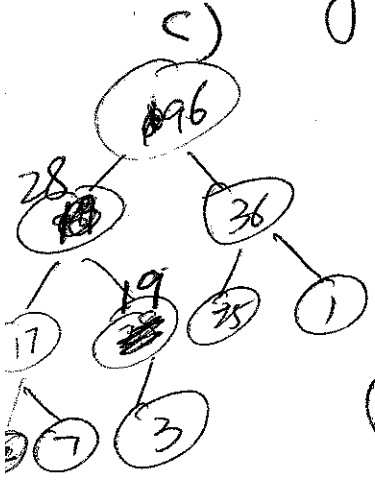
b. enqueue (28



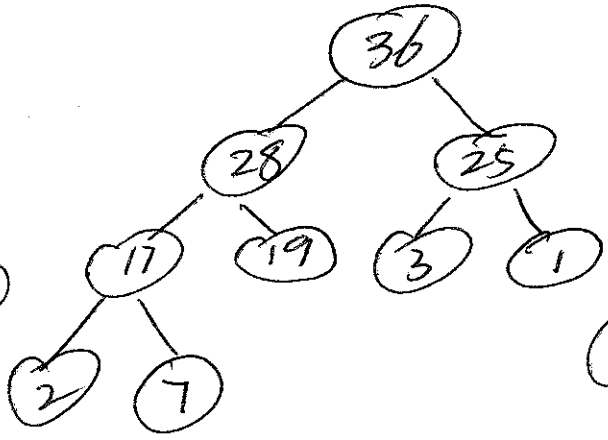
Questions 18 assume access to the following graph:

x = 96
y = 31

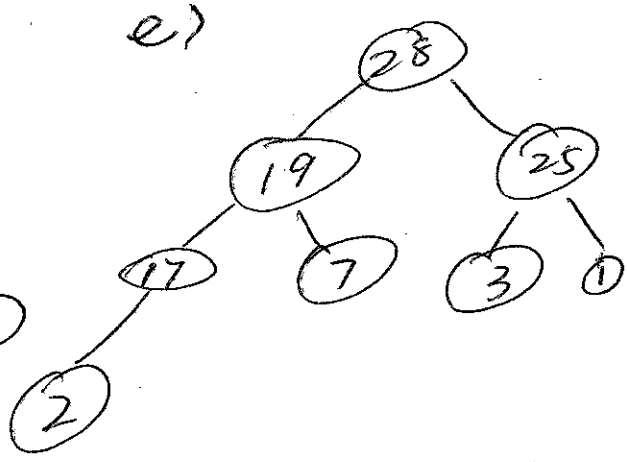
c)

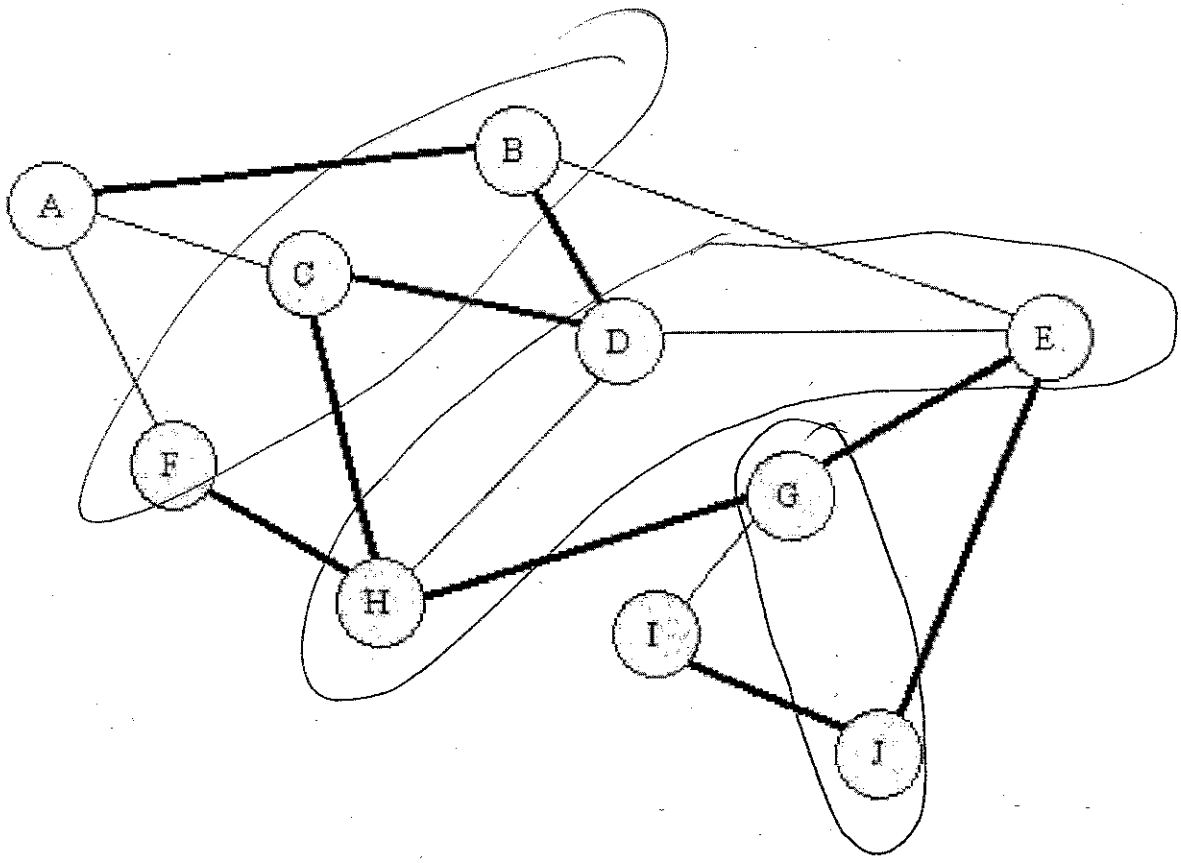


d)



e)





18. Breadth-first traversal of graph visits vertices level-by-level; produce a breadth-first traversal of all the vertices of the above graph starting from vertex A. (3 points)

A, B, C, F, H, D, E, G, J, I

Chapter 10 Sorting and Searching (18 points):

19. What would be the order of the following list after fifth iterations of the "inner" part of the Selection Sort algorithm? (2 points)

10 9 8 7 5 4 3 2 1

1 2 3 4 5 7 8 9 10

20. What would be the order of the following list after three iterations of the "inner" part of the Bubble Sort algorithm? (2 points)

	13	4	16	19	15	12	3	23	20
#1	3	13	4	16	19	15	12	20	23
#2	3	4	13	12	16	19	15	20	23
#3	3	4	12	13	15	16	19	20	23

21. Suppose we are using Merge Sort to sort the following list of numbers. What would be the order of the list immediately before the execution of the *merge* method in the original (non-recursive) call to *mergesort*? (2 points)

11 8 10 9 5 | 14 3 23 2

5 8 9 10 11 | 2 3 14 23

22. Suppose we are using Quick Sort to sort the following list of numbers. What would be the order of the list immediately after one splitting iteration, assuming the first value in the array is used as *splitvalue*? (2 points)

7 8 12 9 5 14 3 23 2

5 2 3 7 9 14 12 23 8

23. Give the 6 sorting algorithms we studied, and considering the efficiency, auxiliary storage requirement and stability of each of the algorithms, what are your thoughts on selecting sorting algorithm? (5 points).

check slides.

24. Store the following list of values into a hash table with 20 positions, using division method of hashing and linear probing method for resolving collisions. (5 points)

25, 93, 41, 181, 256, 431, 72, 12, 202, 25, 34, 45, 78, 194, 402, 58, 212, 316, 40