BRONX COMMUNITY COLLEGE

of The City University of New York

DEPARTMENT OF MATHEMATICS and COMPUTER SCIENCE

CSI 35
XXX Section XXXXX

Sample Final Exam
Fall 2018
(Day) 3 Hours

NAME: _____

Instructions: This exam has two parts. Do all the questions in **Part I** and do any 4 questions in **Part II**. You must show all your work clearly in order to get full credit. Mark the answer clearly.

1 Part I. Do all questions. Each question is worth 4 points.

1. Find the sum $\sum_{k=2}^{54}(2k-5)$.

2. Use *mathematical induction* to prove that 3 divides $n^3 - n$ whenever n is a nonnegative integer.

3. Give a recursive definition of the sequence $\{a_n\}$,
   where $a_n = 1 + (-1)^n$, $n \in Z^+$.

4. Let $R_1 = \{(a,a),(a,b),(a,c),(c,d)\}$ and $R_2 = \{(b,a),(b,b),(b,d),(c,d),(d,c),(d,d)\}$ be relations on the set $\{a,b,c,d\}$. Find
   a) $R_1 \circ R_2$ b) $R_2 \circ R_1$

5. Determine whether the relation S given by its matrix representation is an *equivalence relation* or a *partial order relation*.

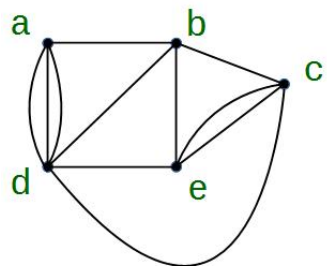
$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

6. Draw the *Hasse diagram* for the divisibility relation $|$ on the set $\{2, 3, 5, 10, 11, 15, 25\}$.

7. Draw an undirected graph represented by the adjacency matrix.

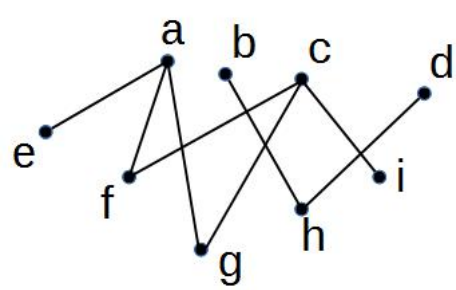
$$\begin{bmatrix} 1 & 3 & 2 \\ 3 & 0 & 4 \\ 2 & 4 & 0 \end{bmatrix}$$

8. Use the adjacency lists matrix to represent the following graph:

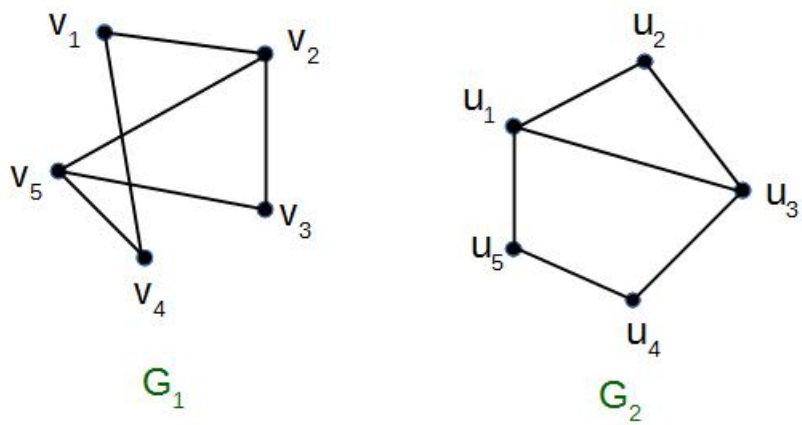


9. Find $\chi(Q_3)$.

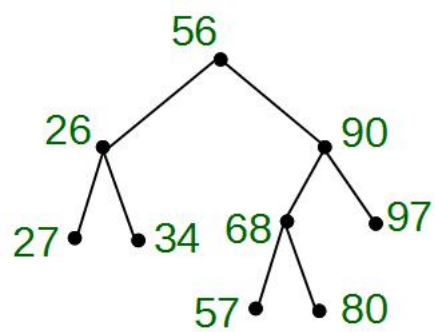
10. Determine whether the given undirected graph is connected.



11. Determine whether the given simple graphs are isomorphic. If they are, exhibit isomorphism.



12. Is this a binary search tree?



13. Are these codes *prefix codes*?

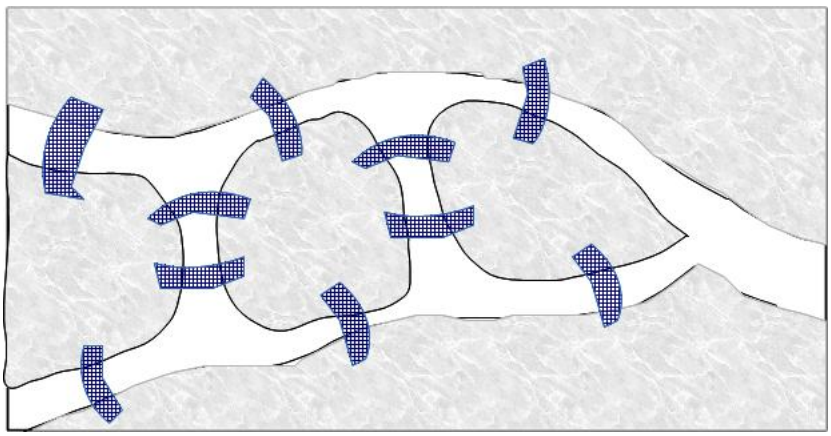
    $a : 1, \quad b : 01, \quad e : 101, \quad f : 011, \quad h : 1010$

14. How many leaves are in a complete *5-ary* tree of height 4?

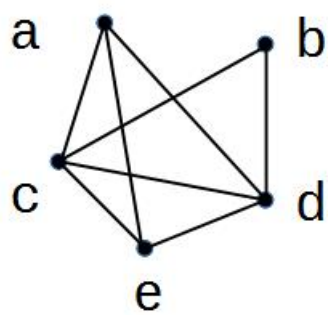
15. Evaluate the *postfix* expression $6 \;\; 3 \;\; 5 \;\; 2 \;\; 1 \;\; - \;\; + \;\; * \;\; 7 \;\; - \;\; /$

2 Part II. Do any 4 questions. Each question is worth 10 points.

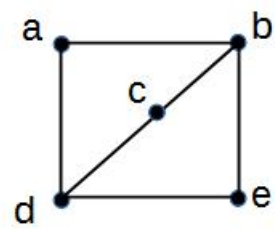
1. Can someone cross all the bridges shown in this map exactly once and return to the starting point?



2. Find the chromatic number of the given graph.



3. Determine whether the given graph has an *Euler circuit*, *Euler path*, *Hamilton circuit*, *Hamilton path*, or neither.



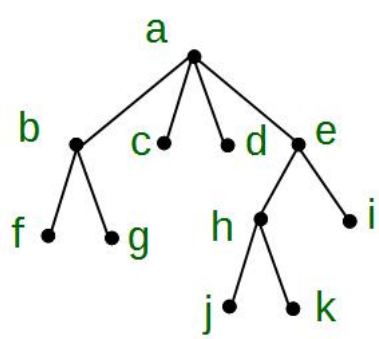
4. Use *Huffman coding* to encode the following symbols with given frequencies:

   $a : 0.01, g : 0.5, n : 0.12, p : 0.26, q : 0.07, w : 0.04.$

   Find the average number of bits required to encode a symbol.

5. **1)** Represent $\left(\dfrac{13 + 2 \times 7}{9}\right)^2 + 1$ using an ordered rooted tree.

   2) For the following tree:

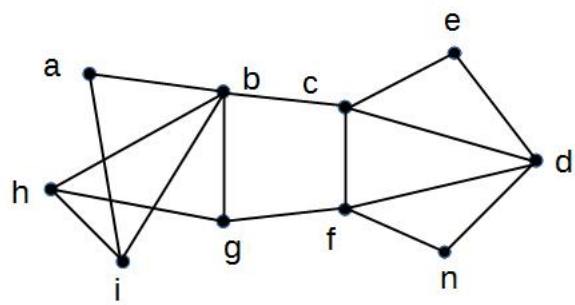


   (a) In which order are the vertices of the tree visited using an inorder traversal?

   (b) In which order are the vertices of the tree visited using an preorder traversal?

   (c) In which order are the vertices of the tree visited using an postorder traversal?

6. Use *Depth-First-Search* (**DFS**) or *Breadth-First-Search* (**BFS**) to find a spanning tree for the given simple graph. Use vertex a as the root of the tree. State which algorithm you are using. Show all the steps (put numbers along the edges).



7. Use **Prim**'s or **Kruskal**'s algorithms to find the minimum spanning tree for the following graph: