Discrete structures mcqs with answers pdf free pdf free

1. Which of the following bits is the negation of the bits “010110”? a) 111001 b) 001001 c) 101001 d) 111111 Answer: c Clarification:- Flip each of the bit to get the negation of the required string. 2.Which of the following option is suitable, if A is “10110110”, B is”11100000” and C is”10100000”? a) C=A or B b) C=~A c) C=~B d) C=A and B Answer: d Clarification:- Output of and is 1 when both other inputs are one. 3.How many bits string of length 4 are possible such that they contain 2 ones and 2 zeroes? a) 4 b) 2 c) 5 d) 6 Answer: d Clarification:- The strings are {0011, 0110, 1001, 1100, 1010 and 0101}. 4.If a bit string contains {0, 1} only, having length 5 has no more than 2 ones in it. Then how many such bit strings are possible? a) 14 b) 12 c) 15 d) 16 Answer: d Clarification:- The total strings are 1(having no one in it) +5(having 1 one in it) +10 (having 2 ones in it) = 16 5.If A is “001100” and B is “010101” then what is the value of A (Ex-or) B? a) 000000 b) 111111 c) 001101 d) 011001 Answer: d Clarification:- In Ex-or if both the inputs are same then output is 0 otherwise 1. 6.The Ex-nor of this string “01010101” with “11111111” is? a) 10101010 b) 00110100 c) 01010101 d) 10101001 Answer: c Clarification:- In Ex-nor if both the inputs are same then output is 1 otherwise 0. 7.What is the one’s complement of this string “01010100”? a) 10101010 b) 00110101 c) 10101011 d) 10101001 Answer: c Clarification:- Negate every bit in one’s complement. 8.What is the 2’s complement of this string “01010100”? a) 10101010 b) 00110100 c) 10101100 d) 10101001 Answer: c Clarification:- In two’s complement negate every bit from left until the first one from right is encountered. 9.If in a bits string of {0,1}, of length 4, such that no two ones are together. Then the total number of such possible strings are? a) 1 b) 5 c) 7 d) 4 Answer: c Clarification:- Strings can be {1001, 1010, 0101, 1000, 0100, 0010, 0001}. 10.Let A: “010101”, B=?, If { A (Ex-or) B } is a resultant string of all ones then which of the following statement regarding B is correct? a) B is negation of A b) B is 101010 c) {A (and) B} is a resultant string having all zeroes d) All of the mentioned Answer: d Clarification:- In Ex-or both if both the inputs are the same then output is 0 otherwise 11.Which of the following statement is a proposition? a) Get me a glass of milkshake b) God bless you! c) What is the time now? d) The only odd prime number is 2 Answer: d Clarification:- Only this statement has got the truth value which is false. 12.The truth value of ‘4+3=7 or 5 is not prime’. a) False b) True Answer: b Clarification:- Compound statement with ‘or’ is true when either of the statement is true. Here the first part of the statement is true, hence the whole is true. 13.Which of the following option is true? a) If the Sun is a planet, elephants will fly b) 3 +2 = 8 if 5-2 = 7 c) 1 > 3 and 3 is a positive integer d) -2 > 3 or 3 is a negative integer Answer: a Clarification:- Hypothesis is false, thus the whole statement is true. 14.What is the value of x after this statement, assuming the initial value of x is 5? ‘If x equals to one then x=x+2 else x=0’. a) 1 b) 3 c) 0 d) 2 Answer: c Clarification:- If condition is false so value decided according to else condition. 15.Let P: I am in Bangalore.; Q: I love cricket.; then q -> p(q implies p) is? a) If I love cricket then I am in Bangalore b) If I am in Bangalore then I love cricket c) I am not in Bangalore d) I love cricket Answer: a Clarification:- Q is hypothesis and P is conclusion. So the compound statement will be if hypothesis then conclusion. 16.Let P: If Sahil bowls, Saurabh hits a century.; Q: If Raju bowls, Sahil gets out on first ball. Now if P is true and Q is false then which of the following can be true? a) Raju bowled and Sahil got out on first ball b) Raju did not bowled c) Sahil bowled and Saurabh hits a century d) Sahil bowled and Saurabh got out Answer: c Clarification:- Either hypothesis should be false or both (hypothesis and conclusion) should be true. 17.The truth value ‘9 is prime then 3 is even’. a) False b) True Answer: b Clarification:- The first part of the statement is false, hence whole is true. 18.Let P: I am in Delhi.; Q: Delhi is clean.; then q ^ p(q and p) is? a) Delhi is clean and I am in Delhi b) Delhi is not clean or I am in Delhi c) I am in Delhi and Delhi is not clean d) Delhi is clean but I am in Mumbai Answer: a Clarification:- Connector should be ‘and’, that is q and p. 19.Let P: This is a great website, Q: You should not come back here. Then ‘This is a great website and you should come back here.’ is best represented by? a) ~P V ~Q b) P ∧ ~Q c) P V Q d) P ∧ Q Answer: b Clarification:- The second part of the statement is negated, hence negation operator is used. 20.Let P: We should be honest., Q: We should be dedicated., R: We should be overconfident. Then ‘We should be honest or dedicated but not overconfident.’ is best represented by? a) ~P V ~Q V R b) P ∧ ~Q ∧ R c) P V Q ∧ R d) P V Q ∧ ~R Answer: d Clarification:- The third part of the statement is negated, hence negation operator is used, for (‘or’ –V) is used and for(‘but’- ∧). 21.Let P and Q be statements, then PQ is logically equivalent to __________ a) P~Q b) ~PQ c) ~P~Q d) None of the mentioned Answer: c Clarification:- Both of them have same truth table, Hence they are equal. 22.What is the negation of the statement A->(B v(or) C)? a) A ∧ ~B ∧ ~C b) A->B->C c) ~A ∧ B v C d) None of the mentioned Answer: a Clarification:- A->P is logically equivalent to ~A v P. 23.The compound statement A-> (A->B) is false, then the truth values of A, B are respectively _________ a) T, T b) F, T c) T, F d) F, F Answer: c Clarification:- For implications to be false hypothesis should be true and conclusion should be false. 24.The statement which is logically equivalent to A∧ (and) B is? a) A->B b) ~A ∧ ~ B c) A ∧ ~B d) ~(A->~B) Answer: d Clarification:- The truth table of both statements are same. 25.Let P: We give a nice overall squad performance, Q: We will win the match. Then the symbolic form of “We will win the match if and only if we give a nice overall squad performance. “is? a) P v Q b) Q ∧ P c) QP d) ~P v Q Answer: c Clarification:- If and only if statements are bi-conditionals. 26.Let P, Q, R be true, false true, respectively, which of the following is true? a) P∧Q∧R b) P∧~Q∧~R c) Q->(P∧R) d) P->(Q∧R) Answer: c Clarification:- Hypothesis is false, hence statement is true. 27.“Match will be played only if it is not a humid day.” The negation of this statement is? a) Match will be played but it is a humid day b) Match will be played or it is a humid day c) All of the mentioned statement are correct d) None of the mentioned Answer: a Clarification:- Negation of P->Q is P∧~Q. 28.Consider the following statements. A: Raju should exercise. B: Raju is not a decent table tennis player. C: Raju wants to play good table tennis. The symbolic form of “Raju is not a decent table tennis player and if he wants to play good table tennis then he should exercise.” is? a) A->B->C b) B∧(C->A) c) C->B∧A d) B∧A∧C Answer: b Clarification:- For conditionals statement (if then), implications are used. 29.The statement (~PQ)∧~Q is true when? a) P: True Q: False b) P: True Q: True c) P: False Q: True d) P: False Q: False Answer: a Clarification:- For a bi-conditional to be true both inputs should be same. 30.Let P, Q, R be true, false, false, respectively, which of the following is true? a) P∧(Q∧~R) b) (P->Q)∧~R c) Q(P∧R) d) P(QvR) Answer: c Clarification:- For a bi-conditional to be true both inputs should be the same. 31.Which of the following statements is the negation of the statements “4 is odd or -9 is positive”? a) 4 is even or -9 is not negative b) 4 is odd or -9 is not negative c) 4 is even and -9 is negative d) 4 is odd and -9 is not negative Answer: c Clarification:- Using De Morgan’s Law ~(A V B) ↔ ~A ∧ ~B. 32.Which of the following represents: ~A (negation of A) if A stands for “I like badminton but hate maths”? a) I hate badminton and maths b) I do not like badminton or maths c) I dislike badminton but love maths d) I hate badminton or like maths Answer: d Clarification:- De Morgan’s Law ~ (A ∧ B) ↔ ~A V ~B. 33.The compound statement A v ~(A ∧ B). a) True b) False Answer: a Clarification:- Applying De-Morgan’s law we get A v ~ A Ξ Tautology. 34.Which of the following is De-Morgan’s law? a) P ∧ (Q v R) Ξ (P ∧ Q) v (P ∧ R) b) ~(P ∧ R) Ξ ~P v ~R, ~(P v R) Ξ ~P ∧ ~R c) P v ~P Ξ True, P ∧ ~P Ξ False d) None of the mentioned Answer: b Clarification:- Definition of De–Morgan’s Law. 35.What is the dual of (A ∧ B) v (C ∧ D)? a) (A V B) v (C v D) b) (A V B) ^ (C v D) c) (A V B) v (C ∧ D) d) (A ∧ B) v (C v D) Answer: b Clarification:- In dual ∧ is replaced by v and vice – versa. 36.~ A v ~ B is logically equivalent to? a) ~ A → ~ B b) ~ A ∧ ~ B c) A → ~B d) B V A Answer: c Clarification:- By identity A → B Ξ ~A V B. 37.Negation of statement (A ∧ B) → (B ∧ C) is ____________ a) (A ∧ B) →(~B ∧ ~C) b) ~(A ∧ B) v (B v C) c) ~(A →B) →(~B ∧ C) d) None of the mentioned Answer: a Clarification:- ~(A →B) Ξ A ∧ ~B using this we can easily fetch the answer. 38.Which of the following satisfies commutative law? a) ∧ b) v c) ↔ d) All of the mentioned Answer: d Clarification:- All of them satisfies commutative law. 39.If the truth value of A v B is true, then truth value of ~A ∧ B can be __________ a) True if A is false b) False if A is false c) False if B is true and A is false d) None of the mentioned Answer: a Clarification:- If A is false then both the condition are obeyed. 40.If P is always against the testimony of Q, then the compound statement P→(P v ~Q) is a _________ a) Tautology b) Contradiction c) Contingency d) None of the mentioned Answer: a Clarification:- Since either hypothesis is false or both (hypothesis as well as conclusion) are true. 41.A compound proposition that is always __________ is called a tautology. a) True b) False Answer: a Clarification:- Tautology is always true. 42.A compound proposition that is always __________ is called a contradiction. a) True b) False Answer: b Clarification:- Contradiction is always false. 43.If A is any statement, then which of the following is a tautology? a) A ∧ F b) A ∨ F c) A ∨ ¬A d) A ∧ T Answer: c Clarification:- A ∨ ¬A is always true. 45.If A is any statement, then which of the following is not a contradiction? a) A ∧ ¬A b) A ∨ F c) A ∧ F d) None of mentioned Answer: b Clarification:- A ∨ F is not always false. 46.A compound proposition that is neither a tautology nor a contradiction is called a __________ a) Contingency b) Equivalence c) Condition d) Inference Answer: a Clarification:- Definition of contingency. 46.¬ (A ∨ q) ∧ (A ∧ q) is a _________ a) Tautology b) Contradiction c) Contingency d) None of the mentioned Answer: b Clarification:- ≡ (¬A ∧ ¬q) ∧ (A ∧ q) ≡ (¬A ∧ A) ∧ (¬q ∧ q) ≡ F ∧ F ≡ F. 47.(A ∨ ¬A) ∨ (q ∨ T) is a _________ a) Tautology b) Contradiction c) Contingency d) None of the mentioned Answer: a Clarification:- ≡ (A ∨ ¬A) ∨ (q ∨ T) ≡ T ∨ T ≡ T. 48.A ∧ ¬(A ∨ (A ∧ T)) is always _________ a) True b) False Answer: b Clarification:- ≡ A ∧ ¬ (A ∨ (A ∧ T)) ≡ A ∧ ¬(A ∨ A) ≡ A ∧ ¬A ≡ F. 49.(A ∨ F) ∨ (A ∨ T) is always ________ a) True b) False Answer: a Clarification:- ≡ (A ∨ F) ∨ (A ∨ T) ≡ A ∨ T ≡ T. 50.A → (A ∨ q) is a ________ a) Tautology b) Contradiction c) Contingency d) None of the mentioned Answer: a Clarification:- ≡ A → (A ∨ q) ≡ ¬A ∨ (A ∨ q) ≡ (A ∨ ¬A) ∨ q ≡ T ∨ q ≡ T. 51.The contrapositive of p → q is the proposition of ___________ a) ¬p → ¬q b) ¬q → ¬p c) q → p d) ¬q → p Answer: b Clarification:- Definition of contrapositive. 52.The inverse of p → q is the proposition of ___________ a) ¬p → ¬q b) ¬q → ¬p c) q → p d) ¬q → p Answer: a Clarification:- Definition of inverse. 53.The converse of p → q is the proposition of ______________ a) ¬p → ¬q b) ¬q → ¬p c) q → p d) ¬q → p Answer: c Clarification:- Definition of converse. 54.What is the contrapositive of the conditional statement? “The home team misses whenever it is drizzling?” a) If it is drizzling, then home team misses b) If the home team misses, then it is drizzling c) If it is not drizzling, then the home team does not misses d) If the home team wins, then it is not drizzling Answer: d Clarification:- q whenever p contrapositive is ¬q → ¬p. 55.What is the converse of the conditional statement “If it ices today, I will play ice hockey tomorrow.” a) “I will play ice hockey tomorrow only if it ices today.” b) “If I do not play ice hockey tomorrow, then it will noz have iced today.” c) “If it does not ice today, then I will not play ice hockey tomorrow.” d) “I will play ice hockey tomorrow only if it ices today.” Answer: a Clarification:- If p, then q has converse q → p. 56.What are the contrapositive of the conditional statement “I come to class whenever there is going to be a test.” a) “If I come to class, then there will be a test.” b) “If I do not come to class, then there will not be a test.” c) “If there is not going to be a test, then I don’t come to class.” d) “If there is going to be a test, then I don’t come to class.” Answer: b Clarification:- q whenever p, has contrapositive ¬q → ¬p. 57.What are the inverse of the conditional statement “ A positive integer is a composite only if it has divisors other than 1 and itself.” a) “A positive integer is a composite if it has divisors other than 1 and itself.” b) “If a positive integer has no divisors other than 1 and itself, then it is not composite.” c) “If a positive integer is not composite, then it has no divisors other than 1 and itself.” d) None of the mentioned Answer: c Clarification:- p only if q has inverse ¬p → ¬q. 58.What are the converse of the conditional statement “When Raj stay up late, it is necessary that Raj sleep until noon.” a) “If Raj stay up late, then Raj sleep until noon.” b) “If Raj does not stay up late, then Raj does not sleep until noon.” c) “If Raj does not sleep until noon, then Raj does not stay up late.” d) “If Raj sleep until noon, then Raj stay up late.” Answer: d Clarification:- Necessary condition for p is q has converse q → p. 60.What are the contrapositive of the conditional statement “Medha will find a decent job when she labour hard.”? a) “If Medha labour hard, then she will find a decent job.” b) “If Medha will not find a decent job, then she not labour hard.” c) “If Medha will find a decent job, then she labour hard.” d) “If Medha not labour hard, then she will not find a decent job.” Answer: b Clarification:- The statement q when p has its contrapositive as ¬q → ¬p. 61.What are the inverse of the conditional statement “If you make your notes, it will be a convenient in exams.” a) “If you make notes, then it will be a convenient in exams.” b) “If you do not make notes, then it will not be a convenient in exams.” c) “If it will not be a convenient in exams, then you did not make your notes.” d) “If it will be a convenient in exams, then you make your notes Answer: b Clarification:- If p then q has inverse ¬p → ¬q. 62.The compound propositions p and q are called logically equivalent if ________ is a tautology. a) p ↔ q b) p → q c) ¬ (p ∨ q) d) ¬p ∨ ¬q Answer: a Clarification:- Definition of logical equivalence. 63.p → q is logically equivalent to ________ a) ¬p ∨ ¬q b) p ∨ ¬q c) ¬p ∨ q d) ¬p ∧ q Answer: c Clarification:- (p → q) ↔ (¬p ∨ q) is tautology. 64.p ∨ q is logically equivalent to ________ a) ¬q → ¬p b) q → p c) ¬p → ¬q d) ¬p → q Answer: d Clarification:- (p ∨ q) ↔ (¬p → q) is tautology. 65.¬ (p ↔ q) is logically equivalent to ________ a) q↔p b) p↔¬q c) ¬p↔¬q d) ¬q↔¬p Answer: b Clarification:- ¬(p↔q)↔(p↔¬q) is tautology. 66.p ∧ q is logically equivalent to ________ a) ¬ (p → ¬q) b) (p → ¬q) c) (¬p → ¬q) d) (¬p → q) Answer: a Clarification:- (p ∧ q) ↔ (¬(p → ¬q)) is tautology. 67.Which of the following statement is correct? a) p ∨ q ≡ q ∨ p b) ¬(p ∧ q) ≡ ¬p ∨ ¬q c) (p ∨ q) ∨ r ≡ p ∨ (q ∨ r) d) All of mentioned Answer: d Clarification:- Verify using truth table, all are correct. 68.p ↔ q is logically equivalent to ________ a) (p → q) → (q → p) b) (p → q) ∨ (q → p) c) (p → q) ∧ (q → p) d) (p ∧ q) → (q ∧ p) Answer: c Clarification:- (p ↔ q) ↔ ((p → q) ∧ (q → p)) is tautology. 70.(p → q) ∧ (p → r) is logically equivalent to ________ a) p → (q ∧ r) b) p → (q ∨ r) c) p ∧ (q ∨ r) d) p ∨ (q ∧ r) Answer: a Clarification:- ((p → q) ∧ (p → r)) ↔ (p → (q ∧ r)) is tautology. Discrete Structure :- Relations and Functions 1.A __________ is an ordered collection of objects. a) Relation b) Function c) Set d) Proposition Answer: c Clarification:- By the definition of set. 2.The set O of odd positive integers less than 10 can be expressed by _____________ a) {1, 2, 3} b) {1, 3, 5, 7, 9} c) {1, 2, 5, 9} d) {1, 5, 7, 9, 11} Answer: b Clarification:- Odd numbers less than 10 is {1, 3, 5, 7, 9}. 3.Power set of empty set has exactly _________ subset. a) One b) Two c) Zero d) Three Answer: a Clarification:- Power set of null set has exactly one subset which is empty set. 4.What is the Cartesian product of A = {1, 2} and B = {a, b}? a) {(1, a), (1, b), (2, a), (b, b)} b) {(1, 1), (2, 2), (a, a), (b, b)} c) {(1, a), (2, a), (1, b), (2, b)} d) {(1, 1), (a, a), (2, a), (1, b)} Answer: c Clarification:- A subset R of the Cartesian product A x B is a relation from the set A to the set B. 5.The Cartesian Product B x A is equal to the Cartesian product A x B. a) True b) False Answer: b Clarification:- Let A = {1, 2} and B = {a, b}. The Cartesian product A x B = {(1, a), (1, b), (2, a), (2, b)} and the Cartesian product B x A = {(a, 1), (a, 2), (b, 1), (b, 2)}. This is not equal to A x B. 6.What is the cardinality of the set of odd positive integers less than 10? a) 10 b) 5 c) 3 d) 20 Answer: b Clarification:- Set S of odd positive an odd integer less than 10 is {1, 3, 5, 7, 9}. Then, Cardinality of set S = |S| which is 5. 7.Which of the following two sets are equal? a) A = {1, 2} and B = {1} b) A = {1, 2} and B = {1, 2, 3} c) A = {1, 2, 3} and B = {2, 1, 3} d) A = {1, 2, 4} and B = {1, 2, 3} Answer: c Clarification:- Two set are equal if and only if they have the same elements. 8.The set of positive integers is _____________ a) Infinite b) Finite c) Subset d) Empty Answer: a Clarification:- The set of positive integers is not finite. 10.What is the Cardinality of the Power set of the set {0, 1, 2}? a) 8 b) 6 c) 7 d) 9 Answer: a Clarification:- Power set P ({0, 1, 2}) is the set of all subsets of {0, 1, 2}. Hence, P({0, 1, 2}) = {null, {0}, {1}, {2}, {0, 1}, {0,2}, {1, 2}, {0, 1, 2}}. 11.The members of the set S = {x | x is the square of an integer and x < 100} is ________________ a) {0, 2, 4, 5, 9, 58, 49, 56, 99, 12} b) {0, 1, 4, 9, 16, 25, 36, 49, 64, 81} c) {1, 4, 9, 16, 25, 36, 64, 81, 85, 99} d) {0, 1, 4, 9, 16, 25, 36, 49, 64, 121} Answer: b Clarification:- The set S consists of the square an integer less than 10. 12.The union of the sets {1, 2, 5} and {1, 2, 6} is the set _______________ a) {1, 2, 6, 1} b) {1, 2, 5, 6} c) {1, 2, 1, 2} d) {1, 5, 6, 3} Answer: b Clarification:- The union of the sets A and B, is the set that contains those elements that are either in A or in B. 13.The intersection of the sets {1, 2, 5} and {1, 2, 6} is the set _____________ a) {1, 2} b) {5, 6} c) {2, 5} d) {1, 6} Answer: a Clarification:- The intersection of the sets A and B, is the set containing those elements that are in both A and B. 14.Two sets are called disjoint if there _____________ is the empty set. a) Union b) Difference c) Intersection d) Complement Answer: c Clarification:- By the definition of the disjoint set. 15.Which of the following two sets are disjoint? a) {1, 3, 5} and {1, 3, 6} b) {1, 2, 3} and {1, 2, 3} c) {1, 3, 5} and {2, 3, 4} d) {1, 3, 5} and {2, 4, 6} Answer: d Clarification:- Two sets are disjoint if the intersection of two sets is the empty set. 16.The difference of {1, 2, 3} and {1, 2, 5} is the set ____________ a) {1} b) {5} c) {3} d) {2} Answer: c Clarification:- The difference of the sets A and B denoted by A-B, is the set containing those elements that are in A not in B. 17.The complement of the set A is _____________ a) A – B b) U – A c) A – U d) B – A Answer: b Clarification:- The complement of the set A is the complement of A with respect to U. 18.The bit string for the set {2, 4, 6, 8, 10} (with universal set of natural numbers less than or equal to 10) is ____________________ a) 0101010101 b) 1010101010 c) 1010010101 d) 0010010101 Answer: a Clarification:- The bit string for the set has a one bit in second, fourth, sixth, eighth, tenth positions, and a zero elsewhere. 19.Let Ai = {i, i+1, i+2, …..}. Then set {n, n+1, n+2, n+3, …..} is the _________ of the set Ai. a) Union b) Intersection c) Set Difference d) Disjoint Answer: b Clarification:- By the definition of the generalized intersection of the set. 20.The bit strings for the sets are 1111100000 and 1010101010. The union of these sets is ___________ a) 1010100000 b) 1010101101 c) 1111111100 d) 1111101010 Answer: d Clarification:- The bit string for the union is the bitwise OR of the bit strings. 21.The set difference of the set A with null set is __________ a) A b) null c) U d) B Answer: a Clarification:- The set difference of the set A by the null set denoted by A – {null} is A. 22.Let the set A is {1, 2, 3} and B is {2, 3, 4}. Then the number of elements in A U B is? a) 4 b) 5 c) 6 d) 7 Answer: a Clarification:- AUB is {1, 2, 3, 4}. 23.Let the set A is {1, 2, 3} and B is { 2, 3, 4}. Then number of elements in A ∩ B is? a) 1 b) 2 c) 3 d) 4 Answer: b Clarification:- A ∩ B is {2, 3}. 25.Let the set A is {1, 2, 3} and B is {2, 3, 4}. Then the set A – B is? a) {1, -4} b) {1, 2, 3} c) {1} d) {2, 3} Answer: c Clarification:- In A – B the common elements get cancelled. 26.In which of the following sets A – B is equal to B – A? a) A = {1, 2, 3}, B = {2, 3, 4} b) A = {1, 2, 3}, B = {1, 2, 3, 4} c) A = {1, 2, 3}, B = {2, 3, 1} d) A = {1, 2, 3, 4, 5, 6}, B = {2, 3, 4, 5, 1} Answer: c Clarification:- A- B= B-A = Empty set. 27.Let A be set of all prime numbers, B be the set of all even prime numbers, C be the set of all odd prime numbers, then which of the following is true? a) A ≡ B U C b) B is a singleton set. c) A ≡ C U {2} d) All of the mentioned Answer: d Clarification:- 2 is the only even prime number. 28.If A has 4 elements B has 8 elements then the minimum and maximum number of elements in A U B are ____________ a) 4, 8 b) 8, 12 c) 4, 12 d) None of the mentioned Answer: b Clarification:- Minimum would be when 4 elements are same as in 8, maximum would be when all are distinct. 29.If A is {{Φ}, {Φ, {Φ}}}, then the power set of A has how many element? a) 2 b) 4 c) 6 d) 8 Answer: b Clarification:- The set A has got 2 elements so n(P(A))=4. 30.Two sets A and B contains a and b elements respectively. If power set of A contains 16 more elements than that of B, value of ‘b’ and ‘a’ are _______ a) 4, 5 b) 6, 7 c) 2, 3 d) None of the mentioned Answer: a Clarification:- 32-16=16, hence a=5, b=4. 31.Let A be {1, 2, 3, 4}, U be set of all natural numbers, then U-A’(complement of A) is given by set. a) {1, 2, 3, 4, 5, 6, ….} b) {5, 6, 7, 8, 9, ……} c) {1, 2, 3, 4} d) All of the mentioned Answer: c Clarification:- U – A’ ≡ A. 32.Which sets are not empty? a) {x: x is a even prime greater than 3} b) {x : x is a multiple of 2 and is odd} c) {x: x is an even number and x+3 is even} d) { x: x is a prime number less than 5 and is odd} Answer: d Clarification:- Because the set is {3}. 33.A function is said to be ______________ if and only if f(a) = f(b) implies that a = b for all a and b in the domain of f. a) One-to-many b) One-to-one c) Many-to-many d) Many-to-one Answer: b Clarification:- A function is one-to-one if and only if f(a)≠f(b) whenever a≠b. 35.The function f(x)=x+1 from the set of integers to itself is onto. Is it True or False? a) True b) False Answer: a Clarification:- For every integer “y” there is an integer “x ” such that f(x) = y. 36.The value of [1/2.[5/2]] is ______________ a) 1 b) 2 c) 3 d) 0.5 Answer: a Clarification:- The value of [5/2] is 2 so, the value of [1/2.2] is 1. 36.Which of the following function f: Z X Z → Z is not onto? a) f(a, b) = a + b b) f(a, b) = a c) f(a, b) = |b| d) f(a, b) = a – b Answer: c Clarification:- The function is not onto as f(a)≠b. 37.The domain of the function that assign to each pair of integers the maximum of these two integers is ___________ a) N b) Z c) Z + d) Z+ X Z+ Answer: d Clarification:- The domain of the integers is Z+ X Z+. 38.Let f and g be the function from the set of integers to itself, defined by f(x) = 2x + 1 and g(x) = 3x + 4. Then the composition of f and g is ____________ a) 6x + 9 b) 6x + 7 c) 6x + 6 d) 6x + 8 Answer: a Clarification:- The composition of f and g is given by f(g(x)) which is equal to 2(3x + 4) + 1. 39.__________ bytes are required to encode 2000 bits of data. a) 1 b) 2 c) 3 d) 8 Answer: b Clarification:- Two bytes are required to encode 2000 (actually with 2 bytes you can encode up to and including 65,535. 40.The inverse of function f(x) = x3 + 2 is ____________ a) f -1 (y) = (y – 2) 1/2 b) f -1 (y) = (y – 2) 1/3 c) f -1 (y) = (y) 1/3 d) f -1 (y) = (y – 2) Answer: b Clarification:- To find the inverse of the function equate f(x) then find the value of x in terms of y such that f -1 (y) = x. 40The function f(x) = x3 is bijection from R to R. Is it True or False? a) True b) False Answer: a Clarification:- The function f(x) = x3 is one to one as no two values in domain are assigned the same value of the function and it is onto as all R of the co domain is images of elements in the domain. 41.The g -1({0}) for the function g(x)= ⌊x⌋ is ____________ a) {x | 0 ≤ x < 1} b) {x | 0 < x ≤ 1} c) {x | 0 < x < 1} d) {x | 0 ≤ x ≤ 1} Answer: d Clarification:- g({0}) for the function g(x) is {x | 0 ≤ x ≤ 1}. Put g(x) = y and find the value of x in terms of y such that ⌊x⌋ = y. Discrete Structure :- Posets & Lattice 1.A Poset in which every pair of elements has both a least upper bound and a greatest lower bound is termed as _______ a) sublattice b) lattice c) trail d) walk Answer: b Clarification:- A poset in which every pair of elements has both a least upper bound and a greatest lower bound is called a lattice. A lattice can contain sublattices which are subsets of that lattice. 2.In the poset (Z+, |) (where Z+ is the set of all positive integers and | is the divides relation) are the integers 9 and 351 comparable? a) comparable b) not comparable c) comparable but not determined d) determined but not comparable Answer: a Clarification:- The two integers 9 and 351 are comparable since 9|351 i.e, 9 divides 351. But 5 and 127 are not comparable since 5 | 127 i.e 5 does not divide 127. 3.If every two elements of a poset are comparable then the poset is called ________ a) sub ordered poset b) totally ordered poset c) sub lattice d) semigroup Answer: b Clarification:- A poset (P, can be True as b≤x ensures x≠a and for all other elements P(x) can be False without violating the given implication. Discrete Structure :- Counting 1. How many even 4 digit whole numbers are there? a) 1358 b) 7250 c) 4500 d) 3600 Answer: c Clarification:- The thousands digit cannot be zero, so there are 9 choices. There are 10 possibilities for the hundreds digit and 10 possibilities for the tens digit. The units digit can be 0, 2, 4, 6 or 8, so there are 5 choices. By the basic counting principle, the number of even five-digit whole numbers is 9 × 10 × 10 × 5 = 45,00. 2.In a multiple-choice question paper of 15 questions, the answers can be A, B, C or D. The number of different ways of answering the question paper are ________ a) 65536 x 47 b) 194536 x 45 c) 23650 x 49 d) 11287435 Answer: a Clarification:- There are 415 = 65536 x 47 different ways of answering the exam paper of 15 MCQs. 3. How many words with seven letters are there that start with a vowel and end with an A? Note that they don’t have to be real words and letters can be repeated. a) 45087902 b) 64387659 c) 12765800 d) 59406880 Answer: d Clarification:- The first letter must be a vowel, so there are 5 choices. The second letter can be any one of 26, the third letter can be any one of 26, the fourth letter can be any one of 26 and fifth and sixth letters can be any of 26 choices. The last letter must be an A, so there is only 1 choice. By the basic counting principle, the number of ‘words’ is 5 × 26 × 26 × 26 × 26 × 26 × 1 = 59406880. 4. Neela has twelve different skirts, ten different tops, eight different pairs of shoes, three different necklaces and five different bracelets. In how many ways can Neela dress up? a) 50057 b) 14400 c) 34870 d) 56732 Answer: b Clarification:- By the basic counting principle, the number of different ways = 12 × 10 × 8 × 3 × 5 = 14400. Note that shoes come in pairs. So she must choose one pair of shoes from ten pairs, not one shoe from twenty. 5.How many five-digit numbers can be made from the digits 1 to 7 if repetition is allowed? a) 16807 b) 54629 c) 23467 d) 32354 Answer: a Clarification:- 75 = 16807 ways of making the numbers consisting of five digits if repetition is allowed. 6.For her English literature course, Ruchika has to choose one novel to study from a list of ten, one poem from a list of fifteen and one short story from a list of seven. How many different choices does Rachel have? a) 34900 b) 26500 c) 12000 d) 10500 Answer: d Clarification:- By the Basic Counting Principle, the number of different choices is 10 × 15 × 7 = 10500. 7. There are two different Geography books, five different Natural Sciences books, three different History books and four different Mathematics books on a shelf. In how many different ways can they be arranged if all the books of the same subjects stand together? a) 353450 b) 638364 c) 829440 d) 768700 Answer: c Clarification:- There are four groups of books which can be arranged in 4! different ways. Among those books, two are Geography books, five are Natural Sciences books, three are History books and four are Mathematics books. Therefore, there are 4! × 2! × 5! × 3! × 4! = 829440 ways to arrange the books. 8. The code for a safe is of the form PPPQQQQ where P is any number from 0 to 9 and Q represents the letters of the alphabet. How many codes are possible for each of the following cases? Note that the digits and letters of the alphabet can be repeated. a) 874261140 b) 537856330 c) 549872700 d) 456976000 Answer: d Clarification:- 103 × 264 = 456976000 possible codes are formed for the safe with the alphanumeric digits. 9.Amit must choose a seven-digit PIN number and each digit can be chosen from 0 to 9. How many different possible PIN numbers can Amit choose? a) 10000000 b) 9900000 c) 67285000 d) 39654900 Answer: a Clarification:- By the basic counting principle, the total number of PIN numbers Amit can choose is 10 × 10 × 10 × 10 × 10 × 10 × 10 = 10,000000. 10. A head boy, two deputy head boys, a head girl and 3 deputy head girls must be chosen out of a student council consisting of 14 girls and 16 boys. In how many ways can they are chosen? a) 98072 b) 27384 c) 36428 d) 44389 Answer: b Clarification:- There are 16 × 15 × 14 + 14 × 13 × 12 × 11 = 27384 ways to choose from a student council. 11. A drawer contains 12 red and 12 blue socks, all unmatched. A person takes socks out at random in the dark. How many socks must he take out to be sure that he has at least two blue socks? a) 18 b) 35 c) 28 d) 14 Answer: d Clarification:- Given 12 red and 12 blue socks so, in order to take out at least 2 blue socks, first we need to take out 12 shocks (which might end up red in worst case) and then take out 2 socks (which would be definitely blue). Thus we need to take out total 14 socks. 12. The least number of computers required to connect 10 computers to 5 routers to guarantee 5 computers can directly access 5 routers is ______ a) 74 b) 104 c) 30 d) 67 Answer: c Clarification:- Since each 5 computer need directly connected with each router. So 25 connections + now remaining 5 computer, each connected to 5 different routers, so 5 connections = 30 connections. Hence, c1->r1, r2, r3, r4, r5 c2->r1, r2, r3, r4, r5 c3->r1, r2, r3, r4, r5 c4->r1, r2, r3, r4, r5 c5->r1, r2, r3, r4, r5 c6->r1 c7->r2 c8->r3 c9->r4 c10->r5 Now, any pick of 5 computers will have a direct connection to all the 5 routers. 13.In a group of 267 people how many friends are there who have an identical number of friends in that group? a) 266 b) 2 c) 138 d) 202 Answer: b Clarification:- Suppose each of the 267 members of the group has at least 1 friend. In this case, each of the 267 members of the group will have 1 to 267-1=266 friends. Now, consider the numbers from 1 to n-1 as holes and the n members as pigeons. Since there is n-1 holes and n pigeons there must exist a hole which must contain more than one pigeon. That means there must exist a number from 1 to n-1 which would contain more than 1 member. So, in a group of n members there must exist at least two persons having equal number of friends. A similar case occurs when there exist a person having no friends. 14. When four coins are tossed simultaneously, in _______ number of the outcomes at most two of the coins will turn up as heads. a) 17 b) 28 c) 11 d) 43 Answer: c Clarification:- The question requires you to find number of the outcomes in which at most 2 coins turn up as heads i.e., 0 coins turn heads or 1 coin turns head or 2 coins turn heads. The number of outcomes in which 0 coins turn heads is 4C0 = 1 outcome. The number of outcomes in which 1 coin turns head is 4C1 = 6 outcomes. The number of outcomes in which 2 coins turn heads is, 4C2 = 15 outcomes. Therefore, total number of outcomes = 1 + 4 + 6 = 11 outcomes. 15. How many numbers must be selected from the set {1, 2, 3, 4} to guarantee that at least one pair of these numbers add up to 7? a) 14 b) 5 c) 9 d) 24 Answer: b Clarification:- With 2 elements pairs which give sum as 7 = {(1,6), (2,5), (3,4), (4,3)}. So choosing 1 element from each group = 4 elements (in worst case 4 elements will be either {1,2,3,4} or {6,5,4,3}). Now using pigeonhole principle = we need to choose 1 more element so that sum will definitely be 7. So Number of elements must be 4 + 1 = 5. 16.During a month with 30 days, a cricket team plays at least one game a day, but no more than 45 games. There must be a period of some number of consecutive days during which the team must play exactly ______ number of games. a) 17 b) 46 c) 124 d) 24 Answer: d Clarification:- Let a1 be the number of games played until day 1, and so on, ai be the no games played until i. Consider a sequence like a1,a2,…a30 where 1≤ai≤45, ∀ai. Add 14 to each element of the sequence we get a new sequence a1+14, a2+14, … a30+14 where, 15 ≤ ai+14 ≤ 59, ∀ai. Now we have two sequences 1. a1, a2, …, a30 and 2. a1+14, a2+14, …, a30+14. having 60 elements in total with each elements taking a value ≤ 59. So according to pigeon hole principle, there must be at least two elements taking the same value ≤59 i.e., ai = aj + 14 for some i and j. Therefore, there exists at least a period such as aj to ai, in which 14 matches are played. 17. In how many ways can 8 different dolls be packed in 5 identical gift boxes such that no box is empty if any of the boxes hold all of the toys? a) 2351 b) 365 c) 2740 d) 1260 Answer: d Clarification:- Dolls are different but the boxes are identical. If none of the boxes is to remain empty, then we can pack the dolls in one of the following ways: Case i. 2, 2, 2, 1, 1 Case ii. 3, 3, 1, 1 Case i: Number of ways of achieving the first option 2, 2, 2, 1, 1. Two dolls out of the 8 can be selected in 8C2 ways, another 2 out of the remaining 6 can be selected in 6C2 ways, another 2 out of the remaining 4 can be selected in 4C2 ways and the last two dolls can be selected in 1C1 ways each. However, as the boxes are identical, the two different ways of selecting which box holds the first two dolls and which one holds the second set of two dolls will look the same. Hence, we need to divide the result by 2. Therefore, total number of ways of achieving the 2, 2, 2, 1, 1 is = (8C2 * 6C2 * 4C2 * 1C1 * 1C1) / 2 = 1260. 18.A group of 20 girls plucked a total of 200 oranges. How many oranges can be plucked one of them? a) 24 b) 10 c) 32 d) 7 Answer: a Clarification:- Suppose all of them plucked the different number of oranges. A girl can pluck at least 0 oranges and the number of oranges plucks by each student is distinct. So, total number of plucked oranges should be less than 100. But 0+1+2…..+19+20 = 210>200 a contradiction. Thus there exist two girls who plucked the same number of oranges. If thus there exist two girls who plucked the same number of oranges. It means each girl of remaining 18 students plucked different number of oranges. Number of oranges Plucked by 18 students = 0+1+2+3…+17 = 153 oranges. Number of oranges plucked by remaining 2 student = 200 – 153 = 47. Both students plucked same number of oranges. So, Number of oranges plucked by one of them = 47/2=24. 19.In a get-together party, every person present shakes the hand of every other person. If there were 90 handshakes in all, how many persons were present at the party? a) 15 b) 14 c) 16 d) 17 Answer: b Clarification:- Let the total number of persons present at the party be m, Then, [{x *(x−1)}/2] = 90. x = 14. 20.A bag contains 25 balls such as 10 balls are red, 7 are white and 8 are blue. What is the minimum number of balls that must be picked up from the bag blindfolded (without replacing any of it) to be assured of picking at least one ball of each colour? a) 10 b) 18 c) 63 d) 35 Answer: b Clarification:- Consider three buckets red, white and blue and we want the total number of balls such that each bucket contain at least one ball. Now consider the state of picking up a ball without replacement : (normally you consider the worst case scenario in these cases) Starting 10 balls all are red and thus goes to bucket name Red. Now again picking up the ball gives 7 balls which are of same colour and put all of them in a bucket named White. The next pick will definitely be of different colour thus: we picked 10 + 7 + 1 = 18. 21.Consider the recurrence relation a1=4, an=5n+an-1. The value of a64is ________ a) 10399 b) 23760 c) 75100 d) 53700 Answer: a Clarification:- an=5n+an-1 = 5n + 5(n-1) + … + an-2 = 5n + 5(n-1) + 5(n − 2) +…+ a1 = 5n + 5(n-1) + 5(n − 2) +…+ 4 [since, a1=4] = 5n + 5(n-1) + 5(n − 2) +…+ 5.1 – 1 = 5(n + (n − 1)+…+2 + 1) – 1 = 5 * n(n+1)/ 2 – 1 an = 5 * n(n+1)/ 2 – 1 Now, n=64 so the answer is a64 = 10399. 22.Determine the solution of the recurrence relation Fn=20Fn-1 − 25Fn-2 where F0=4 and F1=14. a) an= 14*5n-1 b) an= 7/2*2n−1/2*6n c) an = 7/2*2n−3/4*6n+1 d) an = 3*2n−1/2*3n Answer: b Clarification:- The characteristic equation of the recurrence relation is → x2−20x+36=0 So, (x-2)(x-18)=0. Hence, there are two real roots x1=2 and x2=18. Therefore the solution to the recurrence relation will have the form: an=a2n+b18n. To find a and b, set n=0 and n=1 to get a system of two equations with two unknowns: 4=a20+b180=a+b and 3=a21+b61=2a+6b. Solving this system gives b=-1/2 and a=7/2. So the solution to the recurrence relation is, an = 7/2*2n−1/2*6n. 23.What is the recurrence relation for 1, 7, 31, 127, 499? a) bn+1=5bn-1+3 b) bn=4bn+7! c) bn=4bn-1+3 d) bn=bn-1+1 Answer: c Clarification:- Look at the differences between terms: 1, 7, 31, 124,…. and these are growing by a factor of 4. So, 1·4=4, 7·4=28, 31·4=124, and so on. Note that we always end up with 3 less than the next term. So, bn=4bn-1+3 is the recurrence relation and the initial condition is b0=1. 24. If Sn=4Sn-1+12n, where S0=6 and S1=7, find the solution for the recurrence relation. a) an=7(2n)−29/6n6n b) an=6(6n)+6/7n6n c) an=6(3n+1)−5n d) an=nn−2/6n6n Answer: b 25.Find the value of a4for the recurrence relation an=2an-1+3, with a0=6. a) 320 b) 221 c) 141 d) 65 Answer: c Clarification:- When n=1, a1=2a0+3, Now a2=2a1+3. By substitution, we get a2=2(2a0+3)+3. Regrouping the terms, we get a4=141, where a0=6. 26.The solution to the recurrence relation an=an-1+2n, with initial term a0=2 are ________ a) 4n+7 b) 2(1+n) c) 3n2 d) 5*(n+1)/2 Answer: b Clarification:- When n=1, a1=a0+2. By substitution we get, a2=a1+2 ⇒ a2=(a0+2)+2 and so on. So the solution to the recurrence relation, subject to the initial condition should be an=2+2n=2(1+n). 27. Determine the solution for the recurrence relation bn=8bn-1−12bn-2with b0=3 and b1=4. a) 7/2*2n−1/2*6n b) 2/3*7n-5*4n c) 4!*6n d) 2/8n Answer: a Clarification:- Rewrite the recurrence relation bn-8bn-1+12bn-2=0. Now from the characteristic equation: x2−8x+12=0 we have x: (x−2)(x−6)=0, so x=2 and x=6 are the characteristic roots. Therefore the solution to the recurrence relation will have the form: bn=b2n+c6n. To find b and c, set n=0 and n=1 to get a system of two equations with two unknowns: 3=b20+c60=b+c, and 4=b21+c61=2b+6c. Solving this system gives c=-1/2 and b=7/2. So the solution to the recurrence relation is, bn=7/2*2n−1/2*6n. 28.What is the solution to the recurrence relation an=5an-1+6an-2? a) 2n2 b) 6n c) (3/2)n d) n!*3 Answer: b Clarification:- Check for the left side of the equation with all the options into the recurrence relation. Then, we get that 6n is the required solution to the recurrence relation an=5an-1 + 6an-2. 29.Determine the value of a2 for the recurrence relation an = 17an-1 + 30n with a0=3. a) 4387 b) 5484 c) 238 d) 1437 Answer: d Clarification:- When n=1, a1=17a0+30, Now a2=17a1+30*2. By substitution, we get a2=17(17a0+30)+60. Then regrouping the terms, we get a2=1437, where a0=3. 30.Determine the solution for the recurrence relation an = 6an-1−8an-2 provided initial conditions a0=3 and a1=5. a) an = 4 * 2n – 3n b) an = 3 * 7n – 5*3n c) an = 5 * 7n d) an = 3! * 5n Answer: b Clarification:- The characteristic polynomial is x2−6x+8. By solving the characteristic equation, x2−6x+8=0 we get x=2 and x=4, these are the characteristic roots. Therefore we know that the solution to the recurrence relation has the form an=a*2n+b*4n, for some constants a and b. Now, by using the initial conditions a0 and a1 we have: a=7/2 and b=-1/2. Therefore the solution to the recurrence relation is: an = 4 * 2n – 1*3n = 7/2 * 2n – 1/2*3n. Discrete Structure :- Algebraic Structures 1.An infinite cyclic group does not have a ______ series. a) AP b) GP c) Composite d) Finite Answer: c Clarification:- Suppose that any finite group of order less than n has a composition series. Let G be a finite group of order n. If G is simple, then G▷{e}, where e is the identity element of G and hence, it is a composition series. However, any infinite cyclic group does not have a composite series. 2.Every cyclic group is a/an ______ a) infinite subgroup b) abelian group c) monoid d) commutative semigroup Answer: b Clarification:- Let C be a cyclic group with a generator g∈C. Namely, we have G={g.Let x and y be arbitrary elements in C. Then, there exists n, m∈Z such that x=gn and y=gm. It follows that x*y = gn*gm = gn+m = gm*gn = yx. Hence, we find that xy=yx for any x,y belongs to G.Thus, G is an abelian group. 3. What is an irreducible module? a) A cyclic module in a ring with any non-zero element as its generator b) A cyclic module in a ring with any positive integer as its generator c) An acyclic module in a ring with rational elements as its generator d) A linearly independent module in a semigroup with a set of real numbers Answer: a Clarification:- A nonzero R-module M is irreducible if and only if M is a cyclic module with any nonzero element as its generator. Suppose that M is an irreducible module. Let a∈M be any nonzero element and consider the submodule (a) generated by the element a. Since a is a nonzero element, the submodule (a) is non-zero. Since M is irreducible, this implies that M=(a). Hence M is a cyclic module generated by a. Since a is any nonzero element, the module M is a cyclic module with any nonzero element as its generator. 4. A finite group G of order 219 is __________ a) a semigroup b) a subgroup c) a commutative inverse d) a cyclic group Answer: d Clarification:- The prime factorization 219=3·73. By the definition of Sylow’s theorem, determine the number np of Sylow p-group for p=3,73. np≡1(mod p) and np divides n/p. Thus, n3 could be 1, 4, 7, 10, 13,… and n3 needs to divide 219/3=73. Hence the only possible value for n3 is n3=1. So there is a unique Sylow 3-subgroup P3 of G. By Sylow’s theorem, the unique Sylow 3-subgroup must be a normal subgroup of G. Similarly, n73=1, 74,… and n73 must divide 219/73=3 and hence we must have n73=1. Thus, G has a unique normal Sylow 73-subgroup P73. 5.The number of generators of cyclic group of order 219 is __________ a) 144 b) 124 c) 56 d) 218 Answer: a Clarification:- The number of generators of a cyclic group of order n is equal to the number of integers between 1 and n that are relatively prime to n.Namely, the number of generators is equal to ϕ(n), where ϕ is the Euler totient function. We know that G is a cyclic group of order 219. Hence, the number of generators of G is ϕ(219) = ϕ(3)ϕ(73) = 3·73 = 144. 6.The order of a simple abelian group is __________ a) infinite b) real number c) finite d) prime Answer: a Clarification:- Let p be the order of g (hence the order of G). As a contradiction, assume that p=ab is a composite number with integers a > 1, b > 1. Then (ga) is a proper normal subgroup of G. This is a contradiction since G is simple. Thus, p must be a prime number. Therefore, the order of G is a prime number. 7.The Number of Elements Satisfying g7=e in a finite Group F is ______ a) even b) not a number c) odd d) rational Answer: c Clarification:- Let g≠e be an element in group F such that g7=e. As 7 is a prime number, this yields that the order of g is 7. Consider, the subgroup (g) is generated by g. As the order of g is 7, the order of the subgroup (g) is 7. Hence, the order must be odd. 8.All the rings of order p2 is ____________ a) associative b) cyclic c) inverse d) commutative Answer: d Clarification:- Let R be a ring with unit 1. Suppose that the order of R is |R|=p2 for some prime number p. Then it has been proven that R is a commutative ring. 9.An element of a commutative ring R(1≠0) is nilpotent if __________ a) a+1=0 b) an= 0, for some positive integer n c) an= 1, for some integer n d) a2 = 0 Answer: b Clarification:- Since a is nilpotent in a commutative ring R, we have an=0 for some positive integer n. since R is commutative, for any m∈R, we have (am)n=anmn=0. Then we have the following equality: (1−am) (1+(am) +(am)2+⋯+(am) n−1) =1. Hence, 1−am is a unit in R. 10.A group G of order 20 is __________ a) solvable b) unsolvable c) 1 d) not determined Answer: a Clarification:- The prime factorization of 20 is 20=2·5. Let n5 be the number of 5-Sylow subgroups of G. By Sylow’s theorem, we have, n5≡1(mod 5) and n5|4. Thus, we have n5=1. Let P be the unique 5-Sylow subgroup of G. The subgroup P is normal in G as it is the unique 5-Sylow subgroup. Then consider the subnormal series G⊳P⊳{e}, where e is the identity element of G. Then the factor groups G/P, P/{e} have order 4 and 5 respectively. Hence these are cyclic groups (in particular abelian). Hence, the group G of order 20 has a subnormal series whose factor groups are abelian groups, and thus G is a solvable group. Discrete Structure :- Graph Theory 1.A non empty set A is termed as an algebraic structure ________ a) with respect to binary operation * b) with respect to ternary operation ? c) with respect to binary operation + d) with respect to unary operation – Answer: a Clarification:- A non empty set A is called an algebraic structure w.r.t binary operation “*” if (a*b) belongs to S for all (a*b) belongs to S. Therefore “*” is closure operation on ‘A’. 2.An algebraic structure _________ is called a semigroup. a) (P, *) b) (Q, +, *) c) (P, +) d) (+, *) Answer: a Clarification:- An algebraic structure (P,*) is called a semigroup if a*(b*c) = (a*b)*c for all a,b,c belongs to S or the elements follow associative property under “*”. (Matrix,*) and (Set of integers,+) are examples of semigroup. 3.Condition for monoid is __________ a) (a+e)=a b) (a*e)=(a+e) c) a=(a*(a+e) d) (a*e)=(e*a)=a Answer: d Clarification:- A Semigroup (S,*) is defined as a monoid if there exists an element e in S such that (a*e) = (e*a) = a for all a in S. This element is called identity element of S w.r.t *. 4.A monoid is called a group if _______ a) (a*a)=a=(a+c) b) (a*c)=(a+c) c) (a+c)=a d) (a*c)=(c*a)=e Answer: d Clarification:- A monoid(B,*) is called Group if to each element there exists an element c such that (a*c)=(c*a)=e. Here e is called an identity element and c is defined as the inverse of the corresponding element. 5.A group (M,*) is said to be abelian if ___________ a) (x+y)=(y+x) b) (x*y)=(y*x) c) (x+y)=x d) (y*x)=(x+y) Answer: b Clarification:- A group (M,*) is said to be abelian if (x*y) = (x*y) for all x, y belongs to M. Thus Commutative property should hold in a group. 6.Matrix multiplication is a/an _________ property. a) Commutative b) Associative c) Additive d) Disjunctive Answer: b Clarification:- The set of two M*M non-singular matrices form a group under matrix multiplication operation. Since matrix multiplication is itself associative, it holds associative property. 7.A cyclic group can be generated by a/an ________ element. a) singular b) non-singular c) inverse d) multiplicative Answer: a Clarification:- A singular element can generate a cyclic group. Every element of a cyclic group is a power of some specific element which is known as a generator ‘g’. 8.How many properties can be held by a group? a) 2 b) 3 c) 5 d) 4 Answer: c Clarification:- A group holds five properties simultaneously – i) Closure ii) associative iii) Commutative iv) Identity element v) Inverse element. 9.A cyclic group is always _________ a) abelian group b) monoid c) semigroup d) subgroup Answer: a Clarification:- A cyclic group is always an abelian group but every abelian group is not a cyclic group. For instance, the rational numbers under addition is an abelian group but is not a cyclic one. 10.{1, i, -i, -1} is __________ a) semigroup b) subgroup c) cyclic group d) abelian group Answer: c Clarification:- The set of complex numbers {1, i, -i, -1} under multiplication operation is a cyclic group. Two generators i and -i will covers all the elements of this group. Hence, it is a cyclic group. 11.A trivial subgroup consists of ___________ a) Identity element b) Coset c) Inverse element d) Ring Answer: a Clarification:- Let G be a group under a binary operation * and a subset H of G is called a subgroup of G if H forms a group under the operation *. The trivial subgroup of any group is the subgroup consisting of only the Identity element. 12.Minimum subgroup of a group is called _____________ a) a commutative subgroup b) a lattice c) a trivial group d) a monoid Answer: c Clarification:- The subgroups of any given group form a complete lattice under inclusion termed as a lattice of subgroups. If o is the Identity element of a group(G), then the trivial group(o) is the minimum subgroup of that group and G is the maximum subgroup. 13.Let K be a group with 8 elements. Let H be a subgroup of K and H K between two groups M and K is a mapping which satisfies two conditions: 1) f is a bijection and 2) for every x,y belongs to M, we have f(x*My) = f(x) * Kf(y). 21.An infinite cyclic group does not have a ______ series. a) AP b) GP c) Composite d) Finite Answer: c Clarification:- Suppose that any finite group of order less than n has a composition series. Let G be a finite group of order n. If G is simple, then G▷{e}, where e is the identity element of G and hence, it is a composition series. However, any infinite cyclic group does not have a composite series. 22.Every cyclic group is a/an ______ a) infinite subgroup b) abelian group c) monoid d) commutative semigroup Answer: b Clarification:- Let C be a cyclic group with a generator g∈C. Namely, we have G={g.Let x and y be arbitrary elements in C. Then, there exists n, m∈Z such that x=gn and y=gm. It follows that x*y = gn*gm = gn+m = gm*gn = yx. Hence, we find that xy=yx for any x,y belongs to G.Thus, G is an abelian group. 23.What is an irreducible module? a) A cyclic module in a ring with any non-zero element as its generator b) A cyclic module in a ring with any positive integer as its generator c) An acyclic module in a ring with rational elements as its generator d) A linearly independent module in a semigroup with a set of real numbers Answer: a Clarification:- A nonzero R-module M is irreducible if and only if M is a cyclic module with any nonzero element as its generator. Suppose that M is an irreducible module. Let a∈M be any nonzero element and consider the submodule (a) generated by the element a. Since a is a nonzero element, the submodule (a) is non-zero. Since M is irreducible, this implies that M=(a). Hence M is a cyclic module generated by a. Since a is any nonzero element, the module M is a cyclic module with any nonzero element as its generator. 24.A finite group G of order 219 is __________ a) a semigroup b) a subgroup c) a commutative inverse d) a cyclic group Answer: d Clarification:- The prime factorization 219=3·73. By the definition of Sylow’s theorem, determine the number np of Sylow p-group for p=3,73. np≡1(mod p) and np divides n/p. Thus, n3 could be 1, 4, 7, 10, 13,… and n3 needs to divide 219/3=73. Hence the only possible value for n3 is n3=1. So there is a unique Sylow 3-subgroup P3 of G. By Sylow’s theorem, the unique Sylow 3-subgroup must be a normal subgroup of G. Similarly, n73=1, 74,… and n73 must divide 219/73=3 and hence we must have n73=1. Thus, G has a unique normal Sylow 73-subgroup P73. 25.The number of generators of cyclic group of order 219 is __________ a) 144 b) 124 c) 56 d) 218 Answer: a Clarification:- The number of generators of a cyclic group of order n is equal to the number of integers between 1 and n that are relatively prime to n.Namely, the number of generators is equal to ϕ(n), where ϕ is the Euler totient function. We know that G is a cyclic group of order 219. Hence, the number of generators of G is ϕ(219) = ϕ(3)ϕ(73) = 3·73 = 144. 26.The order of a simple abelian group is __________ a) infinite b) real number c) finite d) prime Answer: a Clarification:- Let p be the order of g (hence the order of G). As a contradiction, assume that p=ab is a composite number with integers a > 1, b > 1. Then (ga) is a proper normal subgroup of G. This is a contradiction since G is simple. Thus, p must be a prime number. Therefore, the order of G is a prime number. 27.The Number of Elements Satisfying g7=e in a finite Group F is ______ a) even b) not a number c) odd d) rational Answer: c Clarification:- Let g≠e be an element in group F such that g7=e. As 7 is a prime number, this yields that the order of g is 7. Consider, the subgroup (g) is generated by g. As the order of g is 7, the order of the subgroup (g) is 7. Hence, the order must be odd. 28.All the rings of order p2 is ____________ a) associative b) cyclic c) inverse d) commutative Answer: d Clarification:- Let R be a ring with unit 1. Suppose that the order of R is |R|=p2 for some prime number p. Then it has been proven that R is a commutative ring. 29.An element of a commutative ring R(1≠0) is nilpotent if __________ a) a+1=0 b) an= 0, for some positive integer n c) an= 1, for some integer n d) a2 = 0 Answer: b Clarification:- Since a is nilpotent in a commutative ring R, we have an=0 for some positive integer n. since R is commutative, for any m∈R, we have (am)n=anmn=0. Then we have the following equality: (1−am)(1+(am)+(am)2+⋯+(am)n−1)=1. Hence, 1−am is a unit in R. 30.A group G of order 20 is __________ a) solvable b) unsolvable c) 1 d) not determined Answer: a Clarification:- The prime factorization of 20 is 20=2·5. Let n5 be the number of 5-Sylow subgroups of G. By Sylow’s theorem, we have, n5≡1(mod 5) and n5|4. Thus, we have n5=1. Let P be the unique 5-Sylow subgroup of G. The subgroup P is normal in G as it is the unique 5-Sylow subgroup. Then consider the subnormal series G⊳P⊳{e}, where e is the identity element of G. Then the factor groups G/P, P/{e} have order 4 and 5 respectively. Hence these are cyclic groups(in particular abelian). Hence, the group G of order 20 has a subnormal series whose factor groups are abelian groups, and thus G is a solvable group. Discrete Structure Objective Questions with Answers Pdf Download

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