MCQ

Multiple Choice Question

GRAPH THEORY AND APPLICATION

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GRAPH THEORY AND APPLICATIONS MULTIPLE CHOICE QUESTIONS WITH ANSWERS

UNIT I Basic Results: Introduction-Basic Concepts-Subgraphs-Degrees of Vertices - Paths and Connectedness - Automorphism of a Simple Graph.. Directed Graphs: Introduction-Basic Concepts-Tournaments.

UNIT II : Connectivity and Trees: Connectivity: Introduction-Vertex cut and Edge Cut-Connectivity and Edge Connectivity. Trees: Introduction-Definition, Characterization and Simple Properties-Centers and Centroids-Cutting the Number of Spanning Trees- Cayley's Formula.

UNIT III Independent Sets, Matchings and Cycles: Independent Sets and Matchings: Introduction-Vertex-Independent Sets and Vertex Coverings-Edge-Independent sets-Matchings and Factors-Matchings in Bipartite Graphs. Cycles: Introduction- Eulerian Graphs Hamiltonian Graphs.
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UNIT IV Graph Colorings: Introduction-Vertex colorings -Critical Graphs-Edge colorings of Graphs-Kirkman's Schoolgirl- Problem-Chromatic Polynomials.

UNIT V Planarity: Introduction- Planar and Nonplanar Graphs –Euler Formula and its Consequences K and K ,3 are Nonplanar Graphs – Dual of a Plane Graph- The Four-Color Theorem 5 3 and the Heawood Five- Color Theorem-Hamiltonian Plane Graphs-Tait Coloring.

INDEX

UNIT I

Graph Theory Basic Results

1. What is a graph in graph theory?

   (A) A bar chart used to represent data

   (B) A mathematical structure composed of vertices/nodes connected by edges

   (C) A diagram showing relationships between data points

   (D) A visual representation of statistical trends

   Answer: B) A mathematical structure composed of vertices/nodes connected by edges

   Hint: Think about the fundamental elements of a graph in mathematics.

2. The number of edges incident to a vertex is called its:

   A) Degree

   B) Diameter

   C) Eccentricity

   D) Centrality

   Answer: A) Degree

   Hint: Consider the properties of a vertex within a graph.

3. Which of the following is not a type of graph?

   A) Bipartite graph

   B) Complete graph

   C) Isomorphic graph

   D) Scalar graph

   Answer: D) Scalar graph

Hint: Focus on graph theory terminology and common types of graphs.

4. In a connected graph, every pair of vertices is connected by:

   A) Exactly one edge

   B) At most one edge

   C) At least one path

   D) A cycle

   Answer: c) At least one path

   Hint: Think about the connectivity properties of graphs.

5. What is the maximum number of edges in a simple graph with 6 vertices?

   A) 6

   B) 12

   C) 15

   D) 18

   Answer: c) 15

   Hint: Consider the formula for calculating the maximum number of edges in a simple graph.

6. A graph with all vertices having the same degree is called:

   A) Bipartite graph

   B) Regular graph

   C) Complete graph

   D) Planar graph

   Answer: B) Regular graph

   Hint: Focus on the characteristic feature of the graph's vertices.

7. The complement of a graph G contains an edge between two vertices if and only if:

   A) They have a common neighbour

   B) They are not adjacent in G

   C) They have the same degree

   D) They belong to different components in G

   Answer: B) They are not adjacent in G

   Hint: Think about the relationship between a graph and its complement.

8. A graph without any cycles is called:

   A) Connected graph

   B) Planar graph

   C) Tree

   D) Complete graph

   Answer: c) Tree

   Hint: Consider the absence of cycles in the definition of this type of graph.

9. A path in a graph is:

   A) A sequence of edges with no repeated vertices

   B) A sequence of edges with no repeated edges

   C) A sequence of vertices with no repeated edges

   D) A sequence of vertices with no repeated vertices

   Answer: A

   Hint: Focus on the characteristics of a path within a graph.

10. In a connected graph, the maximum number of edges in a path with n vertices is:

    A) n-1

    B) n

    C) n+1

    D) n/2

    Answer: A) n-1

    Hint: Think about the relationship between vertices and edges in a path.

11. A walk in a graph:

    A) Must contain all vertices

    B) Must contain all edges

    C) May contain repeated edges or vertices

    D) May only contain distinct vertices

    Answer: C) May contain repeated edges or vertices

    Hint: Consider the flexibility of movements within a graph walk.

12. The degree of a vertex in a walk:

    A) Represents the number of vertices

    B) Represents the number of edges

    C) Represents the number of times the vertex appears

    D) Represents the distance from the starting vertex

    Answer: C) Represents the number of times the vertex appears

    Hint: Think about the role of a vertex in a walk.

13. A trail in a graph: A) Contains repeated edges but not repeated vertices

B) Contains repeated vertices but not repeated edges

C) Contains neither repeated edges nor repeated vertices

D) Contains both repeated edges and repeated vertices

Answer: A) Contains repeated edges but not repeated vertices

Hint: Consider the characteristics of a trail compared to other graph paths.

14.The length of a path or a trail in a graph is:

A) The number of edges

B) The number of vertices

C) The sum of the degrees of vertices

D) The number of connected components

Answer: A) The number of edges

Hint: Focus on what constitutes the "length" of a path or trail.

14. In a tree with n vertices, the number of edges is:

A) n-1

B) n

C) n+1

D) n/2

Answer: A) .n-1

Hint: Think about the relationship between vertices and edges in a tree structure.

15. In a simple graph, the maximum number of trails between two vertices is:

A) 1

B) 2

C) 3

D) It depends on the number of vertices

Answer: B)2

Hint: Consider the limitations of trails in a simple graph.

16. A cycle in a graph is:

A) A path that starts and ends at the same vertex

B) A path that visits every vertex exactly once

C) A closed walk with no repeated edges

D) A trail that covers all vertices

Answer: A) A path that starts and ends at the same vertex

Hint: Focus on the defining characteristic of a cycle in a graph.

17. A graph with no cycles is called:

A) Bipartite

B) Connected

C) Acyclic

D) Planar

Answer: C) Acyclic

Hint: Think about the absence of a specific element within this type of graph.

18. In a directed graph, a directed path is:

A) A sequence of edges with no repeated vertices

B) A sequence of edges with no repeated edges

C) A sequence of vertices with no repeated edges

D) A sequence of vertices with no repeated vertices

Answer: A) A sequence of edges with no repeated vertices

Hint: Consider the directional aspect of the path in a directed graph.

19. A Hamiltonian path in a graph is:

A) A path that visits every vertex exactly once

B) A path that starts and ends at the same vertex

C) A path that covers all edges exactly once

D) A path that contains the maximum number of edges

Answer: A) A path that visits every vertex exactly once

Hint: Think about the traversal of vertices in a Hamiltonian path.

21. A graph in which every vertex has the same degree is called:

A) Regular

B) Connected

C) Complete

D) Bipartite

Answer: A) Regular

Hint : Consider vertices with identical connection patterns.

22. The diameter of a graph is:

A) The number of edges in the longest path

B) The number of vertices in the longest path

C) The number of connected components

D) The distance between any two vertices

Answer: A) The number of edges in the longest path

Hint : Focus on the longest path in the graph.

23. A trail that visits every edge exactly once is called:

A) Eulerian trail

B) Hamiltonian trail

C) Closed trail

D) Connected trail

Answer: A

Hint : Think about a trail covering all edges once.

24. A graph that can be drawn without any edges crossing is:

A) Bipartite

B) Planar

C) Connected

D) Cyclic

Answer: B) Hamiltonian trail

Hint: Think about how the graph can be represented on a plane without edges intersecting.

25. In a complete graph with n vertices, the number of edges is:

A) n-1

B) n

C) n(n-1)/2

D) 2n

Answer: C) n(n-1)/2

Hint: Consider how each vertex is connected to every other vertex in a complete graph.

26. The number of edges in a disconnected graph with n vertices and k connected components is:

A) n+k

B) n-k

C) n-k+1

D) n-k-1

Answer: n-k

Hint: Think about how the number of edges relates to the connectivity of the graph.

27. A bipartite graph is a graph:

A) With only even-degree vertices

B) That can be divided into two sets with no edges within sets

C) With no cycles

D) With every vertex connected to all other vertices

Answer: B) That can be divided into two sets with no edges within sets

Hint: Consider the definition of a bipartite graph and how its vertices can be divided into two sets.

28. In a graph, the number of cycles can be determined by:

A) Euler's formula

B) The number of vertices and edges

C) The degree of each vertex

D) The number of connected components

Answer: B) The number of vertices and edges

Hint: Think about how cycles are formed within a graph and their relationship with vertices and edges.

29. In a graph with n vertices and m edges, the sum of the degrees of all vertices is:

A) n + m

B) 2m

C) 2n

D) nm

Answer: B

Hint: Consider the relationship between edges and the degrees of vertices.

30. The minimum and maximum possible degrees of a vertex in a simple graph with n vertices are:

A) 0 and n

B) 1 and n-1

C) 0 and n-1

D) 1 and n

Answer: B

Hint: Think about the constraints on the degrees of vertices in a simple graph.

31. In a complete graph with n vertices, the degree of each vertex is:

A) n

B) n-1

C) 2n

D) n-2

Answer: n-1

Hint: Consider how each vertex is connected to every other vertex in a complete graph.

32. In a bipartite graph with partitions of size p and q, the sum of degrees of all vertices is:

A) p + q

B) pq

C) 2(p + q)

D) 2pq

Answer: C) 2(p + q)

Hint: Think about how the degrees of vertices in each partition contribute to the total sum.

33. In a tree with n vertices, the sum of degrees of all vertices is:

A) n

B) 2n

C) n-1

D) 2(n-1)

Answer: D) 2(n-1)

Hint: Consider the property of trees regarding the relationship between vertices and edges.

34. The number of vertices with odd degree in any graph must be:

A) Even

B) Odd

C) Prime

D) Composite

Answer: A) Even

Hint: Think about how the sum of degrees of all vertices is related to the number of edges in the graph.

35. In a connected graph with n vertices, the maximum possible degree of a vertex is:

A) n

B) n-1

C) 2(n-1)

D) n-2

Answer: B)n-1

Hint: Consider the extreme case of connectivity where each vertex is connected to every other vertex.

36. A graph with n vertices, k connected components, and no isolated vertices has:

A) n-k edges

B) n+k edges

C) 2n edges

D) 2n-k edges

Answer: A)n-k edges

Hint: Think about how connected components and isolated vertices affect the total number of edges.

37. In a simple graph with n vertices, the sum of degrees of all vertices is:

A) n

B) n-1

C) 2n

D) 2(n-1)

Answer: D) 2(n-1)

Hint: Consider the constraints of simple graphs regarding the degrees of vertices.

38. In a directed graph, the sum of in-degrees and out-degrees of all vertices is:

A) Equal to the number of edges

B) Equal to the number of vertices

C) Twice the number of edges

D) Twice the number of vertices

Answer: A) Equal to the number of edges

Hint: Consider the definition of in-degree and out-degree for vertices in a directed graph.

39. A bipartite graph is a graph: A) With only even-degree vertices

B) That can be divided into two sets with no edges within sets

C) With no cycles

D) With every vertex connected to all other vertices

Answer: (B) That can be divided into two sets with no edges within sets

Hint: Think about the characteristic property that defines a bipartite graph.

40. The complete bipartite graph Km,n has:

A) m+n vertices and mn edges

B) mn vertices and m+n edges

C) m+n vertices and m+n edges

D) mn vertices and mn edges

Answer: D)mn vertices and mn edges

Hint: Consider how vertices and edges are arranged in a complete bipartite graph.

41.In a bipartite graph, the maximum number of edges is achieved when:

A) The two sets of vertices have an equal number of vertices

B) The two sets of vertices have the smallest possible number of vertices

C) There are no edges between the two sets of vertices

D) The two sets of vertices have no common vertices

Answer: D) The two sets of vertices have no common vertices

Hint: Think about how edges are distributed between the two sets of vertices to maximize their number.

42. A cycle in a bipartite graph:

A) Is not possible

B) Can exist with an odd number of vertices

C) Can exist with an even number of vertices

D) Always includes all vertices

Answer: Is not possible

Hint: Consider the nature of bipartite graphs and the definition of a cycle.

43. The number of edges in a complete bipartite graph K_{m,n} is:

A)m + n

B) m\n

C) mn

D) mn + 1

Answer: (C)

Hint: Calculate the number of edges based on the definition of a complete bipartite graph.

45. A complete bipartite graph $K_{2,3}$ has:

A) 2 vertices and 3 edges

B) 3 vertices and 2 edges

C) 5 vertices and 6 edges

D) 6 vertices and 6 edges

Answer: (C) 5 vertices and 6 edges

Hint: Count the vertices and edges in each partition of the bipartite graph.

46. A complete graph Kn has:

A) n vertices and n(n-1)/2 edges

B)n vertices and n edges

C) n vertices andn-1 edges

D)n vertices and n+1edges

Answer: A)n vertices and n(n-1)/2 edges

Hint: Recall the formula for the number of edges in a complete graph.

8. In a complete graph K_5, the number of edges is:

A) 5

B) 10

C) 15

D) 20

Answer: (B) 10

Hint: Use the formula for the number of edges in a complete graph.

9. In a complete graph, the number of vertices with odd degree is:

A) Always even

B) Always odd

C) Can be even or odd depending on n D) Always equal ton

Answer: (A) Always even

Hint: Consider the degree of each vertex in a complete graph.

48. The degree of a vertex in a complete graph Kn is:

A)n-1

B)n

C)n+1

D) 2n

Answer: (A) n-1

Hint: Determine the degree of a vertex considering its connection to all other vertices.

49. A subgraph of a graph G is:

A) A graph that contains all the vertices ofG

B) A graph formed by removing edges fromG

C) A graph formed by removing vertices fromG

D) A graph that is disconnected fromG

Answer: (B) A graph formed by removing edges fromG

Hint: Define what a subgraph is in relation to the original graph G.

50. If a graph G has nvertices, the maximum number of subgraphs it can have is:

A)2n

B) n2

C) 2n2

D) n!

Answer: (C)

Hint: Think about the combinatorial possibilities when forming subgraphs from a graph with n vertices.

51. A spanning subgraph of G is a subgraph that:

A) Contains only a subset of vertices of G

B) Contains all the vertices of G

C) Contains only edges that form cycles in G

D) Contains the minimum number of edges inG

Answer: (B)

Hint: Consider the definition of a spanning subgraph in relation to the original graph G.

52. A subgraph formed by removing edges incident to a vertex is called:

A) Induced subgraph

B) Complement subgraph

C) Edge subgraph

D) Vertex subgraph

Answer: (A) Induced subgraph

Hint: Consider the action of removing edges incident to a vertex and what the resulting subgraph is called.

53. A maximum subgraph of a graph is one that:

A) Has the most vertices

B) Has the most edges

C) Has the most connections between vertices

D) Has the most number of cycles

Answer: (B) Has the most edges

Hint: Think about what defines a maximum subgraph in terms of its edges.

54. The empty subgraph of a graph contains:

A) No vertices and no edges

B) No vertices but some edges

C) Some vertices but no edges

D) All the vertices but no edges

Answer: (A) No vertices and no edges

Hint: Consider what constitutes the empty subgraph in terms of vertices and edges.

55. A subgraph isomorphism is:

A) A subgraph with the same number of vertices but different edges

B) A subgraph that can be transformed into the original graph

C) A subgraph with the same structure as the original graph

D) A subgraph that contains all the vertices of the original graph

Answer: (c)A subgraph with the same structure as the original graph

56. A proper subgraph of a graph:

A) Is smaller than the original graph

B) Is disconnected from the original graph

C) Contains only a subset of vertices from the original graph

D) Contains more edges than the original graph

Answer (A) Is smaller than the original graph

Hint : Consider the size comparison between the subgraph and the original graph.

57. The complement of a subgraph includes:

A) All vertices from the original graph but not the edges

B) All edges from the original graph but not the vertices

C) The vertices and edges not included in the subgraph

D) A reversed version of the subgraph

Answer: ©The vertices and edges not included in the subgraph

Hint : Focus on what the complement consists of.

59. A subgraph formed by deleting some edges and vertices is called:

A) Induced subgraph

B) Complement subgraph

C) Edge subgraph

D) Vertex subgraph

Answer: Induced subgraph

Hint : Consider the process of forming this subgraph.

60. An automorphism of a graph G is a:

A) Vertex that connects to all other vertices

B) Permutation of vertices that preserves edge connections

C) Directed edge connecting two specific vertices

D) Transformation of edges into vertices

Answer: Permutation of vertices that preserves edge connections

Hint : Think about preserving the structure of the graph through permutations.

61. The identity mapping in automorphisms of a graphG refers to:

A) No change in the graph

B) Reversing the direction of all edges

C) Adding more vertices and edges

D) Changing the graph to a complete graph

Answer: A)No change in the graph

62.An automorphism that changes a graph into itself is called:

A) An isomorphism

B) A proper automorphism

C) An identity automorphism

D) A non-trivial automorphism

Answer:C) An identity automorphism

63. The set of all automorphisms of a graphG forms a:

A) Cyclic group

B) Symmetric group

C) Diagonal group

D) Transitive group

Answer:B) Symmetric group

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64. A trivial automorphism of a graphG is:

A) An automorphism that changes all vertices

B) An automorphism that preserves the graph as it is

C) An automorphism that adds new edges

D) An automorphism that disconnects the graph

Answer:B) An automorphism that preserves the graph as it is

65 In a complete graphK_n, the number of automorphisms is:

A)n

B)n!

C)2^n

D)2^{n-1}

Answer: B)n!

66. An automorphism group of a graph G refers to:

A) A group that changes the graph into a different type of graph

B) A group formed by all automorphisms ofG

C) A group that reduces the number of vertices in the graph

D) A group that adds more edges to the graph

Answer: B)A group formed by all automorphisms of G

69. The trivial graph has how many automorphisms?

A) 0

B) 1

C) 2

D) Depends on the number of vertices

Answer: B) 1

70. In a cycle graph Cn, the number of non-trivial automorphisms is:

A) 0

B) 1

C) 2

D)n

Answer:C) 2

71. A non-trivial automorphism of a graphG refers to:

A) An automorphism that adds more vertices

B) An automorphism that preserves the graph

C) An automorphism that changes the number of edges

D) An automorphism that disconnects the graph

Answer(A) An automorphism that preserves the graph

72. A directed graph is also known as a:

A) Digraph

B) Bipartite graph

C) Regular graph

D) Subgraph

Answer:A) Digraph

Hint : Consider the specific characteristic of the graph's edges.

73. In a directed graph, an edge connecting vertex A to vertex B is denoted by:

A)(A, B)

B)[A, B]

C)A \rightarrow B

D)A - B

Answer: A rightarrow B

74. The in-degree of a vertex in a directed graph is:

A) The number of vertices connected to it

B) The number of edges leaving it

C) The number of edges coming into it

D) The sum of its neighbors degrees

Answer: C)The number of edges coming into it

75. In a directed graph, a vertex with zero in-degree:

A) Has no outgoing edges

B) Has no incoming edges

C) Has no edges

D) Has only self-loops

Answer: B)Has no incoming edges

76. The out-degree of a vertex in a directed graph is:

A) The number of vertices connected to it

B) The number of edges leaving it

C) The number of edges coming into it

D) The sum of its neighbors' degrees

Answer: C)The number of edges leaving it

77. In a directed graph, a vertex with zero out-degree:

A) Has no outgoing edges

B) Has no incoming edges

C) Has no edges

D) Has only self-loops

Answer: A) Has no outgoing edges

78. The degree sequence in a directed graph refers to:

A) The sequence of in-degrees of vertices

B) The sequence of out-degrees of vertices

C) The sequence of sums of in-degrees and out-degrees

D) The sequence of numbers of edges connected to each vertex

Answer: The sequence of in-degrees of vertices

79. A cycle in a directed graph is a:

A) Path that visits every vertex exactly once

B) Closed path that starts and ends at the same vertex

C) A series of vertices without edges

D) A path with multiple edges

Answer: B)Closed path that starts and ends at the same vertex

80. The transitive closure of a directed graph G represents:

A) The sum of in-degrees and out-degrees of vertices

B) The number of vertices in the graph

C) The graph obtained by adding edges to reach all vertices

D) The difference between in-degrees and out-degrees of vertices

Answer: C)The graph obtained by adding edges to reach all vertices

81. In a strongly connected directed graph:

A) Every vertex has the same degree

B) There is a path from every vertex to every other vertex

C) There are no cycles

D) The graph has no directed edges

Answer:B) There is a path from every vertex to every other vertex

82. A sink vertex in a directed graph refers to a vertex that:

A) Has no incoming edges

B) Has no outgoing edges

C) Has the maximum number of incoming edges

D) Has the maximum number of outgoing edges

Answer:B) Has no outgoing edges

83. In a directed graph, a source vertex refers to a vertex that:

A) Has no incoming edges

B) Has no outgoing edges

C) Has the maximum number of incoming edges

D) Has the maximum number of outgoing edges

Answer:A) Has no incoming edges

84. The adjacency matrix of a directed graph represents:

A) The number of edges between vertices

B) The matrix formed by the in-degree and out-degree of vertices

C) The matrix formed by representing edges between vertices

D) The matrix showing connections between vertices

Answer: D The matrix showing connections between vertices

85. In a cyclic directed graph:

A) There are no edges

B) There is at least one cycle

C) Every vertex has the same degree

D) There are no source or sink vertices

Answer:B) There is at least one cycle

86. The topological sorting of a directed graph:

A) Arranges vertices based on their in-degree

B) Arranges vertices based on their out-degree

C) Arranges vertices based on their degree sequence

D) Arranges vertices based on their connectivity

Answer:A) Arranges vertices based on their in-degree

87. In a directed acyclic graph (DAG):

A) There are no edges

B) There are no cycles

C) Every vertex has the same degree

D) There are no source or sink vertices

Answer: B)There are no cycles

88. The number of edges in a complete directed graph Kn is:

A)n

B) n^2

C) n(n-1)/2

D)2^n

Answer: C)n(n-1) /2

89. The number of strongly connected components in a directed graph:

A) Represents the number of vertices

B) Represents the number of edges

C) Represents the number of cycles

D) Represents the number of equivalence classes

Answer:D) Represents the number of equivalence classes

90. A weighted directed graph is a graph in which:

A) Vertices have different degrees

B) Edges have different lengths or values assigned

C) Vertices have different in-degrees and out-degrees

D) There are cycles between vertices

Answer:B) Edges have different lengths or values assigned

91. The Eulerian path in a directed graph is:

A) A path that visits every vertex exactly once

B) A path that starts and ends at the same vertex

C) A path that covers all edges exactly once

D) A path that contains the maximum number of edges

Answer: C)A path that covers all edges exactly once

92. A tournament in graph theory is a directed graph in which:

A) All vertices are connected to each other

B) There are no cycles

C) There is a directed edge between every pair of distinct vertices

D) There is a cycle between every pair of distinct vertices

Answer:C) There is a directed edge between every pair of distinct vertices

93. In a tournament with n vertices, the maximum number of edges is:

A) n

B) n^2

C) n(n-1)/2

D) 2^n

Answer: n(n-1)/2

94. The vertex with the highest out-degree in a tournament is called the:

A) Sink vertex

B) Source vertex

C) Central vertex

D) Tournament leader

Answer:B) Source vertex

95.A Hamiltonian path in a tournament refers to a path that:

A) Visits every vertex exactly once

B) Starts and ends at the same vertex

C) Covers all edges exactly once

D) Contains the maximum number of edges

Answer: A) Visits every vertex exactly once

96.. In a tournament, a transitive triple refers to:

A) Three vertices without any edges between them

B) Three vertices forming a cycle

C) Three vertices with edges forming a triangle

D) Three vertices connected in a specific direction

Answer: C)Three vertices with edges forming a transitive triangle

97. The degree sequence in a tournament refers to:

A) The sequence of in-degrees of vertices

B) The sequence of out-degrees of vertices

C) The sequence of sums of in-degrees and out-degrees

D) The sequence of numbers of edges connected to each vertex

Answer: B)The sequence of out-degrees of vertices

98. In a tournament, the transitive closure refers to:

A) The number of vertices reachable from a specific vertex

B) The graph obtained by adding edges to ensure transitivity

C) The number of transitive triples in the tournament

D) The process of rearranging vertices for transitivity

Answer:B) The graph obtained by adding edges to ensure transitivity

99. A King in a tournament refers to a vertex that:

A) Connects to all other vertices

B) Has the highest out-degree in the tournament

C) Has the lowest out-degree in the tournament

D) Is in the center of the graph

Answer:A) Connects to all other vertices

100. The minimum number of vertices in a tournament to ensure a Hamiltonian cycle is:

A) 2

B) 3

C) 4

D) 5

Answer:B) 3

101. In a tournament with nvertices, the number of sources is:

A) n

B) n-1

C) 1

D) 0

Answer:A) n

59. A subgraph formed by deleting some edges and vertices is called:

A) Induced subgraph

B) Complement subgraph

C) Edge subgraph

D) Vertex subgraph

Answer:A) Induced subgraph

Hint: Consider the process of forming this subgraph by selectively removing edges and vertices.

60.. An automorphism of a graphG is a:

A) Vertex that connects to all other vertices

B) Permutation of vertices that preserves edge connections

C) Directed edge connecting two specific vertices

D) Transformation of edges into vertices

Answer: B)Permutation of vertices that preserves edge connections

Hint: Think about preserving the structure of the graph through permutations.

61. The identity mapping in automorphisms of a graph G refers to:

A) No change in the graph

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D) Changing the graph to a complete graph

Answer :A) No change in the graph

Hint: Consider the fundamental concept of identity mapping.

62. An automorphism that changes a graph into itself is called:

A) An isomorphism

B) A proper automorphism

C) An identity automorphism

D) A non-trivial automorphism

Answer: C) An identity automorphism

Hint: Think about an automorphism that leaves the graph unchanged.

63. The set of all automorphisms of a graphG forms a:

A) Cyclic group

B) Symmetric group

C) Diagonal group

D) Transitive group

Answer:B) Symmetric group

Hint: Consider the nature of the set formed by all automorphisms of a graph.

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A) An automorphism that changes all vertices

B) An automorphism that preserves the graph as it is

C) An automorphism that adds new edges

D) An automorphism that disconnects the graph

Answer: An automorphism that preserves the graph as it is

Hint: Think about what constitutes a trivial change in the graph.

65 In a complete graphK_n, the number of automorphisms is:

A)n B)n!

C)2^n

D)2^{n-1}

Answer: n!

Hint: Think about the symmetry of a complete graph and the permutations of its vertices.

66. An automorphism group of a graph G refers to:

A) A group that changes the graph into a different type of graph

B) A group formed by all automorphisms ofG

C) A group that reduces the number of vertices in the graph

D) A group that adds more edges to the graph

Answer: A group formed by all automorphisms ofG

Hint: Consider the composition of automorphisms forming a group.

69. The trivial graph has how many automorphisms?

A) 0

B) 1

C) 2

D) Depends on the number of vertices

Answer: 1

Hint: Think about the possible transformations that leave the trivial graph unchanged.

70.In a cycle graph Cn, the number of non-trivial automorphisms is: A) 0

B) 1

C) 2

D)n Answer: 2

Hint: Consider the symmetrical properties of a cycle graph.

71. A non-trivial automorphism of a graph G refers to:
72. A) An automorphism that adds more vertices

B) An automorphism that preserves the graph

C) An automorphism that changes the number of edges

D) An automorphism that disconnects the graph

Answer: An automorphism that preserves the graph

Hint: Think about the significance of non-trivial changes to the graph's structure.

73. A directed graph is also known as a:

A) Digraph

B) Bipartite graph

C) Regular graph

D) Subgraph

Answer: Digraph

Hint: Consider the specific characteristic of the graph's edges.

73. In a directed graph, an edge connecting vertex A to vertex B is denoted by:

A)(A, B)

B)[A, B]

C)A \rightarrow B

D)A - B

Answer: A rightarrow B

Hint: Recall the notation commonly used for directed edges.

74. The in-degree of a vertex in a directed graph is:

A) The number of vertices connected to it

B) The number of edges leaving it

C) The number of edges coming into it

D) The sum of its neighbors' degrees

Answer: The number of edges coming into it

Hint: Think about the directionality of edges entering the vertex.

75.. In a directed graph, a vertex with zero in-degree:

A) Has no outgoing edges

B) Has no incoming edges

C) Has no edges

D) Has only self-loops

Answer: Has no incoming edges

Hint: Consider the implications of having no edges entering a vertex.

76. The out-degree of a vertex in a directed graph is:

A) The number of vertices connected to it

B) The number of edges leaving it

C) The number of edges coming into it

D) The sum of its neighbors' degrees

Answer: The number of edges leaving it

Hint: Think about the directionality of edges leaving the vertex.

77. In a directed graph, a vertex with zero out-degree:

A) Has no outgoing edges

B) Has no incoming edges

C) Has no edges

D) Has only self-loops

Answer: Has no outgoing edges

Hint: Consider the implications of having no edges leaving a vertex.

78. The degree sequence in a directed graph refers to:

A) The sequence of in-degrees of vertices

B) The sequence of out-degrees of vertices

C) The sequence of sums of in-degrees and out-degrees

D) The sequence of numbers of edges connected to each vertex

Answer: The sequence of in-degrees of vertices

Hint: Consider which type of degree is being sequenced.

79. A cycle in a directed graph is a:

A) Path that visits every vertex exactly once

B) Closed path that starts and ends at the same vertex

C) A series of vertices without edges

D) A path with multiple edges

Answer: Closed path that starts and ends at the same vertex

Hint: Think about the cyclic nature of paths in a directed graph.

80. The transitive closure of a directed graph G represents:

A) The sum of in-degrees and out-degrees of vertices

B) The number of vertices in the graph

C) The graph obtained by adding edges to reach all vertices

D) The difference between in-degrees and out-degrees of vertices

Answer: The graph obtained by adding edges to reach all vertices

Hint: Consider the process of ensuring transitivity in the graph

81. In a strongly connected directed graph:

A) Every vertex has the same degree

B) There is a path from every vertex to every other vertex

C) There are no cycles

D) The graph has no directed edges

Answer: There is a path from every vertex to every other vertex

Hint: Think about the connectivity within the graph.

82. A sink vertex in a directed graph refers to a vertex that:

A) Has no incoming edges

B) Has no outgoing edges

C) Has the maximum number of incoming edges

D) Has the maximum number of outgoing edges

Answer: Has no outgoing edges

Hint: Consider the direction of edges with respect to the vertex.

83. In a directed graph, a source vertex refers to a vertex that:

A) Has no incoming edges

B) Has no outgoing edges

C) Has the maximum number of incoming edges

D) Has the maximum number of outgoing edges

Answer: Has no incoming edges

Hint: Think about the direction of edges with respect to the vertex.

84. The adjacency matrix of a directed graph represents:

A) The number of edges between vertices

B) The matrix formed by the in-degrees and out-degrees of vertices

C) The matrix formed by representing edges between vertices

D) The matrix showing connections between vertices

Answer: The matrix showing connections between vertices

Hint: Consider how vertices are connected in a directed graph.

85. In a cyclic directed graph:

A) There are no edges

B) There is at least one cycle

C) Every vertex has the same degree

D) There are no source or sink vertices

Answer: There is at least one cycle

Hint: Think about the presence of cycles in the graph.

86. The topological sorting of a directed graph:

A) Arranges vertices based on their in-degree

B) Arranges vertices based on their out-degree

C) Arranges vertices based on their degree sequence

D) Arranges vertices based on their connectivity

Answer: Arranges vertices based on their in-degree

Hint: Think about the order of vertices with respect to the direction of edges.

87. In a directed acyclic graph (DAG):

A) There are no edges

B) There are no cycles

C) Every vertex has the same degree

D) There are no source or sink vertices

Answer: There are no cycles

Hint: Consider the absence of cycles as a defining characteristic.

88. The number of edges in a complete directed graph Kn is:

A) n

B) n^2

C) n(n-1)/2

D) 2^n

Answer: n(n-1)

Hint: Think about how every vertex is connected to every other vertex.

89. The number of strongly connected components in a directed graph:

A) Represents the number of vertices

B) Represents the number of edges

C) Represents the number of cycles

D) Represents the number of equivalence classes

Answer: Represents the number of equivalence classes

Hint: Consider the organization of strongly connected vertices.

90. A weighted directed graph is a graph in which:

A) Vertices have different degrees

B) Edges have different lengths or values assigned

C) Vertices have different in-degrees and out-degrees

D) There are cycles between vertices

Answer: Edges have different lengths or values assigned

Hint: Think about the additional information associated with edges.

91. The Eulerian path in a directed graph is:

A) A path that visits every vertex exactly once

B) A path that starts and ends at the same vertex

C) A path that covers all edges exactly once

D) A path that contains the maximum number of edges

Answer: A path that covers all edges exactly once

Hint: Consider the traversal of edges in the graph.

92. A tournament in graph theory is a directed graph in which:

A) All vertices are connected to each other

B) There are no cycles

C) There is a directed edge between every pair of distinct vertices

D) There is a cycle between every pair of distinct vertices

Answer: There is a directed edge between every pair of distinct vertices

Hint: Think about the competitive nature of a tournament.

93. In a tournament with n vertices, the maximum number of edges is:

A) n B) n^2

C) n(n-1)/2

D) 2^n

Answer: n(n-1)/2

Hint: Think about the possible connections between distinct vertices.

94. The vertex with the highest out-degree in a tournament is called the:

A) Sink vertex

B) Source vertex

C) Central vertex

D) Tournament leader

Answer: Source vertex

Hint: Consider the role of out-degrees in a tournament.

95. A Hamiltonian path in a tournament refers to a path that:

A) Visits every vertex exactly once

B) Starts and ends at the same vertex

C) Covers all edges exactly once

D) Contains the maximum number of edges

Answer: Visits every vertex exactly once

Hint: Think about traversing through all vertices without repetition.

97. The degree sequence in a tournament refers to:

A) The sequence of in-degrees of vertices

B) The sequence of out-degrees of vertices

C) The sequence of sums of in-degrees and out-degrees

D) The sequence of numbers of edges connected to each vertex

Answer: The sequence of out-degrees of vertices

Hint: Think about the measure of dominance of vertices in a tournament.

98. In a tournament, the transitive closure refers to:

A) The number of vertices reachable from a specific vertex

B) The graph obtained by adding edges to ensure transitivity

C) The number of transitive triples in the tournament

D) The process of rearranging vertices for transitivity

Answer: The graph obtained by adding edges to ensure transitivity

Hint: Consider how transitive closure impacts the connectivity of the tournament.

99. A King in a tournament refers to a vertex that:

A) Connects to all other vertices

B) Has the highest out-degree in the tournament

C) Has the lowest out-degree in the tournament

D) Is in the center of the graph

Answer: Connects to all other vertices

Hint: Think about the leadership role of this vertex in the tournament.

100.The minimum number of vertices in a tournament to ensure a Hamiltonian cycle is:

A) 2

B) 3

C) 4

D) 5

Answer(B) 3

Hint: Consider the minimum configuration required for a cycle to exist.

UNIT II

Independent Sets, Matchings and Cycles

1. A vertex cut in a graph is:

A) A set of vertices whose removal disconnects the graph

B) A set of edges whose removal disconnects the graph

C) A set of vertices that form a cycle

D) A set of edges that form a complete graph

Answer: A) set of vertices whose removal disconnects the graph

2. The minimum number of vertices that form a cut-vertex in a graph is:

A) 0

B) 1

C) 2

D) Depends on the number of edges

Answer: 1

3. In a connected graph, the minimum number of vertices required to disconnect it is:

A) 0

B) 1

C) 2

D) Depends on the number of edges

Answer: B)1

Hint : Consider the minimum number of vertices needed to disconnect a connected graph.

4. The vertex connectivity of a graph refers to:

A) The number of vertices in the graph

B) The minimum number of vertices that disconnect the graph

C) The number of edges in the graph

D) The maximum degree of a vertex in the graph

Answer: B) The minimum number of vertices that disconnect the graph

Hint : The vertex connectivity of a graph refers to the smallest number of vertices that need to be removed in order to disconnect the graph.

5. A bridge in a graph refers to:

A) A set of vertices with maximum connectivity

B) A set of edges that, if removed, disconnects the graph

C) A cycle formed by vertices

D) A complete subgraph

Answer: B) A set of edges that, if removed, disconnects the graph

Hint: Consider the role of certain edges in maintaining the connectivity of a graph

6. The edge connectivity of a graph refers to:

A) The number of edges in the graph

B) The maximum number of edges incident to a vertex

C) The minimum number of edges that disconnect the graph

D) The maximum number of edges that form a cycle

Answer: The minimum number of edges that disconnect the graph

Hint : Focus on disconnecting the graph by removing edges.

7. A biconnected graph is a graph that:

A) Has all vertices connected to each other

B) Has at least one cut-vertex

C) Can be disconnected by removing a single vertex

D) Has at least two connected components

Answer: Has at least one cut-vertex

Hint : Consider the connectivity property in relation to cut-vertices.

8. The minimum number of cut-vertices in a connected graph is:

A) 0

B) 1

C) 2

D) Depends on the number of edges

Answer:B) 1

Hint : Think about the minimum number of vertices whose removal disconnects the graph.

9. In a graph with nvertices, the maximum number of cut-vertices is:

A) n

B) n-1

C) n/2

D) 2n

Answer: n-1

Hint : Consider the upper limit of cut-vertices in terms of n.

10. A cut set in a graph is:

A) A set of vertices that form a cycle

B) A set of edges that form a complete subgraph

C) A set of vertices whose removal disconnects the graph

D) A set of disconnected vertices

Answer: A set of vertices whose removal disconnects the graph

Hint : Think about the set of vertices that impacts the graph's connectivity.

11. In a complete graph Kn, the number of cut-vertices is:

A) 0

B) 1

C)n-2

D)n-1

Answer:n-1

Hint :Consider the minimum number of vertices required to disconnect a complete graph.

12. A trivial cut-vertex in a graph refers to:

A) A vertex with maximum degree

B) A vertex that disconnects the graph

C) A vertex that forms a cycle with itself

D) A vertex that has no neighbors

Answer: B)A vertex that disconnects the graph

Hint : Think about the impact of a single vertex on the graph's connectivity.

13. In a graph, a cut-vertex is also known as a:

A) Bridge

B) Dominating vertex

C) Articulation point

D) Biconnected vertex

Answer:C) Articulation point

Hint :Consider the term used for vertices that impact graph connectivity.

14. The maximum number of edges in a graph with nvertices andk cut-vertices is:

A)n+k

B)n+k-1

C)n-k

D)n-k+1

Answer: D) n+k-1

Hint : Think about the relationship between vertices, edges, and cut-vertices.

15. In a cycle graph Cn, the number of cut-vertices is:

A) 0

B) 1

C) 2

D) n-2

Answer: 2

Hint : Consider the minimum number of vertices to disconnect a cycle graph.

16. The minimum number of edges that form a cut-set in a graph is:

A) 0

B) 1

C) 2

D) Depends on the number of vertices

Answer: 1

Hint : Think about the minimum number of edges needed to disconnect the graph.

17. A complete bipartite graph $K_{m,n}$ has how many cut-vertices?

A) 0

B) 1

C) m+n-2

D) m+n-1

Answer:m+n-2

Hint : Consider the minimum number of vertices required to disconnect a complete bipartite graph.

18. The maximum number of edges in a tree with n vertices and k cut-vertices is:

A)n-1

B)n+k-1

C)n-k

D)n+k

Answer: D)n+k-1

Hint : Think about the relationship between edges, vertices, and cut-vertices in a tree.

19. A chordal graph is a graph that has:

A) No cycles

B) No edges

C) A cycle between every pair of distinct vertices

D) A complete subgraph

Answer: C) A cycle between every pair of distinct vertices

Hint : Consider the specific connectivity between pairs of vertices.

20. In a bipartite graph, the number of cut-vertices is:

A) 0

B) 1

C) 2

D) Depends on the number of edges

Answer: A) 0

Hint : Think about the nature of connectivity in a bipartite graph.

21. In a tree with n vertices, the number of edges is:

A) n

B) n-1

C) n+1

D) 2n

Answer: B)n-1

Hint : Think about the relationship between vertices and edges in a tree.

22. The maximum number of edges in a rooted tree with n vertices is:

A) (n)

B) (n-1)

C) (2n)

D) (n(n-1)

Answer: B)(n-1)

Hint : Consider the nature of edges in a rooted tree.

23. In a tree with n vertices, the number of pendant vertices is:

A) n

B) n-1

C) n+1

D) n/2

Answer:n-1

Hint : the definition of pendant vertices in a tree.

24. A tree with n vertices has a minimum of how many pendant vertices ?

A) 0

B) 1

C) 2

D)n-1

Answer: 1

Hint : Consider the minimum number of endpoints in a tree.

25. A full binary tree with ninternal vertices has how many pendant vertices ?

A) n

B) n-1

C) 2n

D) n+1

Answer: n+1

Hint : Consider the relationship between internal vertices and pendant vertices in a full binary tree.

26. The maximum number of pendant vertices in a tree with k vertices of degree d is:

A) d

B) k-d

C) d-1

D) k-1

Answer: B) k-d

Hint : Think about the relation between vertices, degrees, and pendant vertices .

27. A path graph with n vertices is a tree with how many pendant vertices ?

A) 0

B) 1

C) 2

D)n-1

Answer: 2

Hint : Think about the nature of a path graph and its endpoints.

28. The minimum number of edges in a tree with n vertices is:

A) n

B) n-1

C) n+1

D) 2n

Answer: B) n-1

Hint : Consider the least number of edges to connect nvertices in a tre

30. A star graph with n vertices has how many pendant vertices ?

A) n

B) n-1

C) 1

D) 2

Answer: C)1

Hint : Think about the nature of a star graph.

31. The number of pendant vertices in a tree refers to:

A) Vertices with maximum degree

B) Internal vertices

C) Vertices of degree 1

D) Vertices of degree 2

Answer: Vertices of degree 1

Hint : Consider the endpoints in a tree.

32. A maximal tree is a tree in which:

A) Adding any edge results in a cycle

B) There are no pendant vertices

C) Adding any edge disconnects the tree

D) Adding any vertex results in a cycle

Answer: Adding any edge results in a cycle

Hint : Think about the property of a maximal tree.

33. The maximum number of endpoints in a tree with n vertices is:

A) n

B) (n-1)

C) (2n)

D) n/2

Answer: (n-1)

Hint : Consider the maximum number of pendant vertices in a tree.

34. The height of a tree is:

A) The number of edges in the longest path

B) The number of vertices in the longest path

C) The maximum degree of a vertex

D) The minimum degree of a vertex

Answer: The number of edges in the longest path

Hint : the measurement from the root to the furthest leaf.

35. The depth of a node in a tree refers to:

A) The number of edges to the root

B) The number of edges to the furthest leaf

C) The level of the node in the tree

D) The number of children a node has

Answer: The number of edges to the root

Hint : Consider the distance of a node from the root.

36. A leaf in a tree can be referred to as a:

A) Internal vertex

B) Terminal vertex

C) Root

D) Parent vertex

Answer: Terminal vertex

Hint : the endpoints in a tree.

37. The maximum number of internal vertices in a tree with n pendant vertices is:

A) n-1

B) n

C) 2n

D) 2n-1

Answer: n-1

Hint : the relationship between and internal nodes.

38. The number of vertices of degree 2 in a tree with n vertices and mis:

A)m

B) n-m

C) n-2m

D) 2m

Answer: n-m

Hint : the relation between vertices of degree 2 and pendant vertices .

39. The diameter of a tree is:

A) The length of the longest path

B) The distance between the root and the furthest leaf

C) The maximum degree of a vertex

D) The minimum degree of a vertex

Answer: The length of the longest path

Hint : Consider the longest possible path in a tree.

40. The number of edges in a path graph with n vertices is:

A) n

B) n-1

C) n+1

D) 2n

Answer:n-1

Hint : the connections between vertices in a path graph.

41. The number of bipartite trees with n vertices is:

A) n

B) n-1

C) 2

D) 2n

Answer: 2

Hint : Consider the nature of bipartite trees.

42. A cut vertex in a tree refers to a vertex that, if removed:

A) Disconnects the tree

B) Forms a cycle

C) Increases the number of pendant vertices

D) Reduces the number of edges

Answer: Disconnects the tree

Hint : Think about the impact of removing a vertex.

43. The number of spanning trees in a complete graph Kn is:

A)n

B)n-1

C)n+1

D)2^n

Answer: 2^n

Hint : Consider the number of spanning trees in a complete graph.

44. The number of non-isomorphic trees with4 vertices is:

A) 4

B) 5

C) 6

D) 7

Answer: 6

Hint :Try to draw different tree structures with 4 vertices.

45. The Prüfer sequence of a tree with n vertices has how many elements?

A)n

B)n-1

C)n+1

D) 2n

Answer:n-2

Hint : Consider the representation of a tree using its Prüfer sequence.

46. The number of edges in a complete binary tree with n internal nodes is:

A)n

B)n-1

C) 2n

D)2n-1

Answer:2n-1

Hint : Think about the relationship between internal nodes and edges.

47. A tree in which every non-leaf vertex has exactly two children is called a:

A) Binary tree

B) Full tree

C) Complete tree

D) Balanced tree

Answer: Full tree

Hint : Consider the nature of nodes and their children.

48. The number of edges in a star graph with n vertices is:

A)n

B)n-1

C) 2n

D)n+1

Answer:n-1

Hint :Think about the connections in a star graph.

49. A tree with nvertices andk pendant vertices has how many internal nodes?

A)n-k

B)n-k+1

C)k-1

D)k+1

Answer:n-k+1

Hint :Consider the relation between vertices, pendant vertices , and internal nodes.

50. The number of non-isomorphic trees with5 vertices is:

A) 5

B) 6

C) 7

D) 8

Answer: 6

Hint :Try to draw different tree structures with 5 vertices.

UNIT III

Vertex Independent Set:

1. In a graph, a vertex independent set refers to a set of vertices where:

A) All vertices are connected

B) No two vertices are adjacent

C) All vertices have the same degree

D) All vertices have different degrees

Answer: No two vertices are adjacent

Hint : Think about the condition for vertices in an independent set.

2. The maximum size of an independent set in a complete graph Kn with n vertices is:

A)n

B)1

C) 2n

D) n/2

Answer: 1

Hint : Consider the nature of a complete graph in relation to independent sets.

3. A vertex with no adjacent vertices is referred to as a/an:

A) Leaf

B) Root

C) Independent vertex

D) Pendant vertex

Answer: Independent vertex

Hint : Think about the condition of vertices not adjacent to any other vertices.

4. The minimum number of vertices needed to form an independent set in a path graph Pn is:

A) 0

B) 1

C) 2

D) n

Answer: 2

Hint : Consider the arrangement of vertices in a path graph.

5. In a bipartite graph, the size of the maximum independent set is equal to:

A) The number of vertices in one part

B) The number of edges in the graph

C) The minimum degree of the graph

D) The number of vertices in the other part

Answer: The number of vertices in one part

Hint : Consider the properties of a bipartite graph in relation to independent sets.

6. The independence number of a graph refers to:

A) The maximum number of vertices in an independent set

B) The maximum degree of the graph

C) The number of edges in the graph

D) The number of connected components

Answer: The maximum number of vertices in an independent set

Hint : Consider the definition of the independence number.

7. In a cycle graph Cn, the maximum size of an independent set is:

A) 1

B) 2

C)

D)n

Answer: n/2

Hint : Think about the arrangement of vertices in a cycle graph.

8. The chromatic number of a graph is:

A) The minimum number of colors to color the vertices

B) The maximum number of vertices in an independent set

C) The number of edges in the graph

D) The number of connected components

Answer: The minimum number of colors to color the vertices

Hint : Consider the concept of coloring vertices without adjacent ones having the same color.

9. In a tree with n vertices, the maximum size of an independent set is:

A)n

B)n-1

C) 2n

D) n/2

Answer: n/2

Hint : Think about the connectivity properties in trees.

10. A stable set in a graph refers to:

A) A set of vertices where every vertex is connected

B) A set of vertices where no two are adjacent

C) A set of vertices with the same degree

D) A set of vertices forming a cycle

Answer:B) A set of vertices where no two are adjacent

Hint : the condition for vertices in a stable set.

11. In a graph, a matching refers to a set of edges where:

A) All edges connect the same vertices

B) No two edges share a common vertex

C) All edges have the same weight

D) All edges form a cycle

Answer:B) No two edges share a common vertex

Hint : Consider the condition for edges in a matching.

12. The maximum size of a matching in a complete graph Kn with n vertices is:

A) n

B) n-1

C) 2n

D) n/2

Answer : D)n/2

Hint : the arrangement of edges in a complete graph.

13. A perfect matching in a graph refers to a matching where:

A) All edges are connected to the same vertices

B) Every vertex is matched with another vertex

C) The weight of all edges is the same

D) No edges share a common endpoint

Answer: B) Every vertex is matched with another vertex

Hint : Consider the condition for all vertices in a perfect matching.

14. In a bipartite graph, the size of the maximum matching is equal to:

A) The number of vertices in one part

B) The number of edges in the graph

C) The minimum degree of the graph

D) The number of vertices in the other part

Answer: A)The number of vertices in one part

Hint : Think about the properties of a bipartite graph in relation to matchings.

15. The matching number of a graph refers to:

A) The maximum number of edges in a matching

B) The maximum number of vertices in a matching

C) The number of edges in the graph

D) The number of connected components

Answer: The maximum number of edges in a matching

Hint : Consider the definition of the matching number.

16. In a cycle graph Cn, the maximum size of a matching is:

A) 1

B) 2

C) n/2

D)n

Answer: n/2

Hint : Think about the arrangement of edges in a cycle graph.

17. The minimum number of colors required to color the vertices of a graph is equal to:

A) The maximum size of a matching

B) The number of connected components

C) The maximum number of vertices in an independent set

D) The minimum number of edges in a matching

Answer: The maximum size of a matching

Hint : Think about the relationship between coloring vertices and matchings.

18. A maximum matching in a graph is a matching that:

A) Covers all vertices in the graph

B) Has the maximum number of edges

C) Contains all edges in the graph

D) Has the same weight for all edges

Answer: Has the maximum number of edges

Hint : the size of the matching.

19. In a tree with n vertices, the maximum size of a matching is:

A)n

B)n-1

C) 2n

D) n/2

Answer: n-1

Hint : the connectivity properties in trees.

20. A matching in a graph refers to a set of edges where:

A) All edges connect the same vertices

B) No two edges share a common endpoint

C) All edges have the same weight

D) All edges form a cycle

Answer: No two edges share a common endpoint

Hint : Consider the condition for edges in a matching.

21. In a graph, a vertex cover refers to a set of vertices where:

A) All vertices are connected

B) No two vertices are adjacent

C) All edges are covered by vertices

D) All vertices have different degrees

Answer: All edges are covered by vertices

Hint : the coverage of edges in a vertex cover.

22. The minimum number of vertices needed to cover all edges in a complete graph Kn with n vertices is:

A)n

B)n-1

C) 2n

D) n/2

Answer: 1

Hint : Consider the nature of a complete graph in relation to vertex covering.

23. A vertex that covers all adjacent edges is referred to as a/an:

A) Leaf

B) Covering vertex

C) Independent vertex

D) Pendant vertex

Answer: Covering vertex

Hint : the vertices that cover adjacent edges.

24. The minimum number of vertices needed to form a vertex cover in a path graph Pn is:

A) 0

B) 1

C) 2

D)n

Answer: B) 1

Hint : Consider the arrangement of vertices in a path graph.

25. In a bipartite graph, the size of the minimum vertex cover is equal to:

A) The number of vertices in one part

B) The number of edges in the graph

C) The maximum degree of the graph

D) The number of vertices in the other part

Answer: The number of edges in the graph

Hint : the properties of a bipartite graph in relation to vertex covering.

26. The covering number of a graph refers to:

A) The maximum number of vertices in a covering set

B) The minimum number of vertices in a covering set

C) The number of edges in the graph

D) The number of connected components

Answer: The minimum number of vertices in a covering set

Hint : Consider the definition of the covering number.

27. In a cycle graph Cn, the minimum size of a vertex cover is:

A) 1

B) 2

C) n/2

D)n

Answer: n/2

Hint : the arrangement of vertices in a cycle graph.

28. The independence number of a graph is equal to:

A) The maximum number of edges in a vertex cover

B) The maximum number of vertices in an independent set

C) The number of edges in the graph

D) The number of connected components

Answer: The maximum number of vertices in an independent set

Hint : Consider the definition of the independence number.

29. In a tree with n vertices, the minimum size of a vertex cover is:

A)n

B)n-1

C) 2n

D) n/2

Answer: n-1

Hint : Think about the connectivity properties in trees.

30. A minimum vertex cover in a graph refers to a covering set that:

A) Covers all edges in the graph

B) Contains the maximum number of vertices

C) Covers the vertices with the highest degree

D) Contains the minimum number of vertices

Answer: Covers all edges in the graph

Hint : Think about the coverage of edges in a minimum vertex cover.

31. The maximum size of a vertex cover in a complete graph Kn with n vertices is:

A)n

B) n-1

C) 2n

D) n/2

Answer: n-1

Hint : Consider the nature of a complete graph in relation to vertex covering.

32. In a graph, a cover set refers to a set of vertices where:

A) All vertices are connected

B) No two vertices are adjacent

C) All edges are covered by vertices

D) All vertices have the same degree

Answer: All edges are covered by vertices

Hint : Think about the coverage of edges in a cover set.

33. The minimum number of colors required to color the vertices of a graph is equal to:

A) The maximum size of a vertex cover

B) The number of connected components

C) The maximum number of vertices in an independent set

D) The minimum number of edges in a vertex cover

Answer: The minimum size of a vertex cover

Hint : the relationship between coloring vertices and vertex covering.

34. A maximum vertex cover in a graph is a covering set that:

A) Covers all edges in the graph

B) Contains the maximum number of vertices

C) Covers the vertices with the highest degree

D) Contains the minimum number of vertices

Answer: Covers all edges in the graph

Hint : Think about the coverage of edges in a maximum vertex cover.

35. In a graph, an edge independent set refers to a set of edges where:

A) All edges connect the same vertices

B) No two edges share a common vertex

C) All edges have the same weight

D) All edges form a cycle

Answer: No two edges share a common vertex

Hint : Think about the condition for edges in an edge independent set.

36. The maximum size of an edge independent set in a complete graph Knwith nvertices is:

A)n

B)n-1

C) 2n

D) n/2

Answer: 0

Hint : Consider the nature of a complete graph in relation to edge independent sets.

37. An edge with no common endpoints with other edges is referred to as a/an:

A) Leaf edge

B) Independent edge

C) Covered edge

D) Pendant edge

Answer: Independent edge

Hint : Think about the edges that do not share vertices with other edges.

38. The minimum number of edges needed to form an edge independent set in a path graph Pn is:

A) 0

B) 1

C) 2

D)n

Answer: n/2 (rounded down)

Hint : Consider the arrangement of edges in a path graph.

39. In a bipartite graph, the size of the maximum edge independent set is equal to:

A) The number of vertices in one part

B) The number of edges in the graph

C) The minimum degree of the graph

D) The number of vertices in the other part

Answer: The number of edges in the graph

Hint : Think about the properties of a bipartite graph in relation to edge independent sets.

40. The edge independence number of a graph refers to:

A) The maximum number of edges in an edge independent set

B) The maximum number of vertices in an independent set

C) The number of edges in the graph

D) The number of connected components

Answer: The maximum number of edges in an edge independent set

Hint : Consider the definition of the edge independence number.

41. In a cycle graph Cn, the maximum size of an edge independent set is:

A) 1

B) 2

C) n/2

D)n

Answer: n/2 (rounded down)

Hint : Think about the arrangement of edges in a cycle graph.

42. The minimum number of colors required to color the edges of a graph is equal to:

A) The maximum size of an edge independent set

B) The number of connected components

C) The maximum number of edges in an independent set

D) The minimum number of vertices in an independent set

Answer: The maximum size of an edge independent set

Hint : the relationship between coloring edges and edge independent sets.

43. An independent edge set in a graph refers to a set of edges where:

A) All edges connect the same vertices

B) No two edges share a common endpoint

C) All edges have the same weight

D) All edges form a cycle

Answer: No two edges share a common vertex

Hint : Consider the condition for edges in an independent edge set.

44.In a tree with n vertices, the maximum size of an edge independent set is:

A)n

B)n-1

C) 2n

D) n/2

Answer:n-1

Hint : Think about the connectivity properties in trees.

Eulerian Graphs:

45. An Eulerian graph refers to a graph that:

A) Contains a cycle

B) Contains no cycles

C) Has an Eulerian path

D) Has all vertices with odd degrees

Answer: Has an Eulerian path or an Eulerian circuit

Hint : Think about the properties of Eulerian graphs.

46. In an Eulerian graph, an Eulerian circuit is:

A) A path that visits every edge once

B) A path that visits every vertex once

C) A cycle that visits every edge once

D) A cycle that visits every vertex once

Answer: A cycle that visits every edge once

Hint : Consider the definition of an Eulerian circuit.

47. In a connected graph, the number of vertices with odd degree must be:

A) Even

B) Odd

C) Prime

D) Indeterminate

Answer: Even

Hint : Think about the degree sum and the Handshaking Lemma.

48. A graph where every vertex has an even degree is called a/an:

A) Eulerian graph

B) Hamiltonian graph

C) Bipartite graph

D) Complete graph

Answer: Eulerian graph

Hint : Consider the degree sequence in an Eulerian graph.

49. The necessary and sufficient condition for a graph to be Eulerian is:

A) Every vertex has the same degree

B) Every vertex has an odd degree

C) Every edge is connected to two vertices

D) Every vertex has an even degree

Answer: Every vertex has an even degree

Hint : Think about the degree sum and the Handshaking Lemma.

50. In a disconnected graph, the existence of an Eulerian circuit requires that:

A) Every component has an Eulerian circuit

B) Every component has an odd degree

C) Every component has an even degree

D) Every component has the same degree

Answer: Every component has an Eulerian circuit

Hint : the connectivity and degrees in each component.

51. A graph with an Eulerian circuit must be:

A) Connected

B) Disconnected

C) Planar

D) Complete

Answer: Connected

Hint : Consider the nature of an Eulerian circuit.

52. In a connected graph, if every vertex has an even degree, the graph:

A) Must have an Eulerian circuit

B) Must have a Hamiltonian circuit

C) Is disconnected

D) Is not a simple graph

Answer: Must have an Eulerian circuit

Hint : Think about the condition for Eulerian circuits.

53. The sum of the degrees of all vertices in a graph is:

A) Twice the number of edges

B) Equal to the number of edges

C) Half the number of edges

D) Three times the number of edges

Answer: Twice the number of edges

Hint : Think about the degree sum formula.

54. In a graph with an Eulerian circuit, if a vertex has an odd degree:

A) The graph cannot have an Eulerian circuit

B) The graph has a Hamiltonian circuit

C) The vertex is isolated

D) The vertex has an even degree

Answer: The graph cannot have an Eulerian circuit

Hint : Consider the necessary condition for Eulerian circuits.

55. The number of components in an Eulerian graph can be:

A) Any positive integer

B) Odd

C) Prime

D) Even

Answer: Any positive integer

Hint : Think about the connectivity in Eulerian graphs.

56. A graph that contains an Eulerian path but not an Eulerian circuit is:

A) Disconnected

B) Connected

C) Planar

D) Complete

Answer: Connected

Hint : Consider the nature of Eulerian paths versus circuits.

57. The maximum number of odd-degree vertices in a connected graph to have an Eulerian circuit is:

A) 0

B) 1

C) 2

D) 3

Answer: 2

Hint : Consider the condition for Eulerian circuits regarding degrees.

59. In a connected graph with an Eulerian circuit, if a vertex has an odd degree:

A) The graph cannot have an Eulerian circuit

B) The graph has a Hamiltonian circuit

C) The vertex is isolated

D) The vertex has an even degree

Answer: The graph cannot have an Eulerian circuit

Hint : Think about the necessary condition for Eulerian circuits.

60. A graph that contains isolated vertices:

A) Cannot have an Eulerian circuit

B) Must have an Eulerian circuit

C) Must have a Hamiltonian circuit

D) Cannot be connected

Answer: Cannot have an Eulerian circuit

Hint : Consider the connectivity in graphs with isolated vertices.

61. In an Eulerian graph, the sum of degrees of all vertices is:

A) Odd

B) Even

C) Prime

D) Composite

Answer: Even

Hint : Think about the degree sum and the Handshaking Lemma.

62. The number of edges in an Eulerian graph with n vertices is:

A)n

B) 2n

C)n-1

D) n/2

Answer: Twice the number of edges

Hint : Consider the relationship between vertices and edges in an Eulerian graph.

63. A graph with all vertices having degree 2 is:

A) Always Eulerian

B) Never Eulerian

C) Sometimes Eulerian

D) Always Hamiltonian

Answer: Always Eulerian

Hint : Think about the degrees required for Eulerian graphs.

64. In an Eulerian graph, if a vertex has an odd degree, the graph must have:

A) No Eulerian path

B) No Hamiltonian path

C) At least two connected components

D) No cycles

Answer: No Eulerian path

Hint : Consider the condition for Eulerian paths regarding degrees.

65. A connected graph with n vertices and n-1 edges is:

A) Always Eulerian

B) Always Hamiltonian

C) Sometimes Eulerian

D) Never Eulerian

Answer: Always Eulerian

Hint :Think

Hamiltonian Graphs:

66. A Hamiltonian graph is a graph that:

A) Contains a cycle

B) Contains no cycles

C) Has a Hamiltonian path

D) Has all vertices with odd degrees

Answer: Has a Hamiltonian cycle or path

Hint : Think about the properties of Hamiltonian graphs.

67. In a Hamiltonian graph, a Hamiltonian cycle is:

A) A path that visits every edge once

B) A path that visits every vertex once

C) A cycle that visits every edge once

D) A cycle that visits every vertex once

Answer: A cycle that visits every vertex once

Hint : Consider the definition of a Hamiltonian cycle.

68. In a connected graph, a necessary but not sufficient condition for a graph to be Hamiltonian is:

A) Every vertex has the same degree

B) Every vertex has an odd degree

C) Every edge is connected to two vertices

D) Every vertex has an even degree

Answer: Every vertex has an even degree

Hint : Think about the Handshaking Lemma and necessary conditions for Hamiltonian graphs.

69. A graph where every vertex has a degree of at leastn/2 (rounded down) is:

A) Always Hamiltonian

B) Never Hamiltonian

C) Sometimes Hamiltonian

D) Always Eulerian

Answer: Always Hamiltonian

Hint : Think about the degrees required for Hamiltonian graphs.

70. A Hamiltonian graph is:

A) Always connected

B) Disconnected

C) Planar

D) Complete

Answer: Always connected

Hint : Consider the nature of Hamiltonian graphs.

71. A Hamiltonian path in a graph refers to:

A) A path that visits every edge once

B) A path that visits every vertex once

C) A cycle that visits every edge once

D) A cycle that visits every vertex once

Answer: A path that visits every vertex once

Hint :Consider the definition of a Hamiltonian path.

72. A graph with nvertices where each vertex has degreen-1 is:

A) Always Hamiltonian

B) Never Hamiltonian

C) Sometimes Hamiltonian

D) Always Eulerian

Answer: Always Hamiltonian

Hint :Consider the degrees required for Hamiltonian graphs.

73. The degree sum of all vertices in a graph is:

A) Twice the number of edges

B) Equal to the number of edges

C) Half the number of edges

D) Three times the number of edges

Answer: Twice the number of edges

Hint :Think about the degree sum formula.

74. A complete graph with nvertices is:

A) Always Hamiltonian

B) Never Hamiltonian

C) Sometimes Hamiltonian

D) Always Eulerian

Answer: Always Hamiltonian

Hint :Consider the properties of complete graphs regarding Hamiltonian cycles.

75. The sum of the degrees of all vertices in a graph with nvertices is:

A) 2n

B)n

C)n-1

D)2(n-1)

Answer: Twice the number of edges

Hint :Think about the relationship between vertices and edges in a graph.

76. The number of edges in a Hamiltonian graph with nvertices is:

A)n

B) 2n

C)n-1

D) n/2

Answer:n-1

Hint :Consider the relationship between vertices and edges in a Hamiltonian graph.

77. A Hamiltonian cycle in a graph must include:

A) Every edge exactly once

B) Every vertex exactly once

C) Every vertex with even degree

D) Every vertex with odd degree

Answer: Every vertex exactly once

Hint :Think about the definition of a Hamiltonian cycle.

78. In a connected graph, if a vertex has a degree less thann/2 (rounded down), the graph:

A) Must have a Hamiltonian cycle

B) Cannot have a Hamiltonian cycle

C) Must have an Eulerian cycle

D) Cannot be connected

Answer: Cannot have a Hamiltonian cycle

Hint :Consider the degrees required for Hamiltonian graphs.

79. The minimum degree of a Hamiltonian graph with nvertices is:

A)n-1

B) n/2

C)n

D) (2(n-1)

Answer:n-1

Hint :Think about the degrees required for Hamiltonian graphs.

80. A subgraph of a Hamiltonian graph is:

A) Always Hamiltonian

B) Never Hamiltonian

C) Sometimes Hamiltonian

D) Always Eulerian

Answer: Sometimes Hamiltonian

Hint :Consider the properties of subgraphs of Hamiltonian graphs.

81. A graph with nvertices and fewer thann-1 edges:

A) Is always Hamiltonian

B) Is never Hamiltonian

C) May or may not be Hamiltonian

D) Is always Eulerian

Answer: Is never Hamiltonian

Hint :Consider the necessary conditions for Hamiltonian graphs.

82. A tree with nvertices:

A) Is always Hamiltonian

B) Is never Hamiltonian

C) May or may not be Hamiltonian

D) Is always Eulerian

Answer: Is never Hamiltonian

Hint : Think about the structure and connectivity of trees.

83. The complement of a Hamiltonian graph is:

A) Always Hamiltonian

B) Never Hamiltonian

C) Sometimes Hamiltonian

D) Always Eulerian

Answer: Sometimes Hamiltonian

Hint :Consider the properties of the complement of Hamiltonian graphs.

84. In a graph with a Hamiltonian cycle, if a vertex has an odd degree:

A) The graph cannot have a Hamiltonian cycle

B) The graph has a Hamiltonian path

C) The vertex is isolated

D) The vertex has an even degree

Answer: The graph cannot have a Hamiltonian cycle

Hint :Think about the necessary condition for Hamiltonian cycles.

85. A graph with nvertices andn-1 edges is:

A) Always Hamiltonian

B) Always Eulerian

C) Sometimes Hamiltonian

D) Never Hamiltonian

Answer: Always Hamiltonian

Hint :Consider the relationship between vertices and edges in Hamiltonian graphs.

86. The number of edges in a Hamiltonian graph with nvertices is:

A)n

B) 2n

C)n-1

D) n/2

Answer:n-1

Hint :Think about the relationship between vertices and edges in a Hamiltonian graph.

87. A Hamiltonian cycle in a graph must include:

A) Every edge exactly once

B) Every vertex exactly once

C) Every vertex with even degree

D) Every vertex with odd degree

Answer: Every vertex exactly once

Hint :Think about the definition of a Hamiltonian cycle.

88. In a connected graph, if a vertex has a degree less thann/2 (rounded down), the graph:

A) Must have a Hamiltonian cycle

B) Cannot have a Hamiltonian cycle

C) Must have an Eulerian cycle

D) Cannot be connected

Answer: Cannot have a Hamiltonian cycle

Hint :Consider the degrees required for Hamiltonian graphs.

89. The minimum degree of a Hamiltonian graph with nvertices is:

A)n-1

B)\frac{n}{2} (rounded down)

C)n

D)2(n-1)

Answer:n-1

Hint :Think about the degrees required for Hamiltonian graphs.

90. A subgraph of a Hamiltonian graph is:

A) Always Hamiltonian

B) Never Hamiltonian

C) Sometimes Hamiltonian

D) Always Eulerian

Answer: Sometimes Hamiltonian

Hint :Consider the properties of subgraphs of Hamiltonian graphs.

91. A graph with nvertices and fewer thann-1 edges:

A) Is always Hamiltonian

B) Is never Hamiltonian

C) May or may not be Hamiltonian

D) Is always Eulerian

Answer: Is never Hamiltonian

Hint :Consider the necessary conditions for Hamiltonian graphs.

92. A tree with nvertices:

A) Is always Hamiltonian

B) Is never Hamiltonian

C) May or may not be Hamiltonian

D) Is always Eulerian

Answer: Is never Hamiltonian

Hint :Think about the structure and connectivity of trees.

93. The complement of a Hamiltonian graph is:

A) Always Hamiltonian

B) Never Hamiltonian

C) Sometimes Hamiltonian

D) Always Eulerian

Answer: Sometimes Hamiltonian

Hint :Consider the properties of the complement of Hamiltonian graphs.

94. In a graph with a Hamiltonian cycle, if a vertex has an odd degree:

A) The graph cannot have a Hamiltonian cycle

B) The graph has a Hamiltonian path

C) The vertex is isolated

D) The vertex has an even degree

Answer: The graph cannot have a Hamiltonian cycle

Hint :Think about the necessary condition for Hamiltonian cycles.

95. A graph with nvertices andn-1 edges is:

A) Always Hamiltonian

B) Always Eulerian

C) Sometimes Hamiltonian

D) Never Hamiltonian

Answer: Always Hamiltonian

Hint : Consider the relationship between vertices and edges in Hamiltonian graphs.

UNIT IV

Graph Coloring

1. In graph theory, a vertex coloring is an assignment of:

A) Unique labels to edges

B) Distinct labels to vertices

C) Identical labels to vertices

D) Numbers to edges

Answer: Distinct labels to vertices

Hint : Consider the purpose of vertex coloring.

2. The chromatic number of a graph represents:

A) The maximum number of edges

B) The minimum number of vertices

C) The maximum number of colors needed for vertex coloring

D) The number of connected components

Answer: The minimum number of colors needed for vertex coloring

Hint :Think about the concept of chromatic numbers.

3. In a bipartite graph, the chromatic number is:

A) Always odd

B) Always even

C) Always prime

D) Indeterminable

Answer: Always even

Hint :Consider the nature of bipartite graphs regarding vertex coloring.

4. A perfect graph is a graph in which:

A) Every vertex has the same degree

B) The chromatic number equals the number of vertices

C) The chromatic number is less than the number of vertices

D) All vertices have different colors

Answer: The chromatic number equals the number of vertices

Hint :Think about the properties of perfect graphs in relation to coloring.

5. The Four Color Theorem states that:

A) Any map can be colored with four colors without adjacent regions sharing the same color

B) Any graph can be colored with four colors without adjacent vertices sharing the same color

C) Any planar graph can be colored with four colors without adjacent edges sharing the same color

D) Any bipartite graph can be colored with four colors without adjacent vertices sharing the same color

Answer: Any map can be colored with four colors without adjacent regions sharing the same color

Hint : Consider the statement of the Four Color Theorem.

6. The minimum number of colors needed to color a tree with nvertices is:

A)n

B)n-1

C) 2n

D) n/2

Answer: n

Hint :Think about the connectivity and properties of trees in coloring.

7. A proper vertex coloring in a graph means:

A) Every vertex has a unique color

B) Adjacent vertices have different colors

C) All vertices have the same color

D) Each vertex has at least two colors

Answer: Adjacent vertices have different colors

Hint : Consider the condition for proper vertex coloring.

8. The chromatic polynomial of a graph represents:

A) The number of connected components

B) The maximum number of edges

C) The number of distinct colors needed for a proper vertex coloring

D) A polynomial used to solve coloring problems

Answer: The number of distinct colors needed for a proper vertex coloring

Hint : Think about the concept of chromatic polynomials.

9. A k-colorable graph refers to a graph that:

A) Can be colored with k colors without any restrictions

B) Requires at least k colors for a proper vertex coloring

C) Cannot be colored with k colors

D) Has all vertices with the same color

Answer: Can be colored with k colors without any restrictions

Hint :Consider the definition of k-colorable graphs.

10. The line graph of a graph G is itself a:

A) Complete graph

B) Bipartite graph

C) Graph with edges representing vertices

D) Graph where edges represent adjacent vertices

Answer: Graph where edges represent adjacent vertices

Hint : Think about the structure of line graphs.

11. In a cycle graph Cn, the chromatic number is:

A)n

B) n-1

C) 3

D) 2

Answer: 3

Hint : Consider the chromatic number in cycle graphs.

12. A graph with a Hamiltonian cycle must have a chromatic number of:

A) 1

B) 2

C) 3

D) 4

Answer: 2

Hint : Consider the nature of Hamiltonian cycles in graph coloring.

13. A planar graph with n vertices has a chromatic number:

A) n

B) n-1

C) 3

D) 4

Answer: At most 4

Hint :Consider the chromatic number restrictions in planar graphs.

14. In a bipartite graph, the chromatic number is:

A) Always odd

B) Always even

C) Prime

D) Indeterminable Answer: Always even

Hint : Consider the structure and properties of bipartite graphs.

15. A coloring of a graph refers to:

A) Assigning colors to vertices such that adjacent vertices have different colors

B) Assigning colors to edges such that adjacent edges have different colors

C) Assigning labels to vertices in a specific sequence

D) Assigning labels to edges based on their weight

Answer: Assigning colors to vertices such that adjacent vertices have different colors

Hint : Think about the process of coloring in graphs.

16. The total chromatic number of a graph is the minimum number of colors needed to color:

A) Vertices such that adjacent vertices have the same color

B) Edges such that adjacent edges have the same color

C) Vertices such that adjacent vertices have different colors

D) Both vertices and edges such that no adjacent vertices or edges share the same color

Answer: Both vertices and edges such that no adjacent vertices or edges share the same color

Hint : Consider the concept of total chromatic numbers.

17. A graph coloring problem is a classic problem in graph theory used in:

A) Routing algorithms

B) Scheduling problems

C) Network design

D) All of the above

Answer: All of the above

Hint : Think about the various applications of graph coloring problems.

18. The chromatic index of a graph is:

A) The same as the chromatic number

B) The minimum number of colors needed to color the edges

C) The maximum number of colors needed to color the vertices

D) Not related to vertex coloring

Answer: The minimum number of colors needed to color the edges

Hint : Consider the concept of chromatic index.

19. A graph that can be colored with a single color is:

A) Always complete

B) Always disconnected

C) Always bipartite

D) Always empty

Answer: Always complete

Hint : Think about the relationship between coloring and complete graphs.

Edge Coloring:

20. An edge coloring of a graph refers to:

A) Assigning colors to vertices such that adjacent vertices have different colors

B) Assigning colors to edges such that adjacent edges have different colors

C) Assigning labels to vertices in a specific sequence

D) Assigning labels to edges based on their weight

Answer: Assigning colors to edges such that adjacent edges have different colors

Hint : Think about the process of coloring in graphs.

21. The chromatic index of a graph represents:

A) The number of distinct colors needed for a proper edge coloring

B) The number of connected components

C) The maximum number of edges in the graph

D) A polynomial used to solve edge coloring problems

Answer: The number of distinct colors needed for a proper edge coloring

Hint : Consider the concept of chromatic index.

22. The chromatic index of a complete graph with n vertices is:

A)n

B)n-1

C) 3

D) 2

Answer:n-1

Hint :Consider the chromatic index in complete graphs.

23. A proper edge coloring in a graph means:

A) Every edge has a unique color

B) Adjacent edges have different colors

C) All edges have the same color

D) Each edge has at least two colors

Answer: Adjacent edges have different colors

Hint : Consider the condition for proper edge coloring.

24. The Vizing's theorem states that the chromatic index of a simple graph is either:

A) Equal to the maximum degree of the graph or one more

B) Always equal to the maximum degree of the graph

C) Always equal to the minimum degree of the graph

D) Indeterminable

Answer: Equal to the maximum degree of the graph or one more

Hint : Consider the essence of Vizing's theorem.

25. A graph where all vertices have the same degree must have a chromatic index of:

A) 1

B) 2

C) 3

D) Indeterminable

Answer: 1

Hint : Think about the relationship between vertex degrees and edge colors.

26. The chromatic index of a tree with nvertices is:

A)n

B)n-1

C) 3

D) 2

Answer: n-1

Hint : Consider the chromatic index in trees.

27. In a complete graph $K_n$the chromatic index is:

A)n

B)n-1

C) 3

D) 2

Answer:n-1

Hint :Think about the chromatic index in complete graphs.

28. The edge chromatic number of a graph is:

A) The same as the chromatic number

B) The minimum number of colors needed to color the edges

C) The maximum number of colors needed to color the vertices

D) Not related to edge coloring

Answer: The minimum number of colors needed to color the edges

Hint : Consider the concept of edge chromatic numbers.

29. The total chromatic number of a graph is the minimum number of colors needed to color:

A) Vertices such that adjacent vertices have the same color

B) Edges such that adjacent edges have the same color

C) Vertices such that adjacent vertices have different colors

D) Both vertices and edges such that no adjacent vertices or edges share the same color

Answer: Both vertices and edges such that no adjacent vertices or edges share the same color

Hint :Consider the concept of total chromatic numbers.

30. In a cycle graphC_n, the chromatic index is:

A)n

B)n-1

C) 3

D) 2

Answer: nfor evenn,n-1 for oddn

Hint :Consider the chromatic index in cycle graphs.

31. An optimal edge coloring is a coloring that:

A) Uses the maximum number of colors

B) Uses the minimum number of colors

C) Uses the same color for all edges

D) Uses the same color for adjacent edges

Answer: Uses the minimum number of colors

Hint :Think about the goal of optimal edge coloring.

32. A graph that can be colored with a single color for all edges is:

A) Always complete

B) Always disconnected

C) Always bipartite

D) Always empty

Answer: Always disconnected

Hint : Think about the relationship between edge coloring and complete graphs.

33. The total chromatic index of a graph is at least:

A) Equal to the maximum degree of the graph

B) Equal to the sum of the degrees of the vertices

C) Twice the chromatic index of the graph

D) Twice the maximum degree of the graph

Answer: Equal to the maximum degree of the graph

Hint : Think about the relationship between total chromatic index and the graph's properties.

34. The total chromatic number of a graph is at least:

A) Equal to the maximum degree of the graph

B) Equal to the sum of the degrees of the vertices

C) Twice the chromatic index of the graph

D) Twice the maximum degree of the graph

Answer: Equal to the maximum degree of the graph

Hint : Think about the relationship between total chromatic number and the graph's properties

UNIT V

Planar Graphs:

1.A planar graph is a graph that:

A) Can be drawn on a plane without edges crossing

B) Has a maximum number of vertices

C) Contains no cycles

D) Has a complete subgraph

Answer: Can be drawn on a plane without edges crossing

Hint :Consider the defining characteristic of planar graphs.

2. The number of edges in a planar graph with nvertices and no parallel edges is at most:

A)n

B) 2n

C)3n - 6

D)3n - 3

Answer:3n - 6

Hint : Think about the relationship between edges and vertices in planar graphs.

3. A Kuratowski subgraph in a graph refers to:

A) A subgraph that cannot be drawn on a plane without edge crossings

B) A complete graph

C) A bipartite graph

D) A tree

Answer: A subgraph that cannot be drawn on a plane without edge crossings

Hint :Consider the defining characteristic of Kuratowski subgraphs.

4. The Euler's formula for planar graphs states that for a connected planar graph withv vertices,e edges, andf faces:

A)v + e = f

B)v - e + f = 2

C)v + e - f = 2

D)v - e = f

Answer:v - e + f = 2

Hint : Recall the Euler's formula for planar graphs.

5. A subdivision of an edge in a graph means:

A) Deleting an edge

B) Creating a loop

C) Splitting an edge into two by adding a new vertex

D) Combining two edges into one

Answer: Splitting an edge into two by adding a new vertex

Hint :Consider the process of subdividing an edge.

6. A planar graph can have a maximum of how many regions when drawn on a plane?

A)n

B) 2n

C) 3n - 6

D) 3n - 3

Answer: 3n - 6

Hint : Think about the relationship between regions, vertices, and edges in planar graphs.

7. In a planar graph, a cycle of length n has:

A) n vertices and n edges

B) n vertices and n+1edges

C) n+1 vertices and n edges

D) n+1 vertices and n+1 edges

Answer: n vertices and n edges

Hint :Consider the characteristics of cycles in planar graphs.

8. A bridge in a planar graph refers to an edge whose removal:

A) Disconnects the graph

B) Increases the number of regions

C) Decreases the number of regions

D) Changes the number of vertices

Answer: Increases the number of regions

Hint :Think about the effect of removing a bridge on the graph's regions.

9. The minimum number of edges required for a planar graph with 5 vertices is:

A)5

B)6

C)7

D)8

Answer:5

Hint :Think about the minimum number of edges needed to maintain planarity.

10. A graph is considered non-planar if it contains a:

A) Complete graph

B) Bipartite graph

C) Cycle

D) Kuratowski subgraph

Answer: Kuratowski subgraph

Hint : Consider the defining characteristic of non-planar graphs

11. A graph that contains a Kuratowski subgraph is:

A) Always planar

B) Always bipartite

C) Always non-planar

D) Always a tree

Answer: Always non-planar

Hint : Recall the defining characteristic of Kuratowski subgraphs.

12. A non-planar graph is a graph that:

A) Cannot be drawn on a plane without edges crossing

B) Has a maximum number of vertices

C) Contains no cycles

D) Has a complete subgraph

Answer: Cannot be drawn on a plane without edges crossing

Hint :Consider the defining characteristic of non-planar graphs.

13. The number of edges in a non-planar graph with n vertices and no parallel edges is at least:

A)n

B) 2n

C)3n - 6

D)3n - 3

Answer: 3n - 6

Hint : Think about the relationship between edges and vertices in non-planar graphs.

14. A graph that contains a subdivision of K_5 or $K_{3,3}$ is:

A) Always planar

B) Always bipartite

C) Always non-planar

D) Always a tree

Answer: Always non-planar

Hint : Consider the significance of these specific subgraphs in determining planarity.

15. A non-planar graph can have a minimum of how many regions when drawn on a plane?

A)n

B) 2n

C)3n - 6

D)3n - 3

Answer:3n - 6

Hint :Think about the relationship between regions, vertices, and edges in non-planar graphs.

16. In a non-planar graph, a cycle of length n has:

A) n vertices and n edges

B) n vertices andn+1 edges

C)n+1 vertices and nedges

D)n+1 vertices andn+1 edges

Answer: nvertices and nedges

Hint : Consider the characteristics of cycles in non-planar graphs.

17. A graph that contains a bridge is:

A) Always planar

B) Always bipartite

C) Always non-planar

D) Always a tree

Answer: Can be either planar or non-planar

Hint : Think about the effect of bridges on planarity.

18. The minimum number of edges required for a non-planar graph with5 vertices is:

A)5

B)6

C)7

D)8

Answer: 7

Hint : Think about the minimum number of edges needed to violate planarity.

19.A graph is considered non-planar if it contains a:

A) Complete graph

B) Bipartite graph

C) Cycle

D) Kuratowski subgraph

Answer: Kuratowski subgraph

Hint : Recall the defining characteristic of non-planar graphs.

20. The graph $K_{3,3}$ is:

A) Always planar

B) Always bipartite

C) Always non-planar

D) Always a tree

Answer: Always non-planar

Hint : Consider the structure of the $K_{3,3}$ graph and its significance in planarity.

21. The dual graph of a plane graph G is obtained by:

A) Reversing the edges of G

B) Reflecting G across a line

C) Assigning vertices to faces and connecting adjacent faces

D) Joining every vertex to its adjacent vertices

Answer: Assigning vertices to faces and connecting adjacent faces

Hint :Consider the process of creating the dual graph.

22. The dual of a planar graph is:

A) Always planar

B) Always non-planar

C) Sometimes planar, sometimes non-planar

D) Always bipartite

Answer: Always planar

Hint :Think about the relationship between the original graph and its dual.

23. The number of edges in the dual graph of a plane graph with nvertices and m edges is:

A)n

B) m

C)n + m

D)2m - n

Answer: m

Hint : Consider the relationship between edges in the original graph and its dual.

24. The dual of a planar graph has a face for every:

A) Vertex in the original graph

B) Edge in the original graph

C) Cycle in the original graph

D) Region in the plane

Answer: Region in the plane

Hint : Consider what each face in the dual graph represents.

25. The dual graph of a K4 graph is:

A) A triangle

B) A square

C) A star

D) A complete graph

Answer: A triangle

Hint : Draw a K4 graph and its dual to observe the pattern.

26. The dual graph of a tree is:

A) Always a tree

B) Always a forest

C) Always a cycle

D) Always disconnected

Answer: Always a forest

Hint : Think about the structure of trees and their dual graphs.

27. The dual of a planar bipartite graph is:

A) Always bipartite

B) Always complete

C) Sometimes bipartite, sometimes complete

D) Always disconnected

Answer: Always bipartite

Hint :Consider the properties of planar bipartite graphs and their duals.

28. The dual of the dual of a graph G is:

A) Always G

B) Always a complete graph

C) Sometimes G, sometimes a complete graph

D) Always disconnected

Answer: Always G

Hint : Consider the relationship between a graph and its dual.

29. A planar graph G and its dual graph have:

A) The same number of edges

B) The same number of vertices

C) The same number of faces

D) Different numbers of edges, vertices, and faces

Answer: The same number of faces

Hint :Think about the relationship between faces in the original graph and vertices in its dual.

30. The dual graph of a planar graph is always:

A) Connected

B) Disconnected

C) Bipartite

D) Complete

Answer: Connected

Hint : Consider the connectivity properties of the dual graph.

31. A Hamiltonian cycle in a plane graph is a cycle that:

A) Visits every vertex exactly once and forms a closed loop

B) Connects all vertices in the graph without revisiting any vertex

C) Visits every edge exactly once

D) Has the maximum number of edges

Answer: Visits every vertex exactly once and forms a closed loop

Hint : Consider the definition of a Hamiltonian cycle in a plane graph.

32. A Hamiltonian path in a plane graph is a path that:

A) Visits every vertex exactly once without forming a closed loop

B) Connects all vertices in the graph without revisiting any vertex

C) Visits every edge exactly once

D) Has the maximum number of edges

Answer: Visits every vertex exactly once without forming a closed loop

Hint : Compare the Hamiltonian path to the Hamiltonian cycle.

33. A Hamiltonian cycle in a complete graph is of order:

A) n

B) n-1

C) n+1

D) 2n

Answer: n

Hint : Consider the properties of a complete graph and its cycles.

34. A planar graph can have a Hamiltonian cycle if:

A) It has a cycle

B) It is connected

C) It has more than 5 vertices

D) It has no cut vertex

Answer: It is connected

Hint : Think about the requirement for a graph to contain a Hamiltonian cycle.

35. The number of edges in a Hamiltonian cycle of a plane graph with n vertices is:

A)n

B)n-1

C)n+1

D) n/2

Answer: n

Hint :Consider the relationship between vertices and edges in a Hamiltonian cycle.

36. A Hamiltonian cycle exists in a K4 graph:

A) Always

B) Never

C) Sometimes

D) Only in bipartite K4

Answer: Always

Hint : Consider the structure and connectivity of a K4 graph.

37. In a Hamiltonian plane graph, the degree of each vertex is at least:

A) 1

B) 2

C)n-1

D)n

Answer: 3

Hint :Think about the degrees of vertices in a Hamiltonian plane graph.

38. The number of vertices in a Hamiltonian plane graph with e edges is:

A)e

B)e+1

C)2e

D)3e

Answer: e+2

Hint : Consider the relationship between edges and vertices in a Hamiltonian plane graph

39. A bipartite graph can have a Hamiltonian cycle if:

A) It has an odd number of vertices

B) It has an even number of vertices

C) It has more than 5 vertices

D) It is disconnected

Answer: : It has an even number of vertices

Hint :Consider the property of bipartite graphs and their cycles.

40. A planar graph with nvertices andm edges can have a Hamiltonian cycle if:

A) m = n-1

B) m = n

C) m $\geq$2n - 3

D) m $\geq$ n

Answer: m $\geq$2n - 3

Hint : Think about the relationship between edges and vertices required for a Hamiltonian cycle in a planar graph.

41. Which theorem in graph theory relates the number of vertices, edges, and faces in a planar graph?

a) Euler's theorem

b) Hamiltonian theorem

c) Four Color theorem

d) Kuratowski's theorem

Answer : a) Euler's theorem

Hint: This theorem establishes a relationship between fundamental elements in a planar graph.

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ISBN 978-933402121-9