HCMUT, VNU-HCM
Faculty of CSE

MIDTERM EXAMINATION

Course: **Discrete structures for Computing** (CO1007)

Class: **2018-1-CO1007** Group: **CC01**

Duration: **60 minutes** ***(Closed-book test)***

Examination date: **March 27, 2018**

Student name: ______________

Score: __________ **Student ID:** | | | | | | | |

Examiner: __________ **Examiner's signature:** ______________

(*There are* ***20*** *multiple-choice questions, each question is worth* ***0.5*** *point. Highlight the correct (best) answer:* ■. Cancel out to deselect: ☒ or clear the highlight)

Question 1. How many bit strings of length 9 such that next to every bit 0 is always a bit 1?

(A) 110. (B) 55. (C) 128. (D) 256.

Question 2. The power sets of $(A \times B) \cup (B \times A)$ and $(A \times B) \cup (A \times B)$ have the same number of elements if and only if

(A) $A = \emptyset$ or $B = \emptyset$ or $A = B$.
(B) $A = \emptyset$ or $B = \emptyset$ or $A \cap B = \emptyset$.
(C) $A \cap B = \emptyset$.
(D) $A \cup B = \emptyset$.

Question 3. From a deck of cards we take 12 cards.

- Hearts 1, 2 and 3
- Clubs 1, 2, 3 and 4
- Diamond 1, 2, 3, 4 and 5

Take 5 cards (from 12 cards) such that there is at least one card of each type. In how many ways is that possible? The order of these five cards is irrelevant.

(A) 590 (B) 690 (C) 790 (D) 490

Question 4. Let R be the relation on the set of people consisting of pairs (a, b) where *"a is a parent of b"*. Let S be the relation on the set of people consisting of pairs (a, b) where *"a and b are siblings (brother or sisters)."* What are $S \circ R$ and $R \circ S$?

(A) $S \circ R = \{(a, b) | a$ is a parent of $b\}$; $R \circ S = \{(a, b) | a$ is an aunt or uncle of $b\}$
(B) $S \circ R = \{(a, b) | a$ is an uncle or aunt of $b\}$; $R \circ S = \{(a, b) | a$ is a parent of b and b has a sibling $\}$
(C) $S \circ R = \{(a, b) | a$ is a parent of b and b has a sibling $\}$; $R \circ S = \{(a, b) | a$ is an aunt or uncle of $b\}$
(D) All of the above statements are incorrect

Question 5. Let $P(x, y)$ denote *"x is a factor of y"* where $x \in \{1, 2, 3, \ldots\}$ and $y \in \{2, 3, 4, \ldots\}$. Let $Q(y)$ denote "$\forall x[P(x, y) \rightarrow ((x = y) \vee (x = 1))]$". When is $Q(y)$ true?

(A) $Q(y)$ always false.
(B) $Q(y)$ is an integer number.
(C) $Q(y)$ is a prime number.
(D) $Q(y)$ is a positive number.

Question 6. Given

- $S(x, y)$: x is **older sister** of y
- $B(x, y)$: x is **brother** of y
- $H(x, y)$: x is **husband** of y
- a: Alice
- b: Bob

Which of the following is represented for "***Bob is brother in law of Alice***"?

(A) $\forall x((S(x, a) \wedge H(b, x)) \vee (H(x, a) \wedge B(b, x)))$.
(B) $\forall x((S(x, a) \vee H(b, x)) \wedge (H(x, a) \vee B(b, x)))$.
(C) $\exists x((S(x, a) \vee H(b, x)) \wedge (H(x, a) \vee B(b, x)))$.
(D) $\exists x((S(x, a) \wedge H(b, x)) \vee (H(x, a) \wedge B(b, x)))$.

Question 7. How many terms in the sequence $\frac{5}{6}, \frac{2}{3}, \frac{1}{2}, \cdots$ must be added in order to get $-\frac{121}{2}$?

(A) 31. (B) 32. (C) 33. (D) 34.

Question 8. The assertion: "two statements $\exists x \in \mathbb{Z}\big((x < 0) \wedge (x > 0)\big)$ and $\big(\exists x \in \mathbb{Z}(x < 0)\big) \wedge \big(\exists x \in \mathbb{Z}(x > 0)\big)$ have the same truth value" is

(A) false. (B) true. (C) not able to conclude.

Question 9. Let $f : X \to Y$ be a function, and let $\{S_i : i \in I\}$ be a family subsets of X. Which of the following is incorrect?

(A) $f(\bigcup_{i \in I} S_i) = \bigcup_{i \in I} f(S_i)$
(B) When f is a bijection function: $f^{-1}(S_1 \cup S_2) = f^{-1}(S_1) \cup f^{-1}(S_2)$
(C) $f(S_1 \cap S_2) \subseteq f(S_1) \cap f(S_2)$ (D) $f(S_1) \cap f(S_2) \subset f(S_1 \cap S_2)$

Question 10. The statement $p \wedge q \to \neg q$ is equivalent with which of the following statement

(A) $q \wedge p$. (B) 1 (C) $p \vee \neg q$ (D) $\neg p \vee \neg q$

Question 11. Le R be a relation on the set of positive integers given by "xRy if and only if $x = y + 1$." Which of the following is the transitive closure of R?

(A) $R^* = \{(x, y)|x \geq y\}$. (B) $R^* = \{(x, y)|x \leq y\}$.
(C) $R^* = \{(x, y)|x > y\}$. (D) $R^* = \{(x, y)|x, y \in \mathbb{Z}\}$.

Question 12. Let x be any integer. To prove the statement $x^2 + x$ is even, we follow these steps:

First, because an arbitrary integer is either even or odd, we setup for proof-by-cases inference p: x is even; $q : x$ is odd; $r : x^2 + x$ is even.
Verify premise 1. If x is even, then $x = 2n$, for some integer n. Hence, $x^2 + x = (2n)2 + 2n = 4n^2 + 2n$, which is even.
Verify premise 2. If x is odd, then $x = 2n+1$, for some n. Hence, $x^2+x = (2n+1)2+(2n+1) = (4n^2 + 4n + 1) + (2n + 1) = 4n^2 + 6n + 2$, which is even.

What is the proving method used above?

(A) Contradiction (B) Contraposition (C) Direct (D) Induction

Question 13. Which one of the following statements is true?

(A) For all sets A, B, and C, $(A - B) \cap (C - B) = (A \cap C) - B$.
(B) For all sets A, B, and C, $A - (B - C) = (A - B) - C$.
(C) For all sets A, B, and C, $(A - B) \cap (C - B) = A - (C \cup B)$.
(D) For all sets A, B, and C, if $A \cap C = B \cap C$ then $A = B$.

Question 14. The statement $(p \Leftrightarrow) \Rightarrow (q \Leftrightarrow r)$ is equivalent to

(A) $\sim \big((\sim p \vee r) \wedge (p \vee \sim r)\big) \vee \big((\sim q \vee r) \wedge (q \vee \sim r)\big)$.

(B) $\big((\sim p \vee r) \wedge (p \vee \sim r)\big) \vee \big((\sim q \vee r) \wedge (q \vee \sim r)\big)$.

(C) $\big((\sim p \vee r) \wedge (p \vee \sim r)\big) \vee \sim \big((\sim q \vee r) \wedge (q \vee \sim r)\big)$.

(D) $\sim \big((\sim p \vee r) \wedge (p \vee \sim r)\big) \vee \sim \big((\sim q \vee r) \wedge (q \vee \sim r)\big)$.

Question 15. How many sequences contain 6 numbers from $1, 2, 3, 4, 5, 6$ that meet the conditions: 6 numbers in this sequence are different, and the sum of three first numbers less than the sum of three last number a (1) unit?

(A) 12 (B) 36 (C) 72 (D) 108

Question 16. Which of the following is correct?

(A) Every relation R on A must be satisfied at least one of the following properties: reflexive, symmetric, anti-symmetric, transitive.

(B) If a relation R on A satisfy that R^2 is reflexive, then it is not necessary that R itself is also reflexive.

(C) There is no relation R on A satisfying all the following properties: reflexive, symmetric, anti-symmetric, transitive.

(D) If two relations R_1 v R_2 on A are transitive then their union $R_1 \cup R_2$ is also transitive.

Question 17. Consider the statement: "There exists either a computer scientist or a mathematician who knows both computer coding and discrete math". Which of the followings is not logically equivalent to the statement.

(A) There exists a person who is a computer scientist or there exists a person who is a mathematician who knows discrete math or who knows computer coding.

(B) There exists a computer scientist who knows both discrete math and computer coding or there exists a person who is a mathematician who knows both discrete math and computer coding.

(C) There exists a person who is a computer scientist or a mathematician who knows both discrete math and computer coding.

(D) There is no person who is a computer scientist or a mathematician who knows both discrete math and computer coding.

Question 18. In a certain survey of a group of 200 students, 50% students indicated they can play volley ball, 65% indicated that they can play ping-pong, 15% indicate they cannot play both of them. How many student can play both of two sport games?

(A) 70 (B) 60 (C) 50 (D) 40

Question 19. Let $f : X \to Y$ and $g : Y \to Z$. Suppose $g \circ f$ is injective. Then,

(A) f is injective. (B) f is surjective. (C) f is bijective. (D) g is injective.

Question 20. Let R be the relation on $\mathbb{N} \times \mathbb{N}$ defined by $(a, b)R(c, d)$ if and only if $ad = bc$. Which of the following answer is the most accurately?

(A) R is not a equivalence relation on $\mathbb{N} \times \mathbb{N}$.

(B) R is a equivalence relation on $\mathbb{N} \times \mathbb{N}$.

(C) R is not a symmetric and ir-reflexive relation on $\mathbb{N} \times \mathbb{N}$.

(D) R is not a symmetric and transitive relation on $\mathbb{N} \times \mathbb{N}$.