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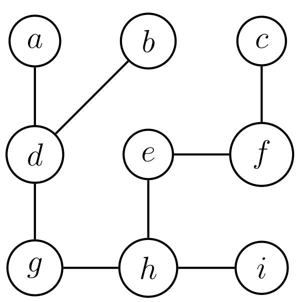
Answer 1

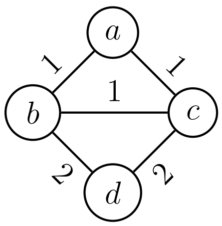
a)
I used Prim's algorithm for finding the minimum spanning tree.

order	edge	weight
1	e,f	1
2	e,h	2
3	h,g	2
4	f,c	3
5	g,d	3
6	d,a	2
7	d,b	3
8	h,i	4

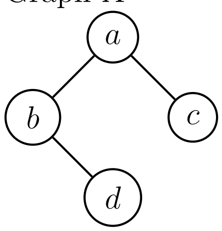
b)
Minimum Spanning Tree of the graph G;



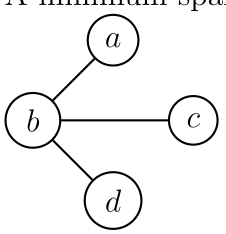
c)
Minimum spanning tree for the graph G is unique.
In general, no. One can not say that the minimum spanning tree unique for any connected edge-weighted undirected graph. A counter example would be enough. For example, for the given graph there exists several minimum spanning trees. two of them are shown below;



Graph A



A minimum spanning tree of graph A.



Another minimum spanning tree of graph A.

d)
Minimum spanning trees of graphs with weighted edges must have edges such that their sum is minimum. If one replaces the unique minimum weight edge with any other edge, then the sum will not be the minimum anymore. Since the sum of edges chosen for the minimum spanning tree must be minimum, the replacement is not possible. Hence, the minimum weight edge must be included in any minimum spanning tree for that graph.

Answer 2

Yes, they are isomorphic since there exists a one-to-one and onto function f that maps the vertices x, y in graph G to the vertices f(x), f(y) in graph H with the property that x and y are adjacent in G if and only if f(x) and f(y) are adjacent in H.

f(a)=n, f(b)=q, f(c)=o, f(d)=r, f(e)=m, f(f)=p

Answer 3

a)
Number of vertices: 7
Number of edges: 6
height: 3

b)
Postorder: $q : 13 \rightarrow s : 19 \rightarrow u : 23 \rightarrow v : 58 \rightarrow t : 43 \rightarrow r : 24 \rightarrow p : 17$
Inorder: $q : 13 \rightarrow p : 17 \rightarrow s : 19 \rightarrow r : 24 \rightarrow u : 23 \rightarrow t : 43 \rightarrow v : 58$
Preorder: $p : 17 \rightarrow q : 13 \rightarrow r : 24 \rightarrow s : 19 \rightarrow t : 43 \rightarrow u : 23 \rightarrow v : 58$

c)
Yes, since every vertex is either a leaf or has 2 children.

d)
No, levels other than the last level must be completely filled. However, they are not completely filled.

e)
No. Height of the left and right subtree of the root differ by 2 which is more than 1.

f)
No, for it to be a binary search tree, vertex u:23 should have been the right child of s:19.

g)
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Minimum number of nodes for a binary tree with height 5 is 6. To make that 6 nodes tree a full binary tree, we need to add a child to every node except the leaf node. Such tree will look like this;