

Previous Year GATE Questions

Q.1 Consider the binary relation $R = \{ (x,y), (x,z), (z,x), (z,y) \}$ on the set $\{x,y,z\}$. Which one of the following is TRUE?

- (A) R is symmetric but NOT antisymmetric
- (B) R is Not Symmetric but antisymmetric
- (C) R is both Symmetric and antisymmetric
- ☒ (D) R is neither Symmetric nor antisymmetric

[GATE 2009, 1 Mark]

Q.2 A binary relation R on $N^* N$ is defined as follows: $(a,b) R(c,d)$ if $a \leq c$ or $b \leq d$. Consider the following propositions

☒ P: R is reflexive

☒ Q: R is transitive

Which one of the following statements is TRUE?

- (A) Both P and Q are true
- ☒ (B) P is true and Q are false
- (C) P is false and Q are true
- (D) Both P and Q are false

[GATE 2016, 2 Marks]

Q.3 Let R be a relation on the set of ordered pairs of positive integers such that $((p,q), (r,s)) \in R$ if and only if $p-s = q-r$. Which one of the following is true about R?

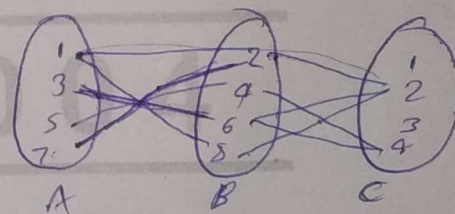
- (A) Both reflexive and symmetric
- (B) Reflexive but not symmetric
- ☒ (C) Not reflexive but symmetric
- (D) Neither reflexive nor symmetric

[GATE 2015, 2 Marks]

Q.4 Let R_1 be a relation from $A = \{1,3,5,7\}$ to $B = \{2,4,6,8\}$ and R_2 be another relation from B to $C = \{1,2,3,4\}$ as defined below:

- (i) An element x in A is related to an element y in B (under R_1) if $x+y$ is divisible by 3.
 - (ii) An element x in B is related to an element y in C (under R_2) if $x+y$ is even but not divisible by 3.
- Which is the composite relation $R_1 R_2$ from A to C?

- (A) $R_1 R_2 = \{(1,2), (1,4), (3,3), (5,4), (7,3)\}$
- (B) $R_1 R_2 = \{(1,2), (1,3), (3,2), (5,2), (7,3)\}$
- ☒ (C) $R_1 R_2 = \{(1,2), (3,2), (3,4), (5,4), (7,2)\}$
- (D) $R_1 R_2 = \{(3,2), (3,4), (5,1), (5,3), (7,1)\}$



[GATE 2004, 1 Mark]

Q.5 Let S be a set of n elements. The number of ordered pairs in the largest and the smallest equivalence relations on S are

- (A) n and n
- ☒ (B) n^2 and n
- (C) n^2 and 0
- (D) n and 1

Q.6 Let R and S be any two equivalence relations on a non-empty set A. Which one of the following statements is TRUE?

- (A) $R \cap S, R \cup S$ are both equivalence relations
- (B) $R \cup S$ is an equivalence relations

(C) $R \cap S$ is an equivalence relations

(D) Neither $R \cap S$, $R \cup S$ are both equivalence relations

[GATE 1998, 1 Mark]

Q.7 Consider the binary relation:

$$S = \{(x, y) \mid y = x + 1 \text{ and } x, y \in \{0, 1, 2, \dots\}\}$$

The reflexive transitive closure of S is

(A) $\{(x, y) \mid y > x \text{ and } x, y \in \{0, 1, 2, \dots\}\}$

(B) $\{(x, y) \mid y \geq x \text{ and } x, y \in \{0, 1, 2, \dots\}\}$

(C) $\{(x, y) \mid y < x \text{ and } x, y \in \{0, 1, 2, \dots\}\}$

(D) $\{(x, y) \mid y \leq x \text{ and } x, y \in \{0, 1, 2, \dots\}\}$

[GATE 2004, 1 Mark]

Q.8 The number of different $n \times n$ symmetric matrices with each elements being either 0 or 1 is: (Note: power(2, x) is same as 2^x)

(A) Power(2, n)

(B) Power(2, n^2)

(C) Power(2, $(n^2 + n)/2$)

(D) Power(2, $(n^2 - n)/2$)

[GATE 2004, 1 Mark]

Q.9 The binary relation $S = f(\text{empty set})$ on set $A = \{1, 2, 3\}$ is

(A) Neither reflexive nor symmetric

(B) Reflexive and symmetric

(C) Reflexive and transitive

(D) Transitive and symmetric

[GATE 2002, 2 Marks]

Q.10 The binary relation $R = \{(1, 1), (2, 1), (2, 2), (2, 3), (2, 4), (3, 1), (3, 2), (3, 3), (3, 4)\}$ on the set $A = \{1, 2, 3, 4\}$ is

(A) Reflexive, symmetric and transitive

(B) Neither reflexive, nor irreflexive but transitive

(C) Irreflexive, symmetric and transitive

(D) Irreflexive and antisymmetric

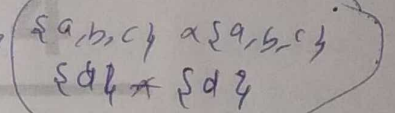
[GATE 1998, 2 Marks]

Q.11 Suppose $A = \{a, b, c, d\}$ and Π is the following partition of A

$$\Pi = \{\{a, b, c\}, \{d\}\}$$

(A) List the ordered pairs of the equivalence relation included by Π

(B) Draw the graph of the above equivalence relation



[GATE 1998, 2 Marks]

Q.12 The number of equivalence relation on the set $\{1, 2, 3, 4\}$ is

(A) 15

(B) 16

(C) 24

(D) 4

[GATE 1997, 1 Mark]

Q.13 Suppose A is a finite set with n elements. The number of elements in the Largest equivalence relation of A is

(A) n

(B) n^2

(C) 1

(D) $n + 1$

[GATE 1998, 1 Mark]

Q.14 Let R_1 and R_2 be two equivalence relations on a set. Consider the following assertions:

- (i) $R_1 \cup R_2$ is an equivalence relation
- (ii) $R_1 \cap R_2$ is an equivalence relation

Which of the following is correct?

- (A) Both assertions are true
- (B) Assertion (i) is true but assertion (ii) is not true
- ☒ (C) Assertion (ii) is true but assertion (i) is not true
- (D) Neither (i) nor (ii) is true

[GATE 1998, 1 Mark]

Q.15 Let R be a non-empty relation on a collection of sets defined $A R B$ if and only if $A \cap B = \phi$. Then, (pick the true statement)

- (A) R is reflexive and transitive
- ☒ (B) R is symmetric and not transitive
- (C) R is an equivalence relations
- (D) R is not reflexive and not symmetric

[GATE 1996, 2 Marks]

Q.16 State whether the following statement are TRUE or FALSE:

☒ False The union of two equivalence relations is also an equivalence relation.

[GATE 1987, 1 Mark]

Q.17 Let R be a symmetric and transitive relation on a set A . then

- (A) R is reflexive and hence an equivalence relations
- (B) R is reflexive and hence a partial order
- (C) R is reflexive and hence not an equivalence relations
- ☒ (D) None of the above

[GATE 1995, 1 Mark]

Q.18 The transitive closure of the relation $\{(1,2), (2,3), (3,4), (5,4)\}$ on the set $A = \{1,2,3,4,5\}$ is _____

$R = \{(1,2), (2,3), (1,3), (3,4), (2,4), (1,4), (5,4)\}$ [GATE 1989, 2 Marks]

Q.19 Let A be a finite set of size n . The number of elements in the power of A^*A is _____

- (A) 2^{2^n}
- ☒ (B) 2^{n^2}
- (C) n^2
- (D) 2^n

[GATE 1993, 1 Mark]

Q.20 If she is my friend and you are her friend, then we are friends. Given this, the friend relationship in this context is _____.

- (i) commutative
 - (ii) transitive
 - (iii) implicative
 - (iv) equivalence
- (A) (i) and (ii)
- (c) (i), (ii), (iii) and (iv)

(B) (iii)

☒ (D) none of these

Q.21 How many relations are there on a set with n -elements that are symmetric and a set with n -elements that are reflexive and symmetric?

(A) $2^{n(n+1)/2}$ and $2^n \cdot 3^{n(n-1)/2}$

(B) $3^{n(n-1)/2}$ and $2^{n(n-1)}$

(C) $2^{n(n+1)/2}$ and $3^{n(n-1)/2}$

☒ (D) $2^{n(n+1)/2}$ and $2^{n(n-1)/2}$

Q.22 The relation "divides" on a set of positive integers is _____

- (A) Transitive and symmetric
- ☒ (B) Transitive and Anti symmetric
- (C) Symmetric only
- (D) Transitive only

Q.23 Suppose that R_1 and R_2 are reflexive relations on a set A

Which of the following statements is correct?

- (A) $R_1 \cap R_2$ is reflexive and $R_1 \cup R_2$ is irreflexive.
- (B) $R_1 \cap R_2$ is irreflexive and $R_1 \cup R_2$ is reflexive.
- ☒ (C) Both $R_1 \cap R_2$ and $R_1 \cup R_2$ is reflexive
- (D) Both $R_1 \cap R_2$ and $R_1 \cup R_2$ is irreflexive

Q.24 Which of the relations on $\{0,1,2,3\}$ is an equivalence relation?

- ☒ (A) $\{(0,0), (0,2), (2,0), (2,2), (2,3), (3,2), (3,3)\}$
- (B) $\{(0,0), (1,1), (2,2), (3,3)\}$
- ☒ (C) $\{(0,0), (0,1), (0,2), (1,0), (1,1), (1,2), (2,0)\}$
- (D) $\{(0,0), (0,2), (2,3), (1,1), (2,2)\}$

Q.25 Let R be the set of all binary relations on the set $\{1,2,3\}$. Suppose a relation is chosen from R at random. The probability that the chosen relation is reflexive (round off to 3 decimal places) is _____.

$$2^{(3^2-3)} / 2^{3^2} = 2^6 / 2^9 = 0.125$$

[GATE 2020]

Q.26 Let $U = \{1,2,\dots,n\}$. Let $A = \{(x, X) | x \in X, X \subseteq U\}$. Consider the following two statements on $|A|$.

- ☒ I. $|A| = n2^{n-1}$
- ☒ II. $|A| = \sum_{k=1}^n k \binom{n}{k}$

Which of the above statements is/are TRUE?

- (A) Only I
- (B) Only II
- ☒ (C) Both I and II
- (D) Neither I or II

[GATE 2019]