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| 2018-2 | Discrete Mathematics | Midterm |
| 예홍진 | | Test time: 60 minutes |

※ (1~10) Determine whether the following statement is true or not. Write "T" for true statement and "F" for false statement. [15 points]

1. The structure (odd integers, +, x) is closed with respect to addition(+) and multiplication(x).

2. Consider operation Δ defined for the set $\{0, 1\}$ by the following table.
Then an identity for Δ is 1 and Δ is commutative.

| Δ | 0 | 1 |
|----------|---|---|
| 0 | 0 | 1 |
| 1 | 1 | 0 |

3. In the pigeonhole principle, if n pigeons are assigned to m pigeonholes and $m < n$, then at least one pigeonhole contains two or more pigeons.

4. Join, meet and boolean product of boolean matrices, all three operations are commutative.

5. Let $A = \{a, b, c\}$. The expression $(aa^*(b^*c)^*(ca^*b^*))$ is a regular expression.

6. The transitive closure of a relation R is the connectivity relation R^∞ .

7. The recurrence relation $f_n = f_{n-1} + 2f_{n-2} - 1$ is a linear homogeneous relation of degree 2. F

8. Let R be a relation from A to B , and let A_1 and A_2 be subsets of A .

Then $R(A_1 \cup A_2) = R(A_1) \cup R(A_2)$.

9. Let $A = \{1, 2, 3, 4\}$ and let $R = \{(1, 2), (2, 2), (3, 4), (4, 1)\}$. Then R is antisymmetric. T

10. Let R be a relation on A . Then the connectivity relation R^∞ is the transitive closure of R .

11. Let R and S be relations on A . $(R \cap S)^2 = R^2 \cap S^2$. T

12. Let aRb if and only if $\text{GCD}(a, b) = 1$ for a, b in $A = \mathbb{Z}^+$, then R is an equivalence relation.

13. Let L be a finite lattice. If $|L| = 2^n$, then L is a Boolean algebra.

14. Let L be a lattice. Then for every a and b in L , $a \vee b = a$ if and only if $a \wedge b = b$.

15. D_{51} , D_{70} , and D_{143} are all Boolean algebras.

※ (16~30) Complete the following statements. [15 points]

[단, 영어 단어나 철자를 정확히 모르는 경우에는 한글로 답하는 것도 인정한다.]

16. If a sequence may stop after n elements, $n \in \mathbb{N}$, then we say that the sequence is ().

17. A structure is () with respect to an operation if that operation always produces another member of the collection of objects.

18. When showing that $P(n)$ is true for all integers $n \geq n_0$, we use mathematical induction that is divided into () and induction step.

19. Let $A = \{1, 3, 4, 5\}$ and $B = \{2, 4, 6, 10\}$. Define the relation R from A to B where aRb if and only if $a|b$. Then, $|R| = ()$.

20. Let $A = \{1, 2, 3, 4\}$, $R = \{(1, 1), (1, 2), (2, 1), (2, 2), (3, 4), (3, 1), (4, 3)\}$. In the digraph of R , vertex 1 has in-degree () and has out-degree ().

21. Suppose that R is a relation on a set A . The reflexive closure of R is ().

22. A relation R on a set A is () if whenever $(a, b) \in R$, then $(b, a) \notin R$.

23. A relation R on a set A is called a(n) () if it is reflexive, antisymmetric, and transitive.

24. Let R be a relation on a set A . Then R is () if and only if $R \cap R^{-1} = \emptyset$.

25. If seven integers from 1 to 12 are chosen, then two of them will add up to ().

26. If Δ is a binary operation, then Δ is () if $(x \Delta y) \Delta z = x \Delta (y \Delta z)$.

27. For a given poset, the process of constructing a linear order is called () sort.

$$\begin{bmatrix} 001 \\ 100 \\ 011 \end{bmatrix} \begin{bmatrix} 110 \\ 001 \\ 100 \end{bmatrix}$$

$$\begin{matrix} 010 \\ 001 \\ 101 \end{matrix}$$

$$123456789101112$$