SELF-TEST

Choose the correct answer:

1. If $R = \{(1, 1), (1, 2), (2, 3), (3, 1), (3, 3)\}$ and $S = \{(1, 2), (1, 3), (2, 1), (3, 3)\}$ then
   (a) $(2, 3) \in S \circ R$ and $(2, 3) \in S^2$
   (b) $(2, 3) \in S \circ R$ and $(3, 2) \in S^2$
   (c) $(3, 2) \in S \circ R$ and $(3, 2) \in S^2$
   (d) $(1, 2) \in S \circ R$ and $(1, 2) \in S^2$.
2. If $R = \{(1, 2), (1, 3), (1, 12), (2, 3), (2, 6), (2, 8), (13, 2)\}$ and $S = \{(2, 13), (3, 13), (3, 22), (2, 17)\}$ then
   (a) $(1, 17) \in S \circ R$ and $(2, 2) \in R \circ S$
   (b) $(1, 17) \in R \circ S$ and $(2, 2) \in S \circ R$
   (c) $(1, 17) \notin S \circ R$ and $(1, 22) \in S \circ R$
   (d) $(3, 2) \notin R \circ S$ and $(3, 2) \in S \circ R$.
3. If mRn if $m^2 = n$, then
   (a) $(-3, -9) \in R$
   (b) $(3, -9) \in R$
   (c) $(-3, 9) \in R$
   (d) $(9, 3) \in R$.
4. If $R \subseteq S$, then
   (a) $R^{-1} \subseteq S^{-1}$
   (b) $S^{-1} \subseteq R^{-1}$
   (c) $R \cup S = R$
   (d) $(R \cup S)^{-1} = R^{-1} \cap S^{-1}$.
5. The number of relations from A to B with $|A| = m$ and $|B| = n$ is
   (a) mn
   (b) 2^n
   (c) 2^m
   (d) 2^{mn}.
6. If R and S are relations in A and $R \subseteq S$, then
   (a) S is reflexive if R is reflexive
   (b) S is symmetric if R is symmetric
   (c) S is transitive if R is transitive
   (d) S is an equivalence relation if R is an equivalence relation.
7. If R and S are relations in A and $R \subseteq S$, then
   (a) S is reflexive if R is reflexive
   (b) S is antisymmetric if R is antisymmetric
   (c) S is transitive if R is transitive
   (d) S is a partial ordering if R is a partial ordering.
8. ϕ and $A \times A$ are
   (a) Both reflexive
   (b) Both symmetric
   (c) Both antisymmetric
   (d) Both equivalence relations.
9. The relation $R = \{(a, a) \mid a \in N\}$ is
   (a) Symmetric but not antisymmetric
   (b) Symmetric and antisymmetric
   (c) Symmetric and asymmetric
   (d) Asymmetric and antisymmetric.
10. The relation aRb if $|a - b| = 2$ where a and b are real numbers, is
    (a) Neither reflexive nor symmetric
    (b) Neither symmetric nor transitive
    (c) An equivalence relation
    (d) Symmetric but not transitive.
11. The relation R defined in Z by mRn if $|m - n| < 2$ is
    (a) Not reflexive
    (b) Not symmetric
    (c) Not transitive
    (d) An equivalence relation.

12. The relation R defined in N by mRn if $m^2 = n$ is
(a) Reflexive
(b) Symmetric
(c) Transitive
(d) Antisymmetric.

13. $\{(1, 2), (2, 1), (1, 1), (2, 2)\}$ is
(a) An equivalence relation
(b) A partial ordering
(c) Not an equivalence relation
(d) Not transitive.

14. The relation R defined in N by mRn if $m|n$ or $n|m$ is
(a) Not reflexive
(b) Not symmetric
(c) Not transitive
(d) None of these.

15. The relation S in N defined by mSn if m and n are relatively prime is
(a) An equivalence relation
(b) A partial ordering
(c) Not transitive
(d) Transitive.

16. The relation $\{(1, 2), (1, 3), (1, 4), (2, 1), (3, 1), (4, 1)\}$ is
(a) Not reflexive or transitive but symmetric
(b) Not symmetric or transitive but reflexive
(c) Not reflexive or symmetric but transitive
(d) An equivalence relation.

17. The relation R defined in Z by mRn if $mn \geq 0$ is
(a) Reflexive, symmetric and transitive
(b) Not reflexive, symmetric and transitive
(c) Reflexive, transitive and not symmetric
(d) Reflexive, symmetric and not transitive.

18. If X is a nonempty set, C is a subset of X and the relation R is defined in $\wp(X)$ by ARB if $A \cap C = B \cap C$, then R is
(a) An equivalence relation
(b) A partial ordering
(c) Reflexive, symmetric but not transitive
(d) Reflexive, antisymmetric but not transitive

19. The relation R = $\{(1, 3), (1, 1), (3, 1), (1, 2), (3, 3), (4, 4)\}$ defined in $\{1, 2, 3, 4\}$ is
(a) Reflexive, symmetric but not transitive
(b) Symmetric, antisymmetric and transitive
(c) Asymmetric, antisymmetric and not transitive
(d) Not reflexive, not symmetric, not transitive.

20. If $R = \{(1, 1), (2, 2), (3, 3), (4, 4)\}$ is a relation in $\{1, 2, 3, 4\}$, then R is
(a) An equivalence relation but not a partial ordering
(b) A partial ordering but not an equivalence relation
(c) An equivalence relation and a partial ordering
(d) Neither an equivalence relation nor a partial ordering.

21. If $R = \{(1, 1), (2, x), (3, 3), (3, 2), (2, y)\}$ is reflexive and symmetric, then
(a) $x = 1$ and $y = 2$
(b) $x = 2$ and $y = 2$
(c) $x = 3$ and $y = 3$
(d) $x = 2$ and $y = 3$.

22. The relation "perpendicularity" in the set of all straight lines in the Euclidean plane is
(a) Reflexive
(b) Symmetric
(c) Antisymmetric
(d) Transitive.

23. The relation $R = \{(a, b), (b, a), (a, c)\}$ is
(a) Neither reflexive nor irreflexive (b) Reflexive and symmetric
(c) Neither symmetric nor antisymmetric (d) Symmetric and antisymmetric.

24. The reflexive closure of a relation R in a set A with n elements has
(a) At most n elements (b) At least n elements
(c) At most 2^n elements (d) At least 2^n elements.

25. aRb if book a costs more and has more pages than book b. Then R is
(a) Reflexive and symmetric (b) Reflexive and antisymmetric
(c) Irreflexive and antisymmetric (d) Irreflexive and symmetric.

26. aRb if book a costs more or has fewer pages than b. Then R is
(a) Reflexive and transitive (b) Irreflexive and transitive
(c) Reflexive and antisymmetric (d) Neither symmetric nor transitive.

27. The relation R in Z defined by mRn if $m < n + 1$ is
(a) Reflexive and symmetric (b) Reflexive and transitive
(c) Irreflexive and transitive (d) Symmetric and transitive.

28. The range of $g \circ f$ when $f: Z \to Z$ and $g: Z \to Z$ are defined by $f(n) = n + 1$ and $g(n) = 2n$ is
(a) Z (b) Z^+
(c) The set of all odd numbers (d) The set of all even numbers.

29. If f, g, h are functions from R to R defined by $f(x) = x + 1$, $g(x) = x^2 + 2$, $h(x) = 2x + 1$, then $(h \circ g \circ f)$ (2) is
(a) 23 (b) 20
(c) 21 (d) 22.

30. $f(A_1 \cap A_2) = f(A_1) \cap f(A_2)$ holds
(a) If f is injective (b) If f is surjective
(c) If f is any function (d) For no function.

31. The relation $\{(x, y) \in R^2 \mid ax + by = c\}$ is an invertible function from R to R if
(a) $a \neq 0$ (b) $b \neq 0, a \neq 0$
(c) $c \neq 0$ (d) $c \neq 0, a \neq 0$.

32. The number of invertible functions from $\{1, 2, 3, 4, 5\}$ to $\{a, b, c, d, e\}$ is
(a) 5^5 (b) 25
(c) 5! (d) None of these.

33. The function $f: Z_8 \to Z_8$ defined by $f(x) = 3x$ is
(a) One-to-one (b) Onto
(c) Bijective (d) None of these.

34. The function defined by $f(x) = \sin x$ is one-to-one when its domain is
(a) $-\frac{\pi}{2} \leq x \leq \frac{\pi}{2}$ (b) $-\pi \leq x \leq \pi$
(c) $0 \leq x < \pi$ (d) $0 \leq x \leq \frac{\pi}{2}$.

35. The function defined by $f(x) = x + 1$ is not onto if f is a function
(a) From R to R (b) From Q to Q
(c) From Z to Z (d) From N to N.

36. If the function f from Z_5 to Z_5 is defined by $f(x) = 2x$ then $f^{-1}(3)$ is
(a) 1 (b) 2
(c) 3 (d) 4.

37. If f is a function from Z_{10} to Z_{11} defined by $f(x) = 2x + 1 \pmod{11}$, then f is
(a) Injective but not surjective (b) Surjective but not injective
(c) Bijective (d) Neither injective nor surjective.

38. If f is a function from Z_{11} to Z_{10} defined by $f(x) = 2x + 1 \pmod{10}$, then f is
(a) Injective but not surjective (b) Surjective but not injective
(c) Bijective (d) Neither injective nor surjective.

39. If f is a function from Z_{10} to Z_{11} defined by $f(x) = 3x + 1 \pmod{11}$, then f is
(a) Injective but not surjective (b) Surjective but not injective
(c) Bijective (d) Neither injective nor surjective.

40. If f is a function from Z_{11} to Z_{10} defined by $f(x) = 3x + 1 \pmod{10}$, then f is
(a) Injective but not surjective (b) Surjective but not injective
(c) Bijective (d) Neither injective nor surjective.

41. If $f: Z \to Z$ is defined by $f(n) = n - (-1)^n$, then f is
(a) Bijective (b) Injective but not surjective
(c) Surjective but not injective (d) Neither injective nor surjective.

42. If f, g, h are functions from Z to Z defined by $f(n) = n - 3$, $g(n) = 2n + 3$, $h(n) = n + 3$, then $g \circ f \circ h$ is equal to
(a) f (b) g
(c) h (d) $h \circ g \circ f$.

43. If f is a function from Z to Z defined by $f(n) = n + 2$, then $f^{-3}(10)$ is
(a) 7 (b) 6
(c) 5 (d) 4.

44. If f and g are functions from R^+ to R^+ defined by $f(x) = e^x$ and $g(x) = x - 3$, then $(g \circ f)^{-1}(x)$ is
(a) $\log(3 + x)$ (b) $\log(3 - x)$
(c) e^{3-x} (d) $\log(x - 3)$.

45. The rule $f(x) = \dfrac{x+1}{x^2+x+1}$ can define a function from
(a) R^+ to R^+ (b) $R - \{1\}$ to $R - \{1\}$
(c) $R - \{-1\}$ to $R - \{-1\}$ (d) R to R.

46. If f is a function from $R \times R$ to $R \times R$ defined by $f(x, y) = (x - 1, y + 1)$, then f^{-1} is defined by
(a) $(x + 1, y - 1)$ (b) $(x + 1, y + 1)$
(c) $(x - 1, y + 1)$ (d) $(x - 1, y - 1)$.

47. The number of 1's in the relation matrix of a total ordering in a set A having n elements is
(a) $n + C(n, 2)$ (b) n^2
(c) $C(n, 2)$ (d) $2C(n, 2)$.

48. The number of total orderings in a set A having n elements is
(a) n^2 (b) 2^n
(c) $n!$ (d) $n^2 + 2^n$.

2. $P \vee (\neg P \wedge Q)$ is equivalent to
   (a) $P \vee Q$ (b) $P \wedge Q$
   (c) P (d) Q.
3. $P \wedge (\neg P \vee Q)$ is equivalent to
   (a) $P \vee Q$ (b) $P \wedge Q$
   (c) P (d) Q.
4. $P \wedge (Q \rightarrow R)$ is equivalent to
   (a) $(P \wedge Q) \vee (P \wedge R)$ (b) $(P \wedge \neg Q) \vee (P \wedge R)$
   (c) $(P \wedge \neg R) \wedge (P \wedge Q)$ (d) $(\neg P \wedge \neg R) \vee (P \wedge Q)$.
5. If P then Q else R can be written as
   (a) $(P \rightarrow Q) \wedge (\neg P \rightarrow R)$ (b) $(P \rightarrow Q) \rightarrow R$
   (c) $P \rightarrow (Q \rightarrow R)$ (d) $(P \wedge Q) \rightarrow R$.
6. $P \rightarrow Q$ and $P \rightarrow \mathbf{T}$ are
   (a) Both tautologies
   (b) Both contradictions
   (c) A contingency and a tautology respectively
   (d) A tautology and a contingency respectively.
7. $P \vee (P \wedge (P \vee (Q \wedge P)))$ is equivalent to
   (a) P (b) Q
   (c) $\mathbf{T}$ (d) $\mathbf{F}$.
8. $\mathbf{T} \rightarrow P$ is a
   (a) Tautology (b) Contradiction
   (c) Contingency (d) None of these.
9. $P \uparrow P$ is equivalent to
   (a) P (b) $\neg P$
   (c) $\mathbf{T}$ (d) $\mathbf{F}$.
10. $(P \uparrow Q) \uparrow (P \uparrow Q)$ is equivalent to
    (a) $P \uparrow Q$ (b) $P \downarrow Q$
    (c) $(P \downarrow P) \downarrow (Q \downarrow Q)$ (d) $(P \downarrow Q) \downarrow (P \downarrow Q)$.
11. A disjunctive normal form of $P \rightarrow Q$ is
    (a) $\neg P \vee Q$ (b) $P \vee \neg Q$
    (c) $(\neg P \wedge Q) \vee (P \wedge \neg Q)$ (d) $(P \wedge Q) \vee (P \wedge \neg Q)$.
12. The argument "A rich man is happy and Ram is rich. Therefore Ram is happy." follows from
    (a) Disjunctive syllogism (b) Hypothetical syllogism
    (c) Modus ponens (d) Modus tollens.
13. The argument "A rich man is happy and Ram is not happy. Therefore Ram is not rich." follows from
    (a) Disjunctive syllogism (b) Hypothetical syllogism
    (c) Modus ponens (d) Modus tollens.
14. The argument "Ram is clever or happy. Ram is not happy. Therefore Ram is clever." follows from
    (a) Disjunctive syllogism (b) Hypothetical syllogism
    (c) Modus ponens (d) Modus tollens.

15. Let
(i) A contradiction is a wff which is not a tautology;
(ii) The disjunction of any wff with a tautology has the truth value T
be two statements. Then (i) and (ii) are
(a) Both true
(b) Both false
(c) (i) is true but (ii) is false
(d) (ii) is true but (i) is false.

16. A valid argument is one in which
(a) The conclusion is always true
(b) Hypothesis $\rightarrow$ conclusion is true
(c) Hypothesis $\rightarrow$ conclusion is false
(d) The conclusion is always false.

17. A valid conclusion from $P \vee Q$ and $\neg P$ is
(a) $P \vee Q$
(b) $P \wedge Q$
(c) P
(d) Q.

18. If a program is efficient, then its execution time is less than a minute. Either the program is efficient or it has a bug. However, the execution time is more than two minutes. Hence
(a) The program has a bug
(b) The program is efficient
(c) The execution time is less than a minute
(d) None of these.

19. The negation of "Every clever fellow is fooled by somebody sometime." is
(a) Every clever fellow is not fooled by somebody sometime;
(b) Some clever fellow is fooled by everybody all the time;
(c) Every clever fellow is not fooled by everybody all the time;
(d) Some clever fellow is not fooled by everbody all the time.

20. From the premises $P \rightarrow Q$, $P \vee \neg R$ and R, a possible conclusion is
(a) P
(b) Q
(c) $P \wedge Q$
(d) $P \vee \neg Q$.

21. From the premises $P \rightarrow Q$, $\neg R \rightarrow \neg Q$ and $\neg R$, a possible conclusion is
(a) $\neg P$
(b) $\neg Q$
(c) $\neg P \wedge \neg Q$
(d) $P \vee \neg Q$.

22. The arguments $P \wedge \neg P \rightarrow Q$ and $\neg P \rightarrow (P \rightarrow Q)$ are
(a) Both valid
(b) Both invalid
(c) The first alone is valid
(d) The second alone is valid.

23. If $P(x, y)$ is $3y + 2 < x$ and R is the universe of discourse, then the truth values of $\exists x \, \forall y \, P(x, y)$ and $\forall x \, \exists y \, P(x, y)$ are
(a) T and T
(b) T and F
(c) F and T
(d) F and F.

24. The negations of $\exists m \, (m + 3 = 7)$ and $\forall n \, (n + 3 < 7)$ are
(a) $\forall m \, (m + 3 \neq 7)$ and $\forall n \, (n + 3 \geq 7)$
(b) $\forall m \, (m + 3 \neq 7)$ and $\exists n \, (n + 3 \geq 7)$
(c) $\exists m \, (m + 3 \neq 7)$ and $\forall n \, (n + 3 \geq 7)$
(d) $\exists m \, (m + 3 \neq 7)$ and $\exists n \, (n + 3 \geq 7)$.

25. The negation of "some students like cricket" is
(a) Some students dislike cricket
(b) Every student dislikes cricket
(c) Every student likes cricket
(d) None of these.

26. The negation of $\forall x \, \exists y \, \exists z \, P(x, y, z)$ is
(a) $\exists x \, \forall y \, \forall z \, (\neg P(x, y, z))$
(b) $\forall x \, \exists y \, \exists z \, \neg P(x, y, z)$
(c) $\forall x \, \exists y \, \forall z \, \neg P(x, y, z)$
(d) None of these.

27. The argument $\forall x\, P(x) \rightarrow \exists x\, P(x)$ follows from
    (a) Universal instantiation and universal generalisation
    (b) Existential instantiation and existential generalisation
    (c) Existential instantiation and universal generalisation
    (d) Universal instantiation and existential generalisation.

28. From the statement $\exists x\, P(x) \wedge \exists x\, Q(x)$, a valid conclusion is
    (a) $\exists x\, [P(x) \wedge Q(x)]$
    (b) $\forall x\, [P(x) \vee Q(x)]$
    (c) $\exists y\, \exists x\, [P(x) \wedge Q(y)]$
    (d) None of these.

29. If $A(x)$ is "x is an auditor"
    $L(x)$ is "x is a lawyer"
    and
    $S(x)$ is "x is a software professional"
    then "no software professional is both an auditor and a lawyer" is
    (a) $\forall x\, [S(x) \rightarrow (\neg A(x) \wedge \neg L(x))]$
    (b) $\forall x\, [S(x) \rightarrow \neg (A(x) \vee L(x))]$
    (c) $\forall x\, [S(x) \rightarrow \neg (A(x) \wedge L(x))]$
    (d) $\forall x\, [\neg S(x) \rightarrow (A(x) \vee L(x))]$.

30. Given the arguments
    (i) No software professional is a bookworm.
    Sam is a bookworm. Therefore Sam is not a software professional;
    (ii) Some software professionals are bookworms.
    Some bookworms are not worldly wise. Therefore some worldly wise persons are not software professionals
    (a) (i) and (ii) are valid
    (b) Both are invalid
    (c) (i) is valid and (ii) is invalid
    (d) (i) is invalid and (ii) is valid.

Answers to Self-test

1. (d)	**2.** (a)	**3.** (b)	**4.** (b)	**5.** (a)	**6.** (c)	**7.** (a)	**8.** (c)	**9.** (b)	**10.** (c)
11. (a)	**12.** (c)	**13.** (d)	**14.** (a)	**15.** (d)	**16.** (b)	**17.** (d)	**18.** (a)	**19.** (d)	**20.** (b)
21. (a)	**22.** (a)	**23.** (c)	**24.** (b)	**25.** (b)	**26.** (a)	**27.** (d)	**28.** (c)	**29.** (c)	**30.** (c)

11. The recurrence relation that determines the sequence $7, \frac{14}{5}, \frac{28}{25}, \frac{56}{125}, \ldots$ is

(a) $2a_n - 5a_{n-1} = 0,\ a_0 = 7$

(b) $a_n = a_{n-1} + \frac{2}{5},\ a_0 = 7$

(c) $a_n = a_{n-1} - \frac{2}{5},\ a_0 = 7$

(d) $a_n = \left(\frac{2}{5}\right) a_{n-1},\ a_0 = 7.$

12. If $a_{n+1} - da_n = 0$, $a_3 = 189$ and $a_5 = 1701$, then d is equal to

(a) 9

(b) -3

(c) 3

(d) ± 3.

13. The first four values of the sequence $S(n)$ defined by

$$S(1) = 1,\ S(n) = n^2\, S(n-1) + (n-1) \text{ are}$$

(a) 1, 5, 47, 755

(b) 1, 5, 47, 750

(c) 1, 5, 40, 755

(d) None of these.

14. The first four values of the sequence $S(n)$ defined by $S(n) = S(n-1) + 2S(n-2) + 3S(n-3)$ for $n > 3$ and $S(1) = 1$, $S(2) = 2$, $S(3) = 3$ is

(a) 10, 22, 51, 125

(b) 14, 22, 51, 125

(c) 10, 24, 51, 125

(d) 10, 22, 51, 130.

15. If $a_1 = 1$ and $a_n = a_{n+1} + 2^{n-1}$ for $n \geq 2$, then a_n is

(a) $2^{n+1} - 1$

(b) 2^{n+1}

(c) 2^n

(d) $2^n - 1,\ n \geq 1.$

16. $\{a_n\}$ is a solution of the recurrence relation $a_n = 3a_{n-1} - 2a_{n-2}$ if a_n is equal to

(a) $A(-2)^n + B$

(b) $A2^n + B$

(c) $A2^n + B(-1)^n$

(d) $A(-2)^n + B(-1)^n$.

17. $\{a_n\}$ is a solution of the recurrence relation $a_n - 8a_{n-1} + 16a_{n-2} = 0$ if a_n is equal to

(a) 4^n

(b) $n4^n$

(c) $A4^n + Bn4^n$

(d) $n^2 4^n$.

18. The homogeneous solution of $a_n + 6a_{n-1} + 12a_{n-2} + 8a_{n-3} = 0$ is

(a) $(A + Bn + Cn^2)(2)^n$ (b) $A + Bn + Cn^2$
(c) $A + (B + Cn)(-2)^n$ (d) $(A + Bn + Cn^2)(-2)^n$.

19. The general solution of the relation $a_n = 4(a_{n-1} - a_{n-2})$ is
(a) $(A + Bn)\, 2^n$ (b) $A2^n + B(-2)^n$
(c) $(A + Bn + Cn^2)\, 2^n$ (d) None of these.

20. If $S(n) = S(n-1) + n^2$ and $S(1) = 1$, then $S(n)$ is
(a) $1 + 2 + \cdots + (n-1) + n^2$ (b) $(n-1)^2 + n^2$
(c) $\dfrac{n(n+1)(2n+1)}{6}$ (d) $1 + n^2$.

21. If $a_n = 2a_{n-1} - 1$ and $a_0 = 1$, then a_n is equal to
(a) 1 (b) n
(c) $n(n+1) - 1$ (d) $2^n - 1$.

22. If $S(1) = 1$ and $S(n) = n\,S(n-1) + n!$, then $S(n)$ is equal to
(a) $n! + \dfrac{n(n+1)}{2}$ (b) $(2n)!$
(c) $n(n!)$ (d) None of these.

23. If $S(n) = 3S(n-1) + 4$ for $n \geq 1$ and $S(0) = 4$, then $S(n)$ is equal to
(a) $3^n + 4$ (b) $3^{n+1} + 4$
(c) $4 + \dfrac{1}{2}(3^{n+1} - 1)$ (d) $2(3^{n+1} - 1)$.

24. The homogeneous solution of the recurrence relation $a_n + 2a_{n-1} + a_{n-2} = 2^n$ is
(a) $(An + B)$ (b) $(An + B)(-1)^n$
(c) $n2^n$ (d) $n(-1)^n$.

25. The particular solution of $a_n + 2a_{n-1} + a_{n-2} = 2^n$ is
(a) 2^n (b) $\dfrac{4}{9}2^n$
(c) $\dfrac{9}{4}2^n$ (d) $4 \cdot 2^n$.

26. If $L(n) = F(n+1) + F(n-1)$ for $n \geq 2$ then
(a) $L(n) = L(n-1) + L(n-2)$ for $n \geq 2$
(b) $L(n) = L(n) + L(n-1)$ for $n \geq 2$
(c) $L(n) = L(n) + L(n+1)$ for $n \geq 2$
(d) $L(n) = L(n+1) + L(n-1)$ for $n \geq 2$.

27. The generating function of the relation $S(n) = 2S(n-1)$, $S(0) = 1$ is
(a) $\dfrac{1}{1-2x}$ (b) $\dfrac{2}{1-x}$
(c) $\dfrac{1}{1+2x}$ (d) $\dfrac{2}{1+x}$.

28. If $G(x)$ is the generating function for $a_0, a_1, a_2, \ldots$, then $xG(x)$ is the generating function for
(a) $a_1, a_2, a_3, \ldots$ (b) $a_2, a_3, a_4, \ldots$
(c) $0, a_0, a_1, \ldots$ (d) $0, a_1, a_2, \ldots$.

29. $\frac{1}{1-x} - x^2$ generates the sequence

(a) 0, 1, 1, …
(b) 0, 0, 1, 1, …
(c) 1, 1, 0, 1, 1, …
(d) None of these.

30. The generating function for the sequence 1, 0, –1, 0, 1, 0, –1, … is

(a) $\frac{1}{1+x^2}$
(b) $\frac{1}{1-x^2}$
(c) $\frac{1}{1+x} + \frac{1}{1-x}$
(d) $\frac{1}{1+x} - \frac{1}{1-x}$.

31. The generating function for $a_n = 2^n + 3^n$ is

(a) $\frac{1}{(1-2x)(1-3x)}$
(b) $\frac{1}{(1+2x)(1+3x)}$
(c) $\frac{1}{1-2x} - \frac{1}{1-3x}$
(d) $\frac{1}{1-2x} + \frac{1}{1-3x}$.

32. The function $\frac{2}{1-2x} + \frac{1}{1-x}$ generates the sequence $\{a_n\}$, where a_n is equal to

(a) $2^{n+1} + 1$
(b) $2^n + 1$
(c) $2^{n+1} - 1$
(d) $2^n - 1$.

SELF-TEST

Choose the correct answer:

1. The student of a college is given a registered number consisting of 3 different letters from A to Z followed by 4 different digits. The number of registered numbers is
   (a) $26 \cdot 25 \cdot 24 \cdot 10 \cdot 9 \cdot 8 \cdot 7$ (b) $26^3\ 10^4$
   (c) $26 \cdot 25 \cdot 24 \cdot 10^4$ (d) $26^3 \cdot 10 \cdot 9 \cdot 8 \cdot 7$.

2. $C(5, 2)$ is not equal to
   (a) $C(5, 3)$ (b) 10
   (c) $\dfrac{5!}{3!\ 2!}$ (d) 20.

3. A coin is tossed 5 times and the outcomes are written as a sequence. The number of such sequences is
   (a) 10 (b) 32
   (c) 6 (d) 5!.

4. The number of permutations of the letters of BAT and BALL are
(a) 3! and 4!
(b) 3! and 3!
(c) 3! and 12
(d) None of these.

5. The number of 6-digit numbers is
(a) 9,00,000
(b) $C(9, 6)$
(c) 10^6
(d) None of these.

6. The number of 6-digit numbers having at least one odd digit is
(a) $900000 - 5^6$
(b) $C(9, 6) - 5^6$
(c) $900000 - 6!$
(d) 5^6.

7. The number of ways of seating 5 persons in a row is
(a) 10
(b) 32
(c) 30
(d) 120.

8. The number of ways in which 6 books can be arranged in a shelf so that two particular books are next to each other is
(a) 240
(b) 120
(c) 6!
(d) 5!.

9. The number of ways in which 10 beads of different colours can appear in a necklace is
(a) 10!
(b) 9!
(c) 2^{10}
(d) 10^2.

10. The number of permutations that can be formed from the letters of MASALA is
(a) $\dfrac{6!}{3!}$
(b) $\dfrac{6!}{3!\,3!}$
(c) 3! 3!
(d) None of these.

11. The number of permutations that can be formed from the letters of MASALA that begin and end with A is
(a) 120
(b) 60
(c) 48
(d) 24.

12. The number of permutations that can be formed from the letters of MASALA in which all 3 A's are together is
(a) 4!
(b) 48
(c) 60
(d) 120.

13. The number of permutations of the letters of MASALA that begin with A and end with S is
(a) 4!
(b) 12
(c) $\dfrac{6!}{2!}$
(d) 6!.

14. One student has 12 US stamps and another student has 16 UK stamps. The number of ways of exchanging 4 US stamps and 4 UK stamps is
(a) $C(16, 4) \cdot C(12, 4)$
(b) 2^4
(c) 4^2
(d) 128.

15. The number of ways of dividing 6 boys into two teams of 3 boys each is
(a) $C(6, 3)$
(b) $2C(6, 3)$
(c) $\dfrac{1}{2}C(6,3)$
(d) 9.

16. The number of ways of distributing 10 prizes to 6 students if each student can receive any number of prizes is
(a) 10^6 (b) 60
(c) 6^{10} (d) None of these.

17. The number of straight lines that can be formed joining 7 pairs of non-collinear points is
(a) 42 (b) 8!
(c) 56 (d) 21.

18. The number of new words (not necessarily meaningful) that are obtained by permuting the letters of the word PERMUTATION is
(a) $11! - 1$ (b) $\frac{11!}{2}$
(c) $\frac{11!}{2} - 1$ (d) None of these.

19. The number of batting orders possible for the Indian team from a squad of 15 players if Virender Sehwag is in the team as an opening batsman is
(a) $C(14, 4)\ 10!$ (b) $C(14, 10)$
(c) $\frac{15!}{10!}$ (d) $\frac{15!}{11!}$.

20. The number of teams (including the twelfth man) chosen from a squad of 15 players if Virender Sehwag is always in the team is
(a) $C(14, 4) \cdot 10!$ (b) $C(14, 10)$
(c) $\frac{14!}{10!}$ (d) $\frac{15!}{11!}$.

21. The sum of the number of sides and number of diagonals of a pentagon is
(a) $C(5, 1) + C(5, 2)$ (b) $C(5, 2)$
(c) 50 (d) 10.

22. The number of ways of scoring a century with 4's and 6's only is
(a) 9 (b) 10
(c) 11 (d) 12.

23. The number of ways of choosing a captain and a vice-captain from a team of 11 players is
(a) $C(11, 2)$ (b) 110
(c) 90 (d) $10 \cdot 9!$.

24. The number of ways of painting 12 balls using 3 colours is
(a) $C(14, 3)$ (b) $C(12, 3)$
(c) $C(14, 2)$ (d) $C(8, 3)$.

25. The number of factors of 432 is
(a) 12 (b) 20
(c) 7 (d) 9.

26. If $C(n, 4) = C(n, 10)$ then n is
(a) 14 (b) 15
(c) 16 (d) 13.

27. The number of 7-digit numbers in which the digit 7 appears in two places and the digit 0 appears in five places is

(a) 35 (b) $C(7, 2)\, C(7, 5)$
(c) 7 (d) 6.

28. There are three rooms in a guesthouse—a single room, a double room and a four-bed room. The number of ways of accommodating 7 persons in the three rooms is

(a) $\dfrac{7!}{2!\ 4!}$ (b) 210
(c) 7! (d) $C(7, 3)$.

29. The number of nine-digit numbers in which no digit is repeated is

(a) $P(10, 9)$ (b) 9!
(c) $10! - 9!$ (d) $9 \cdot 9!$.

30. The number of ten-digit numbers that have at least 2 equal digits is

(a) $9 \cdot 10^9 - 9 \cdot 9!$ (b) $9 \cdot 8!\ C(10, 2)$
(c) $9 \cdot 9!$ (d) $10 \cdot 9!$.

31. The number of r-digit binary sequences having even number of 1's is

(a) 2^r (b) $2^{r/2}$
(c) 2^{r-1} (d) $2^r - 1$.

32. The number of ways of choosing two integers from 1 to 100 so that they differ exactly by 7 is

(a) 93 (b) 186
(c) 99 (d) None of these.

33. The number of ordered pairs having distinct elements from an n-element set is

(a) $n(n-1)$ (b) n^2
(c) $\dfrac{n(n-1)}{2}$ (d) $\dfrac{n(n-1)}{2} - n$.

34. The number of permutations of the letters in the words COMPUTER and PEPPER are

(a) 8! and 6! (b) 8! and 60
(c) 6720 and 6! (d) 6720 and 60.

35. The number of arrangements of the letters of the word ILLOGICAL is

(a) $\dfrac{9!}{2!\ 3!}$ (b) $\dfrac{8!}{2!\ 3!}$
(c) $\dfrac{7!}{2!\ 3!}$ (d) None of these.

36. The number of ways of placing 10 identical balls in 6 boxes is

(a) $C(16, 10)$ (b) $C(15, 10)$
(c) $C(16, 5)$ (d) $C(15, 6)$.

37. Four numbers are selected from the numbers $-4, -2, -1, 1, 3, 5, 7$. The number of ways of selecting four numbers whose product is positive is

(a) 17 (b) 18
(c) 19 (d) 20.

38. $C(n+1, 4) = C(n, 3)$ if n is equal to

(a) 3
(b) 4
(c) 5
(d) None of these.

39. The sum of the elements of the eight row of Pascal's triangle is

(a) 2^9
(b) 2^8
(c) 2^7
(d) 2^6.

40. $C(12, r)$ is greatest when r is equal to

(a) 7
(b) 6
(c) 12
(d) 0.

41. $C(13, r)$ is greatest when r is equal to one of

(a) 13, 0
(b) 8, 9
(c) 7, 8
(d) 6, 7.

42. The number of solutions of the equation $a + b + c + d + e = 36$ in positive integers is

(a) $C(35, 4)$
(b) $C(36, 4)$
(c) $C(39, 4)$
(d) $C(40, 4)$.

43. The number of non-negative solutions of the equation $a + b + c + d + e = 36$ is equal to

(a) $C(35, 4)$
(b) $C(36, 4)$
(c) $C(39, 4)$
(d) $C(40, 4)$.

44. The number of different collections of 3 currency notes formed from one-rupee, two-rupee, five-rupee, ten-rupee and twenty-rupee notes is

(a) 35
(b) $C(7, 3)$
(c) $C(8, 3)$
(d) None of these.

45. The number of different collections of 5 currency notes formed from one-rupee, two-rupee, five-rupee, ten-rupee and twenty-rupee notes is

(a) $C(9, 5)$
(b) $C(9, 6)$
(c) $C(10, 5)$
(d) $C(10, 6)$.

46. The coefficient of $x^2 y^3 z^2$ in the expansion of $(x + y + z)^7$ is

(a) $C(7, 3)\, C(5, 2)$
(b) $C(7, 2)\, C(5, 3)$
(c) $C(7, 3)\, C(7, 2)$
(d) $C(5, 3)\, C(5, 2)$.

47. If $C(n, 0) + C(n, 1) + \cdots + C(n, n) = 64$, then n is

(a) 5
(b) 6
(c) 7
(d) 8.

48. $C(6, 0)^2 + C(6, 1)^2 + \cdots + C(6, 6)^2$ is equal to

(a) 64
(b) 128
(c) $C(12, 6)$
(d) $C(12, 6)^2$.

49. $C(3, 0) + C(4, 1) + C(5, 2)$ is equal to

(a) 15
(b) 30
(c) $C(12, 3)$
(d) $C(5, 3)$.

50. $\sum_{r=0}^{n} C(n, r)\, 2^r$ is equal to

(a) $n3^n$
(b) $(n + 1)\, 2^n$
(c) 2^n
(d) 3^n.

$$= I^{n-1}A$$

SELF-TEST

Choose the correct answer:

1. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$ then

   (a) $AB = BA$ (b) $A^T B = AB^T$

   (c) $A^T B^T = B^T A^T$ (d) $|AB| = |BA|$

2. If A and B are two square matrices such that $A + B = 0$ then

   (a) $A^{-1} = B^{-1}$

   (b) $|A| = |B|$ in some cases

   (c) $|A| = -|B|$ in some cases

   (d) $|A| = (-1)^n |B|$ where n is the order of the matrix A.

3. One of the following statements is not true.

   (a) The adjoint of a scalar matrix (multiple of a unit matrix) is a scalar matrix.

   (b) The adjoint of a diagonal matrix is a diagonal matrix.

   (c) The adjoint of a triangular matrix is a triangular matrix.

   (d) $|A| = |\text{adj } A|$

4. The inverse of $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ is

   (a) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

   (c) $\begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$

5. If $\begin{bmatrix} 2 & 1 \\ 4 & a \end{bmatrix}$ is invertible then

   (a) $a = 2$ (b) $a \neq 2$

   (c) a can take any value (d) a can take any positive value.

6. If the rank of the matrix $\begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$ is 3 then

(a) $abc \neq 0$
(b) $ab \neq 0$
(c) $bc \neq 0$
(d) $ac \neq 0$

7. If the rank of the matrix $\begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$ is 2 then

(a) $abc \neq 0$
(b) $ab \neq 0, c = 0$
(c) $a \neq 0, bc = 0$
(d) $a \neq 0, b \neq 0, c \neq 0$

8. If the rank of the matrix $\begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$ is 1 then

(a) $abc \neq 0$
(b) $ab \neq 0, c = 0$
(c) $a \neq 0, b = c = 0$
(d) a, b, c can take any value

9. The rank of $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & 10 \end{bmatrix}$ is

(a) 3
(b) 2
(c) 1
(d) 0

10. The rank of $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & 9 \end{bmatrix}$ is

(a) 3
(b) 2
(c) 1
(d) 0

11. The rank of $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ is

(a) 3
(b) 2
(c) 1
(d) 0

12. The equations $x + 2y = 4$, $2x + y = 5$ have

(a) a unique solution
(b) infinite number of solutions
(c) no solution
(d) $x = 1, y = 2$ as a solution

13. The system of equations

$$x + 2y + 3z = 4$$
$$2x + 4y + 6z = 8$$
$$3x + 6y + 9z = 12$$ has

(a) a unique solution
(b) infinite number of solution
(c) no solution
(d) $x = y = z = 1$ as a solution

14. $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ satisfies

(a) $A^2 - I = 0$
(b) $A^2 + I = 0$
(c) $A^2 - 2I = 0$
(d) $A^2 + 2I = 0$

15. The matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 7 \end{bmatrix}$ satisfies

(a) $A^3 - I = 0$
(b) $A^3 - 4I = 0$
(c) $A^3 - 7I = 0$
(d) $A^3 - 12A^2 + 39A - 28I = 0$

16. If $A^2 - A = 3I$ then A^{-1} is

(a) $A - I$
(b) $\frac{1}{3}(A - I)$
(c) $A + I$
(d) $\frac{1}{3}(A + I)$

17. The system of linear equations

$$a + 2b + 3c = 7$$
$$2a + 4b + c = 12$$
$$3a + 6b + 4c = 20$$

(a) has a unique solution
(b) has no solution
(c) has infinite number of solutions
(d) has two solutions

18. If $A = \begin{bmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{bmatrix}$ then

(a) A is singular
(b) $A = -I$
(c) $|A| = 0$
(d) $A^2 = I$

19. The number of 3×3 nonsingular matrices with four entries as 1 and the other entries as 0 is

(a) less than 4
(b) 5
(c) 6
(d) at least 7

20. If $A = \begin{bmatrix} ab & bc \\ ad & cd \end{bmatrix}$ then

(a) A is nonsingular
(b) A^{-1} exists
(c) A^{-1} does not exist
(d) $|A| = 2abcd$

21. Which of the following statements is false?

(a) The adjoint of a singular matrix is singular.
(b) The adjoint of a zero matrix is the zero matrix.
(c) The adjoint of a unit matrix is the unit matrix of the same order.
(d) The adjoint of a nonzero matrix is nonzero.

22. If $A=\begin{bmatrix}0 & 1\\1 & 0\end{bmatrix}$ then A^4 is

(a) $\begin{bmatrix}0 & 1\\1 & 0\end{bmatrix}$

(b) $\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$

(c) $\begin{bmatrix}0 & 4\\4 & 0\end{bmatrix}$

(d) $\begin{bmatrix}4 & 0\\0 & 4\end{bmatrix}$

23. If $A=\begin{bmatrix}3 & 2\\0 & 1\end{bmatrix}$ then A^{-1} is

(a) $\frac{1}{3}\begin{bmatrix}1 & -2\\0 & 3\end{bmatrix}$

(b) $3\begin{bmatrix}1 & -2\\0 & 3\end{bmatrix}$

(c) $\frac{1}{3}\begin{bmatrix}1 & 0\\-2 & 3\end{bmatrix}$

(d) $3\begin{bmatrix}1 & 0\\-2 & 3\end{bmatrix}$

Answers to Self-test

1. (d) **2.** (d) **3.** (d) **4.** (b) **5.** (b) **6.** (a) **7.** (b) **8.** (c) **9.** (b) **10.** (c)
11. (a) **12.** (a) **13.** (b) **14.** (a) **15.** (d) **16.** (b) **17.** (b) **18.** (d) **19.** (d) **20.** (c)
21. (d) **22.** (b) **23.** (a)

ELF-TEST

Choose the correct answer to Questions 1–42

1. The number of components of G_1 and G_2 given in Figure 10.103 are

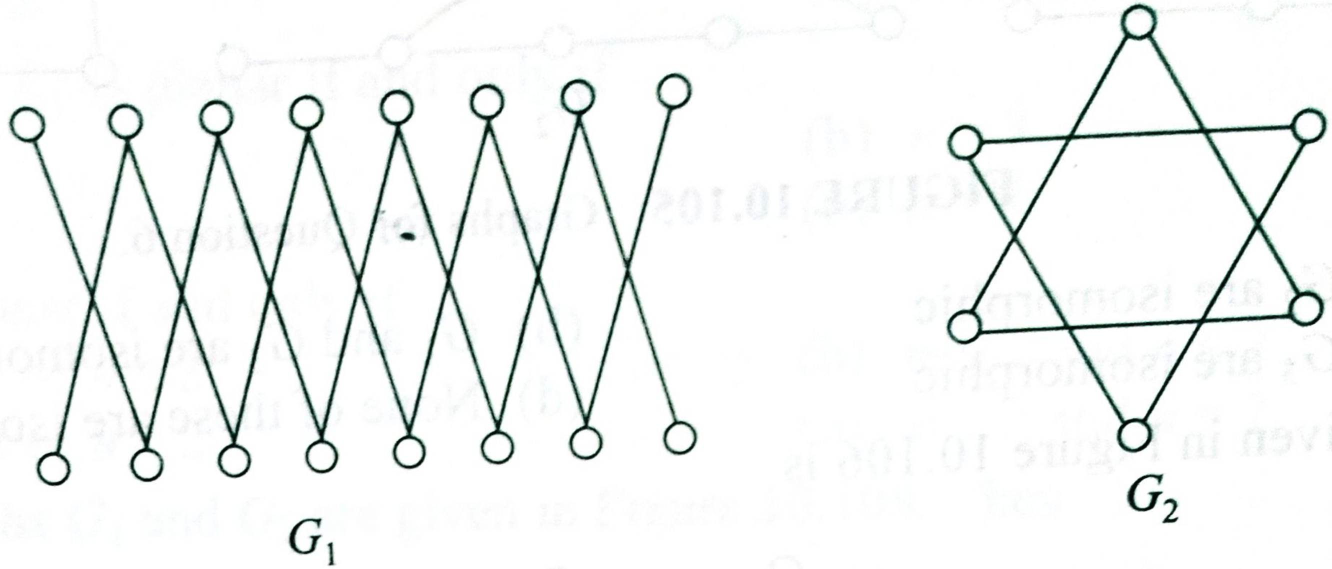


FIGURE 10.103 Graphs for Question 1.

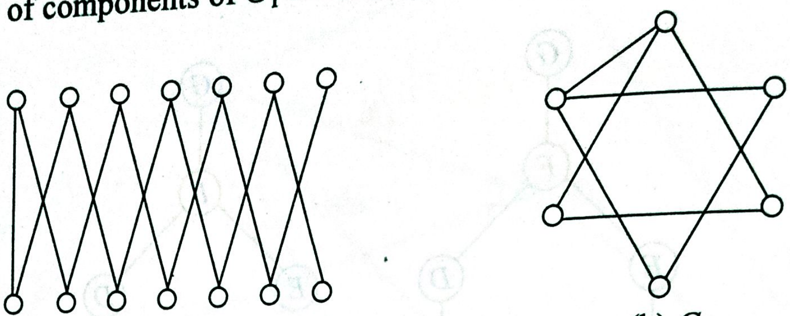
(a) 3, 3

(b) 3, 2

(c) 2, 3

(d) 2, 2.

2. The number of components of G_1 and G_2 given in Figure 10.104 are



(a) G_1 (b) G_2

FIGURE 10.104 Graphs for Question 2.

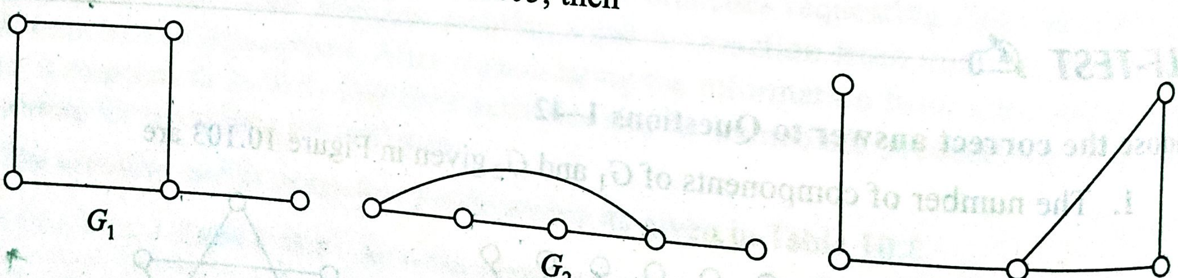
(a) 2, 2
(b) 2, 1
(c) 1, 2
(d) 1, 1.

3. If G is a 2-regular graph with 16 edges then the number of vertices of G *is*
(a) 8
(b) 16
(c) 32
(d) None of these.

4. If G has 21 edges, 3 vertices of degree 4 and the remaining vertices of degree 3, then the number of vertices of G is
(a) 13
(b) 17
(c) 18
(d) 12.

5. If $d_1 = (2, 3, 4, 4, 5)$ and $d_2 = (1, 2, 3, 4, 5)$ are two sequences then
(a) There is no graph whose degree sequence is either d_1 or d_2.
(b) There is a graph with degree sequence d_1 but no graph with degree sequence d_2.
(c) There is a graph with degree sequence d_2 but no graph with degree sequence d_1.
(d) There is a graph with degree sequence d_1 and a graph with degree sequence d_2.

6. If G_1, G_2 and G_3 are given in Figure 10.105, then



G_1 G_2 G_3

FIGURE 10.105 Graphs for Question 6.

(a) G_1 and G_2 are isomorphic
(b) G_1 and G_3 are isomorphic
(c) G_2 and G_3 are isomorphic
(d) None of these are isomorphic.

7. The graph given in Figure 10.106 is

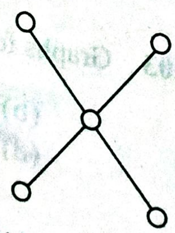


FIGURE 10.106 Graph for Question 7.

(a) C_5
(b) D_5
(c) W_5
(d) Bipartite graph.

8. The graph given in Figure 10.107.

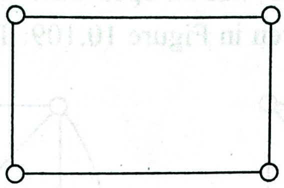


FIGURE 10.107 Graph for Question 8.

(a) Is bipartite but not a tree
(b) Is a tree but not bipartite
(c) Neither a tree nor bipartite
(d) Bipartite and a tree.

9. A tree with 5 vertices can be
(a) D_5
(b) P_5
(c) C_5
(d) W_5.

10. A regular graph with 5 vertices can be
(a) D_5
(b) P_5
(c) C_5
(d) Tree.

11. The chromatic number of P_5 and C_5 are
(a) 2 and 3
(b) 2 and 2
(c) 3 and 2
(d) 3 and 3.

12. The chromatic number of C_5 and W_5 are
(a) 4 and 4
(b) 3 and 3
(c) 4 and 3
(d) 3 and 4.

13. A complete bipartite graph $K_{m,n}$ is a tree when
(a) $m = 1, n = 2$
(b) $m = 2, n = 2$
(c) $m = 2, n = 3$
(d) $m = 3, n = 2$.

14. A 3-regular graph with four or more vertices is
(a) An Euler graph
(b) Not an Euler graph
(c) A wheel
(d) A cycle.

15. The graph K_n is planar if and only if
(a) $n \leq 3$
(b) $n = 3$
(c) $n \leq 4$
(d) $n = 4$.

16. $K_{m,n}$ is planar if and only if
(a) $m \leq 2$ or $n \leq 2$
(b) $m \leq 2$ and $n \leq 2$
(c) $m = 2$ or $n = 2$
(d) $m = 2$ and $n = 2$.

17. Two graphs G_1 and G_2 are given in Figure 10.108. Then

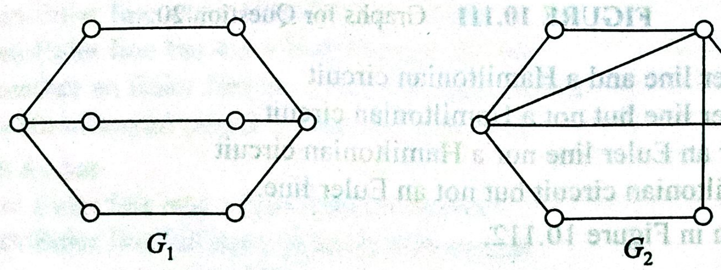


FIGURE 10.108 Graphs for Question 17.

(a) G_1 and G_2 have Euler line
(b) G_1 and G_2 have open Euler line
(c) G_1 has an Euler line and G_2 has an open Euler line
(d) G_2 has an Euler line and G_1 has an open Euler line.

18. Two graphs G_1 and G_2 are given in Figure 10.109. Then

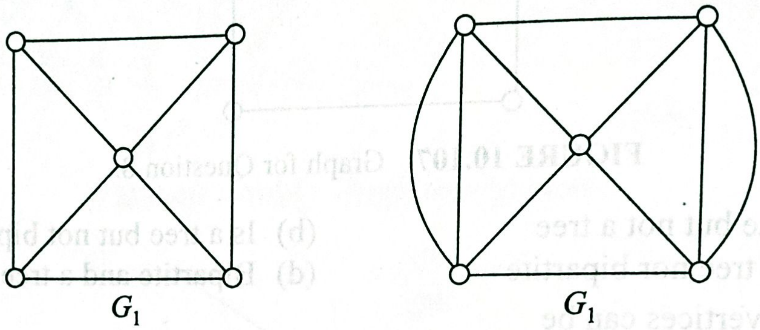


FIGURE 10.109 Graphs for Question 18.

(a) Neither G_1 nor G_2 has an Euler line
(b) Neither G_1 nor G_2 has an open Euler line
(c) Both G_1 and G_2 have Euler line
(d) Both G_1 and G_2 have an open Euler line.

19. The graph given in Figure 10.110.

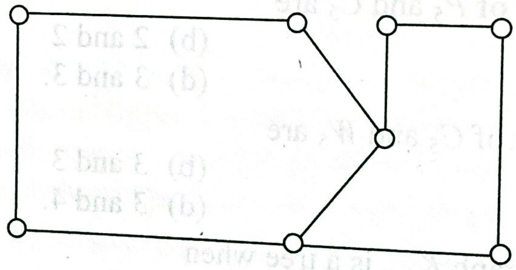


FIGURE 10.110 Graphs for Question 19.

(a) Has an Euler line and a Hamiltonian circuit
(b) Has an Euler line but not a Hamiltonian circuit.
(c) Has neither an Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an Euler line.

20. The graph given in Figure 10.111

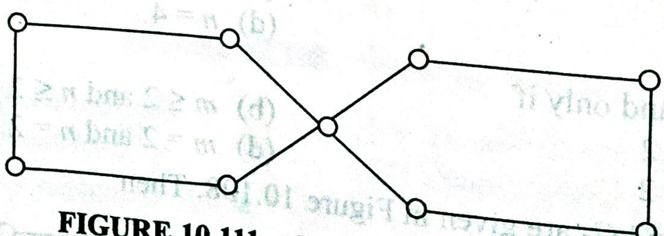


FIGURE 10.111 Graphs for Question 20.

(a) Has an Euler line and a Hamiltonian circuit
(b) Has an Euler line but not a Hamiltonian circuit
(c) Has neither an Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an Euler line.

21. The graph given in Figure 10.112.

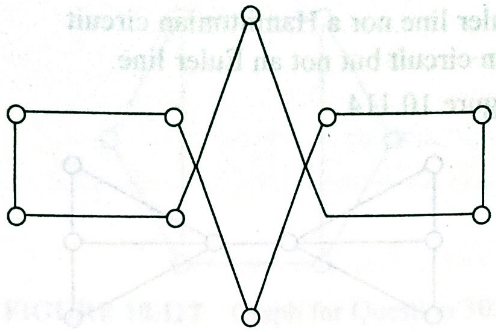


FIGURE 10.112 Graphs for Question 21.

(a) Has an Euler line and a Hamiltonian circuit
(b) Has an Euler line but not a Hamiltonian circuit
(c) Has neither an Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an Euler line.

22. The graph given in Figure 10.113.

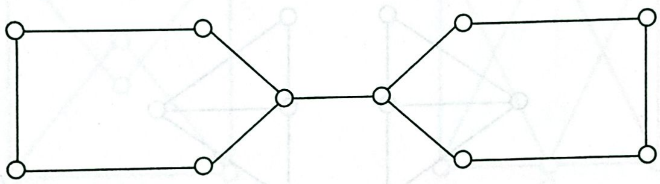


FIGURE 10.113 Graphs for Question 22.

(a) Has an Euler line and a Hamiltonian circuit
(b) Has an Euler line but not a Hamiltonian circuit
(c) Has neither an Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an Euler line.

23. A tree with 3 or more vertices
(a) Has an Euler line and a Hamiltonian circuit
(b) Has an Euler line but not a Hamiltonian circuit
(c) Has neither an Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an Euler line.

24. The graph Q_3
(a) Has an Euler line and a Hamiltonian circuit
(b) Has an Euler line but not a Hamiltonian circuit
(c) Has neither an Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an Euler line.

25. The graph Q_4
(a) Has an Euler line and a Hamiltonian circuit
(b) Has an Euler line but not a Hamiltonian circuit
(c) Has neither an Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an Euler line.

26. The graph K_5 has
(a) Has an Euler line and a Hamiltonian circuit
(b) Has an Euler line but not a Hamiltonian circuit

(c) Has neither an Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an Euler line.

27. The graph given in Figure 10.114

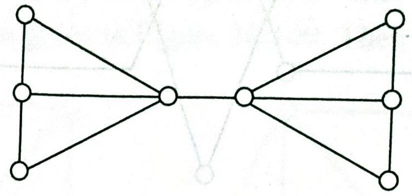


FIGURE 10.114 Graph for Question 27.

(a) Has an open Euler line and a Hamiltonian circuit
(b) Has an open Euler line but no Hamiltonian circuit
(c) Has neither an open Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an open Euler line.

28. The graph given in Figure 10.115

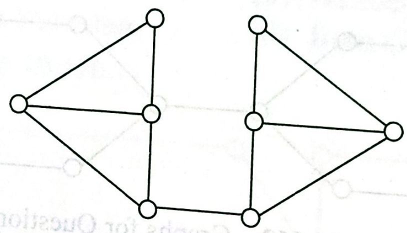


FIGURE 10.115 Graph for Question 28.

(a) Has an open Euler line and a Hamiltonian circuit
(b) Has an open Euler line but no Hamiltonian circuit
(c) Has neither an open Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an open Euler line.

29. The graph given in Figure 10.116

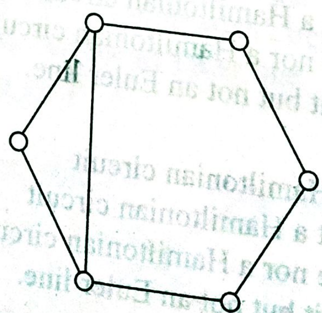


FIGURE 10.116 Graph for Question 29.

(a) Has an open Euler line and a Hamiltonian circuit
(b) Has an open Euler line but no Hamiltonian circuit
(c) Has neither an open Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an open Euler line.

30. The graph given in Figure 10.117

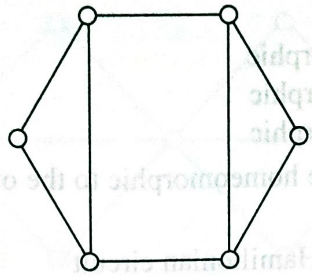


FIGURE 10.117 Graph for Question 30.

(a) Has an open Euler line and a Hamiltonian circuit
(b) Has an open Euler line but no Hamiltonian circuit
(c) Has Neither an open Euler line nor a Hamiltonian circuit
(d) Has a Hamiltonian circuit but not an open Euler line.

31. The graphs G_1 and G_2 are given in Figure 10.118.

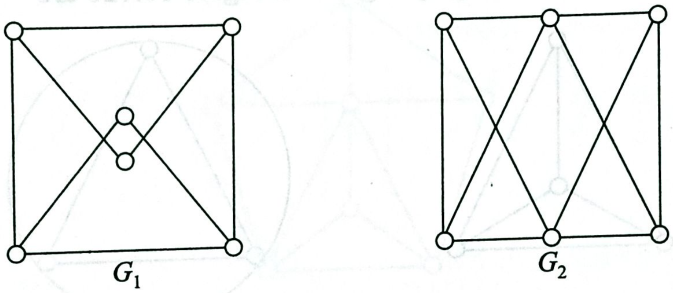


FIGURE 10.118 Graphs for Question 31.

(a) G_1 and G_2 are planar
(b) G_1 and G_2 are nonplanar
(c) G_1 is planar but G_2 is nonplanar
(d) G_2 is planar but G_1 is nonplanar.

32. The graph K_5
(a) is planar
(b) is nonplanar after the removal of any edge
(c) is planar after the removal of any edge
(d) None of these.

33. K_n is nonplanar
(a) for $n \leq 4$
(b) for $n \geq 4$
(c) for $n \leq 5$
(d) for $n \geq 5$.

34. If a connected 4-regular planar graph has 6 vertices then the number of regoins determined by the graph is
(a) 4
(b) 6
(c) 8
(d) 10.

35. If G_1, G_2 and G_3 are given by Figure 10.119

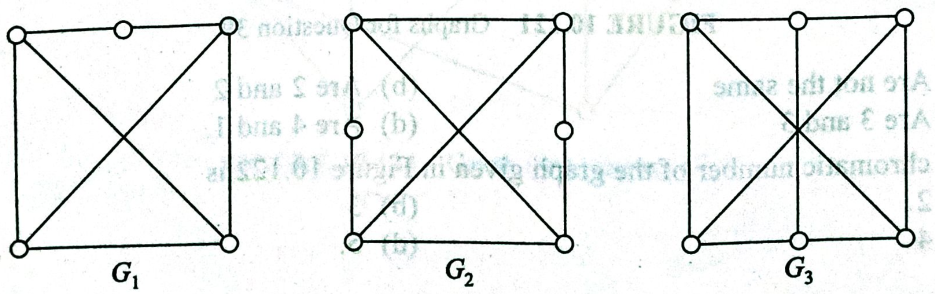


FIGURE 10.119 Graphs for Question 35.

then
(a) G_1 and G_2 are homeomorphic
(b) G_1 and G_3 are homeomorphic
(c) G_2 and G_3 are homeomorphic
(d) None of these graphs are homeomorphic to the other two graphs.

36. Petersen Graph
(a) Has an Euler line and a Hamiltonian circuit
(b) Has neither an Euler line nor a Hamiltonian circuit
(c) Has an Euler line and planar
(d) Has a Hamiltonian circuit and nonplanar.

37. Petersen graph has no n-circuit for
(a) $n = 4$
(b) $n = 5$
(c) $n = 6$
(d) $n = 8$.

38. The chromatic numbers of the graphs given in Figure 10.120 are

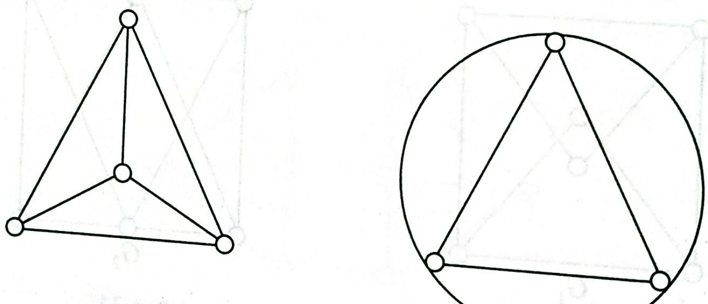
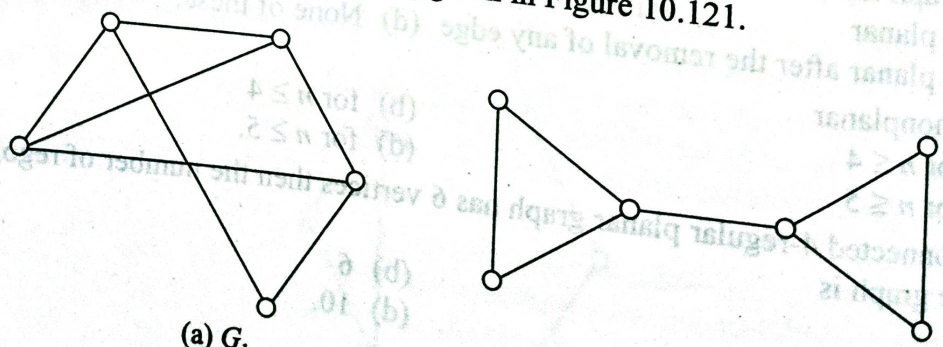


FIGURE 10.120 Graphs for Question 38.

(a) 3 and 3
(b) 4 and 4
(c) 3 and 4
(d) 4 and 3.

39. The chromatic numbers of G_1 and G_2 given in Figure 10.121.



(a) G_1

(b) G_2

FIGURE 10.121 Graphs for Question 39.

(a) Are not the same
(b) Are 2 and 2
(c) Are 3 and 3
(d) Are 4 and 1.

40. The chromatic number of the graph given in Figure 10.122 is
(a) 2
(b) 3
(c) 4
(d) 5.

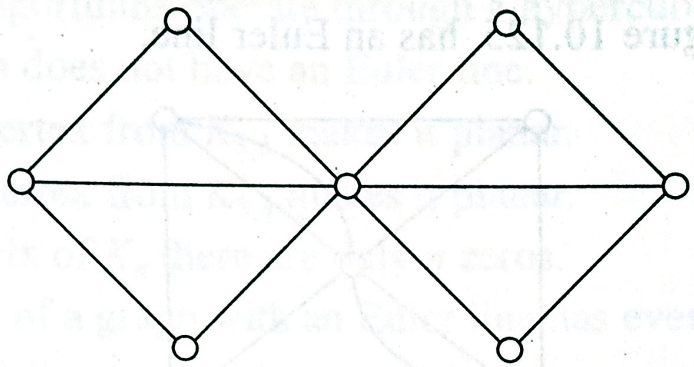


FIGURE 10.122 Graph for Question 40.

41. An example of a 6-chromatic graph is

(a) D_6 (b) C_6

(c) W_6 (d) K_6.

42. The chromatic number of the graph given in Figure 10.123 is

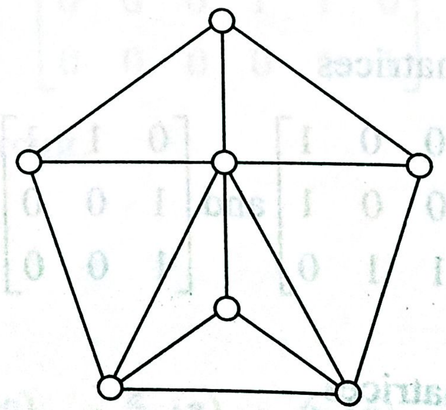


FIGURE 10.123 Graph for Question 42.

(a) 3 (b) 4

(c) 5 (d) 6.