Manoeuvre
The Career Signature

Set and Relation

Symbol	Symbol Name	Meaning	Example
{ }	set	a collection of elements	A = {1, 7, 9, 13, 15, 23}, B = {7, 13, 15, 21}
A ∪ B	union	Elements that belong to set A or set B	A ∪ B = {1, 7, 9, 13, 15, 21, 23}
A ∩ B	intersection	Elements that belong to both the sets, A and B	A ∩ B = {7, 13, 15 }
A ⊆ B	subset	subset has few or all elements equal to the set	{7, 15} ⊆ {7, 13, 15, 21}
A ⊄ B	not subset	left set is not a subset of right set	{1, 23} ⊄ B
A ⊂ B	proper subset / strict subset	subset has fewer elements than the set	{7, 13, 15} ⊂ {1, 7, 9, 13, 15, 23}
A ⊃ B	proper superset / strict superset	set A has more elements than set B	{1, 7, 9, 13, 15, 23} ⊃ {7, 13, 15, }
A ⊇ B	superset	set A has more elements or equal to the set B	{1, 7, 9, 13, 15, 23} ⊃ {7, 13, 15, 21}
Ø	empty set	Ø = { }	C = {Ø}
P (C)	power set	all subsets of C	C = {4,7}, P(C) = {{}, {4}, {7}, {4,7}} Given by 2^s, s is number of elements in set C
A ⊅ B	not superset	set X is not a superset of set Y	{1, 2, 5} ⊅{1, 6}
A = B	equality	both sets have the same members	{7, 13,15} = {7, 13, 15}
A \ B or A-B	relative complement	objects that belong to A and not to B	{1, 9, 23}
A^c	complement	all the objects that do not belong to set A	We know, U = {1, 2, 7, 9, 13, 15, 21, 23, 28, 30} A^c = {2, 21, 28, 30}

A ∆ B	symmetric difference	objects that belong to A or B but not to their intersection	A ∆ B = {1, 9, 21, 23}
a∈B	element of	set membership	B = {7, 13, 15, 21}, 13 ∈ B
(a,b)	ordered pair	collection of 2 elements	(1, 2)
x∉A	not element of	no set membership	A = {1, 7, 8, 13, 15, 23}, 5 ∉ A
|B|, #B	cardinality	the number of elements of set B	B = {7, 13, 15, 21}, |B|=4
A×B	cartesian product	set of all ordered pairs from A and B	{3,5} × {7,8} = {(3,7), (3,8), (5,7), (5, 8) }
N_1	natural numbers / whole numbers set (without zero)	N_1 = {1, 2, 3, 4, 5,…}	6 ∈ N_1
N_0	natural numbers / whole numbers set (with zero)	N_0 = {0, 1, 2, 3, 4,…}	0 ∈ N_0
Q	rational numbers set	Q= {x | x=a/b, a, b∈Z}	2/6 ∈ Q
Z	integer numbers set	Z= {…-3, -2, -1, 0, 1, 2, 3,…}	-6 ∈ Z
C	complex numbers set	C= {z | z=a+bi, -∞<a<∞, -∞<b<∞}	6+2*i* ∈ C
R	real numbers set	R= {x | -∞ < x <∞}	6.343434 ∈ R

1. In a class of 40 students, 12 enrolled for both English and German. 22 enrolled for German. If the students of the class enrolled for at least one of the two subjects, then how many students enrolled for only English and not German?
   a) 30
   b) 10
   c) 18
   d) 28

2. Of the 200 candidates who were interviewed for a position at a call center, 100 had a two-wheeler, 70 had a credit card and 140 had a mobile phone. 40 of them had both, a two-wheeler and a credit card, 30 had both, a credit card and a mobile phone and 60 had both, a two wheeler and mobile phone and 10 had all three. How many candidates had none of the three?
   a) 0
   b) 10
   c) 20
   d) 15

3. In a class 40% of the students enrolled for Math and 70% enrolled for Economics. If 15% of the students enrolled for both Math and Economics, what % of the students of the class did not enroll for either of the two subjects?
   a) 5%
   b) 15%
   c) 0%
   d) 25%
   e) None of these

4. For two sets A and B, let AΔB denote the set of elements which belong to A or B but not both. If P = {1,2,3,4}, Q = {2,3,5,6,}, R = {1,3,7,8,9}, S = {2,4,9,10}, then the number of elements in (PΔQ)Δ(RΔS) is
   a) 7
   b) 8
   c) 9
   d) 6

5. Out of 80 students who appeared for the school exams in Mathematics (M), Physics (P) and Chemistry (C), 50 passed M , 30 passed P and 40 passed C. At most 20 students passed M and P at most 20 students passed P and C and at most 20 students passed C and M. The maximum number of students who could have passed all three exams is _____.

6. In a class of 50 students, it was found that 30 students read "Hitava", 35 students read "Hindustan" and 10 read neither. How many students read both: "Hitavad" and "Hindustan" newspapers?
   a) 25
   b) 20
   c) 15
   d) 30

7. If A = { x, y, z }, then the number of subsets in power set of A is
   a) 6
   b) 8
   c) 7
   d) 9

8. Let *L* be the set of all straight lines in the Euclidean plane. Two lines l_1 and l_2 are said to be related by the relation *R*i is parallel to l_2. Then the relation *R* is
   a) reflexive
   b) all
   c) reflexive & symmetric
   d) transitive & equivalence

9. $x^2 = xy$ is a relation which is
   a) reflexive
   b) none
   c) symmetric
   d) transitive

10. Let *S* be the set of all real numbers. Then the relation $R = \{(a, b) : 1 + ab > 0\}$ on *S* is
   a) Reflexive and symmetric but not transitive
   b) Symmetric, transitive but not reflexive
   c) Reflexive and transitive but not symmetric
   d) Reflexive, transitive and symmetric

11. Let x be a family of sets and R be relation on X defined by A is disjoint from B then R is
   a) reflexive
   b) symmetric
   c) transitive
   d) anti- symmetric

12. The relation "is subset of" on the power set *P*(*A*) of a set *A* is
   a) reflexive
   b) symmetric
   c) transitive
   d) anti- symmetric

13. Let $R = \{(1, 3), (4, 2), (2, 4), (2, 3), (3, 1)\}$ be a relation on the set $A = \{1, 2, 3, 4\}$. The relation R is
    a) reflexive
    b) symmetric
    c) transitive
    d) Not symmetric

14. If x ∈ N and x is prime, then x is _____ set.

    a) Infinite set
    b) Finite set
    c) Empty set
    d) Not a set

15. What is the Cartesian product of set A and set B, if the set A = {1, 2} and set 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) }

16. The members of the set S = {x | x is the square of an integer and x < 100} is _____

    a) {0, 2, 4, 5, 9, 55, 46, 49, 99, 81}
    b) {1, 4, 9, 16}
    c) {0, 1, 4, 9, 16, 25, 36, 49, 64, 81}
    d) {0, 1, 4, 9, 25, 36, 49, 123}

17. If n(A) = 20 and n(B) = 30 and n(A U B) = 40 then n(A ∩ B) is?

a) 20
b) 30
c) 40
d) 10

18. Which of the following statements is FALSE?

(a) C − (B ∪ A) = (C − B) − A
(b) A − (C ∪ B) = (A − B) − C
(c) B − (A ∪ C) = (B − C) − A
(d) A − (B ∪ C) = (B − C) − A

19. Let *A* and *B* be two non-empty subsets of a set *X* such that *A* is not a subset of *B*, then

a) A and the complement of B are always non-disjoint
b) A is always a subset of the complement of B
c) B is always a subset of A
d) A and B are always disjoint

20. The relation *R* = {(1, 1), (2, 2), (3, 3), (1, 2), (2, 3), (1, 3)} on set *A* = {1, 2, 3} is

a) Symmetric and Transitive
b) Neither symmetric nor transitive
c) Reflexive but not transitive
d) Reflexive but not symmetric

21. Let A ={1,2,3} , B= {3,4} ,C ={4,5,6 }Then A ∪ (B ∩C) is

a) {3}
b) {1,2,3,4}
c) {1,2,5,6}
d) {1,2,3,4,5,6}

22. Let A ={x:x is a multiple of 3} and B= {x:x is a multiple of 5}. Then A ∩ B is given by
    a) {3,6,9…..}
    b) {5,10,15,…}
    c) {15,30,45,….}
    d) None

23. If X ={8^n-7n-1: n ∈N} and Y ={49(n-1) : n ∈ N} then
    a) X ⊂ Y
    b) Y⊂ X
    c) X= Y
    d) None

24. Let A ={ (x,y) : y= e^x , x ∈ R} B = { (x,y) : y= e^{-x} , x ∈ R} then
    a) A ∩ B= Ø
    b) A ∩ B ≠ Ø
    a) A ∪ B =R^2
    b) None

25. If A and B are two sets then A∩ (A U B) equals
    a) A
    b) B
    c) Ø
    d) None

➢ Solutions:

1. Let A be the set of students who have enrolled for English and B be the set of students who have enrolled for German.

   Then, n(A ∪ B) is the set of students who have enrolled for at least one of the two languages. As the students of the class have enrolled for at least one of the two languages, we will not find anyone outside A ∪ B in this class.
   So, n(A ∪ B) = 40

   n(A ∪ B) = n(A) + n(B) - n(A ∩ B)
   i.e, 40 = n(A) + 22 - 12
   Or n(A) = 30 which is the set of students who have enrolled for English. This number is the sum of those who have enrolled for only English and those who have enrolled for both the languages.

   However, we have to find out the number of students who have enrolled for only English.
   n(only English)= n(English) - n(A ∩ B)
   = 30 - 12 = 18.

2. Number of candidates who had none of the three = Total number of candidates - number of candidates who had at least one of three devices.

   Total number of candidates = 200.

   Number of candidates who had at least one of the three = n(A ∪∪ B ∪∪ C)
   Where A is the set of those who have a two wheeler, B is the set of those who have a credit card and C is the set of those who have a mobile phone.

   n(A ∪∪ B ∪∪ C) = n(A) + n(B) + n(C) - {n(A ∩∩ B) + n(B ∩∩ C) + n(C ∩∩ A)} + n(A ∩∩ B ∩∩ C)

   Therefore, n(A ∪∪ B ∪∪ C) = 100 + 70 + 140 - {40 + 30 + 60} + 10
   Or n(A ∪∪ B ∪∪ C) = 190.

   As 190 candidates who attended the interview had at least one of the three gadgets, (200 - 190 = 10) candidates had none of three.

3. n(A ∪∪ B) = n(A) + n(B) - n(A ∩∩ B), where (A ∪∪ B) represents the set of people who have enrolled for at least one of the two subjects Math or Economics and (A ∩∩ B) represents the set of people who have enrolled for both the subjects Math and Economics.

   n(A ∪∪ B) = 40 + 70 - 15 = 95%

   That is 95% of the students have enrolled for at least one of the two subjects Math or Economics.

   Therefore, the balance (100 - 95)% = 5% of the students have not enrolled for either of the two subjects.

4. We have to find the number of elements in (P △ Q) △ (R △ S) if
   P = {1 , 2 , 3 , 4} Q = {2 , 3 , 5 , 6 ,} R = {1 , 3 , 7 , 8 , 9} S = {2 , 4 , 9 , 10}
   For P △ Q, we have to find the elements which do not to belong to both P and Q such that
   (P △ Q) = {1, 4 , 5 , 6}
   (R △ S) = {1 , 2 , 3 , 4 , 7 , 8 , 10}
   (P △ Q) △ (R △ S) = {2 , 3 , 5 , 7 , 6 , 8 , 10}
   The number of elements (P △ Q) △ (R △ S) is 7

5. M ∪ P ∪ C = 80 (assume 80 to get max value of x)
   M ∪ P ∪ C = M + P + C - (M ∩ P) - (P ∩ C) - (M ∩ C)+ M ∩ P ∩ C
   80 = 50 + 30 + 40 - (M ∩ P) - (P ∩ C) - (M ∩ C) + x
   (M ∩ P) + (P ∩ C) + (M ∩ C) = 40 + x
   At most 20
   So, 20 + 20 + 20 = 40 + x
   x_{max} = 20

6. P(x)=50,
   P(A ∩ B)' = 10
   So P(A ∪ B) = 50 - 10 = 40.
   So P(A ∩ B) = P(A) + P(B) - P(A ∪ B)
   = 30 + 35 - 40 = 25

7. option B By definition Power set of A, P(A) = {x}, {y}, {z}, {x,y}, {y,z}, {x,z}, {x,y,z} and {}

8. Option B
   Equivalence relations are relations that have the following properties:

   They are reflexive: A is related to A
   They are symmetric: if A is related to B, then B is related to A
   They are transitive: if A is related to B and B is related to C then A is related to C

9. Answer: Reflexive

10. Given relation is Reflexive and symmetric but not transitive

11. Clearly the relation is symmetric but it is neither reflexive nor transitive

12. The relation is not symmetric because $A \subset B$ does not imply that $B \subset A$. But it is anti –symmetric because $A \subset B$ and $B \subset A \Rightarrow A = B$

13. Given relation is clearly not symmetric.

14. Infinite set as There is no extreme prime, so the number of primes is infinite.

15. A subset R of the Cartesian product A x B is a relation from the set A to the set B. thus answer is C.

16. The set S contains the square of an integer less than 10. Option C is correct

17. By using the formula we can calculate $n(A \cap B)$,

    $n(A \cup B) = n(A) + n(B) - n(A \cap B)$.

    $n(A \cap B) = n(A) + n(B) - n(A \cup B)$

    $n(A \cap B) = 20 + 30 - 40$

    So, $n(A \cap B) = 10$

18. From definitions $A - (B \cup C) = (B - C) - A$

19. For the given case A and the complement of B are always non-disjoint hence correct answer is option A.

20. From the given sets it can be concluded that relation is reflexive but not symmetric.

21. Option B

22. x is multiple of 3 and also x is multiple of 5 thus x is multiple of 15.
thus $A \cap B = \{ x : x \text{ is multiple of } 15.\}$
$A \cap B = \{ 15,30,45,\ldots.\}$

23. We have $8^n-7n-1 = (7+1)^n - 7n - 1$
$= {}^nC_2 7^2 + {}^nC_3 7^3 + {}^nC_4 7^4 + \ldots\ldots..$
$= 49 ({}^nC_2 + {}^nC_3 7^1 + {}^nC_4 7^2 \ldots\ldots\ldots..)$ For $n >= 2$
For $n=1$, $8^n-7n-1 = 0$ Thus x consists of integral multiples of 49. Also Y consists of integral multiples of 49 including zero. Therefore, $X \subset Y$

24. A set consists of all points on the curve $y = e^x$ and B set consists of all points on the curve $y = e^{-x}$.
These curves intersect at single point (0,1)thus $A \cap B$ is not a null set .Thus option B is correct.

25. Ans is A.