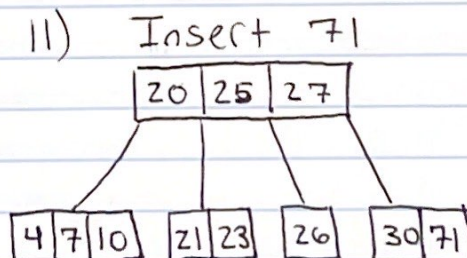
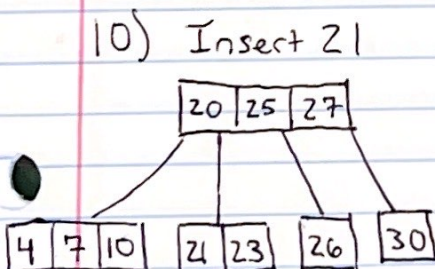
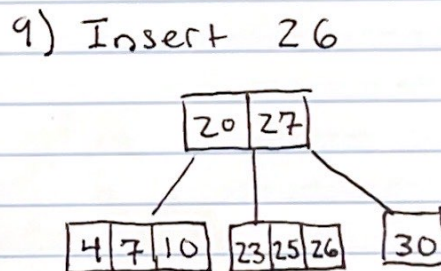
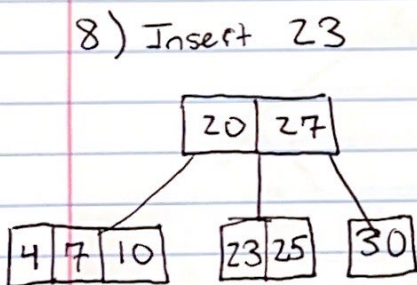
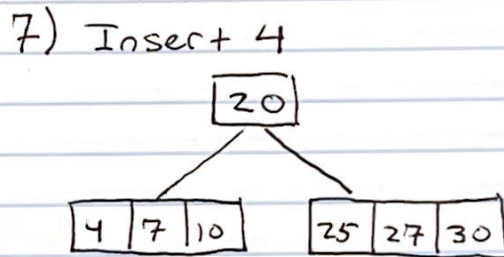
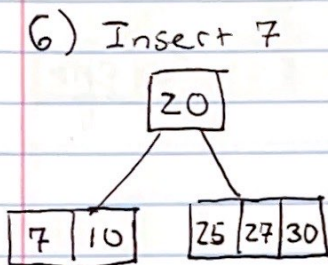
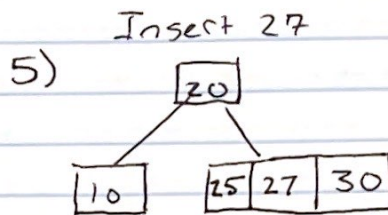
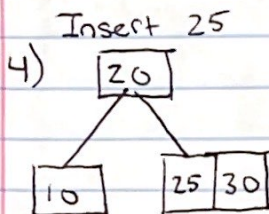
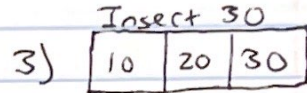
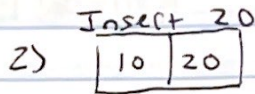
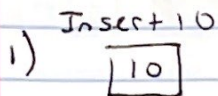


# Homework #5

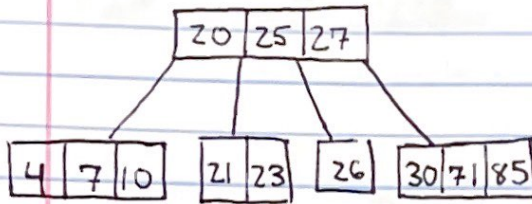
Vincenzo D'Arcu  
CS 253  
5/10/22

Input: 10, 20, 30, 25, 27, 7, 4, 23, 26, 21,  
71, 85, 100

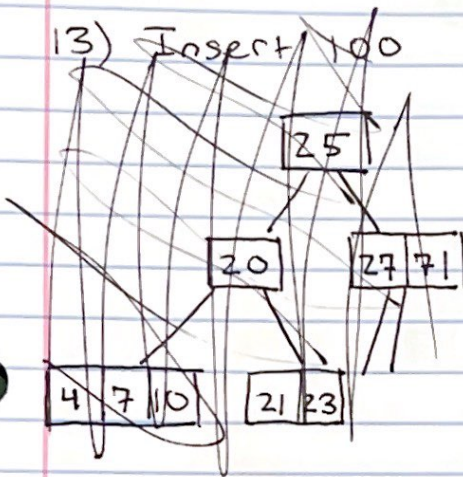
## 2-3-4 Tree:



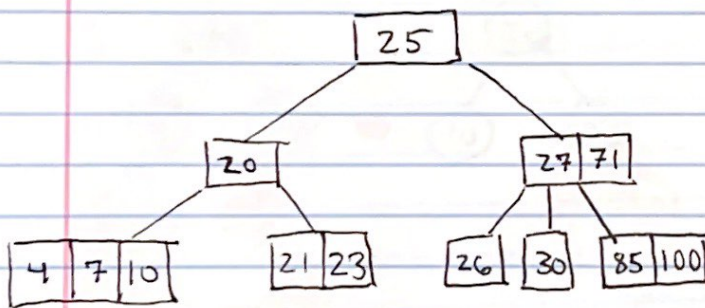
12) Insert 85



13) Insert 100



13) Insert 100





## Red Black Tree:

Key

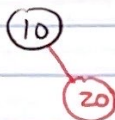
○ → Black

◉ → Red

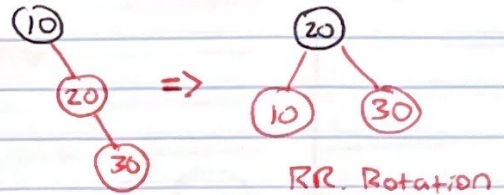
1) Insert 10



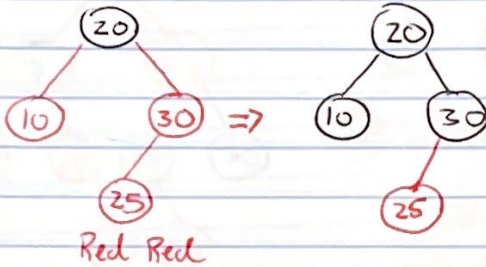
2) Insert 20



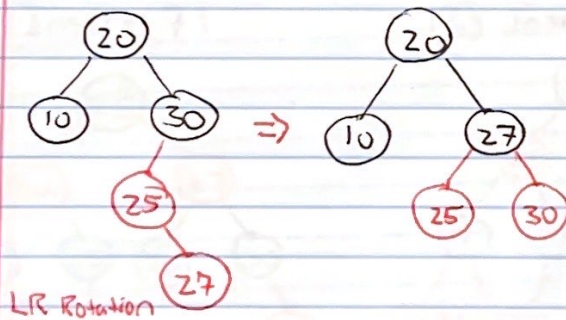
3) Insert 30



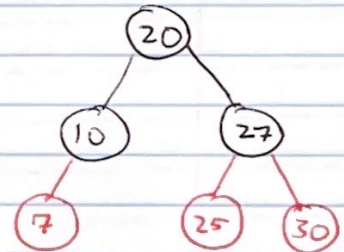
4) Insert 25



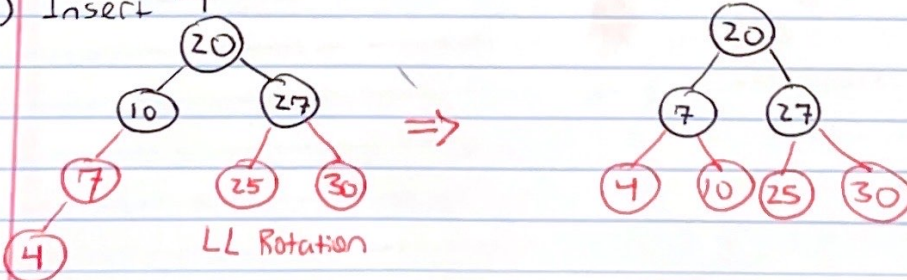
5) Insert 27



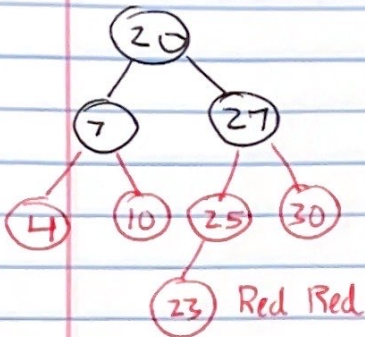
6) Insert 7



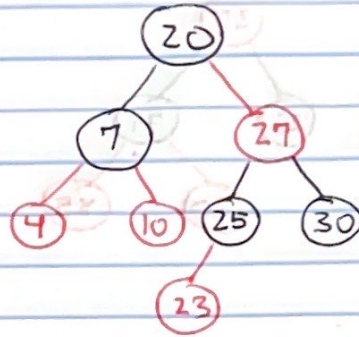
7) Insert 4



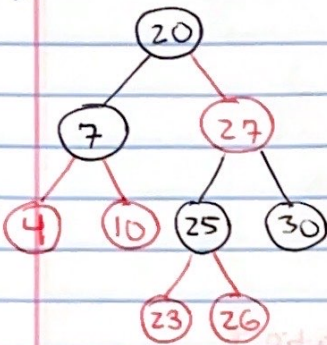
8) Insert 23



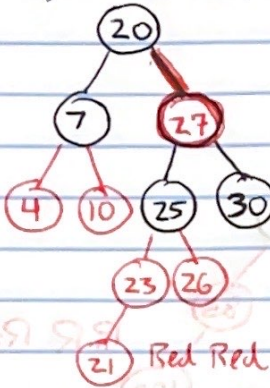
⇒



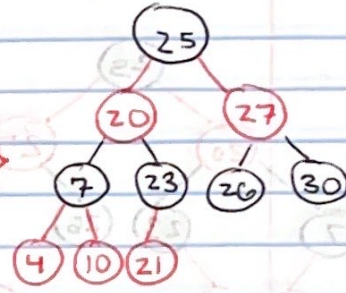
9) Insert 26



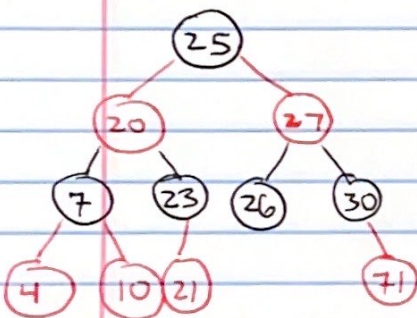
10) Insert 21



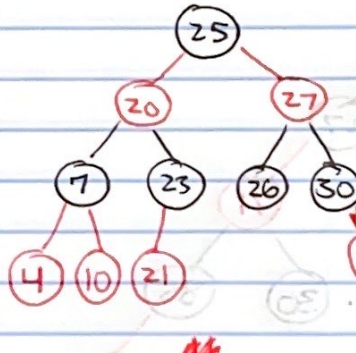
⇒



11) Insert 71



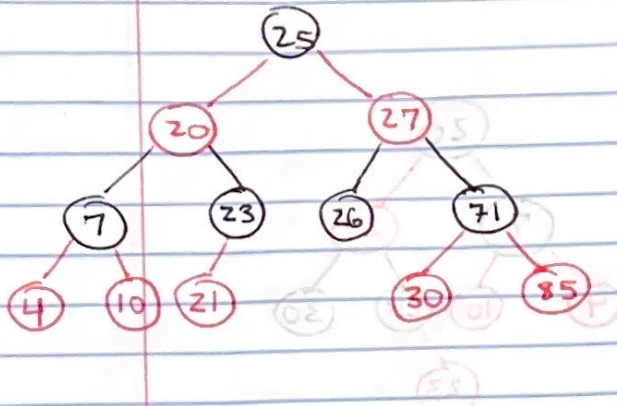
12) Insert 85



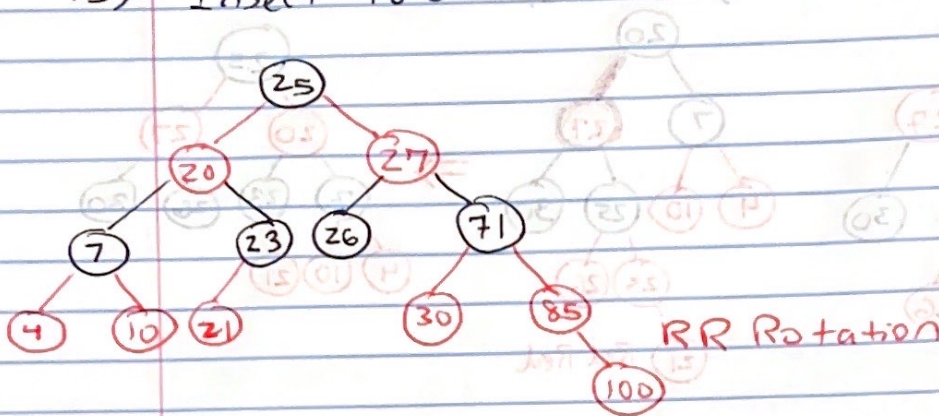
RR  
Rotation



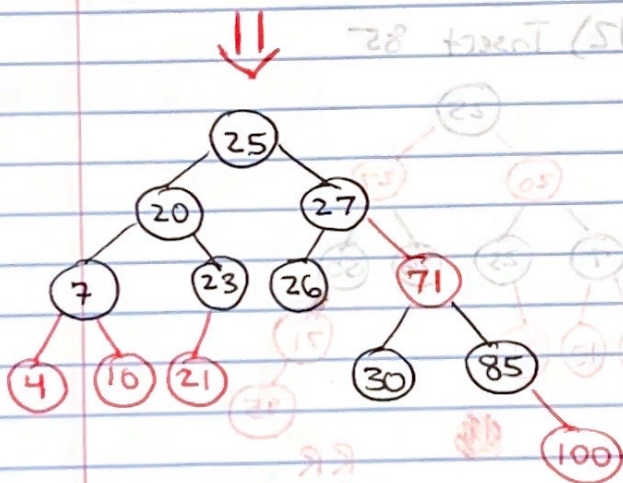




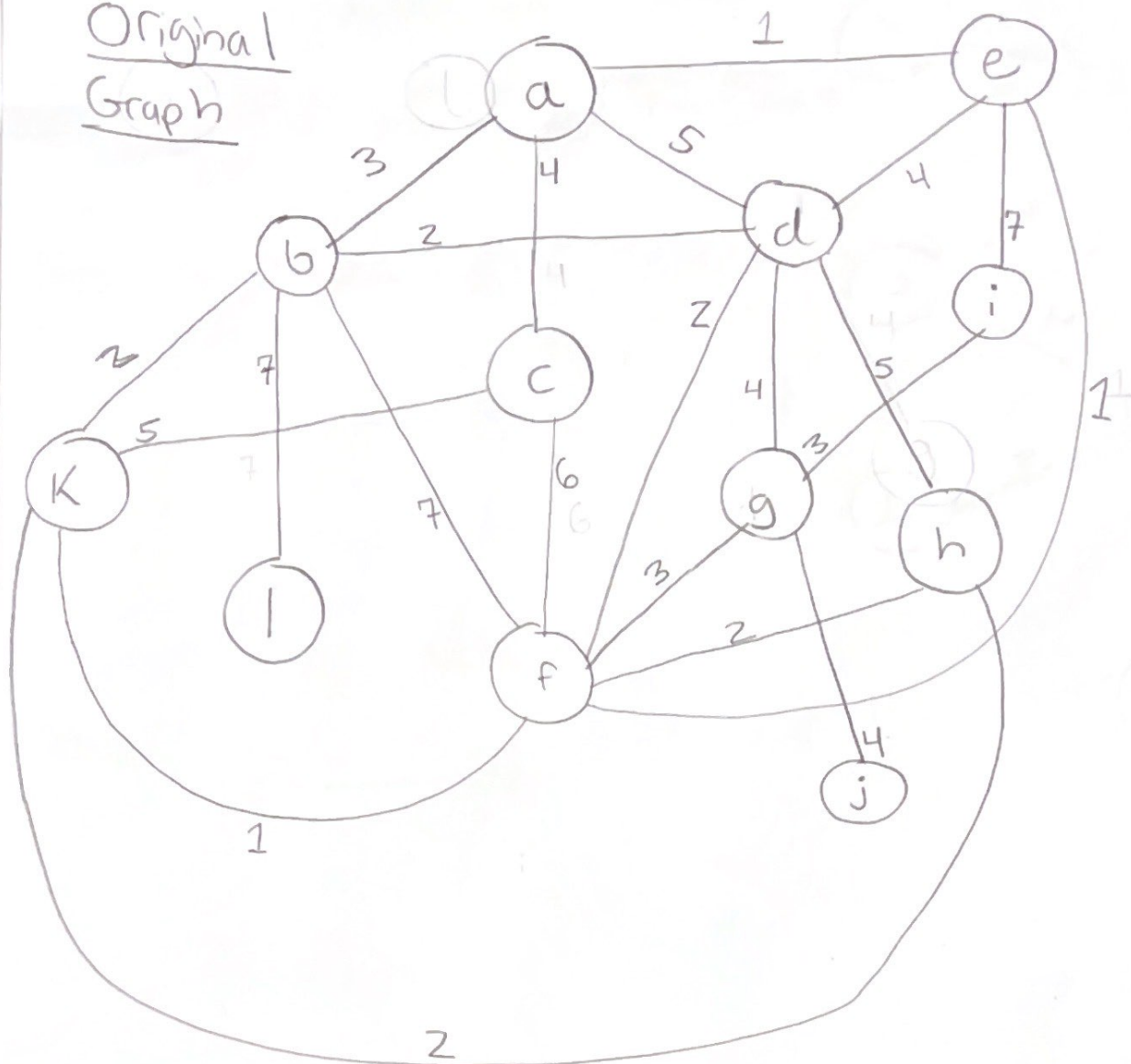
13) Insert 100



RR Rotation



Original  
Graph



# Kruskal's Algorithm — Minimum Spanning Tree

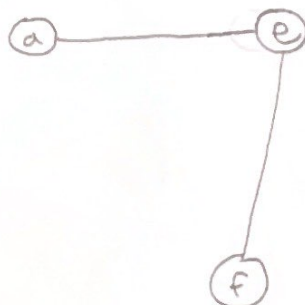
Idea: Add Edges one at a time selecting at each step the shortest edge that doesn't form a cycle.

Step 1:



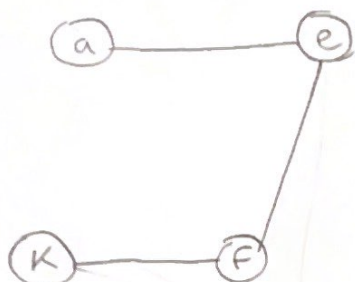
$$\underline{w(a,e)=1}, \quad w(e,f)=1, \\ w(f,k)=1.$$

Step 2:



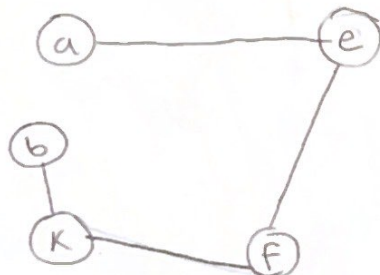
$$\underline{w(e,f)=1}$$

Step 3:



$$\underline{w(f,k)=1}$$

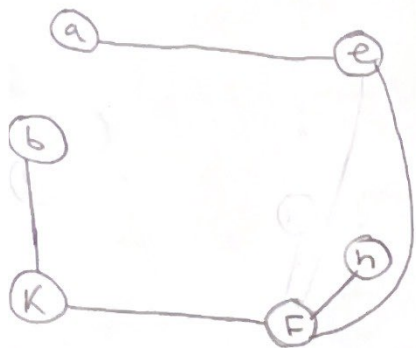
Step 4:



$$\underline{w(b,k)=2}, \quad w(f,h)=2, \\ w(h,k)=2, \quad w(b,d)=2 \\ w(d,f)=2$$

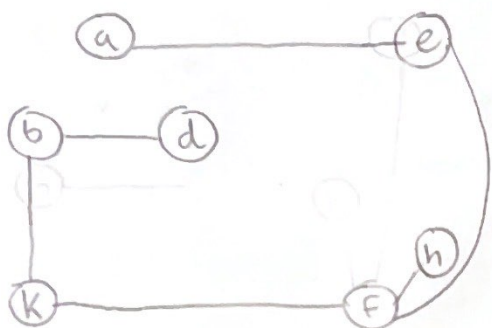


Step 5:



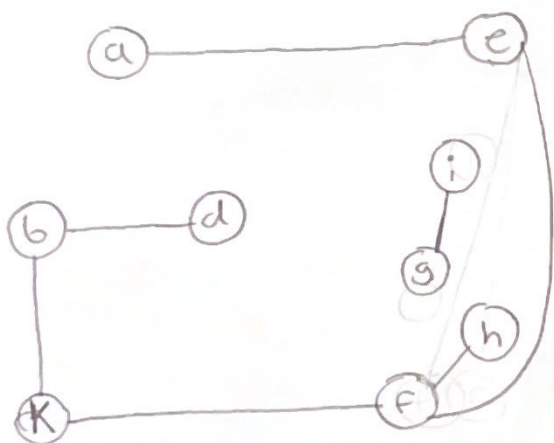
$$\underline{w(f, h) = 2}$$

Step 6:



$$\underline{w(b, d) = 2}$$

Step 7:

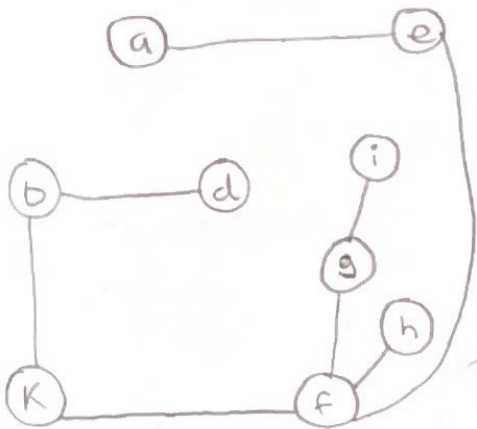


$$w(a, b) = 3, \underline{w(g, i) = 3},$$

$$w(f, g) = 3$$

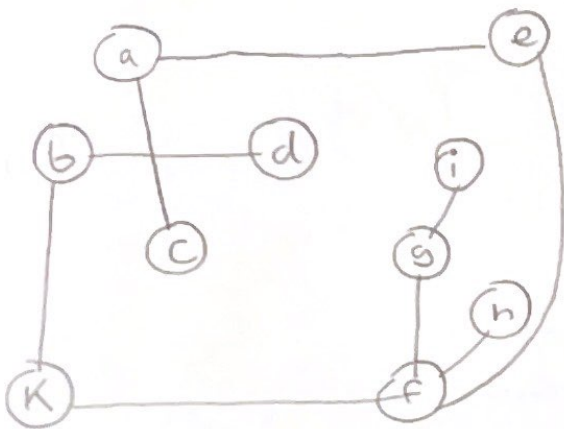


Step 8:



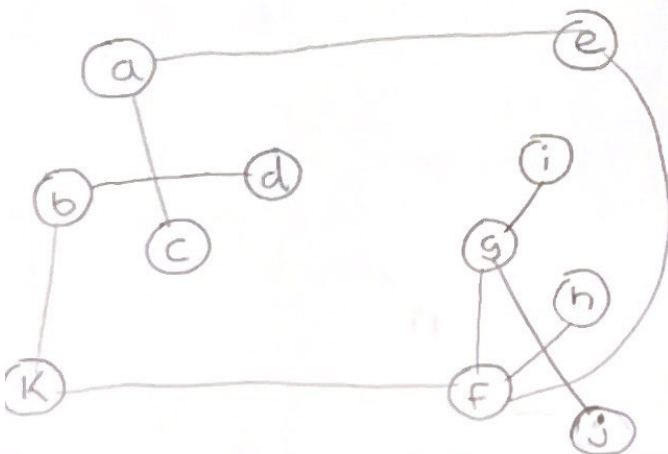
$$\underline{w(f,g) = 3}$$

Step 9:



$$w(d,g) = 4, \quad \underline{w(a,c) = 4}, \\ w(g,i) = 4, \quad w(d,e) = 4$$

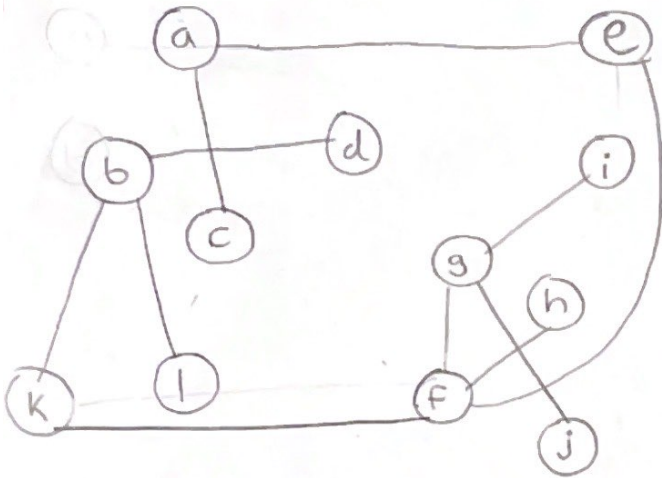
Step 10:



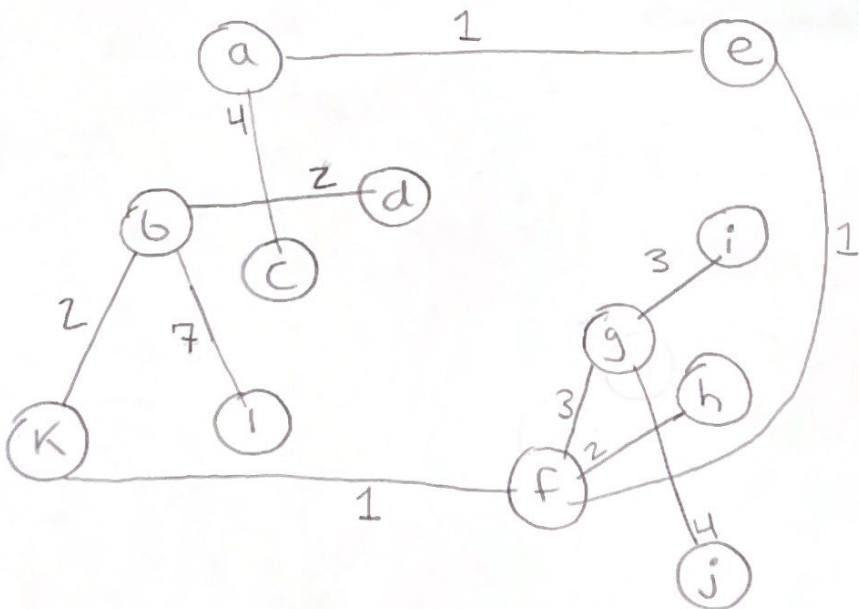
$$\underline{w(g,j) = 4}$$

Step 11 :

$$\underline{w(b,i)=7}, \quad w(e,i)=7, \\ w(b,f)=7$$



Final Minimum Spanning Tree :



Final Weight  
→ = 30