HW-3

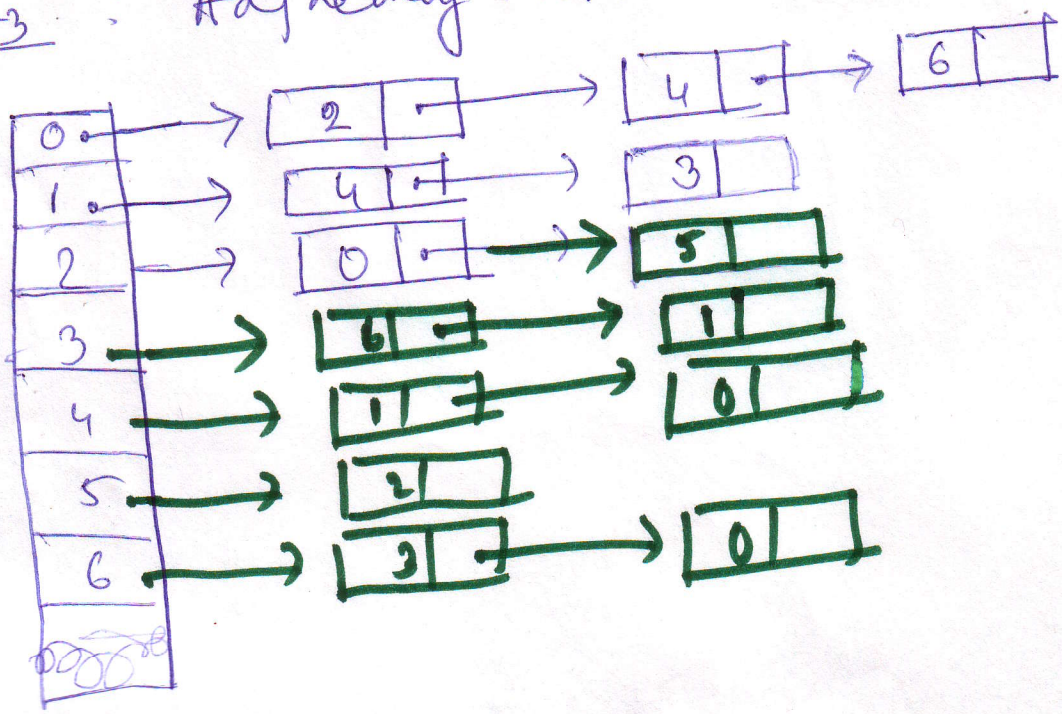
Solution Set:-

3.72. **Adjacency Matrix:-**

I/P pairs:- 0-2, 1-4, 2-5, 3-6, 0-4, 6-0 & 1-3.

	0	1	2	3	4	5	6
0	1	0	1	0	1	0	1
1	0	1	0	1	1	0	0
2	1	0	1	0	0	1	0
3	0	1	0	1	0	0	1
4	1	1	0	0	1	0	0
5	0	0	1	0	0	1	0
6	1	0	0	1	0	0	1

3.73 : Adjacency List:-



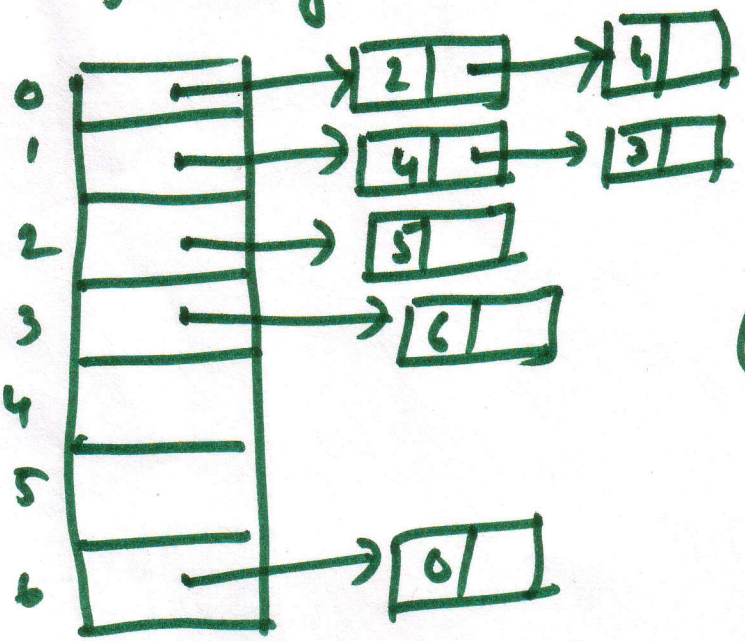
3.74

Directed Graph:-

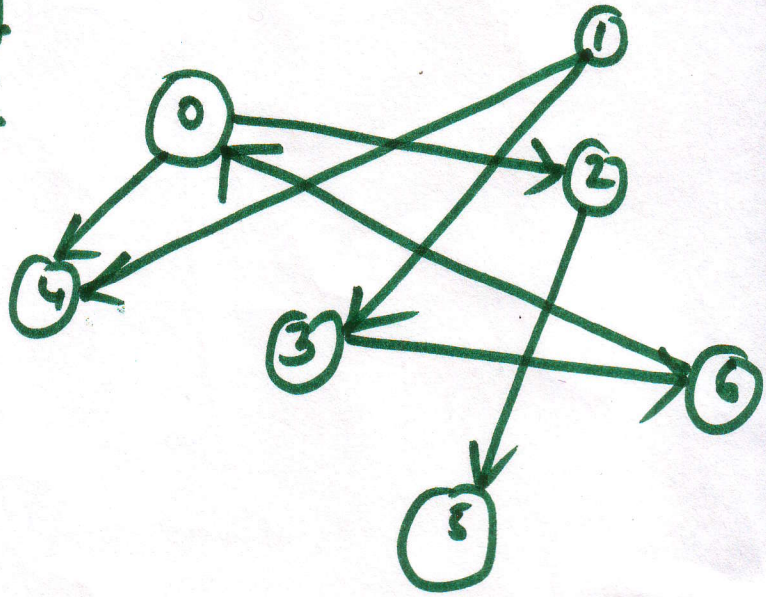
Adjacency Matrix:-

	0	1	2	3	4	5	6
0	0	0	1	0	1	0	0
1	0	1	0	1	1	0	0
2	0	0	1	0	0	1	0
3	0	0	0	1	0	0	1
4	0	0	0	0	1	0	0
5	0	0	0	0	0	1	0
6	1	0	0	0	0	0	1

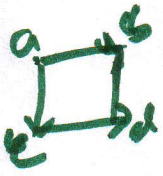
Adjacency List:-

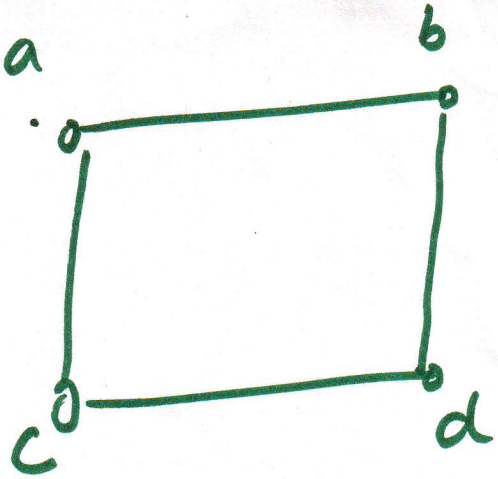


Graph:-



17.19.





→

	a	b	c	d
a	0	1	1	0
b	1	0	0	1
c	1	0	0	1
d	0	1	1	0

Adjacency Matrix

If the graph is undirected, then the adjacency matrix of the 2nd graph is same as that of adj matrix of 1st graph.

For a directed graph, Adj(Graph(G')) = Transpose of Adj(Graph(G)).

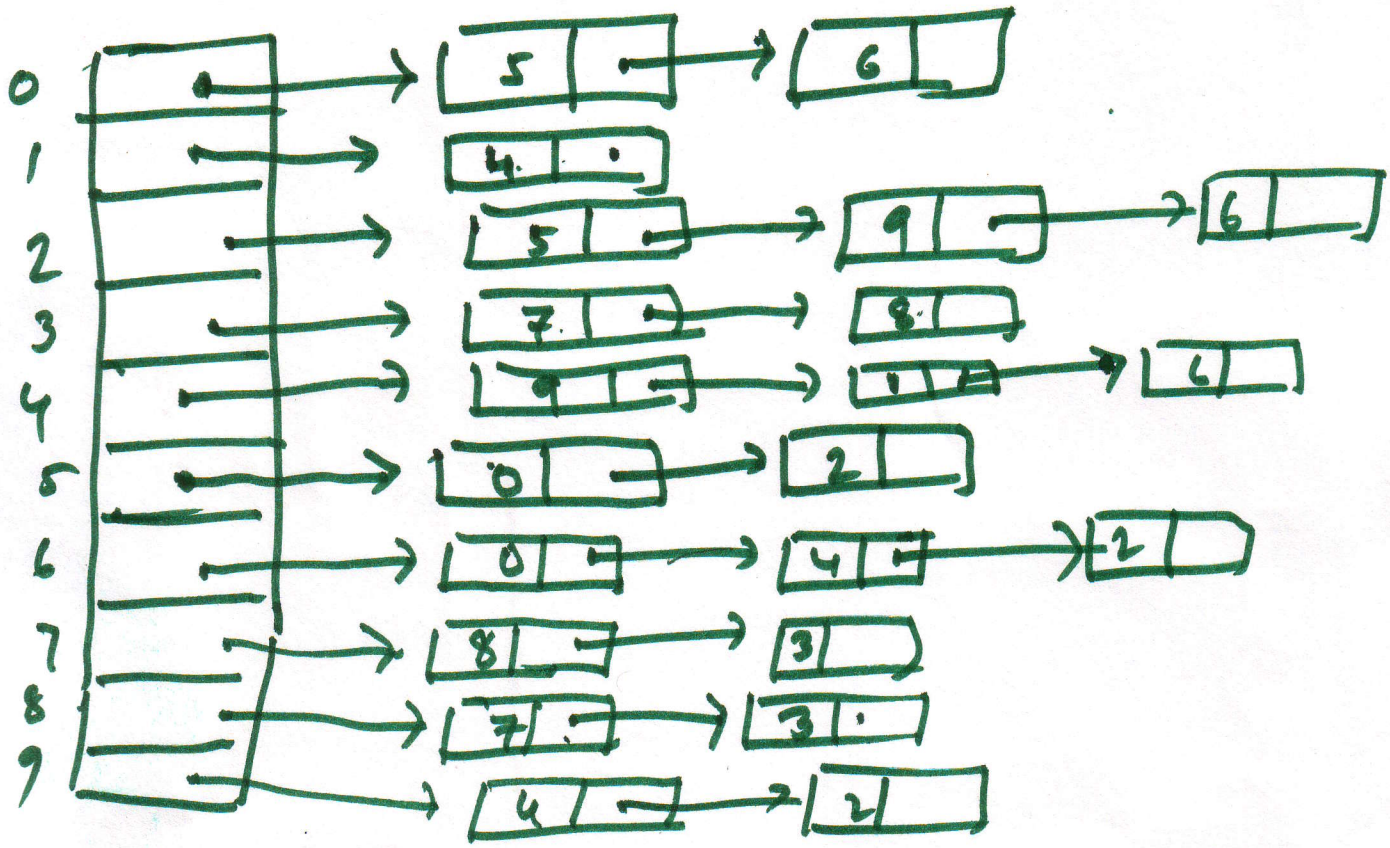
17.25.

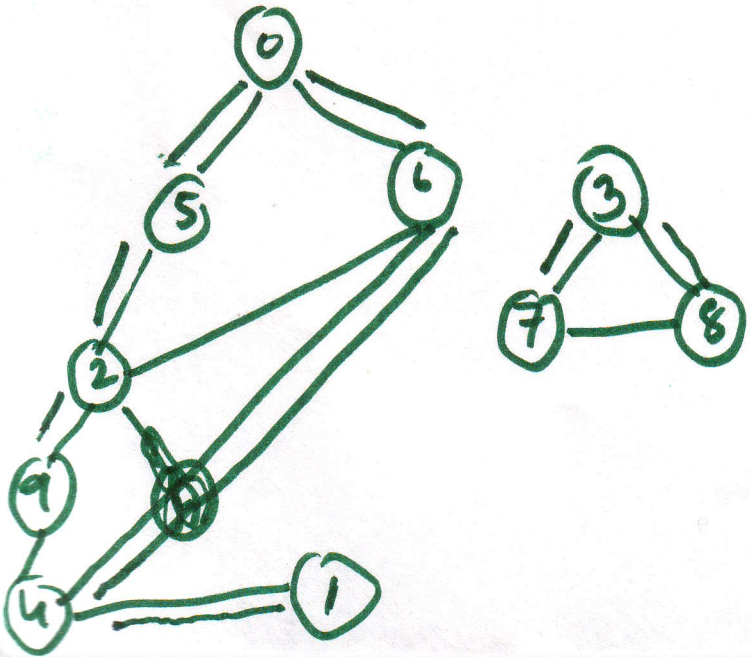
```
p = i+1,   q = v.

for (i = 1 ; v-1, i++)
{
    if (j = k)  then
    {   p = k+1;
        q = v;
    } endif.
    for (j = p ; q ; j++)
    { if adj[i, j] = 1 then
        continue;
      else
        { q = j-1;
          k = j;
        }
    }
}
```

18.50 3-7, 1-4, 7-8, 0-5, 5-2, 3-8, 2-9, 0-6, 4-9, 2-6, 6-4

Adjacency list:





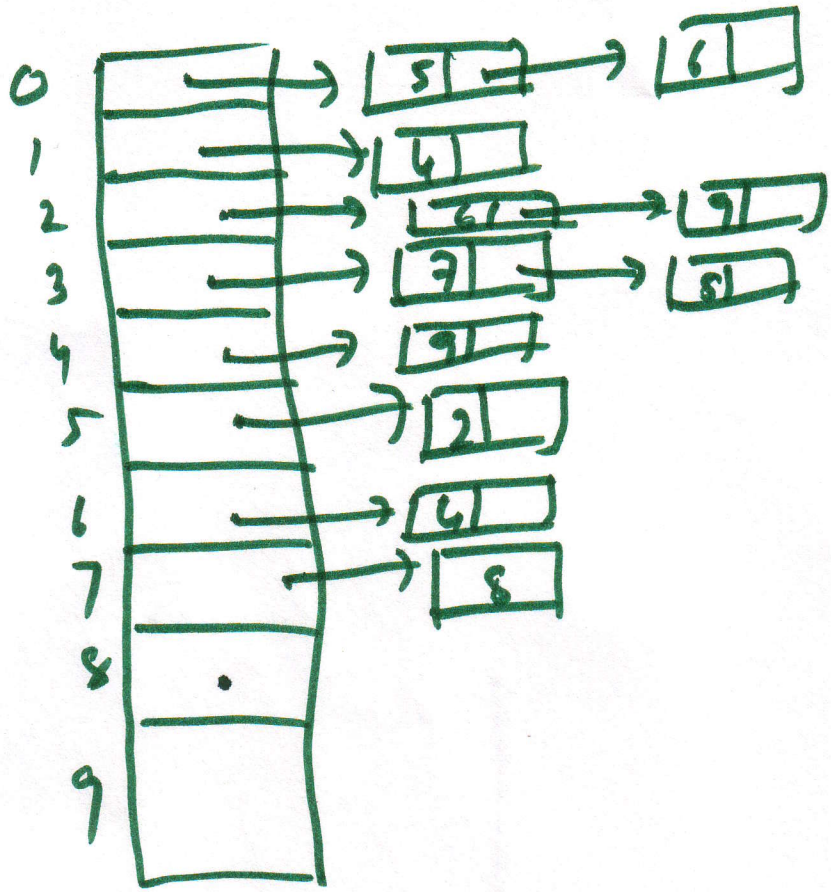
→ BFS Traversal Results:

0-5, 0-6, 5-2, 6-4, 2-9, 4-1, 3-7, 3-8.

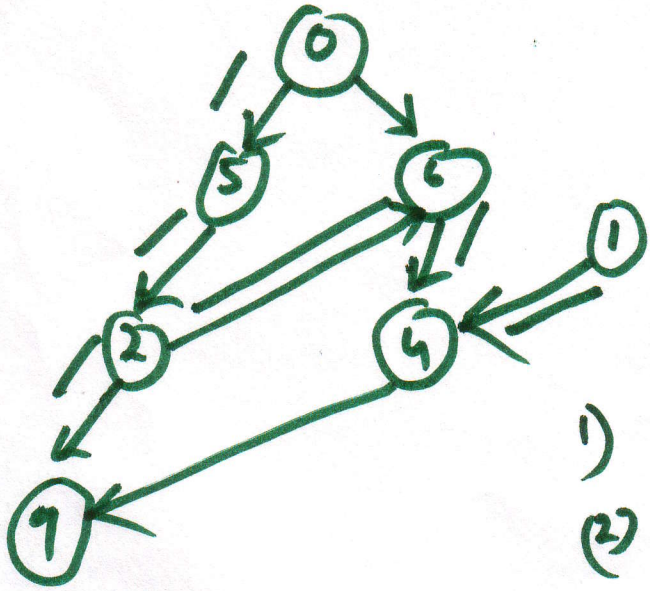
(Ans).

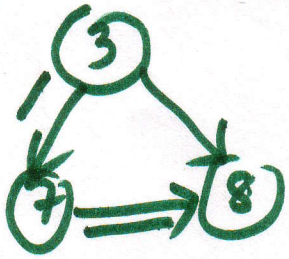
19.30.

Adjacency list of Digraph:.



Digraph:-





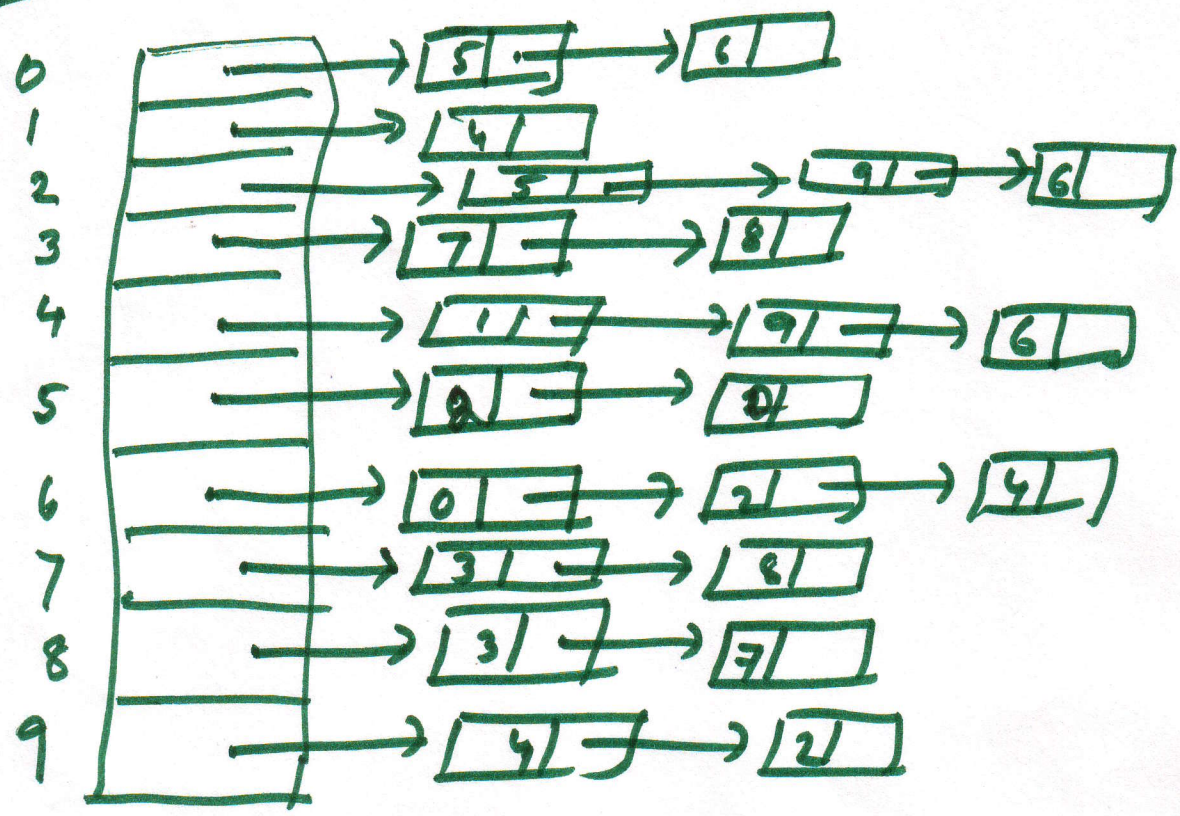
DFS Results:.

1) 0-5, 5-2, 2-9, 2-6, 6-4.

2) 1-4.

3) 3-7, 7-8

18.9



1st Tree.

0-0

0-5

5-2

2-5

2-9

9-4

4-1

1-4

4-9

4-6

6-0

6-2

6-4

0 1 2 3 4 5 6 7 8 9

0 * * * * * * * * *

0 * * * * 1 * * * *

0 * 2 * * 1 * * * *

0 * 2 * * 1 * * * 3

0 * 2 * 4 1 * * * 3

0 5 2 * 4 1 * * * 3

0 5 2 * 4 1 6 * * 3

0 5 2 7 4 1 6 * * 3

0 5 2 7 4 1 6 8 * 3

0 5 2 7 4 1 6 8 9 3

2nd Tree

3-3

3-7

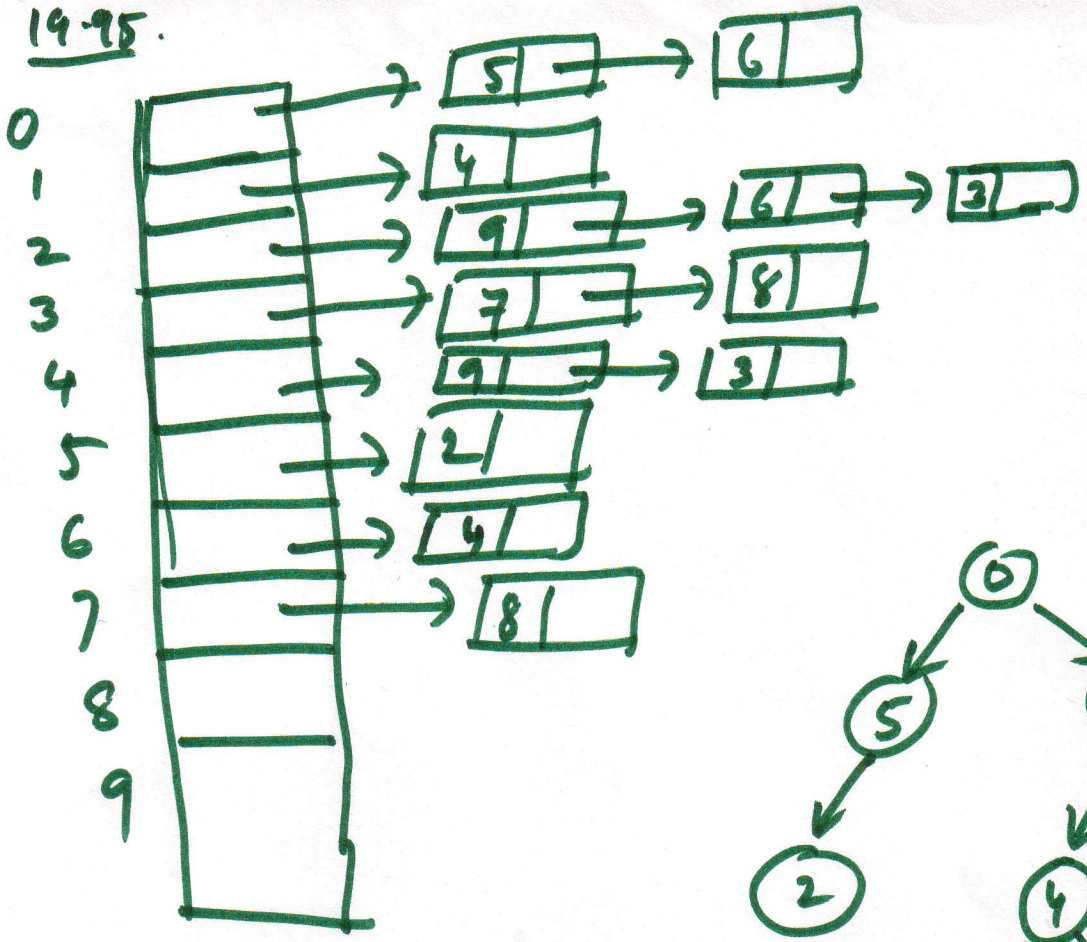
7-8

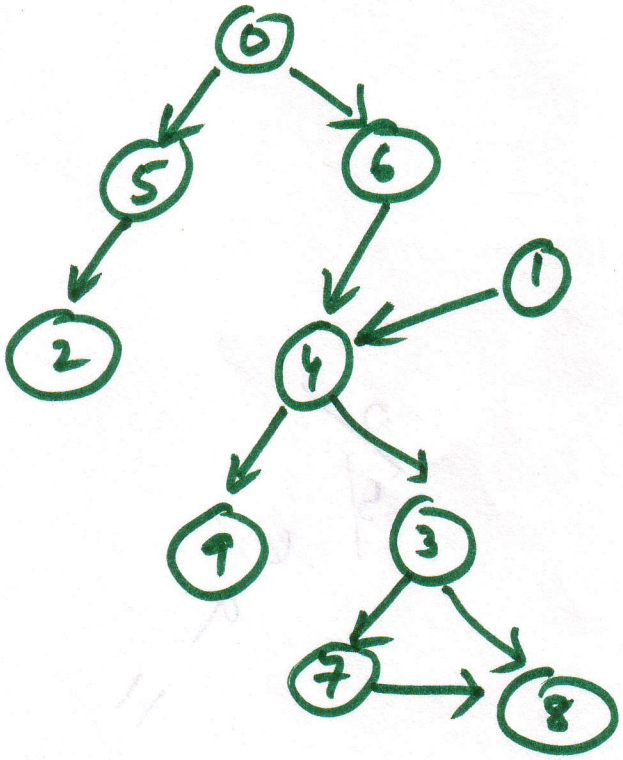
8-7

7-3

(Array

19-95.





DFS Forest:-

0-5, 5-2, 0-6,

6-4, 4-9, 4-3, 3-7,

1-4

Topological sort:-

ordering:-

0 1 5 6 4 2 9 3 7 8

(Answer).

19-96

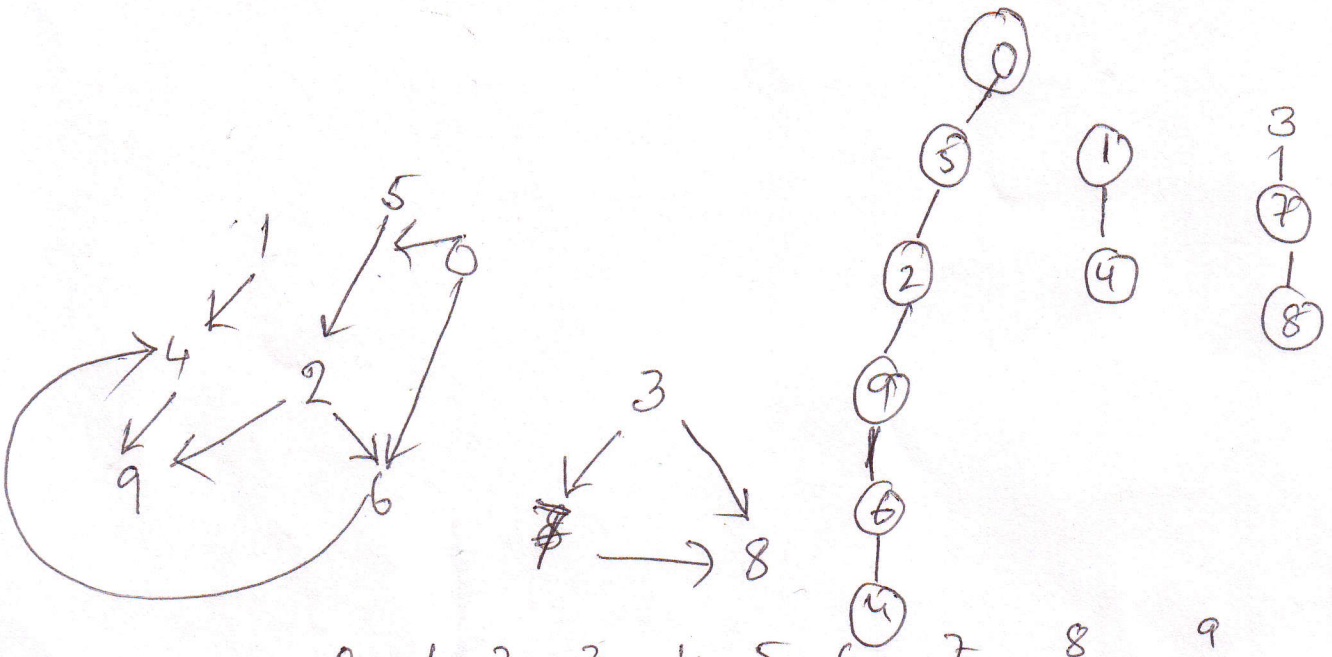
Preorder numbering can be used to do a topological sort. Since Preorder numbering simulates the behavior of a DFS in a graph which in turn can be considered as topological sort for that component.

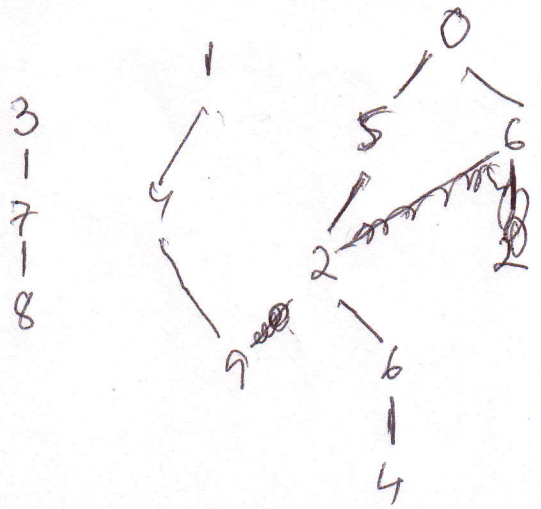
For example,

→ DFS in this graph produces 0 → 1 → 2 which is the topological sorting & preorder numbering of the vertices. (Ans)

19.1.24

3-7, 1-4, 7-8, 0-5,
5-2, 3-8, 2-9, 0-6, 4-9,
2-6, 6-4,





	0	1	2	3	4	5	6	7	8	9
id	1	2	1	0	2	1	1	0	0	2

(Ans).

20.1

Suppose the weight set of the graph = $\{w_1, w_2, \ldots, w_n\}$ in ascending order where $w_1 \le w_2 \le \ldots \le w_n$.

when we add (multiply) a factor say T with all of them,

they scale by

$\{w_1 + t_1 (* t_1), w_2 + t_2 (* t_2), \ldots, w_n + t_n (* t_n)\}$

and still hold the monotone property.

$\therefore w_1 + t_1 (* t_1) \le w_2 + t_2 (* t_2) \le \ldots$

and so on.

Hence the proof.

But if the factor is -ve, say $-t_1$.

Then if we multiply $(-t_1)$

i.e, $w_1 * (-t_1), w_2 * (-t_2), \ldots$ and so on.

the ordering property reverses.

i.e, if previously $w_1 \le w_2 \le \ldots w_n$

now, $w_1 * (-t_1) \ge w_2 * (-t_2) \ldots$ and so on

or because of the multiplication by a -ve factor the property changes. And hence not allowed (primal)

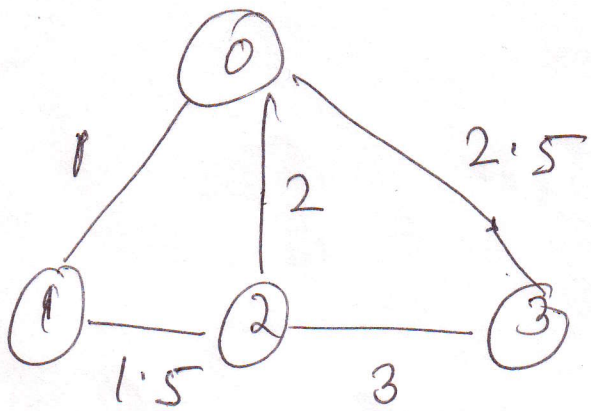
20.4. Maximum ST:-

Perform any spanning tree algo^{m} (say Prims or Kruskal) by examining the edges in order of non-increasing weights (largest first, smallest last). If two or more edges have the same weight, order them arbitrarily (Ans).

20.5. Has a unique MST if the edge weights are distinct.

This is not true.

The counter example is as follows.



All weights are unique. But Two diff MS exists.

0-1, 1-2, 2-3 and the other 0-1, 0-2, 0-3 (Ans).

19.48

	0	1	2	3	4	5	6	7	8	9
0	1	0	1	0	1	1	1	0	0	1
1	0	1	0	0	1	0	0	0	0	1
2	0	0	1	0	1	0	1	0	0	1
3	0	0	0	1	0	0	0	1	1	0
4	0	0	0	0	1	0	0	0	0	1
5	0	0	1	0	1	1	1	0	0	1
6	0	0	0	0	1	0	1	0	0	1
7	0	0	0	0	0	0	0	1	1	0
8	0	0	0	0	0	0	0	0	1	0
9	0	0	0	0	0	0	0	0	0	1

21.1

	0	1	2	3	4	5
0	*	*	*	2.236	4.472	*
1	2.236	*	*	*	*	*
2	*	*	*	3.162	*	*
3	*	*	*	*	3.0	2.236
4	*	*	3.61	*	*	*
5	*	3.61	2.236	*	*	*

19.52


```
 1   1  0  0  0  0  1  1  0  0  0
 2   0  1  0  0  1  0  0  0  0  0
 3   0  0  1  0  0  0  1  0  0  1
 4   0  0  0  1  0  0  0  1  1  0
 5   0  0  0  0  1  0  0  0  0  1
 6   0  0  1  0  0  1  0  0  0  0
 7   0  0  0  0  1  0  1  0  0  0
 8   0  0  0  0  0  0  0  1  1  0
 9   0  0  0  0  0  0  0  0  1  0
10   0  0  0  0  0  0  0  0  0  1
11  --------------------------------
12   1  0  0  0  0  1  1  0  0  0
13   0  1  0  0  1  0  0  0  0  0
14   0  0  1  0  0  0  1  0  0  1
15   0  0  0  1  0  0  0  1  1  0
16   0  0  0  0  1  0  0  0  0  1
17   0  0  1  0  0  1  0  0  0  0
18   0  0  0  0  1  0  1  0  0  0
19   0  0  0  0  0  0  0  1  1  0
20   0  0  0  0  0  0  0  0  1  0
21   0  0  0  0  0  0  0  0  0  1
22  --------------------------------
23   1  0  0  0  0  1  1  0  0  0
24   0  1  0  0  1  0  0  0  0  0
25   0  0  1  0  0  0  1  0  0  1
26   0  0  0  1  0  0  0  1  1  0
27   0  0  0  0  1  0  0  0  0  1
28   0  0  1  0  0  1  0  0  0  0
29   0  0  0  0  1  0  1  0  0  0
30   0  0  0  0  0  0  0  1  1  0
31   0  0  0  0  0  0  0  0  1  0
32   0  0  0  0  0  0  0  0  0  1
33  --------------------------------
34   1  0  0  0  0  1  1  0  0  0
35   0  1  0  0  1  0  0  0  0  0
36   0  0  1  0  0  0  1  0  0  1
37   0  0  0  1  0  0  0  1  1  0
38   0  0  0  0  1  0  0  0  0  1
39   0  0  1  0  0  1  1  0  0  1
40   0  0  0  0  1  0  1  0  0  0
41   0  0  0  0  0  0  0  1  1  0
42   0  0  0  0  0  0  0  0  1  0
43   0  0  0  0  0  0  0  0  0  1
44  --------------------------------
45   1  0  0  0  0  1  1  0  0  0
46   0  1  0  0  1  0  0  0  0  0
47   0  0  1  0  0  0  1  0  0  1
48   0  0  0  1  0  0  0  1  1  0
49   0  0  0  0  1  0  0  0  0  1
50   0  0  1  0  0  1  1  0  0  1
51   0  0  0  0  1  0  1  0  0  0
52   0  0  0  0  0  0  0  1  1  0
53   0  0  0  0  0  0  0  0  1  0
54   0  0  0  0  0  0  0  0  0  1
55  --------------------------------
56   1  0  0  0  0  1  1  0  0  0
57   0  1  0  0  1  0  0  0  0  1
58   0  0  1  0  0  0  1  0  0  1
59   0  0  0  1  0  0  0  1  1  0
60   0  0  0  0  1  0  0  0  0  1
61   0  0  1  0  0  1  1  0  0  1
62   0  0  0  0  1  0  1  0  0  1
63   0  0  0  0  0  0  0  1  1  0
64   0  0  0  0  0  0  0  0  1  0
65   0  0  0  0  0  0  0  0  0  1
66  --------------------------------
67   1  0  1  0  0  1  1  0  0  1
68   0  1  0  0  1  0  0  0  0  1
69   0  0  1  0  0  0  1  0  0  1
70   0  0  0  1  0  0  0  1  1  0
71   0  0  0  0  1  0  0  0  0  1
```

```
 72    0    0    1    0    0    1    1    0    0    1
 73    0    0    0    0    1    0    1    0    0    1
 74    0    0    0    0    0    0    0    1    1    0
 75    0    0    0    0    0    0    0    0    1    0
 76    0    0    0    0    0    0    0    0    0    1
 77   ------------------------------
 78    1    0    1    0    1    1    1    0    0    1
 79    0    1    0    0    1    0    0    0    0    1
 80    0    0    1    0    1    0    1    0    0    1
 81    0    0    0    1    0    0    0    1    1    0
 82    0    0    0    0    1    0    0    0    0    1
 83    0    0    1    0    1    1    1    0    0    1
 84    0    0    0    0    1    0    1    0    0    1
 85    0    0    0    0    0    0    0    1    1    0
 86    0    0    0    0    0    0    0    0    1    0
 87    0    0    0    0    0    0    0    0    0    1
 88   ------------------------------
 89    1    0    1    0    1    1    1    0    0    1
 90    0    1    0    0    1    0    0    0    0    1
 91    0    0    1    0    1    0    1    0    0    1
 92    0    0    0    1    0    0    0    1    1    0
 93    0    0    0    0    1    0    0    0    0    1
 94    0    0    1    0    1    1    1    0    0    1
 95    0    0    0    0    1    0    1    0    0    1
 96    0    0    0    0    0    0    0    1    1    0
 97    0    0    0    0    0    0    0    0    1    0
 98    0    0    0    0    0    0    0    0    0    1
 99   ------------------------------
100    1    0    1    0    1    1    1    0    0    1
101    0    1    0    0    1    0    0    0    0    1
102    0    0    1    0    1    0    1    0    0    1
103    0    0    0    1    0    0    0    1    1    0
104    0    0    0    0    1    0    0    0    0    1
105    0    0    1    0    1    1    1    0    0    1
106    0    0    0    0    1    0    1    0    0    1
107    0    0    0    0    0    0    0    1    1    0
108    0    0    0    0    0    0    0    0    1    0
109    0    0    0    0    0    0    0    0    0    1
110   ------------------------------
111    1    0    1    0    1    1    1    0    0    1
112    0    1    0    0    1    0    0    0    0    1
113    0    0    1    0    1    0    1    0    0    1
114    0    0    0    1    0    0    0    1    1    0
115    0    0    0    0    1    0    0    0    0    1
116    0    0    1    0    1    1    1    0    0    1
117    0    0    0    0    1    0    1    0    0    1
118    0    0    0    0    0    0    0    1    1    0
119    0    0    0    0    0    0    0    0    1    0
120    0    0    0    0    0    0    0    0    0    1
121   ------------------------------
122
```

21.2

0 8.082 0-3-5-1 6.708 0-3-5-2 2.236 0-3 4.472 0-4

4.472 0-3-5

2.236 1-0 10 8.944 1-0-3-5-2 4.472 1-0-3 6.708 1-0-4

6.708 1-0-3-5

11.244 2-3-5-1-0 9.008 2-3-5-1 20 3.162 2-3 6.162 2-3-4

5.398 2-3-5

8.082 3-5-1-0 5.846 3-5-1 4.472 3-5-2 3 3.0 3-4

2.236 3-5

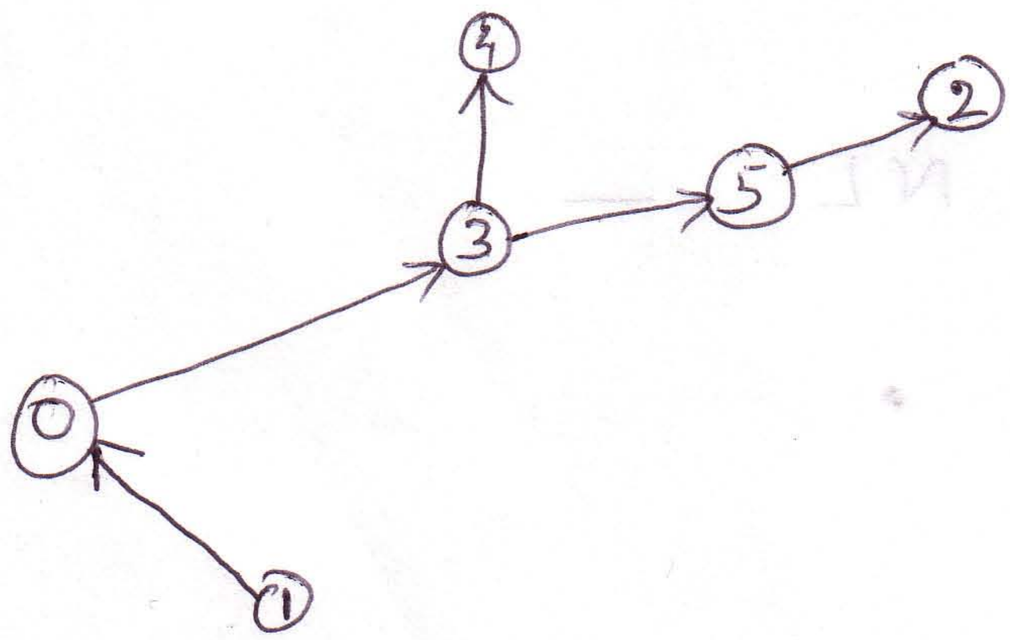
14.854 4-2-3-5-1-0 12.618 4-2-3-5-1 3.61 4-2 6.772 4-2-3

4 9.008 4-2-3-5

5.846 5-1-0 3.61 5-1 2.236 5-2 5.398 5-2-3 8.398 5-2-3-4

5.

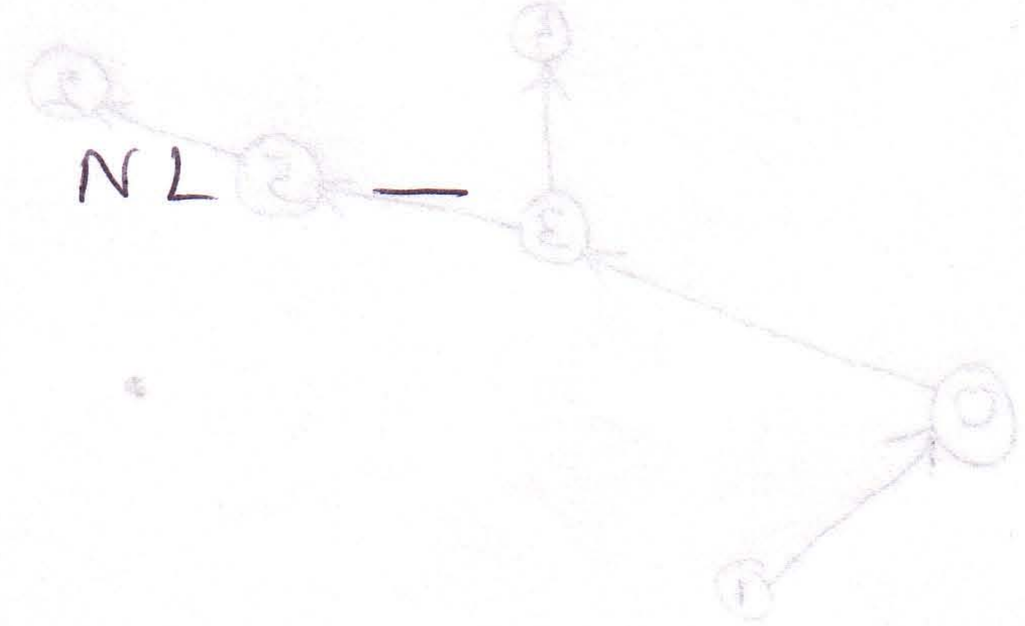
20.27



21.11

	P	W	NL	N
P	-	53	54	48
W	53	-	18	30
NL	54	18	—	12
N	48	30	12	—

	P	W	NL	N
P	-	W	NL	N
W	P	-	NL	NL
NL	P	W	-	N
N	P	NL	NL	-



21.42


```
999.000000 0 999.000000 1 999.000000 2 2.236000 3 4.472000 4 999.000000 5
2.236000 0 999.000000 1 999.000000 2 999.000000 3 999.000000 4 999.000000 5
999.000000 0 999.000000 1 999.000000 2 3.162000 3 999.000000 4 999.000000 5
999.000000 0 999.000000 1 999.000000 2 999.000000 3 3.000000 4 2.236000 5
999.000000 0 999.000000 1 3.610000 2 999.000000 3 999.000000 4 999.000000 5
999.000000 0 3.610000 1 2.236000 2 999.000000 3 999.000000 4 999.000000 5
--------------------------------
999.000000 0 999.000000 1 999.000000 2 2.236000 3 4.472000 4 999.000000 5
2.236000 0 999.000000 1 999.000000 2 4.472000 0 6.708000 0 999.000000 5
999.000000 0 999.000000 1 999.000000 2 3.162000 3 999.000000 4 999.000000 5
999.000000 0 999.000000 1 999.000000 2 999.000000 3 3.000000 4 2.236000 5
999.000000 0 999.000000 1 3.610000 2 999.000000 3 999.000000 4 999.000000 5
999.000000 0 3.610000 1 2.236000 2 999.000000 3 999.000000 4 999.000000 5
--------------------------------
999.000000 0 999.000000 1 999.000000 2 2.236000 3 4.472000 4 999.000000 5
2.236000 0 999.000000 1 999.000000 2 4.472000 0 6.708000 0 999.000000 5
999.000000 0 999.000000 1 999.000000 2 3.162000 3 999.000000 4 999.000000 5
999.000000 0 999.000000 1 999.000000 2 999.000000 3 3.000000 4 2.236000 5
999.000000 0 999.000000 1 3.610000 2 6.772000 2 999.000000 4 999.000000 5
5.846000 1 3.610000 1 2.236000 2 5.398000 2 10.318000 1 999.000000 5
--------------------------------
999.000000 0 999.000000 1 999.000000 2 2.236000 3 4.472000 4 4.472000 3
2.236000 0 999.000000 1 999.000000 2 4.472000 0 6.708000 0 6.708000 0
999.000000 0 999.000000 1 999.000000 2 3.162000 3 6.162000 3 5.398000 3
999.000000 0 999.000000 1 999.000000 2 999.000000 3 3.000000 4 2.236000 5
999.000000 0 999.000000 1 3.610000 2 6.772000 2 9.772000 2 9.008000 2
5.846000 1 3.610000 1 2.236000 2 5.398000 2 8.398000 2 7.634000 2
--------------------------------
999.000000 0 999.000000 1 8.082000 4 2.236000 3 4.472000 4 4.472000 3
2.236000 0 999.000000 1 10.318000 0 4.472000 0 6.708000 0 6.708000 0
999.000000 0 999.000000 1 9.772000 3 3.162000 3 6.162000 3 5.398000 3
999.000000 0 999.000000 1 6.610000 4 9.772000 4 3.000000 4 2.236000 5
999.000000 0 999.000000 1 3.610000 2 6.772000 2 9.772000 2 9.008000 2
5.846000 1 3.610000 1 2.236000 2 5.398000 2 8.398000 2 7.634000 2
--------------------------------
10.318000 3 8.082000 3 6.708000 3 2.236000 3 4.472000 4 4.472000 3
2.236000 0 10.318000 0 8.944000 0 4.472000 0 6.708000 0 6.708000 0
11.244000 3 9.008000 3 7.634000 3 3.162000 3 6.162000 3 5.398000 3
8.082000 5 5.846000 5 4.472000 5 7.634000 5 3.000000 4 2.236000 5
14.854000 2 12.618000 2 3.610000 2 6.772000 2 9.772000 2 9.008000 2
5.846000 1 3.610000 1 2.236000 2 5.398000 2 8.398000 2 7.634000 2
--------------------------------
Distance 10.318000 for 0 3 5 1 0
Distance 8.082000 for 0 3 5 1
Distance 6.708000 for 0 3 5 2
Distance 2.236000 for 0 3
Distance 4.472000 for 0 4
Distance 4.472000 for 0 3 5
Distance 2.236000 for 1 0
Distance 10.318000 for 1 0 3 5 1
Distance 8.944000 for 1 0 3 5 2
Distance 4.472000 for 1 0 3
Distance 6.708000 for 1 0 4
Distance 6.708000 for 1 0 3 5
Distance 11.244000 for 2 3 5 1 0
Distance 9.008000 for 2 3 5 1
Distance 7.634000 for 2 3 5 2
Distance 3.162000 for 2 3
Distance 6.162000 for 2 3 4
Distance 5.398000 for 2 3 5
Distance 8.082000 for 3 5 1 0
Distance 5.846000 for 3 5 1
Distance 4.472000 for 3 5 2
Distance 7.634000 for 3 5 2 3
```

```
 Distance 3.000000 for 3 4
 Distance 2.236000 for 3 5
 Distance 14.854000 for 4 2 3 5 1 0
 Distance 12.618000 for 4 2 3 5 1
 Distance 3.610000 for 4 2
 Distance 6.772000 for 4 2 3
 Distance 9.772000 for 4 2 3 4
 Distance 9.008000 for 4 2 3 5
 Distance 5.846000 for 5 1 0
 Distance 3.610000 for 5 1
 Distance 2.236000 for 5 2
 Distance 5.398000 for 5 2 3
 Distance 8.398000 for 5 2 3 4
 Distance 7.634000 for 5 2 3 5

```

0-8 1-6 2-10 3-7 4-9 5-11

0-8 1-7 2-9 3-6 4-10 5-11

0-8 1-7 2-9 3-6 4-11 5-10

0-8 1-7 2-10 3-6 4-9 5-11

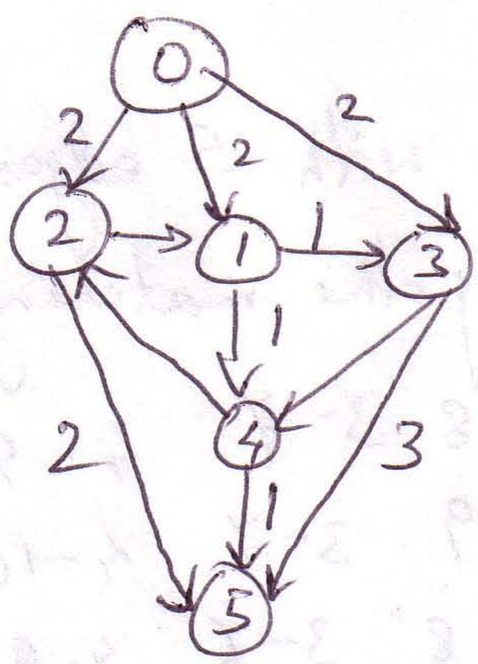
22.1

	cap	Flow
0-1	2	2
0-2	3	3
0-3	2	2
1-2	1	—
1-3	1	1
1-4	1	1
2-4	1	1
2-5	2	2
3-4	2	—
3-5	3	3
4-5	2	2

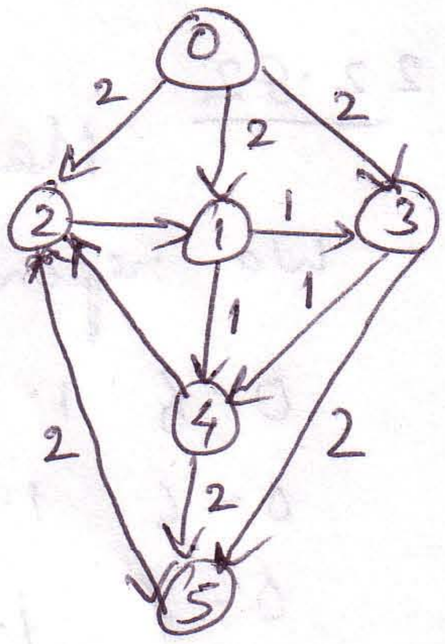
Maxflow = 7 (only one flow possible)

22.13

	Flow1	Flow2
0-1	2	2
0-2	2	2
0-3	2	2
1-3	1	1
1-4	1	1
2-1	—	—
2-5	2	2
3-4	—	1
3-5	3	2
4-2	—	—
4-5	1	2

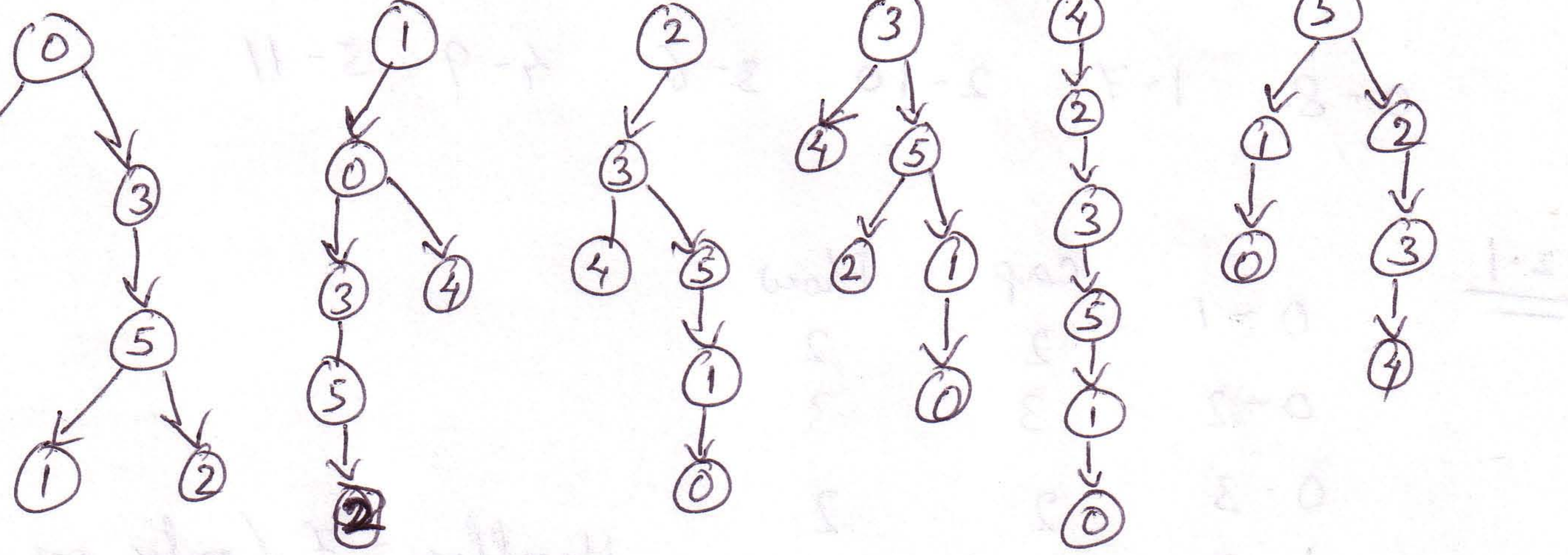


Maxflow = 6

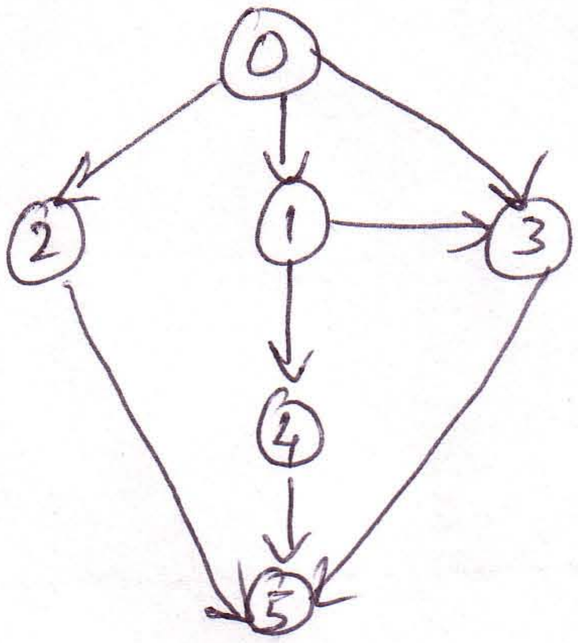


21.14 Error in problem.

21.41



22.2



22.82 Matchings with 5 edges will have too many solutions.
We report only the matchings with 6 edges here.

0-6 1-11 2-8 3-7 4-9 5-10
0-6 1-11 2-9 3-7 4-10 5-8
0-7 1-11 2-8 3-6 4-9 5-10
0-7 1-11 2-9 3-6 4-10 5-8
0-7 1-11 2-10 3-6 4-9 5-8
0-8 1-6 2-9 3-7 4-10 5-11