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Ans. 1

(a) 41 is Composite number?

False:
Because 41 have only two divisior.

(b) $3+6 = 3+9$

False

(c) 2 is Prime number

True

Ans. 2

(a) $x + 5 \neq 8$ when $x = 3$

False

(b) $5 \in \{4, 2, x\}$, when $x = 5$

True

(c) $3x + 5y = 11$ when $x = 0, y = 2$

False

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Ans. 3

(a) Disjunction :

A disjunction is a compound statement formed by combining two statements using the word or.

(b) Open Statement :

An open statement is a sentence containing one or more variable.

(c) Implication :

An implication is the compound statement of the form " if P, then q."

- It is denoted $P \Rightarrow q$.

(d) Biconditional :

A Biconditional is a logical conditional statement in which the antecedent and consequent are interchangeable.

Ans. 4

(a) Converse : If a number is multiple of 8, then the number is even

Inverse : If a number is not a multiple of 8, then the number is not even

Negation : It is not true that if a number is a multiple of 8, then the number is even.

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(c) Converse : If a quadrilateral is a rectangle, then it has two pairs of parallel sides.

Inverse : If a quadrilateral is not a rectangle, then it does not have two pairs of parallel sides

Negation : It is not true that if a quadrilateral is a rectangle, then it has two pairs of parallel sides.

(a) Converse : if x is real, then x is rational.

Inverse : If x is not rational, then x is not real.

Negation : It is not true that if x is rational, then x is real

(b) Converse : If two angles are congruent, then they have the same measure.

Inverse : If two angles do not have the same measure then they are not congruent.

Negation : It is not true that if two angles congruent then they have the same measure.

(d) Converse : If it rains, then they cancel school.

Inverse : If they cancel school, then it is raining

Negation : It is not true that if it rains, then they cancel school.

Ans. 6. $P \vee (q \wedge r) = (P \vee q) \wedge (P \vee r)$

$P \in P$ or $Q \in (q$ and $r)$

$P \in P$ or $(Q \in q$ and $Q \in r)$

$P \in P$ or q and $P \in P$ or $P \in r$

$P \in (P \vee q)$ and $P \in (P \vee r)$

$(P \vee q) \wedge (P \vee r)$

Ans. 7 Prove biconditional eqivalance

if A is true, then B is true
if B is true, then A is true

if P and q are two Proposition then $P \to q$ and $q \to P$ is called biconditional eqivalence.

$A \leftrightarrow B = A \to B \wedge B \to A$

example : $(A \wedge B) \leftrightarrow (B \wedge A)$

A	B	$A \wedge B$	$B \wedge A$	$(A \wedge B) \leftrightarrow (B \wedge A)$
T	T	T	T	T
T	F	F	F	T
F	T	F	F	T
F	F	F	F	T

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Ans. 8 $[(A \to B) \land A] \to B$ is tautology

A	B	$A \to B$	$(A \to B) \land A$	$[(A \to B) \land A] \to B$
T	T	T	T	T
T	F	F	F	T
F	T	T	F	T
F	F	T	F	T

All the values of $[(A \to B) \land A] \to B$ is true
so, that this ~~[illegible]~~ eqn is tautology

Ans. 9 $(A \lor B) \land [(\sim A) \land (\sim B)]$

A	B	$A \lor B$	$\sim A$	$\sim B$	$(\sim A) \land (\sim B)$	$(A \lor B) \land [(\sim A) \land (\sim B)]$
T	T	T	F	F	F	F
T	F	T	F	T	F	F
F	T	T	T	F	F	F
F	F	F	T	T	T	F

all the values are false, so it's called contradiction.

Ans. 10 $(A \lor B) \land (\sim A)$

A	B	$A \lor B$	$(A \lor B) \land (\sim A)$
T	T	T	F
T	F	~~F~~ T	F
F	T	~~F~~ T	T
F	F	F	F

→ This is neither tautology nor contradiction so it's a contengency

Ans. 11 $[(P \to q) \wedge (q \to r)] \to (P \to r)$

p	q	r	$p \to q$	$q \to r$	$(p \to q) \wedge (q \to r)$	$p \to r$	
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	F	T	F	T	T
T	F	F	F	T	F	F	T
F	T	T	T	T	T	T	T
F	T	F	T	F	F	T	T
F	F	T	T	T	T	T	T
F	F	F	T	F	F	T	T

Tautology

(b) $((P \vee q) \wedge \sim P) \to q$

p	q	$\sim p$	$p \vee q$	$(p \vee q) \wedge \sim p$	$((p \vee q) \wedge \sim p) \to q$
T	T	F	T	F	T
T	F	F	T	F	T
F	T	T	T	T	T
F	F	T	F	F	T

- Tautology

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(c) $(p \to q) \leftrightarrow (q \vee \sim p)$ tautology

p	q	$\sim p$	$p \to q$	$q \vee \sim p$	$(p \to q) \leftrightarrow (q \vee \sim p)$
T	T	F	T	T	T
T	F	F	F	F	T
F	T	T	T	T	T
F	F	T	T	T	T

Ans. 12 Distuributive laws are logically equivalent

$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$

p	q	r	$q \wedge r$	$p \vee (q \wedge r)$	$p \vee q$	$p \vee r$	$(p \vee q) \wedge (p \vee r)$
T	T	T	T	T	T	T	T
T	T	F	F	T	T	T	T
T	F	T	F	T	T	T	T
T	F	F	F	T	T	T	T
F	T	T	T	T	T	T	T
F	T	F	F	F	T	F	F
F	F	T	F	F	F	T	F
F	F	F	F	F	F	F	F

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Ans. 13 $(p \to (q \land r)) \land (\sim p \to (\sim p \land \sim r)) \equiv (p \land q \land r) \lor (p' \land q \land r')$
$\lor (p' \land q' \land r')$

p	q	r	$q \land r$	$p \to (q \land r)$	$\sim p$	$\sim r$	$\sim p \land \sim r$	$\sim p \to (\sim p \land \sim r)$
T	T	T	T	T	F	F	F	T
T	T	F	F	F	F	T	F	T
T	F	T	F	F	F	F	F	T
T	F	F	F	F	F	T	F	T
F	T	T	T	T	T	F	F	F
F	T	F	F	T	T	T	T	T
F	F	T	F	T	T	F	F	F
F	F	F	F	T	T	T	T	T

Ans: 14 Find logically equivalent form

$((p \to q) \to q) \to p$

p	q	$(p \to q)$	$(p \to q) \to q$	$((p \to q) \to q) \to p$
T	T	T	T	T
T	F	F	T	T
F	T	T	T	F
F	F	T	F	T

logical equivalent form is

$((p \to q) \to q) \to p \equiv (p \land q) \lor (p \land q') \lor (p' \land q')$

Eq^n

T
F
F
F
F
T
F
T

Ans: 15 →

Show that $q \to p$, and $\sim p \to \sim q$ is not equivalent to $p \to q$

p	q	$\sim p$	$\sim q$	$q \to p$	$\sim p \to \sim q$	$p \to q$
T	T	F	F	T	T	T
T	F	F	T	T	T	F
F	T	T	F	F	F	T
F	F	T	T	T	T	T

from above value of $q \to p$, $\sim p \to \sim q$ and $p \to q$ we prove that $q \to p$, and $\sim p \to \sim q$ is not equivalent to $p \to q$

Ans. 16 $p \leftrightarrow q = p \to q \wedge q \to p$

p	q	$p \to q$	$q \to p$	$p \to q \wedge q \to p$	$p \leftrightarrow q$
T	T	T	T	T	T
T	F	F	T	F	F
F	T	T	F	F	F
F	F	T	T	T	T

From above Truth-table we prove that

$$p \leftrightarrow q = p \to q \wedge q \to p$$

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Ans. 17

(a) $(P \to q) \wedge (q \to P)$

$\to (\sim P \vee q) \wedge (\sim q \vee P)$

(b) $\sim (P \vee q) \leftrightarrow (P \wedge q)$

$\sim (P \vee q) \to (P \wedge q) \wedge (P \wedge q) \to \sim (P \vee q)$

$(\sim (\sim P \vee q)) \vee (P \wedge q) \wedge (\sim (P \wedge q)) \vee (\sim (P \vee q))$

Ans. 18 Symmetric diff. of two sets.
The set which contains the elements which are either in set A or in set B but not in both is called.

Ex. $A = \{1, 2, 3\}$
$B = \{2, 3, 4\}$

$A - B = \{1\}$ $B - A = \{4\}$

(b) class of sets :
Collection of different type of sets.
→ subset, null set, finite and infinite sets

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(c) Power Set :

Set of all subset is known as Power Set

Ex: A = {a, b, c}

P(A) = { {a}, {b}, {c}, {a, b}, {a, c}, {b, c}, {a, b, c} }

(d) Proper Subset :

A Proper Subset is one that contains a few elements of the original set.

A = {2, 4, 6}, B = {2, 4, 8}

A is Proper subset of B because {8} is not in A

(e) Disjoint Set :

A Pair of set which does not have any common element are called

A = {2, 3}
B = {4, 5}

(f) Difference of two sets

: A Set of element which belong A but not to B

A = {1, 2, 3}
B = {2, 3, 4}

A - B = {1}

(h) Superset :

A set have all the elements of another set. then that set called super set

$A = \{1, 2, 3, 4\}$
$B = \{2, 3, 4\}$

A is super set

Ans. 19 $P(A)$ = People in Bus = 30
$P(B)$ = People in train = 35
$P(C)$ = People in auto-mobile = 100
$P(A \cap B)$ = Bus and train = 15
$P(B \cap C)$ = train and auto-mobile = 20
$P(B \cap C)$ = Bus and auto-mobile = 15
$P(A \cap B \cap C)$ = train and bus and auto-mobile = 5

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C)$$

$$= 30 + 35 + 100 - 15 - 20 - 15 + 5$$

$$= 120$$

120 People completed survey form.

Ans. 20 total int = 250

(A) $|A| = \left[\frac{250}{3} \right] = 83$

$|B| = \left[\frac{250}{5} \right] = 50$, $|C| = \left[\frac{250}{7} \right] = 35$

$|A \cap B| = \left[\frac{250}{3 \times 5} \right] = 16$

$|A \cap C| = \left[\frac{250}{3 \times 7} \right] = 11$, $|B \cap C| = \left[\frac{250}{5 \times 7} \right] = 7$

$|A \cap B \cap C| = \left[\frac{250}{3 \times 5 \times 7} \right] = 2$

$|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C|$

$= 83 + 50 + 35 - 16 - 11 - 7 + 2$

$= 136$

$|A \cup B| = |A| + |B| - |A \cap B| = 133 - 16 = 117$

3 or 5 but not by 7

$|A \cup B \cup C| - |C| = 136 - 35 = 101$

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Ans. 21 $|X| = 100$

$|A| = 32$
$|B| = 20$
$|C| = 45$

$|A \cap C| = 15$
$|A \cap B| = 7$
$|B \cap C| = 30$

$(A' \cap B' \cap C') = 30$

$(A \cup B \cup C) = X - (A' \cap B' \cap C')$
$= 100 - 30$
$= 70$

$|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C|$

$70 = 32 + 20 + 45 - 15 - 7 - 30 + |A \cap B \cap C|$

$|A \cap B \cap C| = 5$

for exactly one

Maths $= |A| - |A \cap B| - |A \cap C| + |A \cap B \cap C|$
$= 32 - 7 - 15 + 5$
$= 15$

Phy $= |B| - |B \cap C| - |A \cap B| + |A \cap B \cap C|$
$= 20 - 7 - 10 + 5$
$= 8$

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Biology: $|C| - |A \cap C| - |B \cap C| + |A \cap B \cap C|$
$= 45 - 15 - 10 + 5$
$= 25$

Number of students for exactly one
$= 15 + 8 + 25$
$= 48$

Ans. 22 $|A| = 20,000$ $\quad |A \cup B \cup C| = 52,000$
$|B| = 36,000$
$|C| = 12,000$
$|B \cap C| = 6000$
$|A \cap B| = 9000$
$|A \cap C| = 5000$

(A) $|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |B \cap C| - |A \cap C| + |A \cap B \cap C|$

$52,000 = 20,000 + 36,000 + 12,000 - 6000 - 9000 - 5000 + |A \cap B \cap C|$

$|A \cap B \cap C| = 4000$

(B) exactly one

$= |A| + |B| + |C| - 2|A \cap B| - 2|B \cap C| - 2|A \cap C| + 3|A \cap B \cap C|$
$= 20,000 + 36000 + 12000 - 12000 - 18000 - 10000 + 12000$

$= 40,000$

(c)

Ans. 23 $|A| = 60\%$ $|A \cap B| = 20\%$
$|B| = 50\%$ $|B \cap C| = 30\%$
$|C| = 70\%$ $|A \cap C| = 40\%$

$|A \cap B \cap C| = |A| + |B| + |C| - 2|A \cap B| - 2|B \cap C| - 2|A \cap C|$

$= \cancel{60} + \cancel{50} + \cancel{70}$ ~~(...)~~ $\times 2$

$= 1$

$= 0.6 + 0.5 + 0.7 - 2 \times (0.2 + 0.3 + 0.4)$

$= 0$

It is not Possible

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Ans. 24 $|A| = 104$
$|B| = 84$

$|A' \cap B'| = 68$

$|A \cup B| = x - |A \cup B|'$
$= 200 - 68$
$= 132$

$|A \cup B| = |A| + |B| - |A \cap B|$

$|A \cap B| = 104 + 84 - 68$
$= 56$

Ans. 25 $|A| = 65$ $\quad |A\cap B| = 20$

$|B| = 45$ $\quad |A\cap C| = 25$

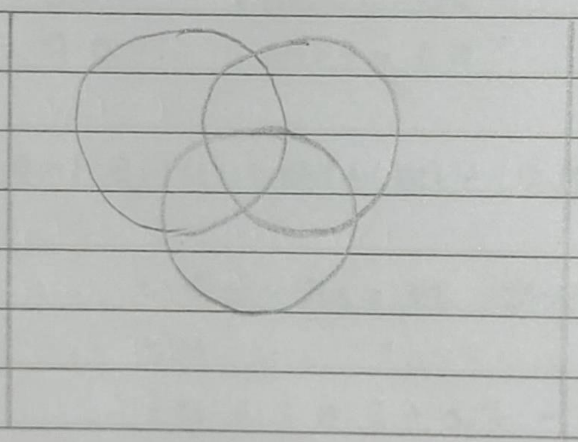
$|C| = 42$ $\quad |B\cap C| = 15$

$|A\cup B\cup C| = 100$

$|A\cap B\cap C| = |A\cup B\cup C| - |A| - |B| - |C| + |A\cap B| + |B\cap C| + |A\cap C|$

$= 100 - 65 - 45 - 42 + 20 + 25 + 15$

$|A\cap B\cap C| = 8$



(c) 1. Exactly one

French $= |A| - |A\cap B| - |B\cap C| + |A\cap B\cap C|$

$= 65 - 20 - 25 + 8$

$= 28$

German $= |B| - |B\cap A| - |B\cap C| + |A\cap B\cap C|$

$= 45 - 20 - 15 + 8$

$= 18$

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Russian $|C| - |A \cap C| - |B \cap C| + |A \cap B \cap C|$

$= 42 - 25 - 15 + 8$

$= 10$

$|A \cap C|$

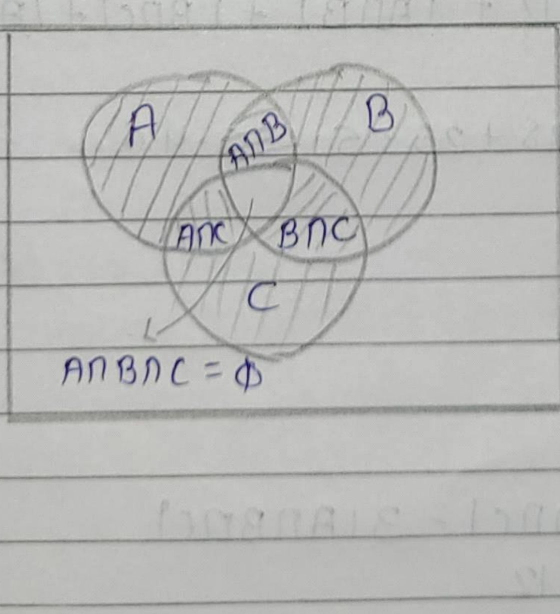
exactly one $= 10 + 28 + 18$
$= 56$

(B) exactly 2

$= |A \cap B| + |B \cap C| + |A \cap C| - 3|A \cap B \cap C|$

$= 20 + 25 + 15 - 24$
$= 36$

Ans. 26 $(A \cap B \cap C) = \phi$
$(A \cap B) \neq \phi$
$(A \cap C) \neq \phi$
$(B \cap C) \neq \phi$



Ans. 27 $(A \cap B) = A$

A is also in B. B is super set of A

$A \subseteq B$

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

B must be empty set. $A \cup \phi = A$

$B = \phi$

Ans. 28 $|A| = 50$ $|A \cap B| = 37$

$|B| = 55$ $|B \cap C| = 28$

$|C| = 46$ $|A \cap C| = 25$

$|A' \cap B' \cap C'| = 7$

$|A \cup B \cup C| = X - |A \cup B \cup C|'$

$= 80 - 7$

$= 73$

(A) $|A \cap B \cap C| = -(|A| + |B| + |C|) + |A \cap B| + |B \cap C| + |A \cap C| + |A \cup B \cup C|$

$= 73 + 37 + 28 + 25 - 50 - 55 - 46$

$= 12$

(B) exactly two

$= |A \cap B| + |B \cap C| + |A \cap C| - 3|A \cap B \cap C|$

$= 37 + 28 + 25 - 3 \times 12$

$= 54$

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(c) exactly one

$= |A| + |B| + |C| - 2|A \cap B| - 2|B \cap C| - 2|A \cap C| + 3|A \cap B \cap C|$
$= 50 + 55 + 46 - 74 - 56 - 50 + 36$
$= 7$

Ans. 29

(a) Subset : one set have all the elements of another set that called subset of another set

$A = \{1, 2\}$
$B = \{1, 2, 3\}$

$A \subset B$

(b) Equality of set : A said equals of B. both sets have the same elements or members of the sets
$A \subset B$ and $B \subset A$

$A = \{1, 2, 3\}$, $B = \{1, 2, 3\}$

(c) Empty set : when set have zero elements in set that called null set or empty set.

$A = \{ \}$

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(d) Ordered Pair :

when two values written in a fixed order with in Parentheses

$A = \{1, 2\}$
$B = \{3, 4\}$

Ordered Pair $= \{(1,3), (1,4), (2,3), (2,4)\}$

(e) Complement of set :

when the members of universal set in any set that known as complement of set

$U = \{1, 2, 3\}$
$A = \{4, 5\}$

$A' = \{1, 2, 3\}$

(f) Cardinality of set :

is a natural number or Possibly a

Ans. 30 $A = 2,\ B = 3,\ C = 5,\ D = 7$

$$|A| = \left|\frac{2000}{2}\right| = 1000, \quad |B| = \left|\frac{2000}{3}\right| = 666$$

$$|C| = \left|\frac{2000}{5}\right| = 400, \quad |D| = \left|\frac{2000}{7}\right| = 285$$

$$|A \cap B| = \left|\frac{2000}{2 \times 3}\right| = 333, \quad |A \cap C| = \left|\frac{2000}{2 \times 5}\right| = 200$$

$$|A \cap D| = \left|\frac{2000}{2 \times 7}\right| = 142, \quad |B \cap C| = \left|\frac{2000}{3 \times 5}\right| = 133$$

$$|B \cap D| = \left|\frac{2000}{3 \times 7}\right| = 95, \quad |C \cap D| = \left|\frac{2000}{5 \times 7}\right| = 57$$

$$|A \cap B \cap C| = \left|\frac{2000}{2 \times 3 \times 5}\right| = 66$$

$$|A \cap B \cap D| = \left|\frac{2000}{2 \times 3 \times 7}\right| = 47$$

$$|B \cap C \cap D| = \left|\frac{2000}{3 \times 5 \times 7}\right| = 19$$

$$|A \cap B \cap C \cap D| = \left|\frac{2000}{2 \times 3 \times 5 \times 7}\right| = 9$$

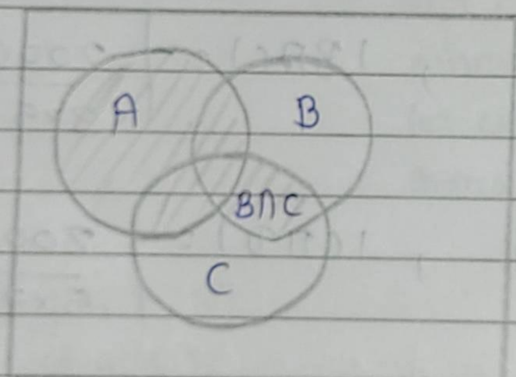
$$|A\cup B\cup C\cup D| = |A| + |B| + |C| + |D| - |A\cap B| - |A\cap C| - |A\cap D| - |B\cap C| - |B\cap D| - |C\cap D| + |A\cap B\cap C| + |B\cap C\cap D| + |A\cap C\cap D| - |A\cap B\cap C\cap D|$$

$$= 2351 - 966 + 132 - 9$$

$$= 1508$$

Ans. 33 Venn diagram

$A\cup(B'\cap C) = (A\cup \bar{B})\cap(A\cup C)$



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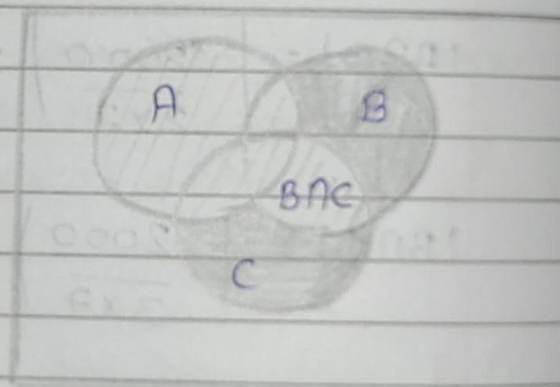
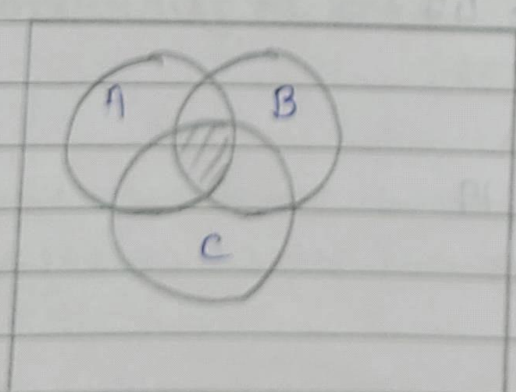


Ans. 34 $(A\cap B\cap C)$ $[A-((A-B)\cup(A-C))]$



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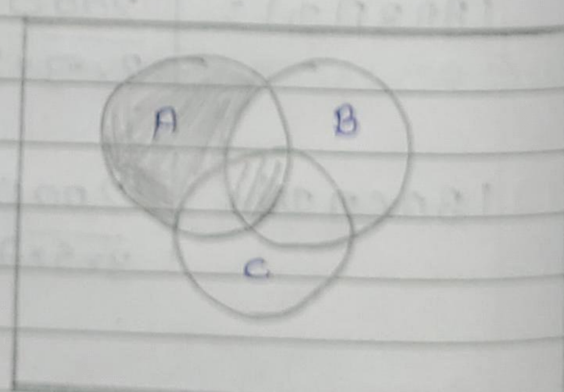

Ans.35 $|A| = 45$

$|B| = 38$

$|C| = 21$

$|A \cap B| = 18$

$|B \cap C| = 4$

$|A \cap C| = 9$

$|A' \cap B' \cap C'| = 23$

$|A \cup B \cup C| = 77$

$|A \cap B \cap C| = |A| + |B| + |C| - |A \cap B| - |B \cap C| - |A \cap C| + |A \cap B \cap C|$

$77 = 45 + 38 + 21 - 18 - 4 - 9 + |A \cap B \cap C|$

$|A \cap B \cap C| = 4$

(A) exactly one

$= |A| + |B| + |C| - 2|A \cap B| - 2|B \cap C| - 2|A \cap C| + 3|A \cap B \cap C|$

$= 45 + 38 + 21 - (18 + 4 + 9) \times 2 + 3 \times 4$

$= 54$

(B) exactly two

$= |A \cap B| + |B \cap C| + |A \cap C| - 3|A \cap B \cap C|$

$= 18 + 4 + 9 - 12$

$= 19$

Ans. 36 Power set

1. $\{a\}$

$P(A) = \{\phi, \{a\}\}$

2. $\{a, \{a, b\}\}$

$P(A) = \{\phi, \{a\}, \{b\}, \{\{a\}\}, \{a, b\}\}$

3. $\{a, b, c\}$

$P(A) = \{\phi, \{a\}, \{b\}, \{c\}, \{a, b\}, \{b, c\}, \{a, c\}, \{a, b, c\}\}$

Ans. 37 $A = \{a, b\}$
$B = \{c, d\}$
$C = \{e, f\}$

1. $(A \times B) = \{(a, c), (a, d), (b, c), (b, d)\}$
$(B \times C) = \{(c, e), (c, f), (d, e), (d, f)\}$

$(A \times B) \cup (B \times C) = \{(a, c), (a, d), (b, c), (b, d),$
$(c, e), (c, f), (d, e), (d, f)\}$

2. $B \cup C = \{c, d, e, f\}$

$A \times (B \cup C) = \{(a, c), (a, d), (a, e), (a, f),$
$(b, c), (d, d), (b, e), (b, f)\}$

Ans. 38 Prove

1. $A \cup (B \cup C) = (A \cup B) \cup C$

A = {[illegible] b, [illegible], [illegible]}
B = [illegible]

$x \in A$ or $x \in (B$ or $C)$
$x \in A$ or $(x \in B$ or $x \in C)$

$x \in A$ or B or $x \in C$

$x \in (A \cup B)$ or $x \in C$

$(A \cup B) \cup C$ L.H.S = R.H.S.

2. $A \cap (B \cap C) = (A \cap B) \cap C$

$x \in A$ and $x \in (B$ and $C)$
$x \in A$ and $(x \in B$ and $x \in C)$

$x \in A$ and B and $x \in C$
$x \in (A \cap B)$ and $x \in C$
$(A \cap B) \cap C$

L.H.S = R.H.S.