Q1

Let n be the number of edges and d be the sum of the degree.

Base case.

n = 1, there is only 1 edge, thus the total degree is 2, thus $d = 2n$.

Suppose $n = i, d = 2i$

When $n = i + 1$, we can select an edge $u - v$ from the undirected graph,

removing this edge from the graph, now it has i edges and the remaining graph

has $2i$ total degree, now add the edge $u - v$, only the degree of u and v increases 1, other

nodes's degree doesn't change, thus now $d = 2i + 2 = 2(i + 1)$.

From above, we have proved that $d = 2n$.

Q2

2.a.i $O(\log(N))$

2.a.ii $O(N)$

2.a.iii $O(|V|^2)$

2.a.iv $O(N)$

2.b.i $O(N^2)$

2.b.ii $O(N^2)$

2.c.i $O(N^2)$

2.c.ii $O(N)$

Q3

3.a

h(29) = 29 % 11 = 7

h(7) = 7 % 11 = 7 7 + 1^2 = 8

h(18) = 18 % 11 = 7 (7 + 2^2) % 11 = 0

h(6) = 6 % 11 = 6

h(19) = 19 % 11 = 8 8 + 1^2 = 9

h(33) = 33 % 11 = 0 (0 + 1^2) = 1

h(55) = 55 % 11 = 0 (0 + 2^2) = 4

Index	0	1	2	3	4	5	6	7	8	9	10
Key	18	33			55		6	29	7	19	

3.b

33 would be no longer findable using the contains method.

Because location 0 set to NULL. When we want to find 33, we first lcoate in 33 % 11 = 0, but location 0 is null, thus return empty.

Q4

```
int[] merge(int[] a, int[] b, int[] c) {
        int[] d = new int[a.length + b.length + c.length];

        int i = 0;

        int u = 0;
        int v = 0;
        int w = 0;

        int x;
        int y;
        int z;

        while (i < d.length) {
            if (u < a.length) {
                x = a[u];
            } else {

                x = Integer.MAX_VALUE;
            }

            if (v < b.length) {
                y = b[v];
            } else {

                y = Integer.MAX_VALUE;
            }
```

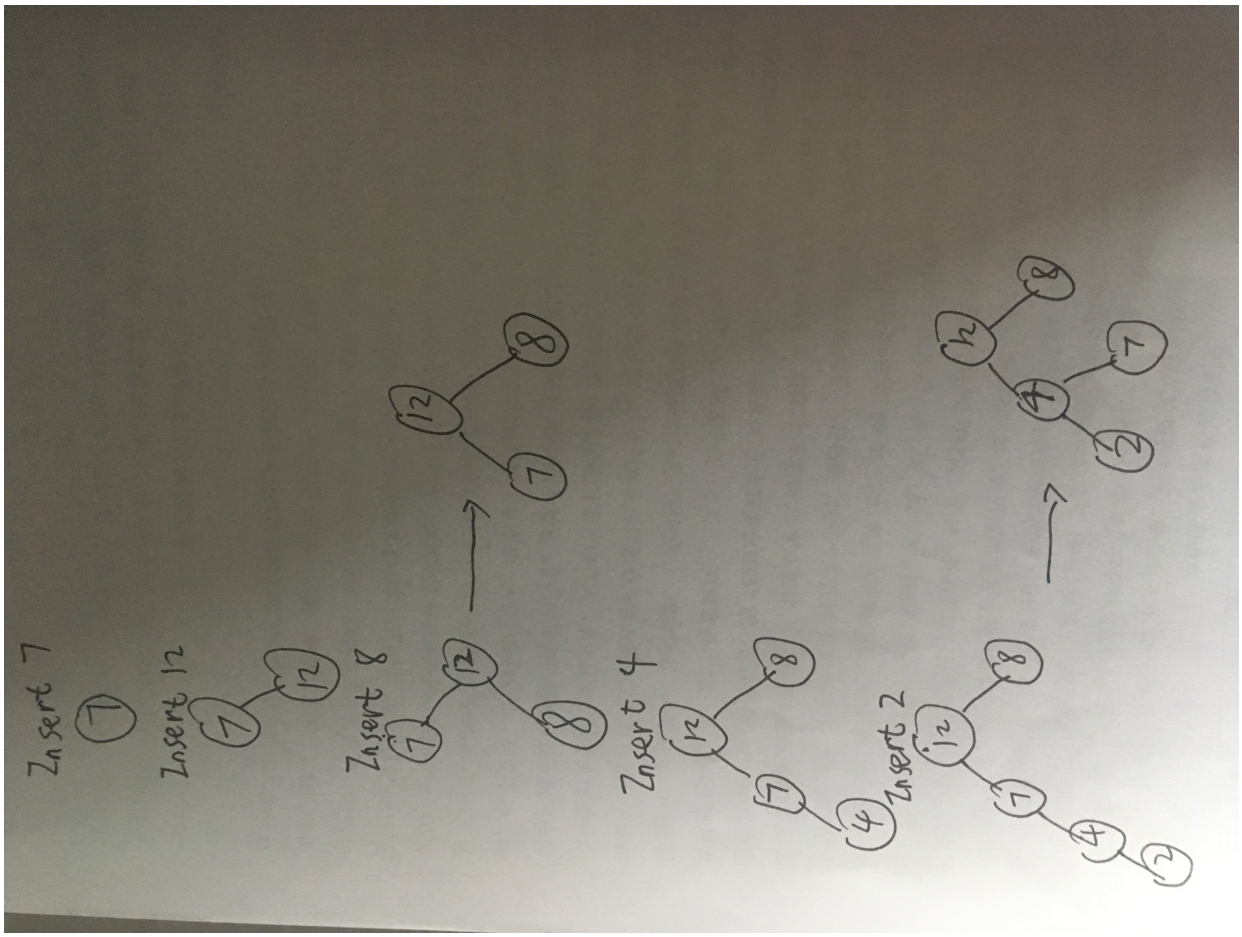
```
            if (w < c.length) {
                z = c[w];

            } else {

                z = Integer.MAX_VALUE;
            }

            int minv;

            if (x <= y && x <= z) {
                u++;
                minv = x;
            } else if (y <= x && y <= z) {
                v++;
                minv = y;

            } else {

                w++;
                minv = z;
            }

            d[i] = minv;

            i++;
        }

        return d;
    }
```

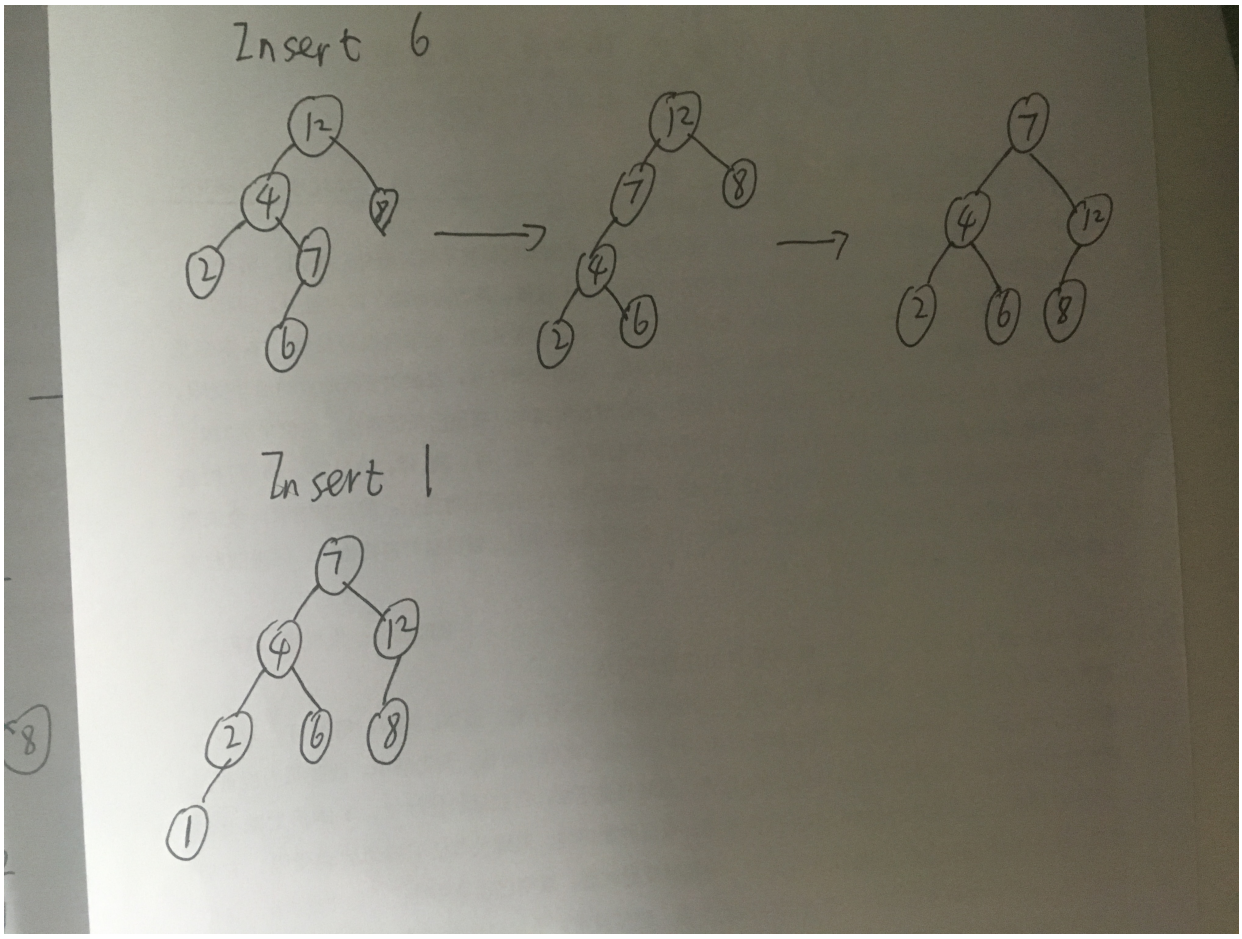
Q5

```
// Q5
   int countInternal(TreeNode root)
   {
        if (root == null)
        {
            return 0;
        }

        if (root.firstChild == null)
        {
            return countInternal(root.nextSibling);

        }else {
```

```
            return 1 + countInternal(root.firstChild) +
countInternal(root.nextSibling);
        }
    }
```

Q6





Q7

```
// Q7
    boolean testMinHeap(int A[]) {

        int N = A.length - 1;

        for(int i=1; i<=N; i++)
        {

            if(2*i <= N)
            {
                if(A[i] > A[2*i])
                {
                    return false;
                }
            }

            if(2*i + 1 <= N)
            {
                if(A[i] > A[2*i + 1])
                {
                    return false;
                }
            }
```

```
        }

        return true;
    }
```

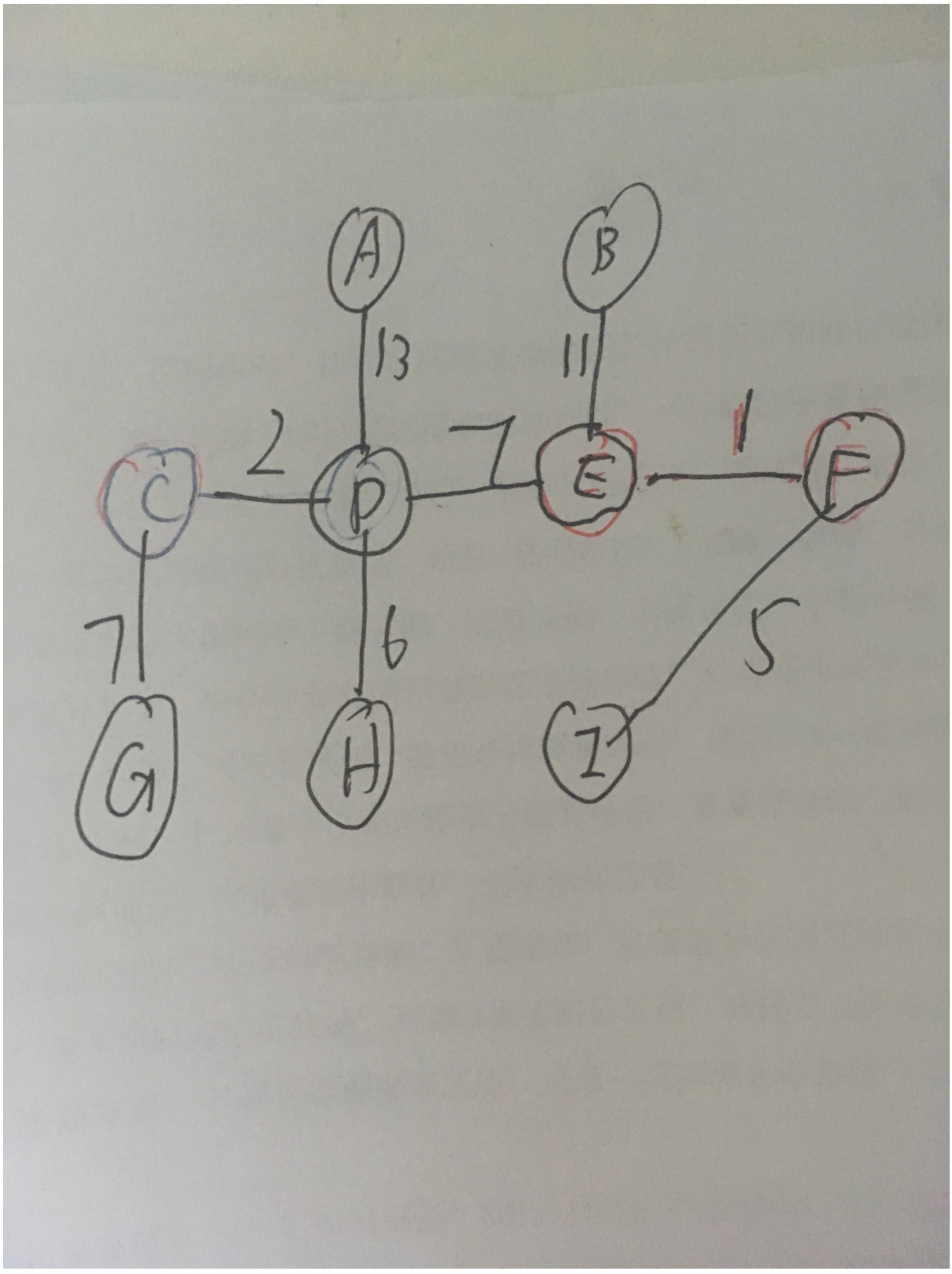
Q8

8.a

No it is not strongly connected. Because there is no path from node F to node C.

8.b

edges examined	accept or rejected
(E F) 1	accept
(C D) 2	accept
(F I) 5	accept
(D H) 6	accept
(C G) 7	accept
(D E) 7	accept
(E I) 8	rejected
(G H) 10	rejected
(B E) 11	accept
(H I) 12	rejected
(A D) 13	accept



Q9

Step	Vertex Chosen	A	B	C	D	E	F	G
0	—-	Infinity	Infinity	0	Infinity	Infinity	Infinity	Infinity
1	C	Infinity	Infinity	0	7	7	Infinity	Infinity
2	D	9	Infinity	0	7	7	13	Infinity
3	E	9	Infinity	0	7	7	8	Infinity
4	F	9	Infinity	0	7	7	8	Infinity
5	A	9	14	0	7	7	8	Infinity
6	B	9	14	0	7	7	8	15

Q10

If we can solve in $O(n^4)$ time, then it means it is solved in polynomial time, and this problem is in P. Because the bounded travelling salesperson problem is a NP-complete problem. Now a NP-complete problem is in P, because every problem in NP can be reduced to NP-complete problem. Thus, every problem in NP can be now solved in polynomial time. Thus, we have $P = NP$.

Q11

It is a directed graph. It is not weakly connected. It is not strongly-connected. It has 5 nodes and 2 edges.