

Sets, Functions, Relations

① Set is a collection of well-defined, distinct objects

examples : $A = \{5, 8, 9, 10\}$

$$B = \{AICS, Maths, Law, BCR, Eco, Bek\}$$

$$C = \{Atal Bihari ji, Manmohan Singh ji, Narendra ji\}$$

$$D = \{a, e, i, o, u\}$$

$$E = \{2, 3, 5, 7, 11, 13, 17, 19\}$$

② i) Any living or non living thing can be called as object/element.

ii) Generally various objects of the set are written in curly bracket or Flowered Bracket.

iii) Generally name of the set is denoted by capital letters

iv) $A = \{5, 8, 9\}$ $B = \{8, 9, 5\}$

sets A, B are same. order of objects is not important.

order in which objects are written in curly bracket is of no relevance.

4) $A = \{a, b, c, e, j\}$ $B = \{a, b, a, e, e, e, a, g, g, e, j\}$
 $B = \{a, b, c, e, j\}$

Repetition of objects in a set is of No use

③ Set is collection of well-defined, Distinct object

Either Listed

OR Described

$$A = \{1, 4, 9, 16, 25, 36, 49, 64, 81, 100\}$$

$$A = \{x^2 : \text{where } x \in \mathbb{N} \text{ and } 4 \leq x \leq 10\}$$

$$B = \{7, 12, 28, 52\}$$

$$B = \{x^2 : \text{where } x \text{ is a prime no. less than } 10\}$$

$$C = \{\text{Indira Gandhi}\}$$

C is a set of Indian Female prime ministers till 2022.

$$D = \{\text{Virender Sehwag, Karun Nair}\}$$

D is a set of Indian crickets who scored Triple century in a Test match at international level till 2022.

List Form,
Roster Form,
Braces Form.

Description Form,
Property Form,
Set Builder Form,
Rule form



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Set Builder Form

Roster Form

M is a set of first 25 prime natural numbers

$$M = \{2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97\}$$

N is set of Indian prime Ministers till 2022 from Maharashtra state

$$N = \{ \} = \phi = \text{Null set} = \text{Empty set}$$

Q is a set of years in which India won Mens Icc cricket world cup till 2022

$$Q = \{1983, 2007, 2011\}$$

R is a set of vowels in English Alphabet

$$R = \{a, e, i, o, u\}$$

Z is a set of first 10 multiples of natural number 5

$$Z = \{5, 10, 15, 20, 25, 30, 35, 40, 45, 50\}$$

K is a set of letters used in the name of VINOD REDDY

$$K = \{v, i, n, o, d, r, e, y\}$$

M is a set of subjects for CA Final NOV-23 exams

$$M = \{FR, SFM, Law, Audit, SCM PE, elective paper, DT, IDT\}$$

$$5) A = \{5, 13, 19, 20, 28, 30, 39\}$$

There are 7 distinct elements in set - A
which can be written as $n(A) = 7$

OR CARDINAL VALUE of set A is 7.

Number of Distinct elements of a set is known as
its - cardinal value

$$6) i) B = \{10, 13, 18, 10, 13, 10, 18, 20, 18, 10, 13, 18, 20, 10\}$$

Find $n(B)$.

$$\implies n(B) = 4$$

$$B = \{10, 13, 18, 20\}$$

\therefore cardinal value of set B is 4.

$$ii) M = \{a, e, d, m, a, d, m, e, k, l, i, e, e, d, a, m, d\}$$

Find $n(M)$

$$\implies M = \{a, e, d, m, k, l, i\}$$

$\therefore n(M) = 7$. cardinal value of set M is 7.

$$7) D = \{1, 2, 3, 4, 5, 6, \dots\}$$

Find $n(D)$

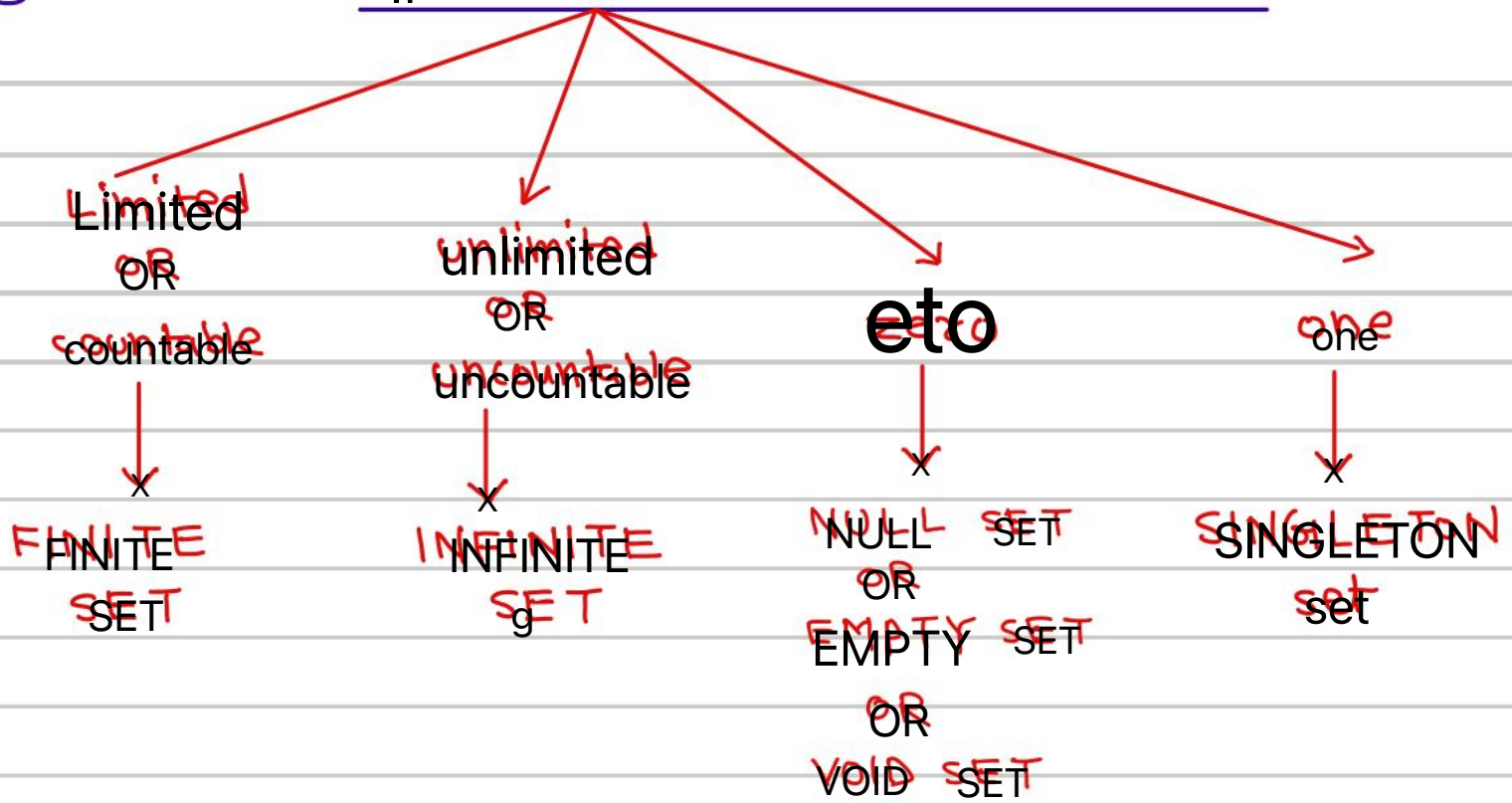
$$\implies n(D) = \infty = \text{Infinity}$$

There are infinite no. of observations in set D

\therefore D is an infinite set

8

If cardinal value of a set is



Null set, Singleton set are also finite sets.

9 Null set is denoted by : $\{\}$, ϕ

100 B = $\{5, 7, 13, 200, 813\}$

7 is one of the obsh of set B.

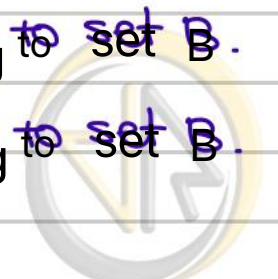
$\therefore 7 \in B$: 7 belongs to set B.

$813 \in B$: 813 belongs to set B.

$5 \in B$: 5 belongs to set B.

$520 \notin B$: 520 does not belong to set B.

$51 \notin B$: 51 does not belong to set B.



(11) $A = \{\infty\}$, $B = \{\emptyset\}$, $C = \{1, 2\}$

A, B, C are singleton sets.

• set of stars in sky is an infinite set

• set of intelligent students is

(a) Finite set

(b) Infinite set

(c) Null set

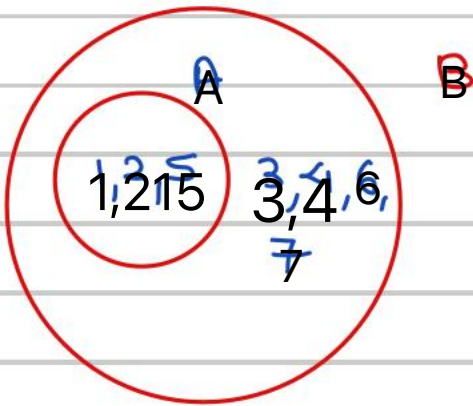
~~(d) not a well defined collection~~

(12) $A = \{1, 2, 5\}$ $B = \{1, 2, 3, 4, 5, 6, 7\}$

Here Every element of set A belongs to set B also

i. A is a subset of B. OR

B is a super-set of A



If every element of set P belongs to set Q also then

P is a subset of Q

↓
X

$$P \subseteq Q$$

(13) $C = \{a, b, \text{pair}\}$ $D = \{a, b, x\}$

Here 'D' is a subset of 'C'

(OR) 'C' is a superset of 'D'



(14) ① Find All possible subsets of set A
 If $A = \{10\}$

$\Rightarrow \{10\}, \phi$ 2 possible subsets

② Find All possible subsets of set A
 If $A = \{10, 12\}$

$\Rightarrow \{10\}, \{12\}, \{10, 12\}, \phi$ 4 possible subsets

③ Find All possible subsets of set A
 If $A = \{10, 12, 20\}$

$\Rightarrow \{10\}, \{12\}, \{10, 12\}, \phi$ 8 possible subsets
 $\{10, 20\}, \{12, 20\}, \{10, 12, 20\}, \{20\}$

④ Find All possible subsets of set A
 If $A = \{10, 12, 20, 30\}$

$\Rightarrow \{10\}, \{12\}, \{20\}, \{30\}, \{10, 12\}, \{10, 20\},$
 $\{10, 30\}, \{12, 20\}, \{12, 30\}, \{20, 30\}, \{10, 12, 30\},$
 $\{10, 12, 20\}, \{10, 20, 30\}, \{12, 20, 30\}, \{10, 12, 20, 30\},$
 ϕ 16 possible subsets

cardinal value of set	no. of all possible subsets
1	$2^1 = 2$
2	$2^2 = 4$
3	$2^3 = 8$
4	$2^4 = 16$
n	2^n



15 Find all possible subsets of set $Q = \{1, 2, 3, 4, 5\}$

$\Rightarrow \emptyset, \{1\}, \{2\}, \{3\}, \{4\}, \{5\}$
 $\{1, 2\}, \{1, 3\}, \{1, 4\}, \{1, 5\}, \{2, 3\}, \{2, 4\}, \{2, 5\},$
 $\{3, 4\}, \{3, 5\}, \{4, 5\}, \{1, 2, 3\}, \{1, 2, 4\}, \{1, 2, 5\},$
 $\{1, 3, 4\}, \{1, 3, 5\}, \{1, 4, 5\}, \{2, 3, 4\}, \{2, 3, 5\}, \{2, 4, 5\},$
 $\{3, 4, 5\}, \{1, 2, 3, 4\}, \{1, 2, 3, 5\}, \{1, 2, 4, 5\}, \{1, 3, 4, 5\},$
 $\{2, 3, 4, 5\}$

$\{1, 2, 3, 4, 5\} \rightarrow$ improper subsets = 1

proper subsets = 31

16 $B = \{60, 78, 90\}$

$\emptyset, \{60\}, \{78\}, \{90\}, \{60, 78\},$
 $\{78, 90\}, \{60, 90\}$

proper subsets = 7

$\{60, 78, 90\}$ Improper subset = 1

17 $K = \{\text{calculator, Book}\}$ Find all possible subsets

\Rightarrow proper subsets : $\{\text{calculator}\}, \{\text{Book}\}, \emptyset$
 Improper subset : $\{\text{calculator, Book}\}$

(18) If cardinal value of set is 'm'

then,

No. of subsets	2^m
No. of improper subsets	1
No. of proper subsets	$(2^m) - 1$
No. of Empty subsets	1
No. of Non-empty subsets	$(2^m) - 1$
No. of Non-empty proper subsets	$(2^m) - 2$

(19) If cardinal value of set is '12'

then,

No. of subsets	$2^{12} = 4096$
No. of improper subsets	1
No. of proper subsets	$(2^{12}) - 1 = 4095$
No. of Empty subsets	1
No. of Non-empty subsets	$(2^{12}) - 1 = 4095$
No. of Non-empty proper subsets	$(2^{12}) - 2 = 4094$

20 $E = \{5, 13\}$



All possible subsets = $\{\emptyset, \{5\}, \{13\}, \{5, 13\}\} = 4$

All proper subsets = $\{\emptyset, \{5\}, \{13\}\} = 3$

All improper subsets = $\{5, 13\} = 1$

All empty subsets = $\emptyset = 1$

All non-empty subsets = $\{5\}, \{13\}, \{5, 13\} = 3$

All non-empty proper subsets = $\{5\}, \{13\} = 2$

21 If set $K = \{P, 9, 30\}$

All possible subsets = $\{P\}, \{9\}, \{30\}, \{P, 9\}, \{9, 30\}, \{P, 30\}, \{P, 9, 30\}, \emptyset = 8$

All proper subsets = $\{P\}, \{9\}, \{30\}, \{P, 9\}, \{9, 30\}, \{P, 30\}, \emptyset = 7$

All improper subsets = $\{P, 9, 30\} = 1$

All empty subsets = $\emptyset = 1$

All non-empty subsets = $\{P\}, \{9\}, \{30\}, \{P, 9\}, \{9, 30\}, \{P, 30\}, \{P, 9, 30\} = 7$

All non-empty proper subsets = $\{P\}, \{9\}, \{30\}, \{P, 9\}, \{9, 30\}, \{P, 30\} = 6$

22 If cardinal value of set is k then

No. of subsets = 2^k

No. of improper subsets = 1

No. of proper subsets = $(2^k) - 1$

No. of empty subsets = 1

No. of Non-empty subsets = $(2^k) - 1$

No. of Non-empty proper subsets = $(2^k) - 2$

23 (i) find all subsets of $\{ \}$

$\Rightarrow \{ \}$

(2) Null set is a subset of any other set.

(3) Any other set is a superset of Null set

(4) Null set also has one subset : $\{ \}$

(5) Null set don't have a proper subset.

24 A is a subset of B $\Rightarrow A \subseteq B$

A is a proper subset of B $\Rightarrow A \subset B$

M is a proper subset of N $\Rightarrow M \subset N$

25 universal set

(1) Set of all observations under the scope of study / investigation is known as universal set.

(2) It is denoted by U or S

(3) universal set is the super set of any other set

(4) Any other set is the subset of universal set.

(5) universal set is represented by Rectangle

in venn diagrams

(6) corresponding term in probability is sample space

26) complementary set

$$A = \{1, 5, 8, 9\} \quad B = \{2, 5, 6, 7, 8, 9\}$$

$$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

then

complementary set of A = $A^c = A' = \{2, 3, 4, 6, 7, 10\}$

complementary set of B = $B^c = B' = \{1, 3, 4, 10\}$

$$n(A) + n(A') = n(U)$$

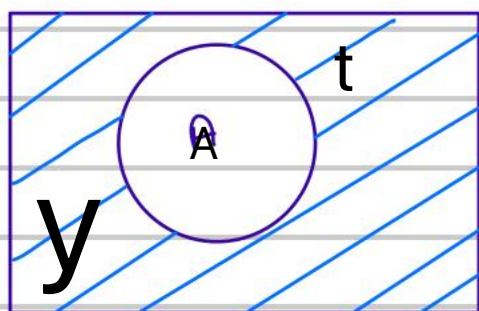
$$n(B) + n(B') = n(U)$$

$$\therefore n(A') = n(U) - n(A)$$

$$n(B') = n(U) - n(B)$$

$$\left(\begin{array}{l} \text{cardinal value} \\ \text{of a set} \end{array} \right) + \left(\begin{array}{l} \text{cardinal value of} \\ \text{its complementary} \\ \text{set} \end{array} \right) = \left(\begin{array}{l} \text{cardinal value} \\ \text{of universal} \\ \text{set} \end{array} \right)$$

27)



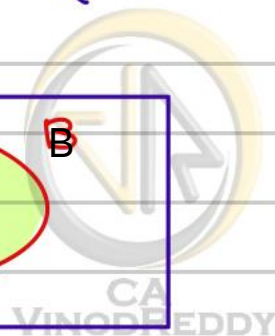
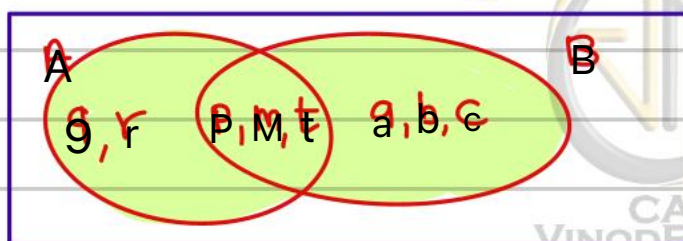
$$\text{shaded area} = A' = A^c$$

$$n(A) + n(A') = n(U)$$

28)

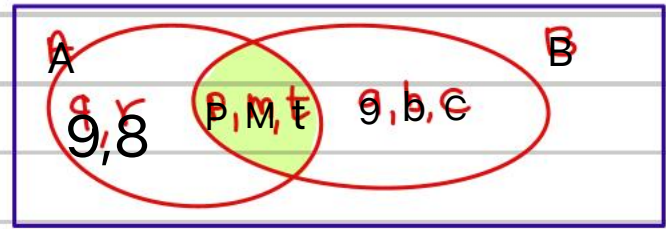
union set : $A = \{p, q, r, m, t\}$ $B = \{a, b, c, m, t, p\}$

$$(A \text{ OR } B) = (A \cup B) = \{p, q, r, m, t, a, b, c\} = (A \text{ union } B)$$



29) Intersection set : $A = \{p, q, r, m, t\}$ $B = \{a, b, c, Mt, P\}$

$$(A \text{ and } B) = (A \cap B) = \{p, m, t\} = (A \text{ intersection } B)$$



30) $A = \{2, 3, 4, 8\}$ $B = \{1, 3, 4, 7, 9, 10\}$

$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$



① $A' = \{1, 5, 6, 7, 9, 10, 11, 12\}$

② $B' = \{2, 5, 6, 8, 11, 12\}$

③ $A \cup B = \{2, 3, 4, 8, 1, 7, 9, 10\}$

④ $A \cap B = \{3, 4\}$

⑤ $A \cap B' = \{2, 8\}$

⑥ $B \cap A' = \{1, 7, 9, 10\}$

⑦ $A' \cap B' = \{5, 6, 11, 12\}$

⑧ $(A \cup B)'$

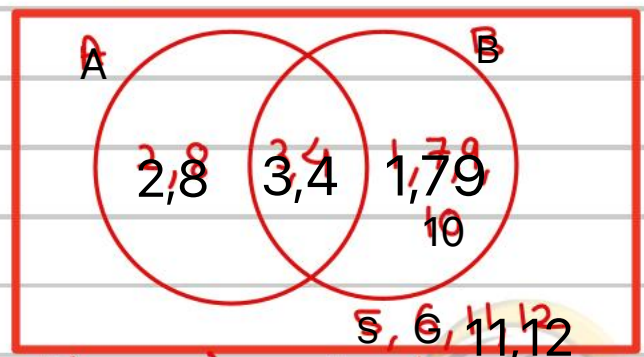
$= \{2, 3, 4, 8, 5, 6, 11, 12\}$

⑨ $(B \cup A)'$

$= \{1, 3, 4, 7, 9, 10, 5, 6, 11, 12\}$

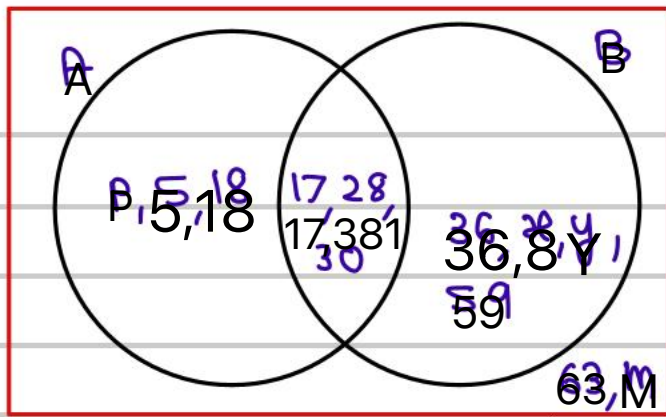
⑩ $(A' \cup B')$

$= \{1, 5, 6, 7, 9, 10, 11, 12, 2, 8\}$



$U =$ universal set

31



$U =$ universal set



Find sets

$$A = \{p, 5, 18, 17, 28, 30\}$$

$$B = \{17, 28, 30, 36, 8, y, 59\}$$

$$A' = \{36, 8, y, 59, 63, m\}$$

$$B' = \{p, 5, 18, 63, m\}$$

$$U = \{p, 5, 18, 17, 28, 30, 36, 8, y, 59, 63, m\}$$

$$A \cap B = \{17, 28, 30\}$$

$$A \cup B = \{p, 5, 18, 17, 28, 30, 36, 8, y, 59\}$$

$$A - B = A \cap B' = \{p, 5, 18\}$$

$$B - A = B \cap A' = \{36, 8, y, 59\}$$

$$A' \cap B' = \{63, m\} = (A \cup B)'$$

$$A \cup B' = \{p, 5, 18, 17, 28, 30, 63, m\}$$

$$B \cup A' = \{17, 28, 30, 36, 8, y, 59, 63, m\}$$

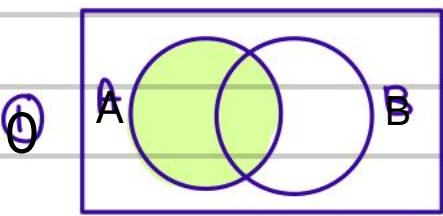
$$A' \cup B' = \{36, 8, y, 59, 63, m, p, 5, 18\}$$

$$A \Delta B = (A - B) \cup (B - A) = \{p, 5, 18, 36, 8, y, 59\}$$

$$\emptyset' = U$$

$$(U)' = \emptyset$$

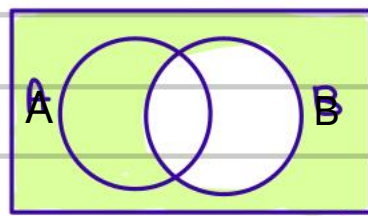
32



U = universal set

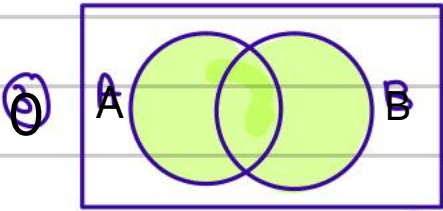
$$n(A) = n(U) - n(A')$$

2



U = universal set

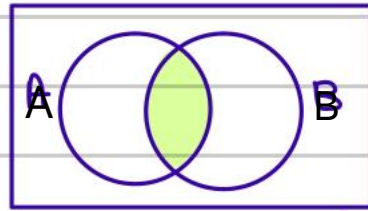
$$n(B) = n(U) - n(B')$$



U = universal set

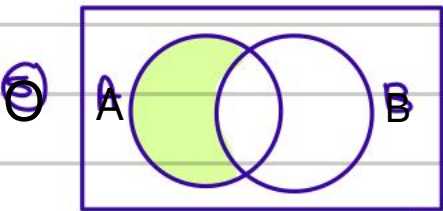
$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

4



U = universal set

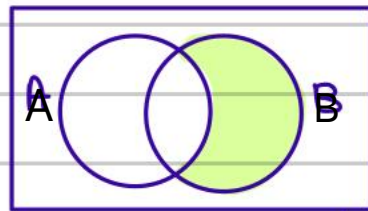
$$n(A \cap B) = n(A) + n(B) - n(A \cup B)$$



U = universal set

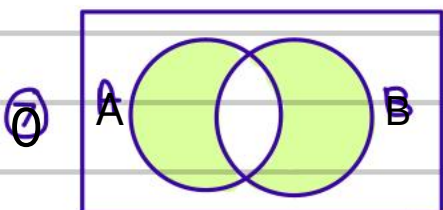
$$n(A - B) = n(A \cap B') = n(A) - n(A \cap B)$$

6



U = universal set

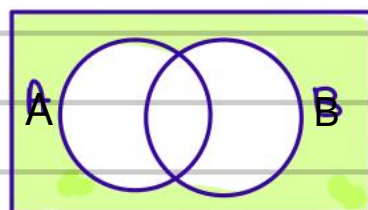
$$n(B - A) = n(B \cap A') = n(B) - n(A \cap B)$$



U = universal set

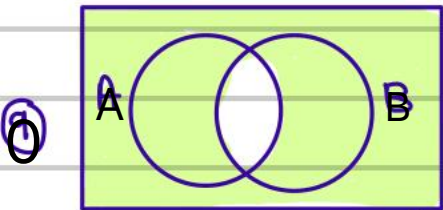
$$n(A \cup B)' = n(A - B)' + n(B - A)'$$

8



U = universal set

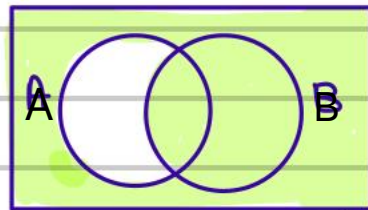
$$n(A \cup B)' = n(A' \cap B')$$



U = universal set

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

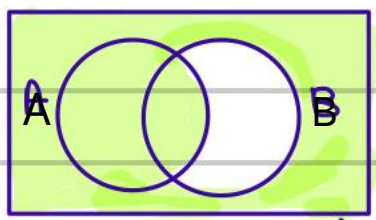
10



U = universal set

$$\begin{aligned} n(B \cap A') &= n(U) - n(A - B) \\ &= n(B) + n(A \cap B') \end{aligned}$$

(11)

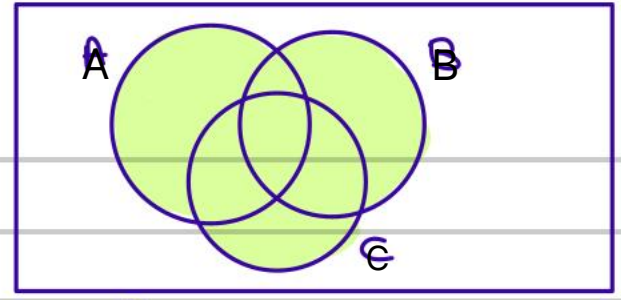


U = universal set

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

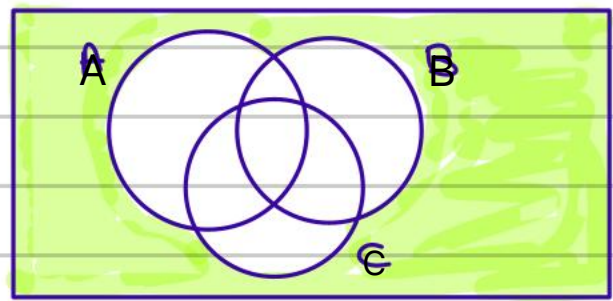
$$= n(A') + n(B')$$

(12)



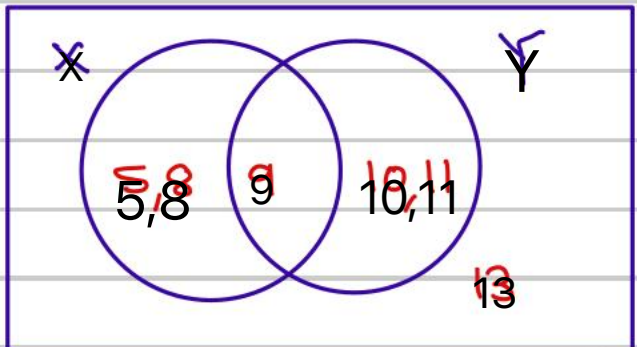
$$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(A \cap C) - n(B \cap C) + n(A \cap B \cap C)$$

(13)



$$n(A \cup B \cup C)' = n(U) - n(A \cup B \cup C)$$

330



U = universal set



$X = \{5, 8, 9\}$	$X \cap Y = \{9\}$	$X' \cap Y' = \{13\}$
$Y = \{9, 10, 11\}$	$X \cup Y = \{5, 8, 9, 10, 11\}$	$X' \cup Y' = \{5, 8, 10, 11, 13\}$
$X' = \{10, 11, 13\}$	$X - Y = \{5, 8\}$	$X \cup Y' = \{5, 8, 9, 13\}$
$Y' = \{5, 8, 13\}$	$Y - X = \{10, 11\}$	$Y \cup X' = \{9, 10, 11, 13\}$

34) If $n(A) = 5783$, $n(B) = 4471$, $n(ANB) = 2358$, $n(U) = 10,000$

Find

① $n(A') = n(U) - n(A) = 10,000 - 5783 = 4217$

② $n(B') = n(U) - n(B) = 10,000 - 4471 = 5529$

③ $n(A \cup B) = n(A) + n(B) - n(ANB) = 5783 + 4471 - 2358 = 7896$

④ $n(A - B) = n(A) - n(ANB) = 5783 - 2358 = 3425$

⑤ $n(B - A) = n(B) - n(ANB) = 4471 - 2358 = 2113$

⑥ $n(A \Delta B) = n(A - B) + n(B - A) = 3425 + 2113 = 5538$

OR $n(A \Delta B) = n(A \cup B) - n(ANB) = 7896 - 2358 = 5538$

⑦ $n(A \cup B') = n(U) - n(B - A) = 10,000 - 2113 = 7887$

OR $n(A \cup B') = n(A) + n(A' \cap B') = 5783 + 2104 = 7887$

⑧ $n(A' \cap B') = n(U) - n(A \cup B) = 10,000 - 7896 = 2104$

⑨ $n(B \cup A') = n(U) - n(A - B) = 10,000 - 3425 = 6575$

⑩ $n(A' \cup B') = n(U) - n(ANB) = 10,000 - 2358 = 7642$

35) $A = \{2, 3, 5, 6, 7\}$ $B = \{\text{pair, sit}\}$

$C = \{18, 25, 38, \text{min}\}$

Here $n(A) = n(B) = n(C) = 5$

$\therefore A, B, C$ are equivalent sets.

2 or more sets are said to be equivalent if their cardinal value is same

36) $A = \{2, 3, 5\}$ $B = \{2, 3, 5\}$

Here A is a subset of B \neq
 B is a subset of A

$\therefore A$ & B are improper subsets of each other.

$\therefore A$ & B are Equal sets

37) $P = \{m, n, x, y, z, 9, 2, 8, 3, 4\}$ $Q = \{x, n, m, z, y, 9, 14, 8\}$

Here $P \subseteq Q$ & $Q \subseteq P \therefore P, Q$ are Equal sets

$\neq P, Q$ are Equivalent also.

38) All Equal sets are Equivalent also,

but All Equivalent sets are not necessarily equal sets.

$A = \{5, 7, 8\}$, $B = \{5, 3, 8, 0\}$ $C = \{2, 5, 10\}$

Here A, B are Equal sets \therefore Equivalent also

B, C are Equivalent sets but not equal sets

A, C are Equivalent sets but not equal sets

A, B, C are equivalent sets.

39) When sets A, B are said to be

Equal sets ?

If $A \subseteq B$ and $B \subseteq A$

Equivalent sets ?

If $n(A) = n(B)$

$$A = \{2, 8, 9, 10, 13, 15, 20\} \quad B = \{20, 13, 15, 10, 8, 2, 9, 9, 10\}$$

Here A, B are Equal sets as well as Equivalent sets.

$$(40) \quad B = \{10, 15, 28, 35, 28, 10, 48, 36, 48, 10, 28, 15, 35\}$$

Find cardinal value of set B.

$$\Rightarrow B = \{10, 15, 28, 35, 48, 36\}$$

There are 6 distinct elements in set B

\therefore cardinal value of set B is 6.

$$\therefore h(B) = 6$$

$$(41) \quad (1) \quad M = \{5, 6, 7\} \quad N = \{7, 5, 5, 5, 6, 6, 7, 5, 7, 6\}$$

Here M, N are Equal sets and Equivalent sets.

$$(2) \quad A = \{2, 3, 5\} \quad B = \{5, 8, 9\}$$

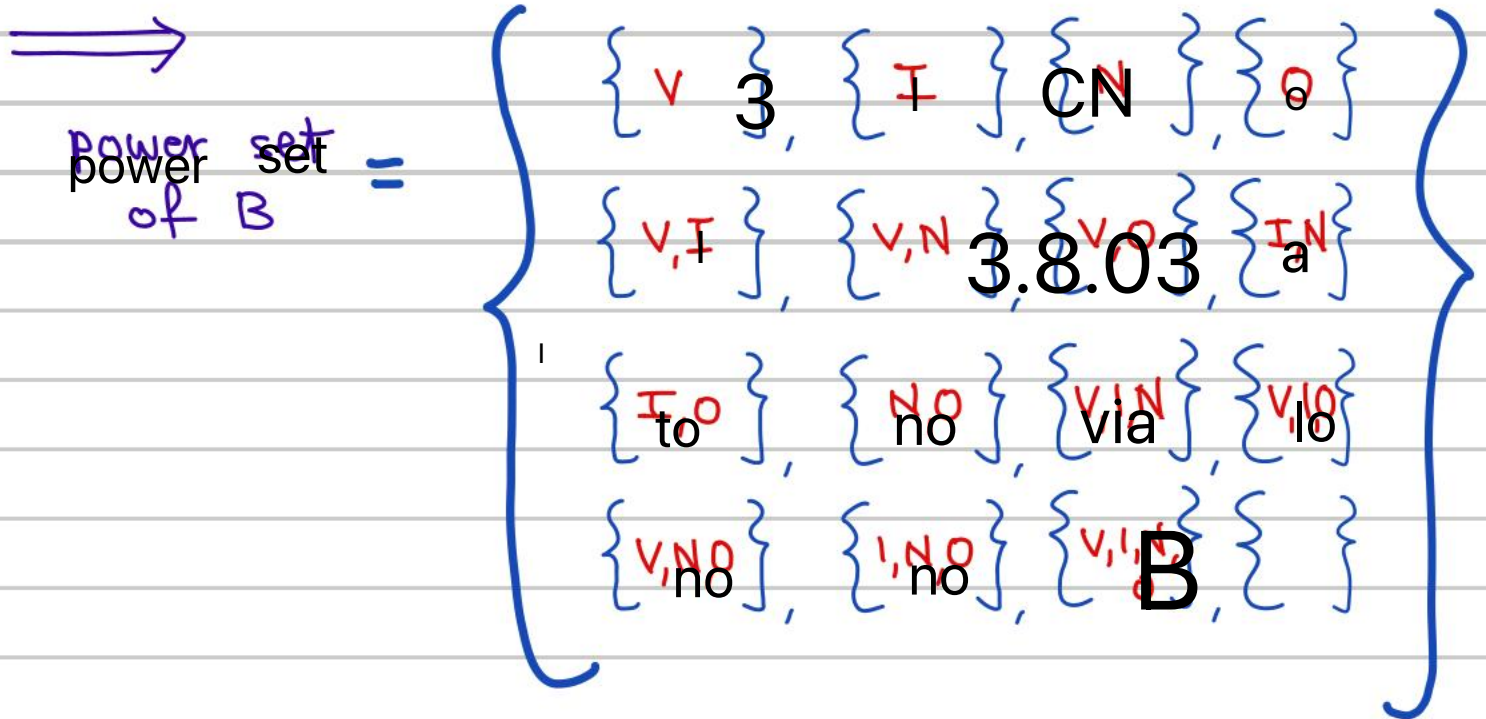
Here A, B are Equivalent sets but not equal sets.

$$h(A) = h(B) = 3$$

$$(42) \quad \text{If } A = \{5, 100, 850\} \text{ . Find power set of A .}$$

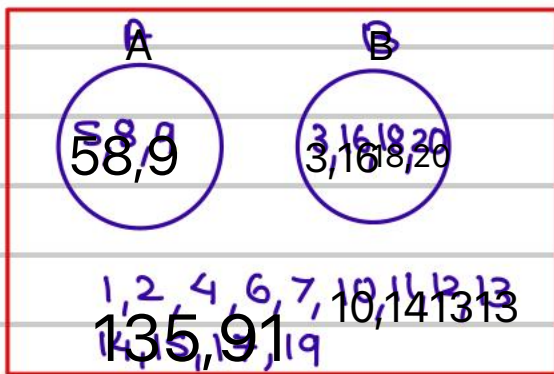
$$\text{Power set of A} = \left\{ \{5\}, \{100\}, \{850\}, \{5, 100\}, \{5, 850\}, \{100, 850\}, \{5, 100, 850\} \right\}$$

43) $B = \{V, I, N, \emptyset\}$ Find power set of B.



Set of all possible subsets is known as power set.

44) $A = \{5, 8, 9\}$ $B = \{3, 16, 18, 20\}$
 $U = \{1, 2, 3, 4, \dots, 20\}$



Here $(A \cap B) = \emptyset$

i.e. $n(A \cap B) = 0 = \text{Zero}$

i. A, B are said to be Disjoint sets OR

Mutually exclusive sets.

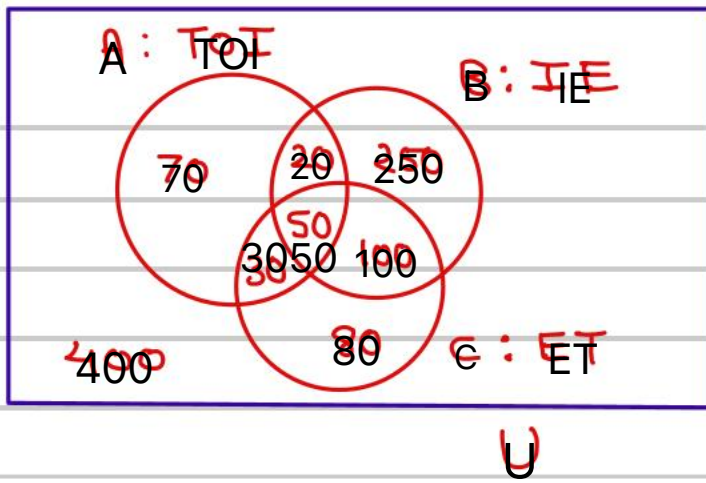
45) $A = \{5, 8, 10, 13\}$, $B = \{6, 7, 10, 15, 18, 20, 25\}$

whether A, B are disjoint sets?

NO, as $n(A \cap B) = 1 \neq 0$

$A \cap B = \{10\}$

46



$$n(U) = 1000$$

$$\Rightarrow \textcircled{1} n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(AB) - n(BC) - n(AC) + n(ABC)$$

$$= 170 + 420 + 260 - 70 - 150 - 80 + 50$$

$$= 600$$

$$\textcircled{2} n(A \cup B) = n(A) + n(B) - n(AB) = 170 + 420 - 70 = 520$$

$$\textcircled{3} n(A - B) = n(A) - n(AB) = 170 - 70 = 100$$

$$\textcircled{4} n(A' \cap B' \cap C') = n(U) - n(A \cup B \cup C) = 1000 - 600 = 400$$

$$\begin{aligned} \textcircled{5} n(B \cap C) &= n(B \cup C) - n(B \cap C) \\ &= [n(B) + n(C) - n(BC)] - n(BC) \\ &= (420 + 260 - 150) - 150 \\ &= 380 \end{aligned}$$

$\textcircled{6}$ How many of them read only one news paper?

$$\Rightarrow 70 + 250 + 80 = 400$$

$\textcircled{7}$ How many of them read only 2 newspapers?

$$\Rightarrow 20 + 30 + 100 = 150$$

$\textcircled{8}$ How many of them read at least one news paper?

$$\Rightarrow 600$$

$$(47) \quad A = \{9, 10, 13, 18\} \quad B = \{5, 10, 13, m, p, q\}$$

$$U = \{9, 10, 13, 18, 5, m, p, q, r, t\} \quad \text{Find :}$$

$$\Rightarrow A^c = \{5, m, p, q, r, t\}$$

$$B^c = \{9, 18, r, t\}$$

$$(A \cup B) = \{9, 10, 13, 18, 5, m, p, q\}$$

$$(A \cap B) = \{10, 13\}$$

$$(A \cap B^c) = \{9, 18\}$$

$$A \cap B = (A \cap B^c) \cup (B \cap A^c)$$

$$= \{9, 18, 5, m, p, q\}$$

$$B \cap A^c = \{5, m, p, q\}$$

$$A^c \cap B^c = \{r, t\}$$

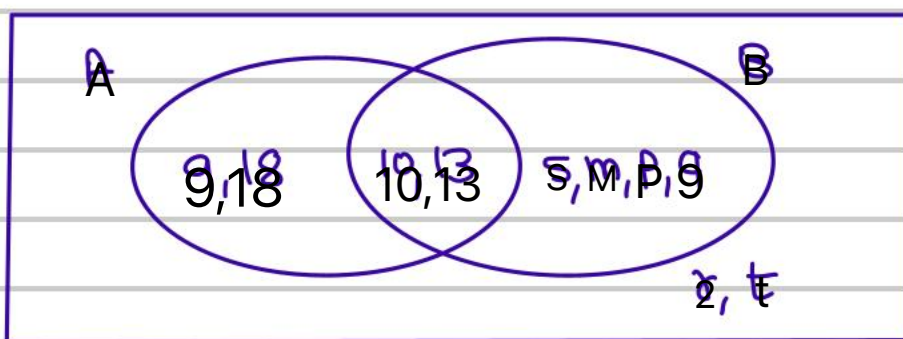
$$A \cup B^c = \{9, 10, 13, 18, r, t\}$$

$$B \cup A^c = \{5, 10, m, 13, p, q, r, t\}$$

SITE

$$A^c \cup B^c = \{5, m, p, q, r, t\}$$

Email



$$(48) \quad A = \{2, 10, 13, 18\} \quad \text{Find}$$

$$\Rightarrow A \cup A = \{2, 10, 13, 18\}$$

$$A \cup \phi = \{2, 10, 13, 18\}$$

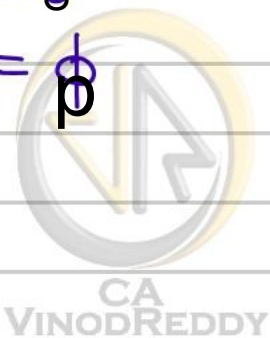
$$A \cap A = \{2, 10, 13, 18\}$$

$$A \cap \phi = \phi$$

49

- ① $A \cup A = A$
- ② $B \cup B = B$
- ③ $B \cap B = B$
- ④ $A \cup \emptyset = A$
- ⑤ $A \cap \emptyset = \emptyset$
- ⑥ $B \cup \emptyset = B$
- ⑦ $A \cup A' = U$
- ⑧ $A \cap A' = \emptyset$
- ⑨ $B \cup B' = U$
- 100 $B \cap B' = \emptyset$
- ⑪ $U \cup \emptyset = U$
- ⑫ $U \cup U = U$
- ⑬ $U \cap U = U$
- ⑭ $U \cap \emptyset = \emptyset$
- ⑮ $(\emptyset)' = U$
- 160 $(U)' = \emptyset$
- ⑰ $\emptyset \cup \emptyset = \emptyset$
- 180 $\emptyset \cap \emptyset = \emptyset$
- ⑱ $\emptyset \cup \emptyset' = U$
- 200 $\emptyset \cap \emptyset' = \emptyset$
- ⑳ $(A \cup B) \cup A = (A \cup B)$

- ⑳ $(A \cap B) \cup (A \cup B) = (A \cup B)$
- 230 $(A \cap B) \cap (A \cup B) = (A \cap B)$
- 240 $(A - B) \cup (B - A) = (A \Delta B)$
- ⑳ $(A - B) \cap (B - A) = \emptyset$
- 26 $(A \cup B) \cup (A' \cap B') = U$
- 27 $(A \cup B) \cap (A' \cap B') = \emptyset$
- 280 $(A - B) \cup A = A$
- 290 $(B - A) \cup B = B$
- 30 $(B - A) \cup A = (A \cup B)$
- 31 $(A \Delta B) \cup (A \cap B) = (A \cup B)$
- 320 $(A \Delta B) \cap (A \cap B) = \emptyset$
- 330 $(A - B) \cup (A' \cap B') = B'$
- 340 $A \cap (A' \cap B) = \emptyset$
- 35 $(A \cup B)' \cup (A \cap B) = U$
- 36 $(A' \cap B) \cap (A \cap B) = \emptyset$
- 37 $(A \Delta B) \cup (A' \cap B') = (A' \cap B) \cup (A \cap B) = (A \cap B)'$
- 38 $(A \Delta B) \cap (A' \cap B') = \emptyset$
- 39 $[A \cup (B - A) \cup (A' \cap B')] = U$
- 400 $[(A - B) \cup (B - A) \cup (A \cap B)] = (A \cup B)$
- 41 $(A \cup B) \cap (A - B) = (A - B)$
- 42 $(A \cap B) \cap (B - A) = \emptyset$
- 43 $(A' \cup B') \cup (A \cup B) = U$
- 44 $(A \cup B') \cup (B \cap A') = U$
- 45 $(B \cup A') \cap (A - B) = \emptyset$



50 In a college of 500 students.

80 play cricket, 130 play Hockey, 220 play football

30 play C & H, 80 play H & F, 25 play C & F,

15 play all 3 games.

Find no. of students who

① play at least one game
= 290

② play one & only one game
= $20 + 15 + 130 = 165$

③ play exactly 2 games = $35 + 10 + 65 = 110$

④ play No game of these three = 210

⑤ play cricket or Hockey = $500 - 210 - 130 = 160$

⑥ play Hockey but not football = $35 + 15 = 50$

51 In a class of 150 students, 70 read physics but not maths, 20 read physics & maths, 27 read neither physics nor maths. Find no. of students who

① Read physics = 90

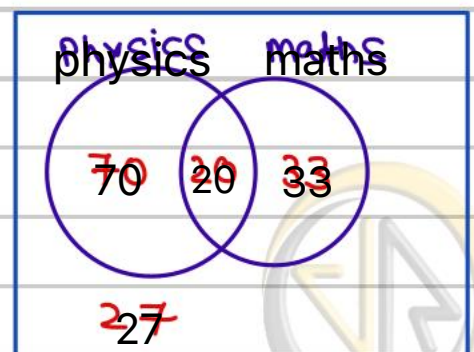
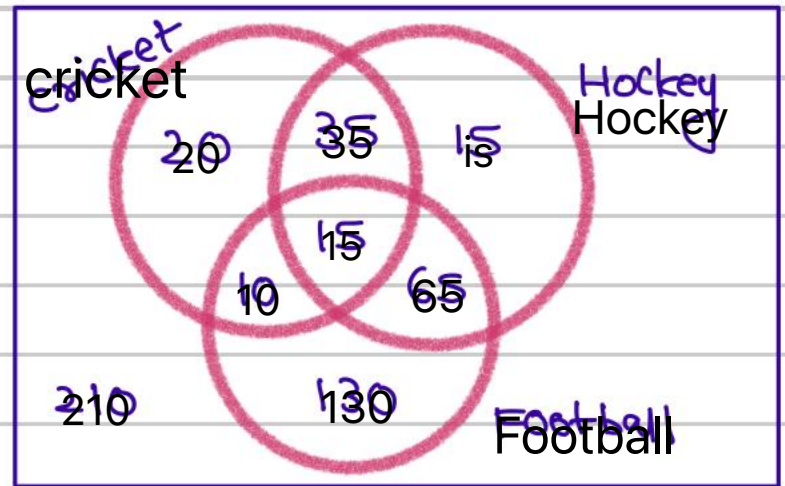
② Read maths = 53

③ Read physics or maths = 123

④ Read maths but not physics = 33

⑤ Read one & only one subject = 103

⑥ Don't read physics = 60



(S2) If $A \subseteq B$ then

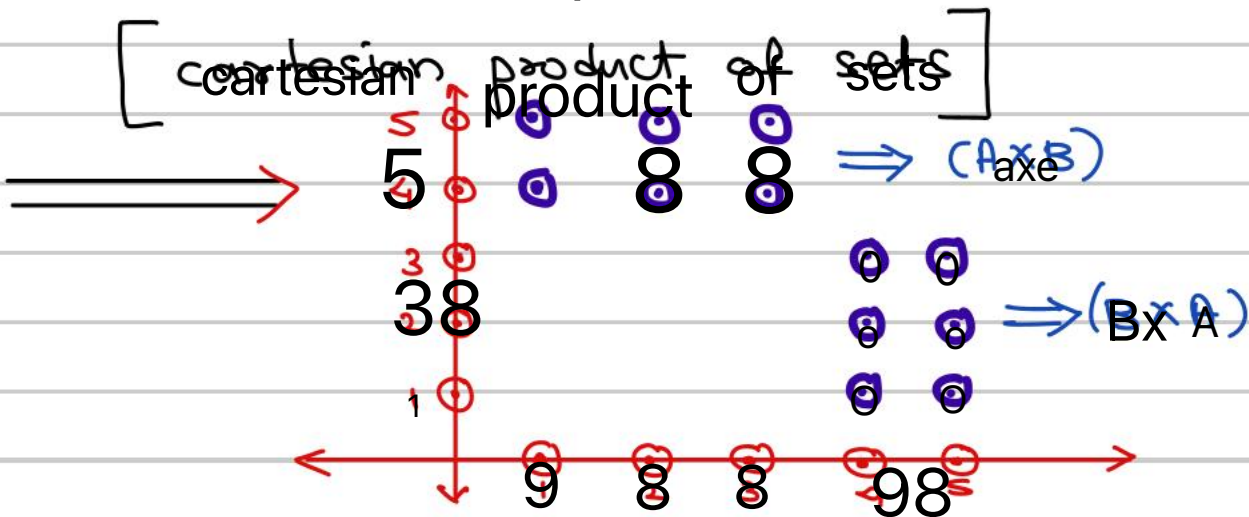
- (a) $B \subseteq A$ (b) $B' \subseteq A$ (c) $B' \subseteq A'$ (d) $A' \subseteq B'$

$$A = \{1, 2, 3\} \quad B = \{1, 2, 3, 4, 5\} \quad U = \{1, 2, 3, 4, 5, 6, 7, 8\}$$

$$A' = \{4, 5, 6, 7, 8\}, \quad B' = \{6, 7, 8\}$$

(S3) $A = \{1, 3, 3\} \quad B = \{4, 5\}$

Find $(A \times B)$ & $(B \times A)$



$$A \times B = \{(1,4), (1,5), (3,4), (3,5), (5,4), (5,5)\}$$

$$B \times A = \{(4,1), (4,3), (5,1), (5,3)\}$$

$$\therefore (A \times B) \neq (B \times A)$$

but $n(A \times B) = n(B \times A) = n(A) \cdot n(B)$

$$= 3 \times 2$$

$$= 6$$

(54) $(A \times B)$ is a set of all ordered pairs (i, j) where $i \in A$ & $j \in B$

(55) $A = \{ \text{mumbai, pune} \}$

$B = \{ 3, 9, 8, 9 \}$ $C = \{ 11, 3, 18, 9, 12, 5 \}$

Find $A \times (B \cap C)$

$\Rightarrow A = \{ \text{Mumbai, Pune} \}$ $B \cap C = \{ 3, 9 \}$

$A \times (B \cap C) = \{ (\text{Mumbai}, 3), (\text{Mumbai}, 9), (\text{Pune}, 3), (\text{Pune}, 9) \}$

(56) $A = \{ 5, 6, 8, 9, 10 \}$ $B = \{ 3, 6, 13, 14, 15 \}$

$C = \{ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 \}$

Find $C \times (A \cap B)$

$\Rightarrow \{ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 \} \times \{ 6 \}$

$= \{ (1, 6), (2, 6), (3, 6), (4, 6), (5, 6), (6, 6), (7, 6), (8, 6), (9, 6), (10, 6) \}$



(57)

$$y = 32^2 + 82 + 9$$

$$y = e^{109x} + 32 + \text{tax}$$

$$y = 522^{2x+3}$$

$$y = 9^{\text{art}} + \frac{13}{995}$$

$$y = 83e$$

$$y = 100/x + x^2$$

$$y = \text{Log} \left(\frac{5x+3}{563} \right) + 8^x + 19$$

y is expressed in terms of x

i. y = Dependent variable
x = Independent variable

y is a function of x which can be written as,

y = f(x)
y = h(x)
y = k(x)
y = j(x)

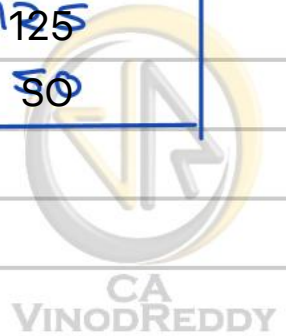
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(58) Demand (y) is dependent on price (x)

then we can say that y = f(x)

say y = f(x) = 200 - 5x

x	y = f(x) = 200 - 5x
20	f(20) = 200 - 5(20) = 100
22	f(22) = 200 - 5(22) = 90
23	f(23) = 200 - 5(23) = 85
18	f(18) = 200 - 5(18) = 110
17	f(17) = 200 - 5(17) = 115
15	f(15) = 200 - 5(15) = 125
30	f(30) = 200 - 5(30) = 50



59

$$f(x) = 8x^2 + 22x + 1, \quad g(x) = 20x - 2$$

Find $f(3), f(f^{-1}107), g(8), g(137), g(-3),$
 $f(f^{-1}12), f(0), g(0)$

$$\Rightarrow f(x) = 8x^2 + 22x + 1 \quad | \quad g(x) = 20x - 2$$

$$f(3) = 8(3)^2 + 2(37) + 1 = 79$$

$$g(8) = 20(8) - 2 = 158$$

$$f(f^{-1}107) = 8(-107)^2 + 2(510) + 1 = 781$$

$$g(137) = 20(137) - 2 = 258$$

$$f(f^{-1}12) = 8(-12)^2 + 2(6-12) + 1 = 1129$$

$$g(-3) = 20(-3) - 2 = -62$$

$$f(0) = 8(0)^2 + 2(0) + 1 = 1$$

$$g(0) = 20(0) - 2 = -2$$

60

$$\text{If } f(p) = 8p^2 + 3p + 25$$

8pt3p

Find $f(2), f(m), f(10), f(-3), f(0)$

\Rightarrow

$$f(p) = 8p^2 + 3p + 25$$

$$f(2) = 8(2)^2 + 3(2) + 25$$

$$f(m) = 8m^2 + 3m + 25$$

$$f(10) = 8(10)^2 + 3(10) + 25 = 855$$

$$f(-3) = 8(-3)^2 + 3(-3) + 25 = 88$$

$$f(0) = 8(0)^2 + 3(0) + 25 = 25$$

61

$$\text{If } f(x) = 39x - 7, \quad g(x) = 3x + 5$$

Find $f[g(27)], g[f(8)]$

\Rightarrow

$$i) f[g(27)] = f[3(27) + 5] = f(117) = 39(117) - 7 = 422$$

$$f[g(2)] = f \cdot g(2)$$

$$ii) g[f(8)] = g \cdot f(8) = g[39(8) - 7] = g(305)$$

$$= 3(305) + 5 = 920$$



(62)

y = Vinod Reddy's income

x = No. of students in his batches

k = No. of students pursuing CA course in India

m = India's industrial/service sector growth rate

$$y = f(x), \quad x = g(k), \quad k = h(m)$$

$$y = f \circ g \circ h$$

$$y = f [g(k)]$$

$$= f \cdot g \cdot (k)$$

$$y = f \cdot g [h(m)]$$

$$y = f \cdot g \cdot h(m)$$

Function of Function is known as composite function.

(63) $f(x) = 2x + 7$, $g(x) = 4x - 9$

Find $f \cdot g(10)$, $g \cdot f(11)$, $f \cdot g(-m)$



① $f \cdot g(10) = f [4(10) - 9] = f(31) = (2 \times 31) + 7 = 69$

② $g \cdot f(11) = g [2(11) + 7] = g(29) = (4 \times 29) - 9 = 107$

③ $f \cdot g(-m) = f [4(-m) - 9] = f(-4m - 9)$

$$= 2(-4m - 9) + 7$$

$$= -8m - 18 + 7$$

$$= -8m - 11$$

$$\begin{aligned} \textcircled{64} \quad f(x) &= 7x + 3 \\ g(x) &= 2x + 11 \\ h(x) &= 10x - 3 \end{aligned}$$

Find $f \cdot g \cdot h(10)$, $g \cdot f \cdot f \cdot h \cdot g \cdot h(f^{-1})$



$$\begin{aligned} \textcircled{1} \quad f \cdot g \cdot h(10) &= f \cdot g \cdot [10(10) - 3] \\ &= f \cdot g(97) \\ &= f[2(97) + 11] \\ &= f(205) \\ &= (7 \times 205) + 3 = 1438 \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad g \cdot f \cdot f \cdot h \cdot g \cdot h(f^{-1}) &= g \cdot f \cdot f \cdot h \cdot g(f^{-1}) \\ &= g \cdot f \cdot f \cdot h(f^{-1}) \\ &= g \cdot f \cdot f(-153) \\ &= g \cdot f(-1068) \\ &= g(-7473) \\ &= -14,935 \end{aligned}$$

$$\textcircled{65} \quad f(x) = 3x^2 + 2x + 1$$

Find $f(f+2)$, $f(f-3)$, $f(f+2)$



$$\begin{aligned} \textcircled{1} \quad f(f+2) &= 3(x+2)^2 + 2(x+2) + 1 \\ &= 3(x^2 + 4x + 4) + 2x + 4 + 1 \\ &= 3x^2 + 12x + 12 + 2x + 5 \\ &= 3x^2 + 14x + 17 \end{aligned}$$

$$\textcircled{2} \quad f(f+2) = 3x^2 + 14x + 17$$

$$\begin{aligned} \textcircled{3} \quad f(x-3) &= 3(x-3)^2 + 2(x-3) + 1 \\ &= 3(x^2 - 6x + 9) + 2x - 6 + 1 \end{aligned}$$

$$\begin{aligned} \text{CA Vinod Reddy | Maths Regular Notes} &= 3x^2 - 18x + 27 + 2x - 5 \\ &= 3x^2 - 16x + 22 \end{aligned}$$



(66)

Demand = y
 $f(x)$



(67)

$$f(x) = 8x^2 - x - 1 \quad , \quad g(x) = 11x + 3$$

Find $f \circ g(2)$, $g \circ f(1)$



$$\textcircled{1} \quad f \circ g(2) = f[11(2) + 3] = f(25)$$

$$= 8(25)^2 - 25 - 1 = 4974$$

$$\textcircled{2} \quad g \circ f(1) = g[8(1)^2 - (1) - 1] = g(6)$$

$$= 11(6) + 3 = 69$$

(68)

$$f(x) = 3x^2 - x - 1$$

$$g(x) = x^2 + 2x + 3$$

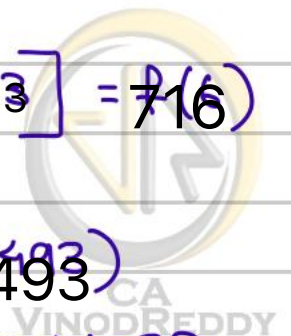
Find $f \circ g(-3)$, $g \circ f(13)$

$$\textcircled{1} \quad f \circ g(-3) = f[(-3)^2 + 2(-3) + 3] = f(0)$$

$$= 3(0)^2 - 0 - 1 = -1$$

$$\textcircled{2} \quad g \circ f(13) = g[3(13)^2 - 13 - 1] = g(493)$$

$$= 493^2 + 2(493) + 3 = 244038$$



$$(69) \quad f(x) = 13x^2 - 7x - 8$$

Find $f(2x-1)$, $f(x+3)$, $f(p-10)$



$$\begin{aligned} (1) \quad f(2x-1) &= 13(2x-1)^2 - 7(2x-1) - 8 \\ &= 13(4x^2 - 4x + 1) - 14x + 7 - 8 \\ &= 52x^2 - 52x + 13 - 14x - 1 \\ &= 52x^2 - 66x + 12 \end{aligned}$$

$$\begin{aligned} (2) \quad f(x+3) &= 13(x+3)^2 - 7(x+3) - 8 \\ &= 13(x^2 + 6x + 9) - 7x - 21 - 8 \\ &= 13x^2 + 78x + 117 - 7x - 29 \\ &= 13x^2 + 71x + 88 \end{aligned}$$

$$\begin{aligned} (3) \quad f(p-10) &= 13(p-10)^2 - 7(p-10) - 8 \\ &= 13(p^2 - 20p + 100) - 7p + 70 - 8 \\ &= 13p^2 - 260p + 1300 - 7p + 62 \\ &= 13p^2 - 267p + 1362 \end{aligned}$$

$$(70) \quad \text{If } f(2x-7) = 10x + 23 \quad \text{Find } f(x), ACP$$



$$f(2x-7) = 10x + 23$$

$$f(2x-7) = 5(2x-7) + 35 + 23$$

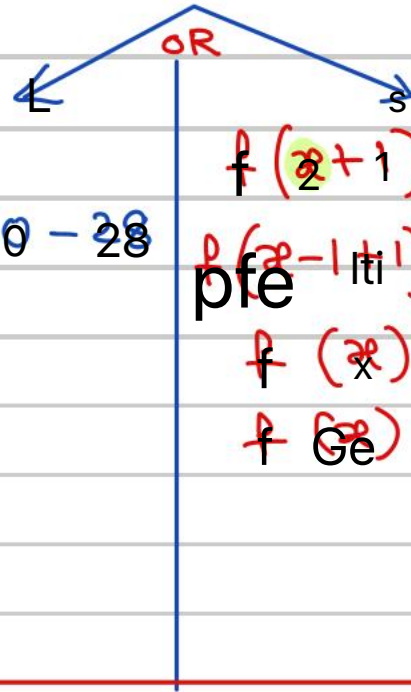
$$f(2x-7) = 5(2x-7) + 58$$

$$(1) \quad f(p) = 5p + 58$$

$$(2) \quad f(x) = 5x + 58$$



71) If $f(x+1) = 10x - 28$. Find $f(x)$, $f(p)$, $f(13)$



$$f(x+1) = 10x - 28$$

$$f(x+1) = 10(x+1) - 10 - 28$$

$$f(x) = 10x - 38$$

$$f(p) = 10p - 38$$

$$f(13) = (10 \times 13) - 38$$

$$= 92$$

$$f(x+1) = 10x - 28$$

$$f(x-1+1) = 10(x-1) - 28$$

$$f(x) = 10x - 10 - 28$$

$$f(x) = 10x - 38$$

72) $f(3x-1) = 11x - 35$ Find $f(p)$, $f(m)$, $f(y)$



$$f(3x-1) = (11x - 35)$$

$$f(3x-1) = \frac{11}{3}(3x-1) + \frac{11}{3} - 35$$

$$f(3x-1) = \frac{11}{3}(3x-1) + \frac{-94}{3}$$

$$f(p) = \frac{11}{3}p - \frac{94}{3} = \frac{11p - 94}{3}$$

$$f(m) = \frac{11m - 94}{3}$$

$$f(y) = \frac{11y - 94}{3}$$



730 $f(x) = \text{Log} \left(\frac{5x+3}{7x-8} \right)$. Find the $f(x-1)$

\Rightarrow the $D = \text{Log} \left[\frac{5(x-1)+3}{3(x-1)-5} \right]$

$= \text{Log} \left(\frac{5x-2}{7x-8} \right)$

74 $f(x-1) = x^2$ Find $f(x)$, $f(p)$, $f(p+1)$

\Rightarrow

$f(x-1) = x^2$

$f(x+1-1) = (x+1)^2$

$f(x) = (x+1)^2 = x^2 + 2x + 1$

$f(p) = (p+1)^2$

$f(p+1) = (p+1+1)^2 = (p+2)^2$

OR $f(x-1) = x^2$

$f(x-1) = (x-1)^2 = x^2 - 2x + 1$

$f(x-1) = (x-1)^2 = x^2 - 2x + 1$

$f(x) = x^2 + 2x + 1 = (x+1)^2$

75 $f(x+1) = x^3$. Find $f(p)$

\Rightarrow $f(x+1) = x^3$

$f(p-1+1) = (p-1)^3$

$f(p) = (p-1)^3$



76) If $f(x) = 1 - x - x^2$ and $f(x-1) = f(x+2)$. Find value of x

$$\implies f(x-1) = f(x+2)$$

$$1 - (x-1) - (x-1)^2 = 1 - (x+2) - (x+2)^2$$

$$1 - x + 1 - (x^2 - 2x + 1) = 1 - x - 2 - (x^2 + 4x + 4)$$

$$1 - x + 1 - x^2 + 2x - 1 = 1 - x - 2 - x^2 - 4x - 4$$

$$2x = -4x - 6$$

$$6x = -6$$

$$x = -1$$

77) If $g(x) = 13 - 2x - 3x^2$ and $g(p+1) = g(p-3)$. Find value of p .

$$\implies g(p+1) = g(p-3)$$

$$13 - 2(p+1) - 3(p+1)^2 = 13 - 2(p-3) - 3(p-3)^2$$

$$13 - 2p - 2 - 3(p^2 + 2p + 1) = 13 - 2p + 6 - 3(p^2 - 6p + 9)$$

$$-2 - 3p^2 - 6p - 3 = 6 - 3p^2 + 18p - 27$$

$$-6p - 5 = 18p - 21$$

$$16 = 24p$$

$$\therefore p = \frac{16}{24} = \frac{2}{3}$$

780) If $f(x) = 18 - 10x - 8x^2$ and $f(p+4) = f(p-5)$. Find p

$$\implies$$

$$18 - 10(p+4) - 8(p+4)^2 = 18 - 10(p-5) - 8(p-5)^2$$

$$18 - 10p - 40 - 8(p^2 + 8p + 16) = 18 - 10p + 50 - 8(p^2 - 10p + 25)$$

$$-40 - 8p^2 - 64p - 128 = 50 - 8p^2 + 80p - 200$$

$$-64p - 168 = 80p - 150$$

$$-18 = 144p$$

79) If $g(x) = 3x^2 - 17x + 25$

and $g(x+1) = g(x-1)$. Find x

$$\begin{aligned} \implies 3(x+1)^2 - 17(x+1) + 25 &= 3(x-1)^2 - 17(x-1) + 25 \\ 3(x^2 + 2x + 1) - 17x - 17 + 25 &= 3(x^2 - 2x + 1) - 17x + 17 \\ 3x^2 + 6x + 3 - 17x + 8 &= 3x^2 - 6x + 3 - 17x + 17 \\ 6x - 14 &= -6x + 20 \\ 12x &= 34 \\ x &= \frac{34}{12} = \left(\frac{17}{6}\right) = 2.833333 \\ &= 2\frac{5}{6} \end{aligned}$$

80) $y = f(x) = 8x + 3$

$$\begin{aligned} y &= 8x + 3 \\ 8x &= y - 3 \end{aligned}$$

$$x = \left(\frac{y-3}{8}\right)$$

y is a function of x ,

$x = f^{-1}(y) = \left(\frac{y-3}{8}\right)$, now x is the inverse function of y

Here

Dependent variable = y
Independent variable = x

If y is the function of x then x is the inverse function of y

If Demand is the function of price then price is the inverse function of demand.



81) $y = f(x) = 13x - 17$

Find $f^{-1}(y)$, $f^{-1}(p)$, $f^{-1}(35)$, $f^{-1}(1140)$, $f^{-1}(0)$, $f^{-1}(0)$



If $y = f(x)$ then
 $x = f^{-1}(y)$

① $y = 13x - 17$
 $x = \frac{y+17}{13}$

$f^{-1}(y) = \frac{y+17}{13}$

⑤ $f^{-1}(x) = \frac{x+17}{13}$

② $f^{-1}(p) = \frac{p+17}{13}$

⑥ $f^{-1}(0) = \frac{0+17}{13}$

③ $f^{-1}(35) = \frac{35+17}{13} = 4$

$= \frac{17}{13}$

④ $f^{-1}(1140) = \frac{1140+17}{13} = 87$

82) If $y = f(x) = 10x + 23$. Find $f^{-1}(y)$, $f^{-1}(m+1)$, $f^{-1}(f-80)$, $f^{-1}(x)$, $f^{-1}(-2/3)$

$y = f(x) = 10x + 23$
 $x = \frac{y-23}{10}$

$f^{-1}(y) = \frac{y-23}{10}$

$f^{-1}(x) = \frac{x-23}{10}$

$f^{-1}(m+1) = \frac{m+1-23}{10} = \frac{m-22}{10}$

$f^{-1}(-2/3) = \frac{-2/3-23}{10}$

$f^{-1}(f-80) = \frac{f-80-23}{10} = \frac{f-103}{10}$

$= \frac{-2-69}{30} = \frac{-71}{30}$

83 If $y = f(x) = \left(\frac{8x-10}{3x+13} \right)$ Find $f^{-1}(y)$, $f^{-1}(e)$, $f^{-1}(12)$



$$y = \frac{8x-10}{3x+13}$$

$$3xy + 13y = 8x - 10$$

$$32y - 8x = -10 - 13y$$

$$24(3y-8) = -10 - 13y$$

$$x = \left(\frac{-10 - 13y}{3y - 8} \right) = \left(\frac{10 + 13y}{8 - 3y} \right)$$

i) $f^{-1}(y) = \frac{10 + 13y}{8 - 3y}$

ii) $f^{-1}(e) = \frac{10 + 13e}{8 - 3e}$

iii) $f^{-1}(12) = \frac{10 + 13(12)}{8 - 3(12)} = \frac{166}{-28} = \frac{83}{-14} = -\left(\frac{83}{14}\right)$

84 If $f(x) = \left(\frac{8-2x}{3x+2} \right)$ find $f^{-1}(p)$, $f^{-1}(38)$, $f^{-1}\left(\frac{5}{7}\right)$



$$y = f(x) = \frac{8-2x}{3x+2}$$

$$3xy - 2y = 8 - 2x$$

$$32y + 2x = 8 + 2y$$

$$x(3y+2) = 8 + 2y$$

$$x = \left(\frac{8 + 2y}{3y + 2} \right)$$

$$f^{-1}(y) = \left(\frac{8 + 2y}{3y + 2} \right)$$

$$f^{-1}(p) = \left(\frac{8 + 2p}{3p + 2} \right)$$

$$f^{-1}(38) = \frac{8 + 2(38)}{3(38) + 2} = \frac{806}{116}$$

$$= \frac{403}{58}$$

$$f^{-1}\left(\frac{5}{7}\right) = \left(\frac{8 + 2 \times \frac{5}{7}}{3 \times \frac{5}{7} + 2} \right) = \frac{56 + 105}{15 + 14}$$

$$= \left(\frac{161}{29} \right)$$

85) $g(x) = \left(\frac{8x+21}{13} \right)$ Find $g^{-1}(y)$, $g^{-1}(30)$, $g^{-1}(x)$



$$y = g(x) = \frac{8x+21}{13}$$

By $13y = 8x+21$

$$x = \left(\frac{13y-21}{8} \right)$$

$$g^{-1}(y) = \left[\frac{13y-21}{8} \right]$$

$$g^{-1}(30) = \frac{13(30)-21}{8} = \frac{369}{8}$$

$$g^{-1}(x) = \left(\frac{13x-21}{8} \right)$$

$y = g(x)$
 ye goes
 then
 $x = g^{-1}(y)$

86) Speed = f (acceleration)

then acceleration = f^{-1} (speed)

87) If $f(x) = \text{Log} \left(\frac{8x+3}{x-17} \right)$. Find $f(4/3)$

⇒ $f(4/3) = \text{Log} \left[\frac{8 \times \frac{4}{3} + 3}{\frac{4}{3} - 17} \right]$

$$= \text{Log} \left(\frac{16+9}{18-51} \right) = \text{Log} \left(\frac{25}{-33} \right)$$

$$= \text{Log} \left(-\frac{25}{33} \right)$$



88) If $f(x) = \left(\frac{3x+7}{3-2x} \right)$. Find $f^{-1}[f(10)]$



$y = f(x) = \left(\frac{3x+7}{3-2x} \right)$

$11y - 2xy = 3x + 7$
 $11y - 7 = 3x + 2xy$
 $(11y - 7) = x(3 + 2y)$

∴ $x = \left(\frac{11y-7}{3+2y} \right)$

$f^{-1}(y) = \left(\frac{11y-7}{3+2y} \right)$

$f^{-1}[f(10)]$
 $= f^{-1}\left[\frac{3(10)+7}{3-2(10)}\right]$
 $= f^{-1}\left(\frac{37}{-17}\right)$
 $= \left[\frac{11\left(\frac{-37}{-17}\right) - 7}{3 + 2\left(\frac{-37}{-17}\right)} \right]$
 $= \left(\frac{-407 - 63}{27 - 74} \right) = \frac{-470}{-47}$
 $= 10$

Shortcut : $f^{-1}[f(m)] = m$

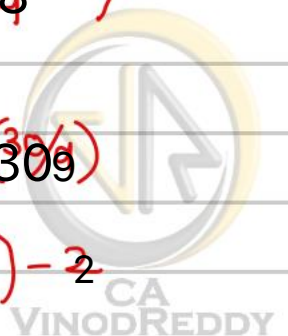
$f[f^{-1}(m)] = m$

89) $f(x) = 9x - 2$ Find $f^{-1}[f(20)]$

⇒ $y = f(x) = 9x - 2$
 $\therefore x = \left(\frac{y+2}{9} \right)$

$f^{-1}(y) = \left(\frac{y+2}{9} \right)$

① $f^{-1}[f(20)]$
 $= f^{-1}[9(20) - 2]$
 $= f^{-1}(178) = \left(\frac{178+2}{9} \right) = 20$
 ② $f[f^{-1}(28)]$
 $= f\left[\frac{28+2}{9}\right] = f\left(\frac{30}{9}\right)$
 $= f\left(\frac{10}{3}\right) = \left(9 \times \frac{10}{3} \right) - 2$
 $= 28$



$$f^{-1}[f(x)] = x = f[f^{-1}(x)]$$

90) If $f(x) = x^2$ find $f(8), f(-8)$

$$\Rightarrow f(8) = 8^2 = 64$$

$$f(-8) = (-8)^2 = 64$$

Here $f(x) = f(-x)$

$\therefore f(x)$ is said to be even function

91) If $f(x) = x^2 + x^4$ Find $f(2), f(-2)$

$$\Rightarrow f(2) = 2^2 + 2^4 = 4 + 16 = 20$$

$$f(-2) = (-2)^2 + (-2)^4 = 4 + 16 = 20$$

Here $f(x) = f(-x)$

When $f(x) = f(-x)$ then $f(x)$ is said to be Even function of x

92) If $f(x) = x^3$ Find $f(8), f(-8)$

$$\Rightarrow f(8) = 8^3 = 512$$

$$f(-8) = (-8)^3 = -512$$

$$f(-8) = -f(8)$$

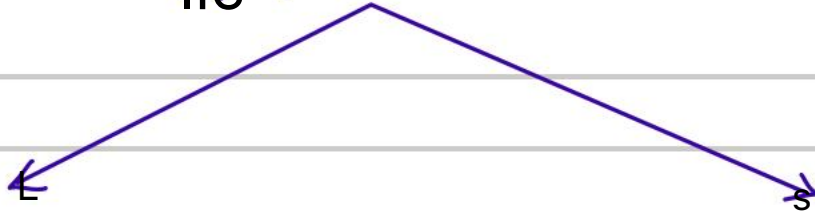
$$-f(-8) = f(8)$$

\therefore Here $f(x) = -f(-x)$ OR $f(-x) = -f(x)$

If $f(x) = -f(-x)$ or $f(-x) = -f(x)$ then $f(x)$ is said to be an odd function

93

$f(x)$ is said to be



an even function

an odd function

When

$$f(x) = f(-x)$$

When

$$f(x) = -f(-x) \text{ (OR)}$$

$$-f(x) = f(-x)$$

94

If $f(x) = x^2 + x^3$ then $f(x)$ is _____

- a) an odd function
- b) an even function
- c) Neither odd nor even function
- d) Both odd as well as even function

$$f(x) = x^2 + x^3$$

$$f(-x) = (-x)^2 + (-x)^3 = x^2 - x^3$$

$$f(6) = 6^2 + 6^3 = 252$$

$$f(-6) = -6^2 - 6^3 = 36 - 216 = -180$$

95

If $f(x) = x^3 - x^5$ then $f(x)$ is _____

- a) an odd function
- b) an even function
- c) Neither odd nor even function
- d) Both odd as well as even function

$$f(10) = 10^3 - 10^5 = 1000 - 100,000 = -99,000$$

$$f(-10) = (-10)^3 - (-10)^5 = -1000 - (-100,000) = 99,000$$

$$f(-x) = (-x)^3 - (-x)^5 = -x^3 - (-x^5) = -x^3 + x^5$$

$$= -(x^3 - x^5) = -f(x)$$

96) If $f(x) = \text{Log} \left(\frac{1+x}{1-x} \right)$ then $f(x)$ is _____

~~(a)~~ an odd function

(b) an even function

(c) Neither odd nor even function

(d) Both odd as well as even function



$$1) f(x) = \text{Log} \left(\frac{1+x}{1-x} \right) = \text{Log} \left(\frac{1+x}{1-x} \right) = \text{Log}(1+x) - \text{Log}(1-x) \quad \text{----- } (1)$$

$$2) f(-x) = \text{Log} \left[\frac{1+(-x)}{1-(-x)} \right] = \text{Log} \left(\frac{1-x}{1+x} \right) = \text{Log}(1-x) - \text{Log}(1+x)$$

$$f(-x) = - \left[\text{Log}(1+x) - \text{Log}(1-x) \right]$$

$$f(-x) = -f(x)$$

97) If $f(x) = (x^3 + x^{11})$ then $f(x)$ is

~~(a)~~ an odd function

(b) an even function

(c) Neither odd nor even function

(d) Both odd as well as even function

$$f(x) = x^3 + x^{11}$$

$$f(-x) = (-x)^3 + (-x)^{11}$$

$$f(-x) = -x^3 - x^{11}$$

$$f(-x) = - (x^3 + x^{11})$$

$$f(-x) = -f(x)$$



98) If $f(x) = 3x^2 + 2x + 1$
and $f(x+1) = f(x-2)$. Find value of x

$$\begin{aligned} \Rightarrow 3(x+1)^2 + 2(x+1) + 1 &= 3(x-2)^2 + 2(x-2) + 1 \\ 3(x^2 + 2x + 1) + 2x + 2 + 1 &= 3(x^2 - 4x + 4) + 2x - 4 + 1 \\ 3x^2 + 6x + 3 + 2x + 2 + 1 &= 3x^2 - 12x + 12 + 2x - 4 + 1 \\ 6x + 6 &= -10x + 9 \\ 16x &= 3 \\ x &= \frac{3}{16} = \frac{1}{6} \end{aligned}$$

99) If $g(x) = 2x^2 - 10x + 3$ &
 $g(x-2) = g(x+2)$. Find value of x

$$\begin{aligned} \Rightarrow 2(x-2)^2 - 10(x-2) + 3 &= 2(x+2)^2 - 10(x+2) + 3 \\ 2(x^2 - 4x + 4) - 10x + 20 + 3 &= 2(x^2 + 4x + 4) - 10x - 20 + 3 \\ 2x^2 - 8x + 8 - 10x + 20 + 3 &= 2x^2 + 8x + 8 - 20 + 3 \\ 40 &= 16x \\ \therefore x &= \frac{40}{16} = \frac{5}{2} = 2.5 \end{aligned}$$

100) If $f(x) = \left(\frac{3x-11}{3-x} \right)$ Find $f^{-1}(y)$, $f^{-1}(p)$, $f^{-1}(13)$

$$\Rightarrow y = \frac{3x-11}{3-x}$$

$$xy = 3x - 11$$

$$11 = 3x - xy$$

$$11 = x(3-y)$$

$$\therefore x = \left(\frac{11}{3-y} \right)$$

If $y = f(x)$
then
 $x = f^{-1}(y)$

$$\therefore f^{-1}(y) = \left(\frac{11}{3-y} \right)$$

$$f^{-1}(p) = \left(\frac{11}{3-p} \right)$$

$$f^{-1}(13) = \left(\frac{11}{3-13} \right) = \frac{11}{-10} = -\frac{11}{10}$$



100

Iff $f(x) = 5x + 11$

$g(x) = 3x - 1$

Find $f \circ g(p)$ & $g \circ f(p)$



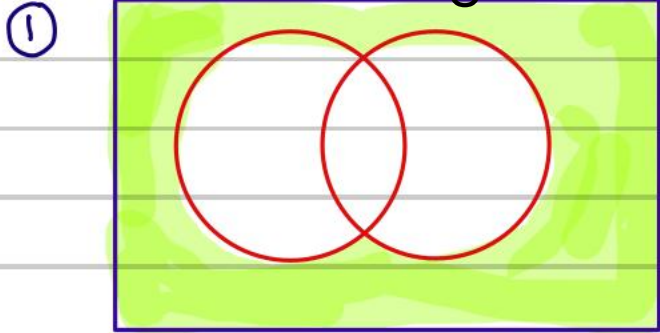
① $f \circ g(p) = f(3p - 1)$
 $= 5(3p - 1) + 11$
 $= 15p - 5 + 11 = 15p + 6$

② $g \circ f(p) = g(5p + 11)$
 $= 3(5p + 11) - 1$
 $= 15p + 33 - 1 = 15p + 32$

100

De-morgan's rule of sets

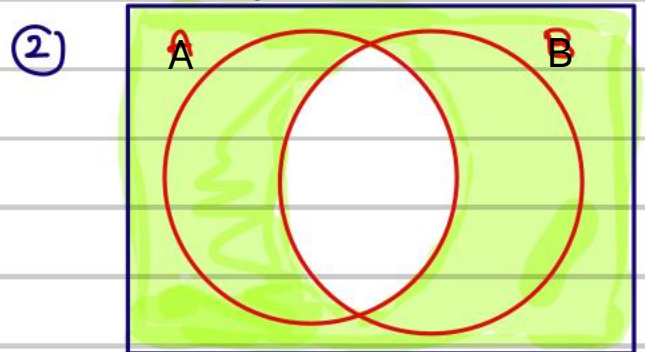
U = universal set



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

$n(A' \cap B') = n(A \cup B)'$
 $= n(U) - n(A \cup B)$

U = universal set



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

$n(A' \cup B') = n(A \cap B)'$
 $= n(U) - n(A \cap B)$

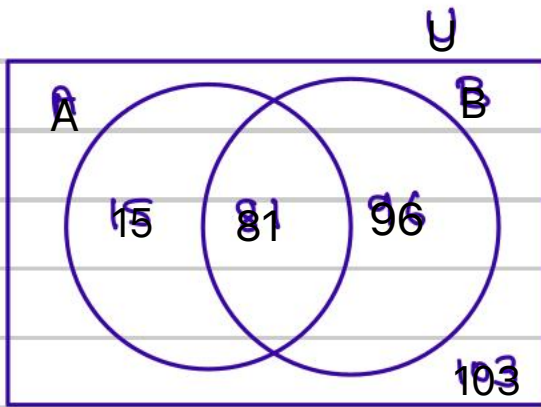
1030

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



$$ii) n(A \cap B | A') = n(U) - n(A \cup B)$$

104



$$n(A) = 115$$

$$n(B) = 118$$

$$n(A') = 180$$

$$n(B') = 177$$

$$n(U) = 295$$

$$n(A \cap B) = 81$$

$$n(A \cup B) = 192$$

$$n(A \cap B') = 34$$

$$n(A - B) = n(A \cap B') = 34$$

$$n(B - A) = n(B \cap A') = 37$$

$$n(A \cup B') = 180$$

$$n(B \cup A') = 180$$

$$n(A' \cap B) = 37$$

$$n(A \cup B) = 192$$

105 If $f(x) = \left(\frac{1}{1+x}\right)$, $g(x) = (x-1)$

Find $f \circ g\left(\frac{1}{2}\right)$, $g \circ f\left(\frac{3}{2}\right)$, $g \circ f(p-3)$

$$\Rightarrow \textcircled{1} f \circ g\left(\frac{1}{2}\right) = f\left[\frac{\frac{1}{2}-1}{\frac{1}{2}}\right] = f\left(\frac{-\frac{1}{2}}{\frac{1}{2}}\right) = f(-1)$$

$$= \frac{1}{1+(-1)} = \frac{1}{0} = \text{not defined}$$

$$\textcircled{2} g \circ f\left(\frac{3}{2}\right) = g\left[\frac{1}{1+\frac{3}{2}}\right] = g\left(\frac{1}{\frac{5}{2}}\right) = g\left(\frac{2}{5}\right)$$

$$= \left(\frac{\frac{2}{5}-1}{\frac{2}{5}}\right) = \frac{\frac{2-5}{5}}{\frac{2}{5}} = \frac{-3}{2}$$

$$\textcircled{3} \quad g \cdot f f p^{(p-3)} = g \left[\frac{1}{1+16^{-3}} \right] = g \left(\frac{1}{gf^2} \right)$$

$$= \left(\frac{\frac{1}{p-2} - 1}{\frac{1}{p-2}} \right) = \frac{1 - (p-2)}{1} = 1 - p + 2 = (3 - p)$$

1060 $A = \{3, 5, 8\}, B = \{8, 3, 5, 8, 3, 3, 8\}$

A, B are

- (a) Equal sets
 (b) Equivalent sets
 (c) Both of these
 (d) None of these

$$A = \{3, 5, 8\}, B = \{3, 5, 8\}$$

100 $P = \{m, n, s, e, d\}, Q = \{p, m, j, r, j, g, m\}$

Here P, Q are

- (a) Equal sets
 (b) Equivalent sets
 (c) Both of these
 (d) None of these

$$P = \{m, n, s, e, d\}, Q = \{p, m, j, a\}$$

$$n(P) = n(Q) = 4$$

1080 $(A \cup B) \cup (A \cap B) =$

- (a) $(A \cup B)$
 (b) $(A - B)$
 (c) $A' \cap B'$
 (d) U

1090 $A = \{3, 3, 5, 8, 9\}, B = \{5, 5, 6, 6, 7\}$

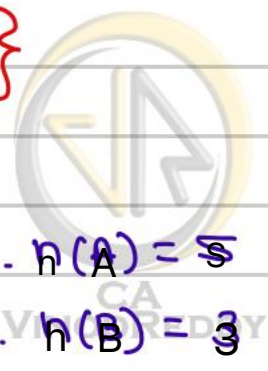
Here A, B are

- (a) Equal sets
 (b) Equivalent sets
 (c) Both of these

(d) None of these

$$A = \{2, 3, 5, 8, 9\} \therefore n(A) = 5$$

$$B = \{5, 6, 7\} \therefore n(B) = 3$$



1100 $A = \{y : y = 1 - 5^{-1/x} \text{ \& } x \in \mathbb{N}\}$

then $y = ?$

- (a) $\{ \}$ (b) $\{1\}$ (c) $\{1,2\}$ ~~(d) $\{0,2\}$~~

$x = 1$	$y = 1 - (5^{-1})^1 = 2$
$x = 2$	$y = 1 - (5^{-1/2})^2 = 0$
$x = 3$	$y = 1 - (5^{-1/3})^3 = 2$
$x = 4$	$y = 1 - (5^{-1/4})^4 = 0$
$x = 5$	$y = 1 - (5^{-1/5})^5 = 2$
$x = 6$	$y = 1 - (5^{-1/6})^6 = 0$

(iii) If E is a set of all Even natural numbers
 $\&$ O is a set of all odd natural numbers

then Find

$$(E \cup O) = \{1, 2, 3, 4, 5, 6, 7, 8, \dots\} = \mathbb{N}$$

$$(E \cap O) = \phi$$

Here E, O are disjoint sets

(112) If R is a set of all positive rational numbers
 and V is a set of all Real numbers then

- (a) $R \subseteq V$ ~~(b) $R \subset V$~~ (c) OVER (d) $V \subset R$



(113) If R is the set of all quadrilaterals &

M is a set of all Rectangles then

- (a) $M \subseteq R$ ~~(b) $M \subset R$~~ (c) $R \subseteq M$ (d) $R \subseteq M$

(114) If S is a set of all squares &

R is a set of all Rectangles then

$S \subset R$: S is a subset of R
in fact

S is a proper subset of R

(115) If $D = \{x^2 : \text{where } x \in \mathbb{N}\}$ then

D is _____

- (a) Null set (b) Singleton set ~~(c) Infinite set~~ (d) Finite set

$$D = \{1, 4, 9, 16, 25, 36, 49, \dots\}$$

(1160) If $M = \{x : \text{where } x \geq 10 \text{ and } x \leq 10\}$ then

M is a

- (a) Null set ~~(b) Singleton set~~ (c) Finite set
(d) Infinite set

$$M = \{10\}$$



1170 If $N = \{x : \text{where } x > 50 \text{ \& } x < 50\}$ then

N is

- ~~(a) Null set~~ (b) singleton set (c) finite set
(d) infinite set

1180 $K = \{0\}$ Here set K is

- (a) Null set ~~(b) singleton set~~ (c) void set
(d) infinite set

1190 $B = \{0\}$ Here set B is

- (a) Null set (b) Empty set (c) void set ~~(d) None of these~~

120 Null set is represented by

- (a) $\{\}$ (b) ϕ ~~(c) a or b~~ (d) None of these

121 If $h(x) = \frac{px-9}{qx-p}$ then $x = ?$

- ~~(a) h(y)~~ (b) $h(y)$ (c) $h(y)$ (d) none of these

$$\Rightarrow y = h(x) = \frac{px-9}{qx-p}$$

$$h(x) = \frac{px-9}{qx-p}$$

$$qxy - py = px - 9$$

$$h(y) = \frac{py-9}{qy-p} \dots \textcircled{2}$$

$$qxy - px = py - 9$$

$$x(qy - p) = py - 9$$

$$\therefore x = \frac{py-9}{qy-p} \dots \textcircled{1}$$

(22) If $n(A) = 3$, $n(B) = 8$ then

$$n(A \times B) = ?$$

(a) 8

(b) 11

~~(c) 24~~

(d) 48

(23) $A = \{3, 5\}$ $B = \{8, 9\}$ then

$$A \times B = \{(3, 8), (3, 9), (5, 8), (5, 9)\}$$

$$B \times A = \{(8, 3), (8, 5), (9, 3), (9, 5)\}$$

Here $(A \times B) \neq (B \times A)$

$$\begin{aligned} \text{but } n(A \times B) &= n(B \times A) = n(A) \times n(B) \\ &= 2 \times 2 \\ &= 4 \end{aligned}$$

$\therefore (A \times B), (B \times A)$ are Equivalent sets but not Equal sets.

(24) $A = \{2, 10\}$, $B = \{10, 2\}$ Find

$$A \times B = \{(2, 10), (2, 2), (10, 2), (10, 10)\}$$

$$B \times A = \{(2, 10), (2, 2), (10, 2), (10, 10)\}$$

$$(A \times B) \cup (B \times A) = \{(2, 10), (2, 2), (10, 2), (10, 10)\}$$

$$(A \times B) \cap (B \times A) = \{(2, 10), (2, 2), (10, 2), (10, 10)\}$$

\therefore If A, B are equal sets then,

$$(A \times B) = (B \times A) = [(A \times B) \cup (B \times A)] = [(A \times B) \cap (B \times A)]$$

125) If $f(x) = e^{2x}$ then

$$f(p+q) = ?$$

a) $f(p) + f(q)$

~~b) $f(p) \times f(q)$~~

c) $f(p) / f(q)$

d) None of these



$$f(x) = e^{2x}$$

$$f(p) = e^{2p}$$

$$f(q) = e^{2q}$$

$$f(p+q) = e^{2(p+q)}$$

$$= e^{2p} \times e^{2q}$$

$$f(p+q) = f(p) \times f(q)$$

126) $f(x) = \frac{1}{1-x}$, $g(x) = \frac{x-1}{x}$ find $f \circ g\left(\frac{1}{2}\right)$

⇒ $f \circ g\left(\frac{1}{2}\right) = f\left[\frac{\frac{1}{2}-1}{\frac{1}{2}}\right]$

$$= f\left(\frac{1-2}{1}\right)$$

$$= f(1-2) = \frac{1}{1-(1-2)}$$

$$= \frac{1}{1-1+2} = \frac{1}{2}$$

127) If $f(x) = \left(\frac{x}{1-x}\right)$ Find $f \circ f\left(\frac{1}{2}\right)$

⇒ $f \circ f\left(\frac{1}{2}\right) = f\left[\frac{-\frac{1}{2}}{1-\left(-\frac{1}{2}\right)}\right] = f\left[\frac{-\frac{1}{2}}{\frac{3}{2}}\right]$

$$= f\left(-\frac{1}{3}\right) = \frac{-\frac{1}{3}}{1-\left(-\frac{1}{3}\right)}$$

$$= \frac{-\frac{1}{3}}{1+\frac{1}{3}} = \frac{-\frac{1}{3}}{\frac{4}{3}} = \left(-\frac{1}{4}\right)$$

1280 $f(x-D) = x^3 - 1$ Find $f(p)$

$$\begin{aligned} \Rightarrow f(x-D) &= x^3 - 1 \\ f(p+1) &= (p+1)^3 - 1 \\ f(p) &= (p+1)^3 - 1 \\ &= p^3 + 3p \times 1 + 3 \times 1 + 1 - 1 \\ &= p^3 + 3p^2 + 3p \end{aligned}$$

1290 The set $A = \{x : 0 < x < 5 \text{ \& } x \in \mathbb{N}\}$ represents

- ~~(a) $\{1, 2, 3, 4\}$~~ (b) $\{0, 1, 3, 4\}$ (c) $\{1, 3, 4, 5\}$
 (d) $\{0, 1, 2, 3, 4, 5\}$

130 The set $A = \{x : 0 < x \leq 5 \text{ \& } x \in \mathbb{N}\}$ represents

- (a) $\{1, 2, 3, 4\}$ (b) $\{0, 1, 3, 4\}$ ~~(c) $\{1, 3, 4, 5\}$~~
 (d) $\{0, 1, 2, 3, 4, 5\}$

131 Any subset of product set $X \cdot Y$ is said to define a relation from X to Y and any relation from X to Y in which no 2 diff ordered pairs have the same first element is called as Function.

$$X = \{MH, Karnataka, Bihar\} \quad Y = \{Mumbai, Pune, Bang, Patna, Jaipur\}$$

then

$$X \cdot Y = \left\{ \begin{aligned} &(MH, Mumbai), (MH, Pune), (MH, Bang), (MH, Patna), (MH, Jaipur) \\ &(Karna, Mumbai), (Karna, Pune), (Karna, Bang), (Karna, Patna), (Karna, Jai) \\ &(Bihar, Mumbai), (Bihar, Pune), (Bihar, Bang), (Bihar, Patna), (Bihar, Jai) \end{aligned} \right\}$$

$f : X \rightarrow Y$ $x = \text{state}$ $y : \text{capital city}$

$= \left\{ (MH, \text{Mumbai}), (Karnataka, \text{Bang}), (Bihar, \text{Patna}) \right\}$

Relations :

1. one to one
2. one to many
3. many to one
4. many to many

out of these 4 relations one to one & Many to one relations are Functions

Functions :

1. one to one
2. many to one

when $y = f(x)$ then x : pre-image
 y : Image

1320 one to many & many to many : are relations but not functions.

Every function is a relation but every relation is not necessarily a function.

1330 $A = \{1, 2, 3, 4, 5\}$ $B = \{1, 9, 9, 16, 25, 36, 99\}$

There will be 35 ordered pairs in set $(A \times B)$

Any subset of $(A \times B)$ will form a relation both A & B

$f : A \rightarrow B$ where $f(x) = x^2$

$f : A \rightarrow B = \left\{ (1, 1), (2, 4), (3, 9), (4, 16), (5, 25) \right\}$

pre-image (x)	image ($f(x)$)
1	1
2	4
3	9
4	16
5	25

$$\text{Domain} = \{1, 2, 3, 4, 5\}$$

$$\text{co-domain} = \{1, 4, 9, 16, 25, 36, 49\}$$

$$\text{Range} = \{1, 4, 9, 16, 25\}$$

Here Range is the proper subset of co-domain.

When,

Range is the proper subset of co-domain : IN To function

Range is the improper subset of co-domain : ON To function

$$R = \{(10, 30), (20, 60), (15, 45), (25, 75), (30, 90)\}$$

Here

$$\text{Domain} = \{10, 20, 15, 25, 30\} = \text{set of all first elements}$$

$$\text{Range} = \{30, 60, 45, 75, 90\} = \text{Set of all second elements}$$

This is one to one relation.



(135) $R = \left\{ (10,1), (20,1), (30,17), (40,17), (50,1), (60,1) \right\}$

Here

Domain = $\{ 10, 20, 30, 40, 50, 60 \}$

Range = $\{ 1 \}$

This is example of many to one correspondence.

(136) When a Relation is said to be

Let $S = \{ a, b, c, d, \dots \}$ then the relation R is any subset of $(S \times S)$

Reflexive : If R contains all ordered pairs (a, a) in $S \times S$ then R is said to be Reflexive

symmetric : If $(a, b) \in R$ then $(b, a) \in R$
 For every $(a, b) \in R$ then R is said to be symmetric

Transitive : If $(a, b), (b, c) \in R$ then $(a, c) \in R$
 For Every $(a, b), (b, c) \in R$ then R is said to be transitive

If a Relation is Reflexive, symmetric, Transitive then it is a Relation of Equivalence.



1370 'Is Equal to' Relation is

- (a) Reflexive (b) symmetric (c) transitive (d) Equivalence

1380 'Is less than' Relation is :

- (a) Reflexive (b) symmetric (c) transitive (d) Equivalence

1390 'Is Reciprocal of' Relation is

- (a) Reflexive (b) symmetric (c) transitive (d) Equivalence

140 'Is parallel to' Relation is

- (a) Reflexive (b) symmetric (c) transitive (d) Equivalence

141 'Is Greater than' Relation is

- (a) Reflexive (b) symmetric (c) transitive (d) Equivalence

1420 'Is \perp to' Relation is

- (a) Reflexive (b) symmetric (c) transitive (d) Equivalence

1430 Everything in this word, Living or non-living is called as OBJECT

144 Set is a collection of well-defined and distinct objects

145 Find power set of B If $B = \{8\}$

$$\Rightarrow \text{power set of B} = \{ \{8\}, \emptyset \}$$



1460 A set of all possible subsets is known as power set

147 If $n(A) = 3379$, $n(U) = 10879$

Find $n(A')$

$$\begin{aligned}\Rightarrow n(A') &= n(U) - n(A) \\ &= 10879 - 3379 \\ &= 7500\end{aligned}$$

Ingrassia [cardinal value of any set + cardinal value of its complementary set] = 15 [cardinal value of universal set]

$$n(A \cup B) + n(A \cup B)' = n(U)$$

1480 set of cubes of all natural numbers is :

(a) Finite set (b) Null set (c) singleton set

~~(d) Infinite set~~

1490 Inverse Function is possible only

when function is one to one.

only one to one functions are invertible

150 $y = f(x) = \frac{1}{1-x}$ Find $f^{-1}(y)$, $f^{-1}(p)$, $f^{-1}(10)$

\Rightarrow

$$ye = \frac{1}{1-x}$$

$$y(1-x) = 1$$

$$y - xy = 1$$

$$y - 1 = xy$$

$$\therefore x = \left(\frac{y-1}{y} \right)$$

$$f^{-1}(y) = \left(\frac{y-1}{y} \right), \quad f^{-1}(p) = \left(\frac{p-1}{p} \right), \quad f^{-1}(10) = \frac{10-1}{10} \\ = \left(\frac{9}{10} \right)$$

(151) If $h(x) = 10^{1+x}$ where $3 \leq x \leq 10$

then Range of $h(x)$ is :



Range of $h(x)$



$$10^{1+3} \leq h(x) \leq 10^{1+10}$$

$$10^4 \leq h(x) \leq 10^{11}$$

Lined writing area for notes.

