1. Answer the time complexity & Yes/No for the following terms. (15pt)

Sorting	Best	Average	Worst	Stability
Quick	O(nlogn)	(1)	(2)	(3)
Merge	(4)	O(nlogn)	(5)	(6)
Heap	(7)	(8)	O(nlogn)	(9)
Selection	(10)	(11)	(12)	Yes
Insertion	(13)	(14)	$O(n^2)$	(15)

2. Construct (a) adjacency list, and (b) adjacency multilists, for the following graph.(10pt)
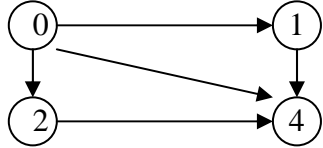
3. (a) Given 4 nodes, draw all the binary trees. (5pt)

   (b) Given the preorder sequence ABDGHCEFI and the inorder sequence BGDHAECIF, what is the binary tree? (5pt)

4. Given (55, 6, 17, 25, 91),

   (a) Construct the max heap in O(n) time. (5pt)

   (b) Implement the Quick sort . (5pt)

   (c) Implement the natural merge sort. (5pt)

5. (a) Write the postfix form of the expression 1 * (2 – 3 + 4) / 3. (5pt)

   (b) Draw the contents of the stack in each step of postfix evaluation for the expression in (a). (10pt)

6. Draw the sparse matrix array representation of the following matrix: (10pt)

$$\begin{bmatrix} 0 & 5 & 0 & 0 \\ 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & 3 \end{bmatrix}$$

7. For the following array representation of disjoint sets, answer the questions:

   (a) How many sets are in the array representation? (5pt)

   (b) Draw the tree representation of these sets. (5pt)

   (c) After running weight-union(1, 3), what is the tree representation of sets? (5pt)

i	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
parent	1	-4	-1	-5	3	3	1	3	6	4

8. If a hash file is partitioned into 10 buckets, what is the probability of at least two of three arbitrary records hashing to the same section? (Assume the hash function gives no bucket priority over the others.)   (10pt)