ACKNOWLEDGEMENT

We would like to thank **Muhammad Akram Khan** for his time and competent effort. Without his help, it would not have been possible to review and upgrade this book.

SETS

SETS

A collection of well defined and distinct objects is called a set. Each object in the set is called elements of a set.

NUMBER OF ELEMENTS

No of elements of set A is denoted by $n(A)$ or $0(A)$ or $|A|$

$n(\phi) = 0$

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

or

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

$n(A') = n(\cup) - n(A)$

SOME WELL KNOWN SETS

Notations for Sets of Numbers

i) $N = \{1, 2, 3, \ldots\}$
i.e., the set of all natural numbers

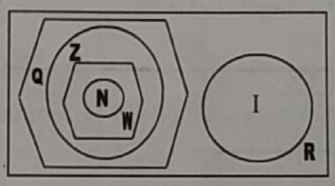
ii) $W = \{0, 1, 2, 3, \ldots\}$
i.e., the set of whole numbers.

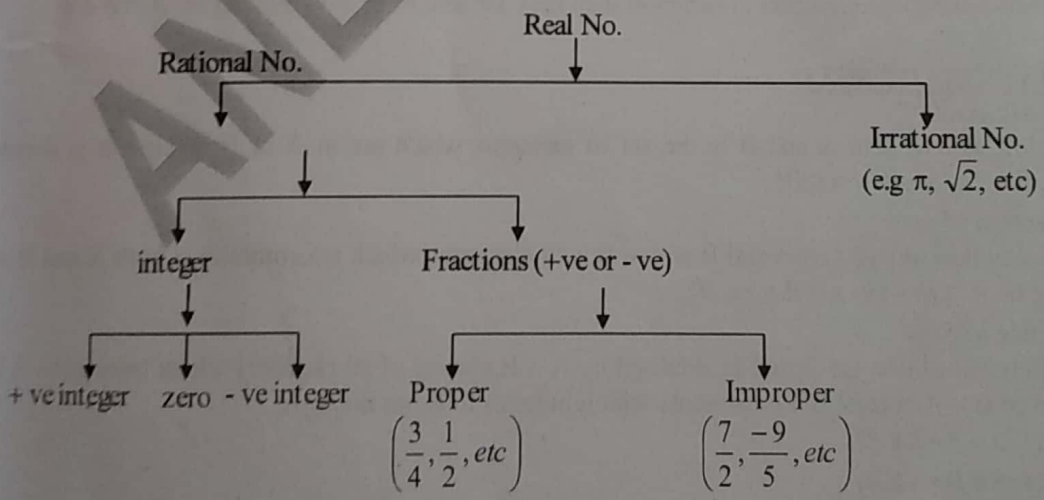
iii) $Z = \{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$
i.e., the set of all integers.

iv) $Q = \left\{x \mid x = \frac{p}{q}, p \text{ and } q \in Z, q \neq 0\right\}$
i.e., the set of all rational numbers.

v) $I = \left\{x \mid x \neq \frac{p}{q}, p \text{ and } q \in Z, q \neq 0\right\}$
i.e., the set of all irrational numbers.

vi) $R = \left\{x \mid x = \frac{p}{q}, \text{or } x \neq \frac{p}{q}, p \text{ and } q \in Z, q \neq 0\right\}$
i.e., the set of all real numbers.





DIFFERENT WAYS OF DESCRIBING A SET

i) Descriptive Method, { set of first five Even Numbers }
ii) Tabular Method, { 2, 4, 6, 8, 10 }
iii) Set–Builder Method, $\{x : x \in E \wedge x \leq 10\}$

SUBSETS AND SUPERSETS

A set B is a subset of a set A, denoted by $B \subseteq A$, if every element of B is also an element of A.

Note:
i) Ø is a subset of every set A.
ii) Every non–empty set has a least two subsets, i.e., A itself and Ø.
iii) If A contains n elements, then 2^n different subsets can be formed from its elements.

PROPER SUBSET AND IMPROPER SUBSET

If A is subset of B and B contains at least one element which is not an element of A, then A is a proper subset of B[$A \subset B$].

EQUAL SETS AND EQUIVALENTS SETS

Two sets A and B are equal [A=B], if and only if each element of A also contain in B and vice versa.
Two sets A and B are said to be equivalent, denoted by A~B, if they have same number of elements, i.e. O(A)=O(B).

Note:
i) Equal sets are also Equivalent set, but not vice versa.
ii) A~B and B~C then A~C. This is called the transitive property of equivalence of sets.

UNIVERSAL SETS (U)

Universal set is the set, which contains all the available elements.

NULL SET

A null set { } or empty set is the set which contains no elements. It is also denoted by ϕ

DISJOINT SETS

If two sets do not have an element in common, they are said to be disjoint as $A \cap B = \phi$.

OVER LAPPING SETS

If two sets have some elements in common then they are said to be over lapping as $A \cap B \neq \phi$

OPERATIONS OF SETS

i) **Union of Sets**
The union of two sets A and B is the set of elements which are in A or B or both it is denoted by $A \cup B = \{x / x \in A \vee x \in B\}$.

ii) **Intersection of sets**
The intersection of two sets A and B is two sets of elements, which are common to both A and B it is denoted by $A \cap B = \{x / x \in A \wedge x \in B\}$.

iii) **Difference of Sets**
The difference of two set A and B, denoted by A – B consist of all elements which belongs to A but not to B or B – A consist of all elements which belongs to B but not to A.
A – B $\{x / x \in A \wedge x \notin B\}$
B – A $\{x / x \in B \wedge x \notin A\}$

iv) **Complement**
The complements of a set A relative to a universal set U is the set of all elements in U except those in A denoted by A' and $A' = \cup - A$. $A' = \{x / x \in \cup \wedge x \notin A\}$

v) **Cartesian Product of two Sets**
The Cartesian production of any set A with other set B is the set of all ordered pairs (x, y) Where $x \in A$ *and* $y \in B$ it is denoted by $A \times B = \{(x, y) / x \in A,\ y \in B\}$.

EXHAUSTIVE SETS
If A and B be subset of set U such that
$A \cup B = \cup$
Then the sets A and B are called "Exhaustive sets".

CELLS
If two exhaustive set are disjoint then they are known as cells or partitioned sets such that $A \cup B = \cup$ *and* $A \cap B = \phi$.

PROPERTIES OF OPERATIONS ON SETS
i) Closure property holds for union, intersection and difference between any two sets.
ii) Commutative property holds for union and intersection only, not for difference.
iii) Associative property holds for union and intersection only.
iv) Identity holds only w.r.t union of sets.

DISTRIBUTIVE LAWS
If A, B and C are three sets then

$A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
$A \times (B \cup C) = (A \times B) \cup (A \times C)$
$A \times (B \cap C) = (A \times B) \cap (A \times C)$

DE MORGAN'S LAWS
If A and B are any two sets then

$(A \cup B)' = A' \cap B'$
$(A \cap B)' = A' \cup B'$

SELF SCORER

1. U, A and B are three sets then $A \subseteq$ ____ where $\cup$ is a universal set
   A. $A \cap B$ ✓B. $A \cup B$
   C. A' D. B'

2. If A and B are two sets then $A \cup B = A$ if
   A. $A \subseteq B$ B. $A \not\subset B$
   ✓C. $B \subseteq A$ D. $B \not\subset A$

3. If A and B are two sets $A \cup B = A \cap B$ if
   A. $A \subset B$ ✓B. $A = B$
   C. $A \not\subset B$ D. $A \neq B$

4. If U and A are two sets the $A' = U - A$ is defined as
   A. $\{x \mid x \in U\}$ B. $\{x \mid x \in A\}$
   C. $\{x \mid x \in U \text{ or } x \notin A\}$ D. $\{x \mid x \in U \text{ and } x \notin A\}$

5. If B and C are two improper subsets and $B \subseteq C$ *and* $C \subseteq B$ if
   A. $C \neq B$ B. $C \cup B = C$
   C. $C \cup B = B$ D. $C = B$

6. $A \subseteq B$ then $A \cap B$ is
   A. $B - A$ B. B
   C. $A - B$ D. A

7. If A and B are two sets then
   A. $A \cup B \subseteq A \cap B$ B. $A \cap B \subseteq A \cup B$
   C. $A \cup B = A \cap B$ D. None of these

8. If Z : Set of all integers
   W : Set of whole number
   N : Set of natural No.
   R : Set of real number
   Q : Set of rational number

   Then which one of the following selection is correct.
   A. $Z \supseteq W \supseteq N \supseteq Q$ B. $R \supseteq W \supseteq N$
   C. $N \subseteq W \subseteq Z$ D. $Q \subseteq R \subseteq Z$

9. State which of the following statements are not true:
   i. $(A \cup B) \cup C = A \cup (B \cup C)$ ii. $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
   iii. $A - (B \cup C) = (A - B) \cap (A - C)$ iv. $A - (B \cap C) = (A - B) \cup (A - C)$
   A. I & IV are not true B. II & IV are not true
   C. IV is not true D. all are true

10. If $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ then this property is called _____.
    A. Associative property of union
    B. Associative property of inter section
    C. Distributive property of union over intersection
    D. Distributive property of intersection over union

11. If $A = \{1, 2, 3\}$ $B = \{1, 2\}$ Then which one of the following relation is correct
A. $A \cap B \subseteq A$ B. $A \cap B \subseteq A \cup B$
C. $A \cup B \subseteq A$ D. All of these

12. If $A = \{1, 2, 3\}$ and $B = \{3, 1, 2\}$ then
A. $A \supset B$ B. $B \subset A$
C. $A = B$ D. $B \sim A$

13. $U = \{1, 2, 3\}$, $A = \{1, 2\}$, $B = \{2, 3\}$, $C = \{1, 3\}$ Then $(A \cup B \cup C)'$ is
A. A B. B
C. C D. ϕ

14. $A = \{2, 3\}$, $B = \{3, 4\}$, $C = \{4, 5\}$ Then $(A \times B) \cap (A \times C)$ is
A. $A \times (B \times C)$ B. $A \cap (B \times C)$
C. $A \times (B \cap C)$ D. None of the above

15. $S = \{0, 1\}$, $T = \{2, 3\}$ then $S \times T = ?$
A. $\{(0,2),(0,3),(1,2),(1,3)\}$ B. $\{\ \}$
C. $\{(0,1,2)\}$ D. It cannot be determined

16. If $A = \{x \mid x^2 = 16 \text{ and } 2x = 4\}$ then A is a
A. Proper set B. Subset of A
C. Null set D. None of these

17. Given that $U = \{0, 1, 2, 3\}$ $A = \{0, 1, 2\}$ $B = \{1\}$ and $C = \{2, 3\}$ then the set A, B and C are
A. Cells B. Exhaustive set
C. Commutative set D. Disjoint set

18. Let A be the set of prime number less than 50 and B be set of odd number greater than 40, then $A \cap B$ is:
A. B B. $\{41, 43, 47\}$
C. $\{41, 43, 45, 47, 49\}$ D. A

19. If $A = \{a,b,c\}$
$B = \{3,4,5\}$
Then the relation b/w A and B is
A. $A = B$ B. $A \sim B$
C. $A \neq B$ D. $A \neq B$

20. If $E = \{\text{month of the year}\}$
$F = \{\text{month with only 30 days}\}$
$G = \{\text{month with 31 days}\}$
Then which one is correct
A. $G \subseteq F$ B. $G \subset E$
C. $F \subseteq G$ D. $F \not\subseteq E$

21. $U = \{1, 2, 3\}$, $A = \{2, 3\}$, $B = \{1, 3\}$
$(A \cup B)'$
A. $\emptyset$ B. $\{1, 2\}$
C. $\{1, 3\}$ D. $\{1\}$

22. $A' \cap B' = ?$

A. $(A \cup B)'$ B. $(A \cap B)'$

C. $A' \cup B'$ D. None

23. $A = \{e, f, g\}, B = \{x, y, z\}$ & $U = \{e, f, g, x, y, z\}$ then set "A" & "B" are called

A. Exhaustive set B. Cells

C. Union of sets D. Overlaping sets

24. $A = \{e, f, g\}$ & $B = \{f, x, y, z\}$ & $U = \{e, f, g, x, y, z\}$ then "A" & "B" are called

A. exhaustive set B. Cells

C. union of sets D. Disjoint sets

25. Let $m = \{r, s, t\}$ which of the following is true

i. $r \in m$ ii $r \subset m$

iii. $\{r\} \in m$ iv. $m \supset r$

A. i only B. iii only

C. i & iv D. i & iii

26. We have

i) Ø ii) { }

iii) {0} iv) {Ø}

Which of these is a null set?

A. i & iv B. ii & iv

C. i, ii & iv D. i, ii

27. Let $V = \{d\}$, $W = \{c, d\}$, $X = \{a, b, c,\}$, $Y = \{a, b\}$ and $Z = \{a, b, d\}$. Which of the following statement is false

i. $Y \subset X$ ii. $W \not\supset V$

iii. $V \not\subset Y$ iv. $Z \supset V$

A. i only B. ii only

C. iii only D. ii & iv

28. Let A be a subset of B and let B be a subset of C, that is, $A \subset B$ and $B \subset C$, suppose $a \in A$, $b \in B$, $c \in C$, and suppose $d \notin A$, $e \notin B$, $f \notin C$. Which of the following statements must always be true:

i. $a \in C$ ii. $b \in A$

iii. $c \notin A$ iv. $e \notin A$

A. i only B. ii only

C. iii only D. i & iv

29. Let $A = \{2, \{4, 5\}, 4\}$; which of the following statements is incorrect

A. $\{4, 5\} \subset A$ B. $\{4, 5\} \in A$

C. $\{\{4, 5\}\} \subset A$ D. None of the above

30. Let $S = \{3, \{1, 4\}, 2\}$; The number of elements in power set of S will be:

A. 6 B. 8

C. 12 D. 16

31. If S is only non–empty set then which of the following is correct?

A. $S \subset P(S)$ B. Both C & D

C. $S \in P(S)$ D. $\{S\} \subseteq P(S)$

32. Let U = {1, 2, 3, ..., 9}, A = {1, 2, 3, 4}, B = {2, 4, 6, 8} and C = {3, 4, 5, 6}, then $(A \cap C)' = ?$
A. U
B. {1, 2, 5, 6, 7, 9}
C. {1, 2, 5, 6, 8, 9}
D. {1, 2, 5, 6, 7, 8, 9}

33. Let U = {1, 2, 3, ..., 9}, A = {1, 2, 3, 4}, B = {2, 4, 6, 8} and C = {3, 4, 5, 6}, then $A' \cap B' = ?$
A. {5, 6, 9}
B. {5, 7, 8, 9}
C. {5, 7, 9}
D. None of the above

34. Let U = {a, b, c, d, e}, A = {a, b, d} and B = {b, d, e}, then $A' \cap B = ?$
A. {a}
B. {b}
C. {c}
D. {e}

35. Let U = (a, b, c, d, e}, A = (a, b, d} and B = {b, d, e}, then $B' - A'$ is
A. {a}
B. {b}
C. {c}
D. {b, c}

36. Let U = (a, b, c, d, e, f, g}, A = (a, b, c, d, e} and B = {a, c, e, g}, and C = {b, e, f, g} then $(A - C)' = ?$
A. {a, c, f, g}
B. {b, e, f, g}
C. {b, c, f, g}
D. None of the above

37. Let U = (a, b, c, d, e, f, g}, A = (a, b, c, d, e} and B = {a, c, e, g}, and C = {b, e, f, g} then $(A \cap A')' = ?$
A. A
B. A′
C. B′
D. U

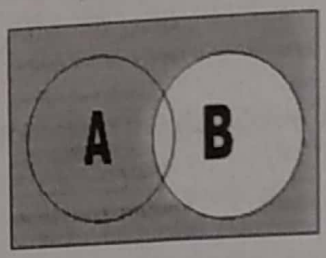
38. Let A = {a, b}, B = {2, 3} & C = {3, 4}, then $A \times (B \cup C) = ?$
A. {(2, a), (2, b), (3, a), (3, b), (4, a), (4, b)}
B. {(a, 2), (a, 3), (a, 4), (b, 2), (b, 3), (b, 4)}
C. {(a, 2), (a, 3), (a, 4), (c, 2), (c, 3), (c, 4)}
D. None of the above

39. Let A = {a, b}, B = {2, 3} & C = {3, 4}, then $A \times (B \cap C) = ?$
A. {(a, 3), (b, 3)}
B. {(3, a), (3, b)}
C. {(a, b), 3}
D. None of the above

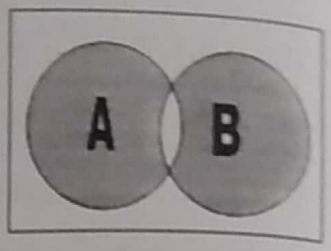
40. Which of the following statement is true
i. $A \times (B \cup C) = (A \times B) \cap (A \times C)$
ii $A \times (B \cup C) = (A \times B) \cup (A \times C)$
iii. $A \times (B \cap C) = (A \times B) \cup (A \times C)$
iv. $A \times (B \cap C) = (A \times B) \cap (A \times C)$
A. i & iii
B. i & iv
C. ii & iv
D. ii & iii

41. The Venn diagram for $A' \cap B'$ is

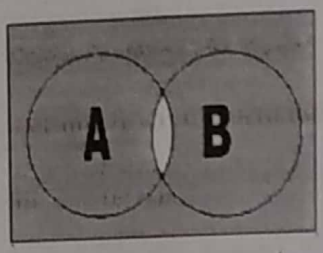
A.



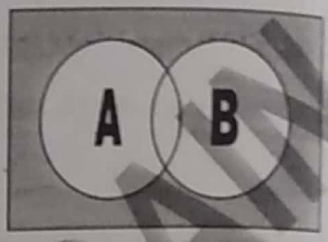
B.



C.

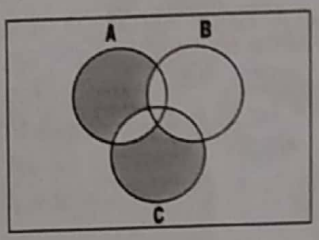


D.

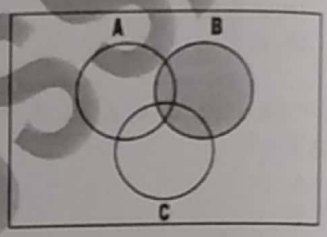


42. The correct Venn diagram for $(A \cap B) \cup (A \cap C)$ is

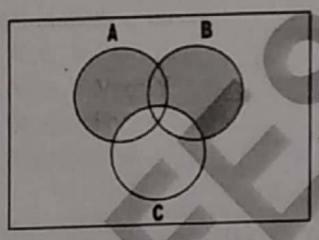
A.



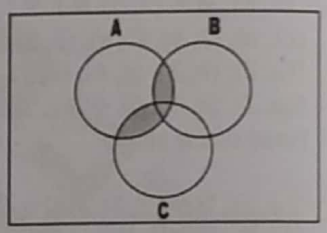
B.



C.

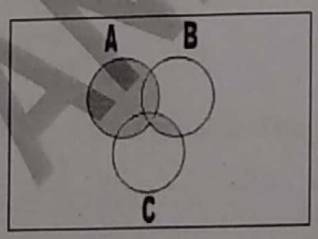


D.

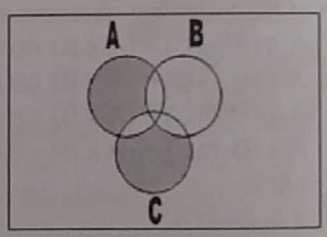


43. Venn diagram for $(A \cup B) \cap (A \cup C)$ is

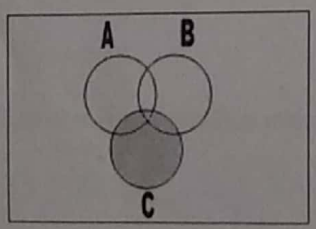
A.



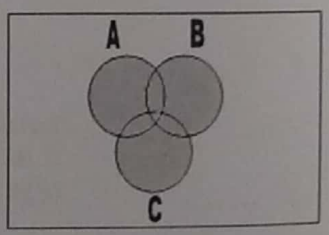
B.



C.

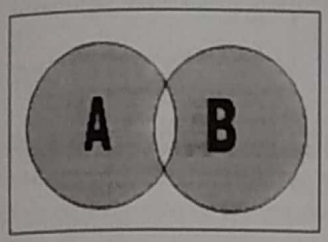


D.

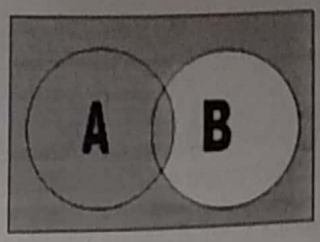


44. Venn diagram for $(B-A)'$ is

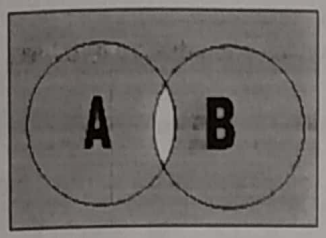
A.



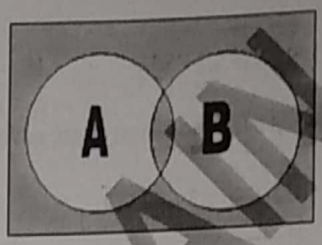
B.



C.

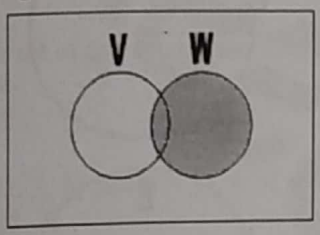


D.

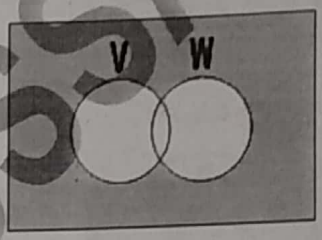


45. Venn diagram for $V' \cup W$ is

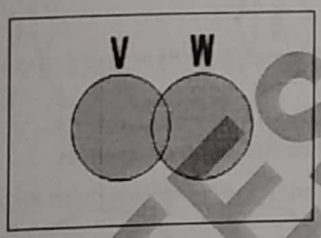
A.



B.



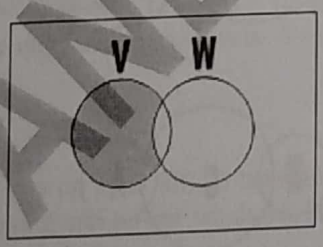
C.



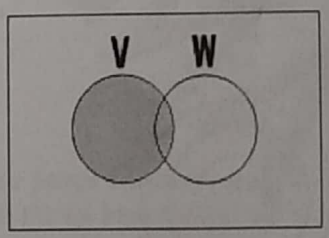
D. None of the above

46. The Venn diagram for $V' - W'$ is

A.



B.



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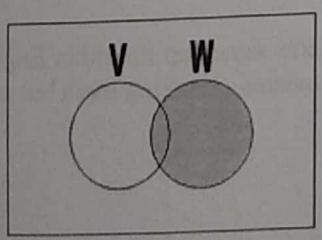
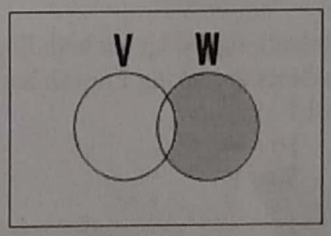
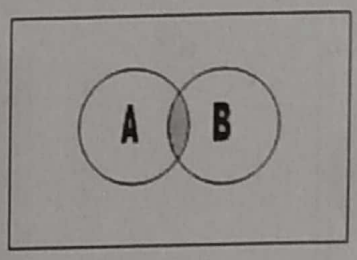


D.



47.

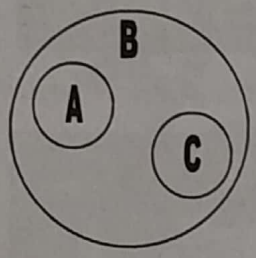


The above Venn diagram represents:

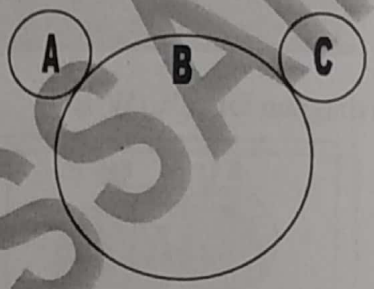
A. $A \cap B$ B. $B \cup A$
C. $A - B$ D. $B - A$

48. If A, B, C are non–empty sets such that $A \subset B$, $C \not\subset B$ $A \cap C \neq \emptyset$, then the Venn diagram will be

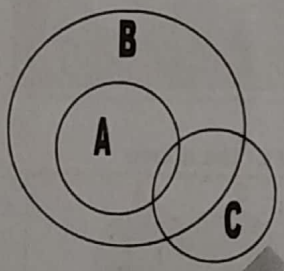
A.



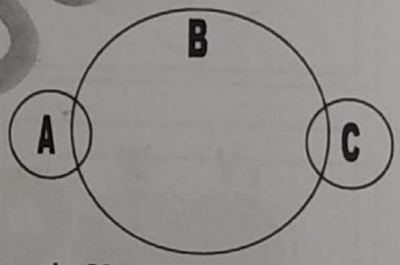
B.



C.

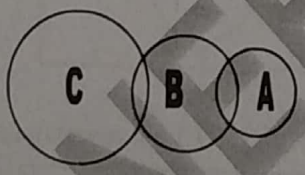


D.

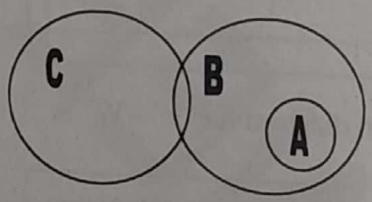


49. If A, B, C are non–empty sets such that $A \subset B$, $B \subseteq C$, then the Venn diagram is

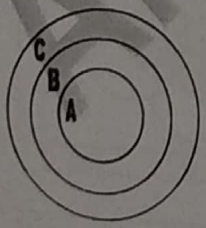
A.



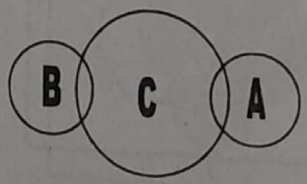
B.



C.



D.



50. 50 students signed up for both English and Math. 90 students signed up for either English or Math. If 25 students are taking English but not Math, how many students are taking math but not taking English?

A. 10 B. 15
C. 50 D. 65

51. Of the 410 students at Kennedy High School, 240 study Spanish and 180 study French. If 25 study neither language, how many students study both?
A. 35 B. 15
C. 20 D. 25

52. 70 Students are enrolled in Math, English, or German. 40 students are in Math, 35 are in English, and 30 are in German. 15 students are enrolled in all three of the courses. How many of the students are enrolled in exactly two of the courses: math, English and German?
A. 5 B. 10
C. 15 D. 20

53. Which of the following is the commutative law?
A. $A \cap B' = B \cap A'$ B. $A \cap B = B \cap A$
C. $A \cap B = B' \cap A$ D. $A \cap B = B \cap A'$

54. The numbers $\sqrt{3}, \sqrt{5}, \sqrt{7}, \sqrt{13}$ and $\sqrt{17}$ are
A. Odd B. Rational
C. Irrational D. Integers

55. If power set of any set contain 32 elements, then find the number of elements of that set.
A. 4 B. 5
C. 3 D. 7

56. If A = {2, 3, 4} and B = {3, 4, 5} then which of the following is the element of the set A x B.
A. (3, 2) B. (5, 3)
C. (4, 2) D. (3, 5)

57. If, A = {a, b, d}, B = {b, c, d} and U = {a, b, c, d, e}. Find $B' - A'$
A. $B - A$ B. $A - B$
C. $A' - B'$ D. None

58. What is the relationship between the sets F and G, if $F \cap G = F \cup G$
A. $F \cap G$ B. $F = G$
C. $G \not\subseteq F$ D. $F \not\subseteq G$

59. Let A = {2, 3}, B = {3, 4}, C = {c, f} and U = {2, 3, 4, c, f},
Find the number of elements in $A \times (B \cap C)$
A. 0 B. 2
C. 6 D. 8

60. The 65 cars on a car lot, 45 have air – conditioning, 30 have power windows, and 12 have both air conditioning and power windows. How many of the cars on the lot have neither air – condition nor power windows?
A. 2 B. 8
C. 10 D. 15

SETS

ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10
Answer	B	C	B	D	D	D	B	C	D	C

Question	11	12	13	14	15	16	17	18	19	20
Answer	D	C	D	C	A	C	B	B	B	B

Question	21	22	23	24	25	26	27	28	29	30
Answer	A	A	B	A	A	D	B	D	A	B

Question	31	32	33	34	35	36	37	38	39	40
Answer	B	D	C	D	A	B	D	B	A	C

Question	41	42	43	44	45	46	47	48	49	50
Answer	D	D	A	B	D	D	A	C	C	B

Question	51	52	53	54	55	56	57	58	59	60
Answer	A	A	B	C	B	D	B	B	A	A