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## Discrete Structures

### Set1

Q1. Find the 4th term of the Fibonacci sequence :

$$f_n = f_{n-1} + f_{n-2} \text{ for } n \geq 3, f_1 = 1, f_2 = 1$$

- a) 2
- b) 3
- c) 4
- d) 5

Q2. The graphs in which loops and parallel edges are allowed are called:

- a) Fixed graph
- b) Parallel edge graph
- c) Trivial graph
- d) Pseudo graph

Q3. The Adjacency Matrix of a simple graph is :

- a) symmetric
- b) asymmetric
- c) polar
- d) Bipolar

Q4. \_\_\_\_\_ is defined as the pictorial representation of a relation R.

- a) Finite graph
- b) Acyclic graph
- c) Digraph
- d) Indirected graph

Q5. Which of the following is not a linear recurrence relation ?

- a)  $7a_n = 3a_{n-2} + 4a_{n-3} + 5a_{n-4}$
- b)  $3a_n + 2^3 a_{n-1} = 5a_{n-2}$
- c)  $2a_n = a_{n-3} + 3$
- d)  $a_n = a_{n-1} + a_{n-2}$

Q6. A mapping  $f : A \rightarrow B$  is called surjective if :

- a)  $f(A)$  is not equal to  $B$
- b) every element in  $B$  has at least one pre-image in  $A$
- c)  $f(A)$  is a proper subset of  $B$
- d) None of these

Q7. If the sequence is  $a_n = a^n$  ( $a \neq 0$ , and constant) then  $G(t)$  is :  
where  $G(t)$  denotes the generating function

- a)  $1/1+at$
- b)  $1/1-at$
- c)  $1/1+t$
- d)  $1/1-t$

Q8. Let  $L$  be a lattice. Then  $a \wedge b = a$  if and only if

- a)  $a \vee b = b \vee a$
- b)  $a \wedge b = c$
- c)  $a \vee b = b$
- d)  $a \vee b = b \wedge a$

Q9. Which of the following is a Redundancy law?

- a)  $x.(x + y) = x$
- b)  $x + (x.y) = y \wedge ]x$
- c)  $x.(x + y) = y$
- d)  $x + x = x*y \vee x$

Q10. Minimum number of edges in an unweighted graph defines \_\_\_\_\_.

- a) shortest path
- b) minimum weight
- c) smaller edges
- d) None of these

Q11. Idempotent law is defined as:

- a)  $a \vee b = b \vee a$
- b)  $a \wedge b = b \wedge a$
- c)  $a \wedge (b \wedge c) = (a \wedge b) \wedge c$
- d)  $a \vee a = a$

Q12. \_\_\_\_\_ is defined as a matrix whose rows are rows of the unit matrix but not necessarily in the same order.

- a) directed matrix
- b) permutation matrix
- c) adjacency matrix
- d) Any of these

Q13. The logical expression  $\{(P \wedge Q) \Rightarrow (R \wedge P)\} \Rightarrow P$  is :

- a) a tautology
- b) a contradiction
- c) a contingency
- d) None of these

Q14. Calculate the Cardinality of the Power set of the set  $\{9, 8, 7, 6\}$ .

- a) 32
- b) 16
- c) 33
- d) 15

Q15. Suppose  $A = \{\}$ ,  $B = \{1,2,3\}$ . What does the set  $B \times A$  contain ?

- a)  $\{\}$
- b)  $\{\phi\}$
- c)  $\{(1),(2),(3)\}$
- d)  $\{1,2,3\}$

Q16. Simplify the given Boolean expression:  $PQ + PQR + PQRS + PQRST + PQRSTU$

- a) PQR
- b)  $PQ + RS(TU)$
- c) **PQ**
- d)  $P + Q(R+S(T+U))$

Q17. Consider a function  $f : \mathbb{R} \rightarrow \mathbb{R}, f(x) = x^2 + 1$

$g : \mathbb{R} \rightarrow \mathbb{R}, h(x) = \begin{cases} 1 & \text{if } x \geq 0 \\ 0 & \text{if } x < 0 \end{cases}$

What will be the value of  $g \circ f$  ?

- a) **1**
- b) 2
- c) 3
- d) 4

Q18. In how many ways can we divide a group of 10 persons into 3 teams such that team 1 has 5 persons, team 2 has 3 persons and team 3 has 2 persons?

- a) 2039 ways
- b) 2040 ways
- c) 2519 ways
- d) **2520 ways**

Q19. What will be the 3<sup>rd</sup> term of the recurrence relation :

$$a_n = a_{n-1} + 5, n \geq 2 \text{ with } a_1 = 3$$

- a) 8
- b) **13**
- c) 26
- d) 10

Q20. Which of the following is a declarative statement ?

- a) Close the window.
- b) It is beautiful.
- c) Two may not be a prime number .
- d) **All of these**

Q21. The closed form for the generating function of the given sequence is :

$$a_n = {}^5C_n$$

- a)  $(1+x)^{5/\sup]$
- b)  $(1-x)^8$
- c)  $(1-x)$
- d)  $(1/x)^2$

Q22. How many operations are required to find a minimum spanning tree of a graph with  $e$  edges using Prim's algorithm?

- a)  $O(e \log v)$
- b)  $O(v \log e)$
- c)  $O(e \log e)$
- d)  $O(\log e)$

Q23. Which of the following distributive laws is false for a distributive lattice?

- (i)  $p \vee (q \wedge r) = (p \vee q) \wedge (p \vee r)$ .
- (ii)  $p \wedge (q \wedge r) = (p \wedge q) \wedge r$ .
- (iii)  $p \wedge (q \vee r) = (p \wedge q) \vee (p \wedge r)$ .
- (iv)  $p \vee (q \vee r) = (p \vee q) \vee r$

- a) (i) only
- b) (i) and (iii)
- c) (iii) only
- d) (ii) and (iv)

Q24. What is the complement of 4 in the lattice  $D = \{1, 2, 3, 4, 6, 12\}$  ?

- a) 2
- b) 3
- c) 4
- d) No complement

Q25. In a graph, a node which is not adjacent to any other node is known as:

- a) isolated node

- b) separated node
- c) parallel node
- d) None of these

Q26. In an examination hall 5 chairs are vacant. In how many ways can 3 students take these seats?

- a) 120
- b) 9
- c) 60
- d) 3

Q27. What is the maximum number of edges in a bipartite graph with  $n$  vertices?

- a)  $n$
- b)  $n^2/2$
- c)  $n/2$
- d)  $n^2$

Q28. If a connected 6-regular planar graph has 10 vertices then what is number of regions determined by the graph?

- a) 12
- b) 10
- c) 6
- d) 8

Q29. Which of the following statements is/are true?

- (i) A connected graph  $G$  is Euler if and only if the degree of every vertex is odd.
- (ii) An edge  $e$  of a graph  $G$  is cut edge if  $e$  is a part of any cycle in  $G$ .
- (iii) A relation on a set  $P$  is said to be partial if it is reflexive, symmetric and transitive.

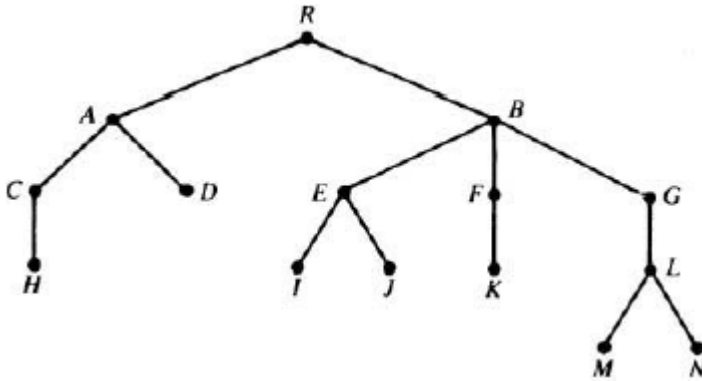
- a) Only (i)
- b) Only (ii)
- c) (i) and (iii)
- d) All are true

Q30. Determine the number of edges in a graph with 12 nodes, 4 of degree 0, 2 of degree 1, 1 of degree 2, 2 of degree 3 and 3 of degree 4.

- a) 22
- b) 11

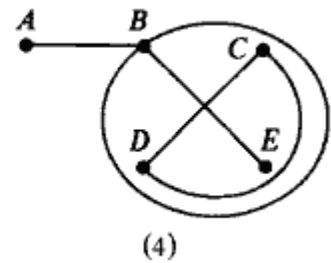
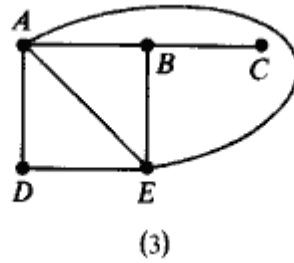
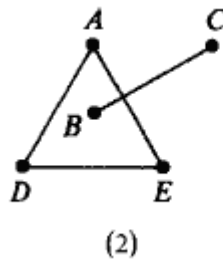
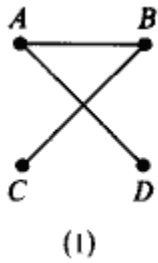
- c) 12
- d) 18

Q31. In the below given graph find the siblings of E.



- a) I & J
- b) F & G
- c) Only B
- d) B, I & J

Q32. Which of the following graphs is/are loop free?



- a) Only 1
- b) 4 only
- c) 1, 2 and 3
- d) 1 and 4

Q33. Which of the following statements is/are false?

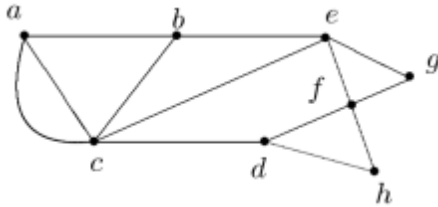
- (i) Hamiltonian's cycle problem is in class NP (Non-deterministic polynomial).
- (ii) Euler's cycle problem can't be solved in polynomial time.
- (iii) Traveling salesman problem is in NP.

- a) (i) and (ii)



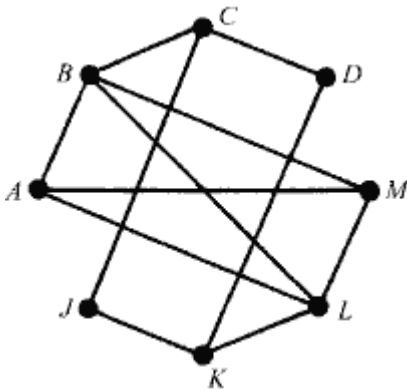
- b) Only (ii)
- c) (i) and (iii)
- d) All are false

Q34. Which of the following is a shortest path between the vertices of a and e in the below graph using Breadth first search?



- a) a -> b -> e
- b) a -> c -> b -> e
- c) a -> b -> c -> e
- d) a -> c -> d -> f -> e

Q35. Find the chromatic number for the below given Graph.



- a) 14
- b) 4
- c) 8
- d) 7

Q36. Which of the following is a tautology ?

- a)  $x \vee y \rightarrow y \quad z$
- b)  $x \quad y \rightarrow y \vee z$
- c)  $x \vee y \rightarrow (y \rightarrow z)$
- d)  $(x \rightarrow y) \rightarrow (y \rightarrow z)$

Q37. Which of the following is the total solution for given the recurrence relation?

$$a_{n+1} - 5a_n = 5^n, a_0 = 3$$

- a)  $a_n = (3+n).3^{n+1}$
- b)  $a_n = (3+n/2).5^{n-1}$
- c)  $a_n = (3+n/5).5^n$
- d) Insufficient data

Q38. Let P be the set of non-zero integers and let R be the relation on  $P \times P$  defined as  $(p,q)R(r,s)$  iff  $ps = qr$ . The relation P is \_\_\_\_\_ .

- a) partial order relation
- b) transitive and symmetric relation
- c) reflexive and symmetric but not a transitive relation
- d) equivalence relation

Q39. There are 30 people in a gathering. Out of these 2 are kids. Find the number of ways in which we can arrange 30 people around a circular table so that there is exactly one person between the kids.

- a)  $27!*3!$
- b)  $28!*3!$
- c)  $27!*2!$
- d)  $28!*2!$

Q40. How many different words can be formed with all the letters of the word 'ENGINEERING' such that there are always three letters between any consecutive E's?

- a) 1680
- b) 3360
- c) 5040
- d) 3000

## Set2

Q1. Which of the following options correctly represents an Empty set ?

- a)  $\{\} = \{\{\phi\}\}$
- b)  $\phi = \{\emptyset\}$
- c)  $\phi = \{\}$
- d) None of these

Q2. Find the number of subsets of the sets :  $\{A|A \text{ is a bag containing 8 balls}\}$  .

- a) 127
- b) 128
- c) 256
- d) 124

Q3. If a relation on set A is , then the A relation is said to be a partial order relation if and only if it is :

- a) reflexive, antisymmetric and transitive
- b) reflexive, symmetric and transitive
- c) only reflexive and antisymmetric
- d) only reflexive

Q4. If  $G_1(x)$  and  $G_2(x)$  are two generating functions then the product of  $G_1(x)$  and  $G_2(x)$  is :

- a) always a generating function
- b) must be a recurrence relation
- c) a characteristic equation
- d) can never be a generating function

Q5. Which of the following is a characteristic equation for the given recurrence relation :

$$a_n - 4a_{n-1} + 6a_{n-2} - 4a_{n-3} + a_{n-4} = 0$$

- a)  $S^4 - 3S^2 + 6S^2 - 4S + S = 0$
- b)  $S^4 - 4S^3 + 6S^2 - 4S + 1 = 0$
- c)  $1 - 4S + 6S^2 + 2S^3 - 4S^4 = 0$
- d)  $1 - 4S + 6S^2 - 4S^3 + S^4 = 0$

Q6. Dual of  $p \quad (p \vee q) = p$   
is :

- a)  $p \quad (p \quad p) = p$
- b)  $q \quad (p \quad p) = p$
- c)  $p \vee (p \quad q) = p$
- d)  $p \vee (p \vee q) = p$

Q7. A lattice  $L$  is called \_\_\_\_\_ if every non empty sub-set of  $L$  has a least upper bound and a greatest lower bound.

- a) distributive lattice
- b) complete lattice
- c) reflexive lattice
- d) both complemented & modular lattice

Q8. Find the number of relations from  $A = \{1, 2, 3\}$  to  $B = \{a, b\}$ .

- a) 33
- b) 32
- c) 64
- d) 63

Q9. Which of the following is an edge in graph but not in spanning tree?

- a) Branch
- b) Tangent
- c) Chord
- d) Segment

Q10. The star Graph is a \_\_\_\_\_.

- a) Partial bipartite graph
- b) Complete bipartite graph
- c) Pseudo graph
- d) Multi graph

Q11. What is the maximum degree of any vertex in a simple graph with  $n$  vertices?

- a)  $n$
- b)  $n-1$
- c)  $n(n-1)/2$
- d)  $n^2$

Q12. The recurrence relation  $a_n + 5a_{n+2} = n^2$  is :

- a) linear
- b) non-linear
- c) both linear and non-linear
- d) Can't be determined

Q13. What is the cardinality of the set of all odd positive integers less than 20 ?

- a) 7
- b) 8
- c) 9
- d) 10

Q14. How many distinguishable permutations can be made from the word "ABCBCB" ?

- a) 240
- b) 720
- c) 60
- d) 120

Q15. What will be the degree of the given below recurrence relation ?

$$(a_n + 1)^3 + a_{n-1}^7 + a_n = 9$$

- a) 4
- b) 7
- c) 3
- d) 9

Q16. Which of the following statements is false for any relation R ?

- i) If R is not reflexive then R is irreflexive.
- ii) If R is reflexive then R is not irreflexive.

- a) only i) is false
- b) only ii) is false
- c) both i) and ii) are false
- d) Can't say anything

Q17. Express  $E = A(AB' + A'B + B'C)$  in minimal SOP

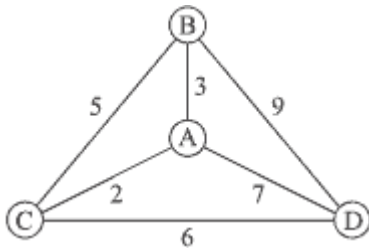
form.

- a)  $AB' + AB + AB'C$
- b)  $AB' + AB'C$
- c)  $AB' + A'BC$
- d)  $A'B + AB'C$

Q18. A complete graphs with n vertices denoted by  $K_n$  has \_\_\_\_\_ edges.

- a)  $n/2$
- b)  $n-1$
- c)  $n(n-1)/2$
- d)  $N$

Q19. Which of the following is a possible Hamiltonian circuit in the following graph?



- a) |ABCDA|
- b) |ACDBA|
- c) |ACBDA|
- d) All of these

Q20. What will be the postorder traversal of the given list of letters?

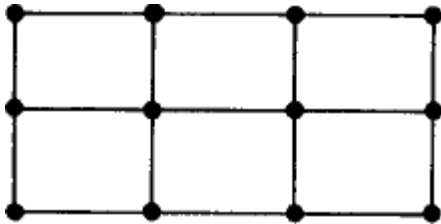
F, G, N, A, B, I, K

- a) A, B, K, I, N, G, F
- b) B, A, K, I, N, G, F
- c) F, B, A, K, I, N, G
- d) B, A, F, K, I, N, G

Q21. Simplify the Boolean expression :  $(P + Q)'(R + S + T)' + (P + Q)'$

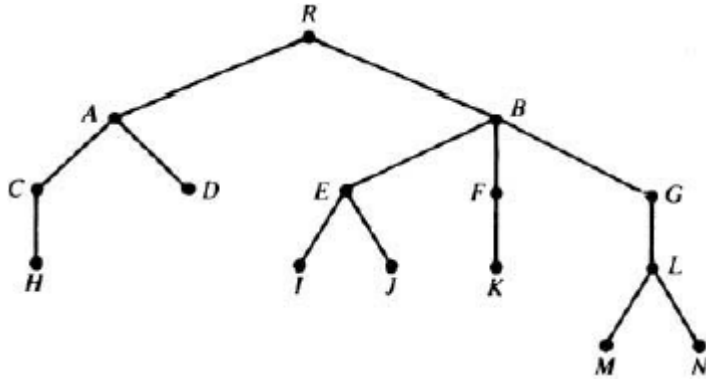
- a) P'Q'
- b) R'S'T'
- c) R + S + T
- d) P'Q'R'S'T'

Q22. Find the minimum number of colors needed to paint the regions of the below given map.



- a) 2
- b) 3
- c) 5
- d) 7

Q23. For the path  $\alpha$  from root R to H, find the level number n of the vertex H in the following graph.



- a) 4
- b) 2
- c) 5
- d) **3**

Q24. \_\_\_\_\_ is a finite graph with one vertex and no edges.

- a) Fixed graph
- b) Null edge graph
- c) **Trivial graph**
- d) Pseudo graph

Q25. Which of the following statements is true for adjacency matrix?

- a) Adjacency matrix for a directed multigraph must be symmetric.
- b) Adjacency matrix for a simple graph is asymmetric.
- c) **Adjacency matrix for a pseudo-graph is symmetric.**
- d) All of these

Q26. What is maximum number of edges possible in planar graph with 12 vertices?

- a) **30**
- b) 36
- c) 18
- d) 15

Q27. Find the number of diagonals formed in an decagon.



- a) 70
- b) 35
- c) 50
- d) 90

Q28. There are 15 people among whom two are brothers. Find the number of ways in which we can arrange them around a circle so that there is exactly one person between the two brothers.

- a) 13!
- b) 2!14!
- c) 13!2!
- d) 14!

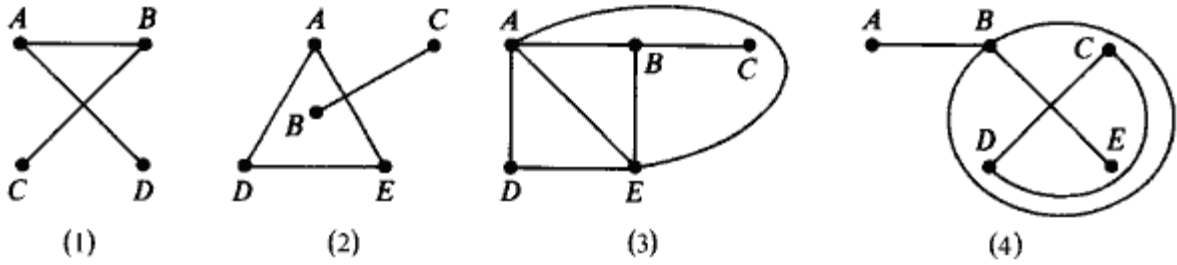
Q29. Which of the following relations is Reflexive and symmetric but not transitive?

- a)  $R = \{(a, a), (b, b), (c, c), (a, c)\}$
- b)  $R = \{(a, a), (c, c), (a, c), (a, c), (c, c)\}$
- c)  $R = \{(a, a), (b, b), (c, c), (c, b), (b, a), (b, c), (c, b)\}$
- d)  $R = \{(a, a), (a, b), (a, c), (b, b), (b, a), (c, a)\}$

Q30. Logical Expression  $(A \vee B) \rightarrow (C \vee A) \equiv 1$  is :

- a) dual of A
- b) contingency
- c) well formed formula
- d) None of these

Q31. Which of the following graphs are not connected?

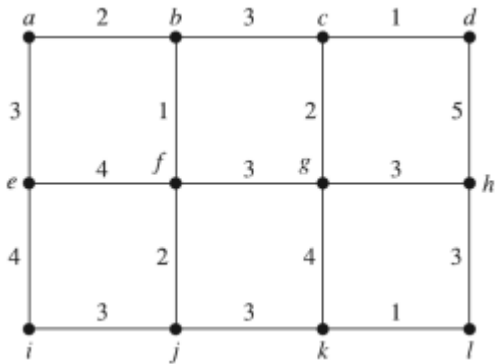


- a) Only 1
- b) 1 and 3
- c) 1,3 and 4
- d) **2 and 4**

Q32. There are two parallel line segments in a plane XY and AB. XY contains 14 marked points whereas AB contains 10 marked points. How many triangles can be formed by using these marked points as vertices?

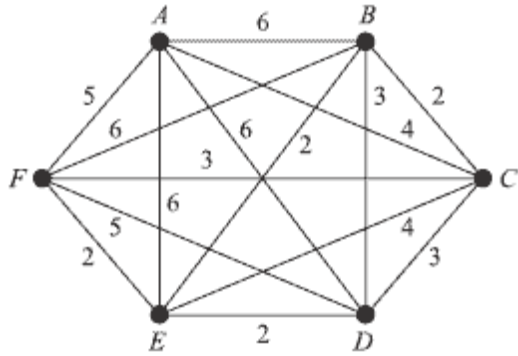
- a)  ${}^{24}C_3$
- b) **1540**
- c)  $14! \times 10!$
- d) None of the mentioned options

Q33. Find the weight of a minimum spanning tree using kruskal's algorithm for the following graph.



- a) 22
- b) 17
- c) 47
- d) **24**

Q34. Find the path weight using nearest neighbor algorithm for the below graph starting from vertex A?



- a) 20 or 21
- b) 21 or 22
- c) 20 or 22
- d) 21 or 19

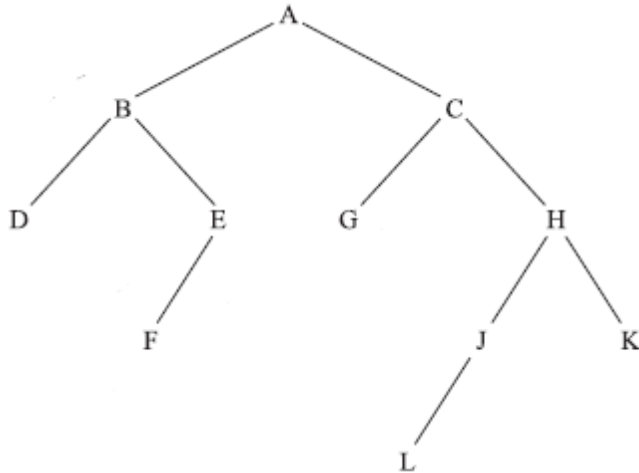
Q35. Let  $S = \{1, 2, 3, \dots, 9\}$   
Which of the following is the partition of  $S$ ?

- a)  $\{\{1,3,5\}, \{6\}, \{4,8,9\}\}$
- b)  $\{\{1,3,5\}, \{2,4,6\}, \{5,7,9\}\}$
- c)  $\{\{1,3,5\}, \{2,4,6,8\}, \{7,9\}\}$
- d)  $\{\{1,5\}, \{2,4,6,8\}, \{7,9\}\}$

Q36. If the degree of every non-pendent vertex in a tree is 3, then the number of vertex of the tree is :

- a) even
- b) odd
- c) either even or odd
- d) no such tree exists

Q37. Which of the following is the Postorder traversal for the below given graph?



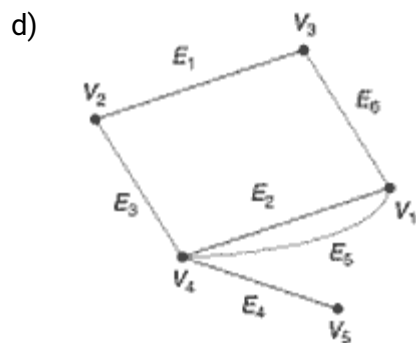
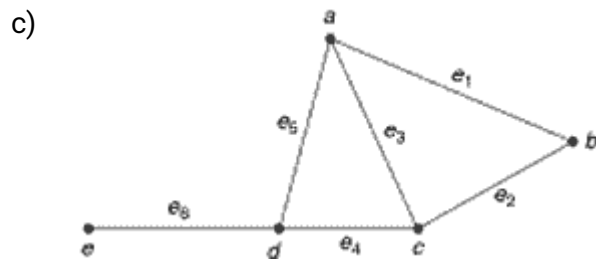
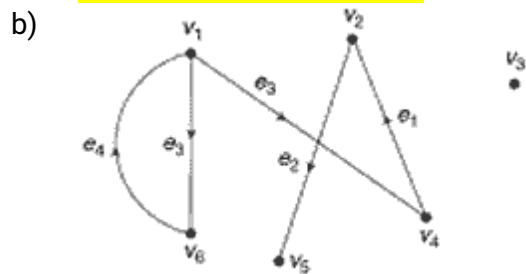
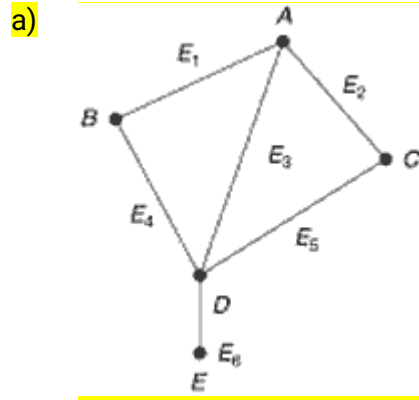
- a) DFEBGLJKHCA
- b) DFEBAGCLJKH
- c) DBFEAGCLJHK
- d) ABDEF CGHJLK

Q38. Which of the following options is true for a set of odd integers under the operation of multiplication?

- a) It will not form a group
- b) It will form a group
- c) It will form an abelian group
- d) It does not have any identity element.

Q39. Which of the following graphs represents the below Incidence matrix?

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



Q40. A postman has 6 letters and each is to be delivered at a particular address. In how many ways can the letters be delivered so that no letter is delivered at correct address?

- a) 720
- b) 718
- c) 719
- d) None of the mentioned options