

## Practice Problems (Relations)

- Q.1 The number of relations on a  $n$  element set is:  
 (A)  $2^{n^2}$  (B)  $2^{n(n-1)}$  (C)  $2^{\frac{n(n+1)}{2}}$  (D)  $3^{\frac{n(n-1)}{2}}$
- Q.2 The number of relations on a  $n$  element set that are reflexive is:  
 (A)  $2^{n^2}$  (B)  $2^{n(n-1)}$  (C)  $2^{\frac{n(n+1)}{2}}$  (D)  $3^{\frac{n(n-1)}{2}}$
- Q.3 The number of relations on a  $n$  element set that are symmetric is:  
 (A)  $2^{n^2}$  (B)  $2^{n(n-1)}$  (C)  $2^{\frac{n(n+1)}{2}}$  (D)  $3^{\frac{n(n-1)}{2}}$
- Q.4 The number of relations on a  $n$  element set that are asymmetric:  
 (A)  $2^{n^2}$  (B)  $2^{n(n-1)}$  (C)  $2^{\frac{n(n+1)}{2}}$  (D)  $3^{\frac{n(n-1)}{2}}$
- Q.5 The number of relations on a  $n$  element set that are antisymmetric:  
 (A)  $2^n 3^{\frac{n(n-1)}{2}}$  (B)  $2^{n(n-1)}$  (C)  $2^{\frac{n(n+1)}{2}}$  (D)  $3^{\frac{n(n-1)}{2}}$
- Q.6 The number of relations on a  $n$  element set that are irreflexive is:  
 (A)  $2^{n^2}$  (B)  $2^{n(n-1)}$  (C)  $2^{\frac{n(n+1)}{2}}$  (D)  $3^{\frac{n(n-1)}{2}}$
- Q.7 The number of relations on a  $n$  element set that are not reflexive is:  
 (A)  $2^{n(n-1)}(2^n - 1)$  (B)  $2^{n(n-1)}$  (C)  $2^{\frac{n(n+1)}{2}}$  (D)  $3^{\frac{n(n-1)}{2}}$
- Q.8 How many relations are there on the power set of  $X = \{\phi\}$ ?  
 (A)  $2^4$  (B)  $2^2$  (C)  $2^{16}$  (D)  $2^8$
- Q.9 Let  $R$  be the relation on  $\mathbb{R}$  given by  $xRy$  if and only if  $x < y + 1$ .  
 (A) Reflexive, but not symmetric and not transitive.  
 (B) Reflexive, symmetric and not transitive.  
 (C) Not Reflexive, not symmetric and not transitive.  
 (D) Reflexive, but not symmetric and transitive.
- Q.10 Define a relation on the integers by  $aRb$  if  $|a - b| < 5$ . Choose the most complete correct statement from the following:  
 (A)  $R$  is transitive (B)  $R$  is reflexive and symmetric  
 (C)  $R$  is reflexive and transitive (D)  $R$  is symmetric and transitive

Determine which of the following properties applies to each relation.

- (i) Reflexive
- (ii) Irreflexive
- (iii) Symmetric
- (iv) Antisymmetric
- (v) Asymmetric
- (vi) Transitive

- Q.11 Let  $R$  be the relation on  $N$  given by  $xRy$  iff  $x$  divides  $y$ .
- (A) (i) and (vi) only                      (B) (i), (iii) and (vi) only  
(C) (i), (iv) and (vi) only              (D) (ii), (v), (vi) only
- Q.12 Let  $X$  be a set and let  $R$  be the relation " $\subseteq$ " defined on subsets of  $X$ .
- (A) (i) and (vi) only                      (B) (i), (iv) and (vi) only  
(C) (ii) and (iv) only                    (D) (i) only
- Q.13 Let  $R$  be the relation on the real numbers given by  $xRy$  iff  $x - y$  is rational.
- (A) (i) and (vi) only                      (B) (i), (iii) and (vi) only  
(C) (ii) and (iv) only                    (D) (ii), (iv), (v) only
- Q.14 Let  $R$  be the relation on the real numbers given by  $xRy$  iff  $x - y$  is irrational.
- (A) (i) and (iii) only                      (B) (i), (iv) and (vi) only  
(C) (ii), (iv) and (v) only              (D) (ii) and (iii) only
- Q.15 Let  $R$  be the relation on the real numbers given by  $xRy$  iff  $(x - y)^2 < 0$ .
- (A) (ii) and (vi) only                      (B) (i), (iv) and (vi) only  
(C) (ii), (iii) and (vi) only              (D) (ii), (iii), (iv), (v) and (vi) only

## True or False

1. A relation which is not reflexive is always irreflexive.
2. The properties of being symmetric and anti-symmetric are not negatives of each other.
3. Empty set is a relation
4. Asymmetric implies irreflexive
5. Asymmetric implies antisymmetric
6. A relation can be simultaneously Symmetric and antisymmetric
7. Symmetric and antisymmetric implies transitive
8. A relation can simultaneously be both reflexive and ir-reflexive implies all properties
9. reflexive and irreflexive implies all properties
10. Empty relation  $\phi$  is symmetric, antisymmetric, asymmetric, transitive, irreflexive and may or may not be reflexive depending upon the domain.