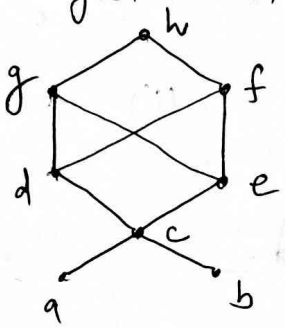
1) Let $A = \{1, 2, 3, 4\}$
If $R = \{(a, b) / (a-b)$ is an integral nonzero multiple of $2\}$
& $S = \{(a, b) / (a-b)$ is an integral nonzero multiple of $3\}$
Find ① $R \cup S$ ② $R \cap S$ ③ R^c

2) Find the transitive closure of R by Warshall's algorithm where $A = \{1, 2, 3, 4, 5, 6\}$ & $R = \{(x, y) / |x-y| = 2\}$

3) Let $A = \{1, 2, 3, 4\}$
$R = \{(1,1), (1,2), (1,3), (2,1), (2,2), (3,1) (3,2) (2,3) (3,3), (4,4)\}$
Is R an equivalence relation. if so, find the equivalence classes.

4) Consider the poset whose Hasse diagram is given below. Find the length of the longest chain. Find also the antichains



5) Let Z be the set of integers and let aRb iff b is a multiple of a Determine whether R is ① reflexive ② symmetric ③ antisymmetric, ④ irreflexive ⑤ transitive

6) Let $A = \{1, 2, 3, 5, 6, 10, 15, 30\}$ and let R be the relation "divides" on A. Draw the Hasse diagram of R

7) Let $X = \{a, b, c, d\}$. Using X, construct example of a relation on X of each of the following type
(i) reflexive, symmetric but not transitive
(ii) reflexive, transitive but not symmetric
(iii) symmetric, transitive but not reflexive
(iv) which is neither reflexive, nor symmetric, nor transitive.
(v) symmetric but neither reflexive nor transitive.

8) Test the following mapping $f: \mathbb{R} \to \mathbb{R}$ for injectivity and surjectivity
(i) $f(x) = 2x^2 + 1$, $x \in \mathbb{R}$ (ii) $f(x) = \sin x$, for all $x \in [0, \pi]$

(9) Among the integers 1 to 1000
(i) How many of them are not divisible by 3 nor by 5 nor by 7
(ii) How many are not divisible by 5 or 7 but divisible by 3.

(10) Define the following
(i) equivalence relation (ii) group (iii) partial order relation
(iv) equivalence classes ~~(v) bijective mapping~~ (v) Monoid (vi) homomorph

(11) Let $X = \{2, 3, 6, 12, 24, 36\}$
$x \leq y$ if x divides y
Find (i) maximal element (ii) minimal element
(iii) chain (iv) antichain (v) Is poset lattice?

(12) Find the shortest path from 'a' to 'z' by using Dijkstra's algorithm

(13) For the following set of weights, construct optimal prefix code

(14) Find the minimum spanning tree of the given graph using Kruskal's algorithm

(15) Determine whether the two graphs are isomorphic or

(i)

(ii)

(16) Find whether $K_{3,3}$ are isomorphic or not?

(17) Define the [illegible] give an example of each

(i) bipartite (ii) Spanning subgraph

(iii) Complement of a graph (iv) Subgraph (v) weighted graph.

(vi) Complete bipartite graph. (vii) Complete graph.

(18) Is there [illegible] regular graph of degree [illegible] vertices?

(19) Let $Z_n = \{0, 1, 2, \ldots, n-1\}$
In Z_{12} what is the order of 3, 6 and 8.

(20) Let $(\mathbb{Q}, *)$ is an algebraic system defined as $a * b = \frac{ab}{2}$ $\forall a, b \in \mathbb{Q}$
$*$ is a binary [illegible]
Determine whether $(\mathbb{Q}, *)$ is a group.

(21) Give an example of a graph

(i) that has [illegible] Hamiltonian circuit

(ii) Eulerian circuit but no Hamiltonian circuit.

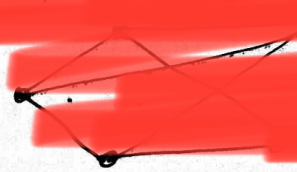
(iii) Hamiltonian circuit but no Eulerian circuit.

(iv) neither Hamiltonian circuit nor Eulerian circuit.

(v) Eulerian path but no Eulerian circuit.

(22) Find edge connectivity of

(i)



(ii)

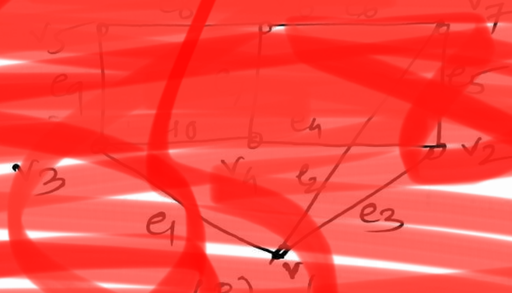
(23) [illegible] trees on 4, 5 and [illegible] tices.

(24) Answer [illegible] tree.

(i) [illegible]
[illegible] find the ancestors [illegible]
[illegible] the descendant of e and d
[illegible] tree rooted at [illegible] tree.
(v) find height [illegible]

(25) [illegible] there a full [illegible] tree with [illegible] ?

(26) Determine all possible [illegible] of the following graphs. [illegible] graph G and find it's all Construct [illegible] spanning [illegible] fundamental [illegible]



(27) Construct [illegible] for the data to find optimal tree. Also find it's weight
(i) [illegible] (ii) 8, 9, 10, 11, 13, 15, 22.

(28) Find the eccentricity of each vertex, centre and radius of the following tree.

(29) [illegible] (a) Fundamental [illegible] t.
(c) [illegible] mus/bridge (d) [illegible] tree (e) eccentricity of [illegible] x.
(f) binary [illegible]

(30) Let $A = \{1, 2, 3, 4, 5\}$
the relation matrix is

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

Draw it's digraph.

(31) For each of the following, determine whether the binary operation is associative or commutative.

(a) On $\mathbb{R}$, where $a * b = a\sqrt{b}$

(b) On $\mathbb{Z}^+$, where $a * b = ab + 1$

(32) If a committee has eight members

(a) How many ways can the committee members be seated in a row.

(b) How many ways can the committee select a president, vice-president and secretary?

(33) How many ways are there to pick two different cards from a standard 52-card deck such that

(a) the first is an ace and the second card is not a queen.

(b) the first card is a space and second card is not a queen.

(34) Find the prime factorization of (a) 88 (b) 1111 (c) 729.

(35) By using Euclidean algorithm find g.c.d of

(a) 1529, 14038 (b) 1528, 6060 (c) 9888, 6060.

(36) Using Chinese remainder theorem, find solution to the system of congruences

(a) $x \equiv 2 \pmod 3$
$x \equiv 1 \pmod 4$
$x \equiv 3 \pmod 5$

(b) $x \equiv 1 \pmod 2$
$x \equiv 2 \pmod 3$
$x \equiv 3 \pmod 5$
$x \equiv 4 \pmod{11}$

(37) Represent the graphs given [illegible] with an adjacency [illegible] and [illegible] matrix

(a) a

(38) [illegible] strongly connected [illegible] but weakly connected.

(a) 

(c) 

(39) [illegible] number of

(c) 

(40) [illegible]

(b) Give [illegible] planar graph.

(41) What is multiset? Explain with atleast two examples.

(42) How many numbers of 7 digits can be formed with the digits 0, 2, 2, 5, 6, 6, 6. How many of them are even.

(43) What is Fuzzy set? Explain any three operations on Fuzzy sets?

(44) When the lattice is said to be (a) bounded (b) distributive?

(45) State ~~four~~ all properties of a tree.

(46) ~~Write and~~ How many vertices are necessary to construct a graph with 6 edges in which the degree of each vertex is atleast 2.

(47) Evaluate (i) $(25^2 \bmod 41) \bmod 19$

(ii) $(148 \bmod 29 + 480 \bmod 29) \bmod 29$.

(48) Let G be a group of all 2x2 matrices $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ with $ad - bc \neq 0$ under matrix multiplication. Show that $H = \left\{ \begin{bmatrix} a & 0 \\ 0 & d \end{bmatrix} / ad \neq 0 \right\}$ is a subgroup of G.