Venn Diagrams

Sets are also represented with the help of diagrams. Diagrams are easy to understand and also give a clear idea to solve problems. Diagramatic representation of sets was first given by Swedish Mathematician Euler and English Mathematician John Venn. Therefore, pictorial representation of sets is called Venn diagrams.

Sets are shown by circles. The exception to this rule is the Universal set. The universal set is represented by rectangle.

Example

a) Universal Set = U = {1,2,3,4,5,6,7,8,9,10|}

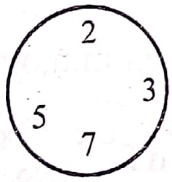
Pictorial representation = U =

1	2	3	4
5	6	7	
8	9	10	

b) A = {xlx is a prime number within 10 }
= {2,3,5,7}

Pictorial representation

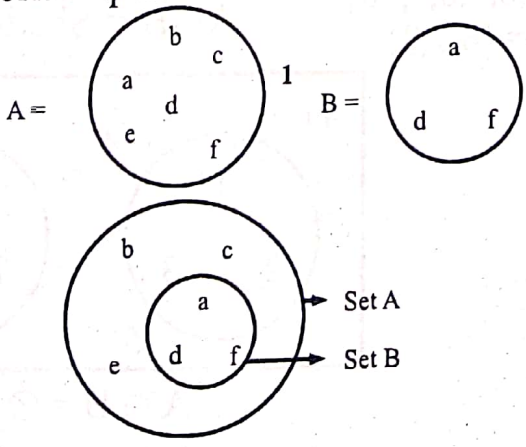
A =



Subset

Example

a) Let set A = {a,b,c,d,e,f} and B = {a,d,f}
'B' is the sub set of set A.
Pictorial representation



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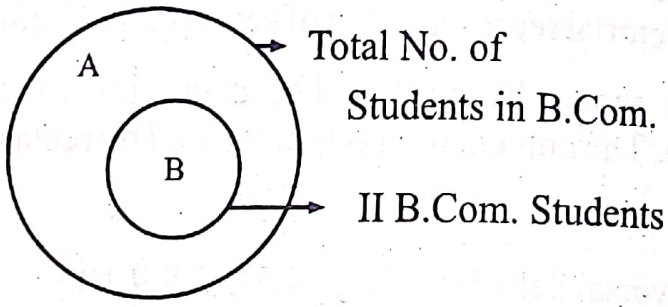
Example

b) Let A = [Total No. of students in B.Com of college X].

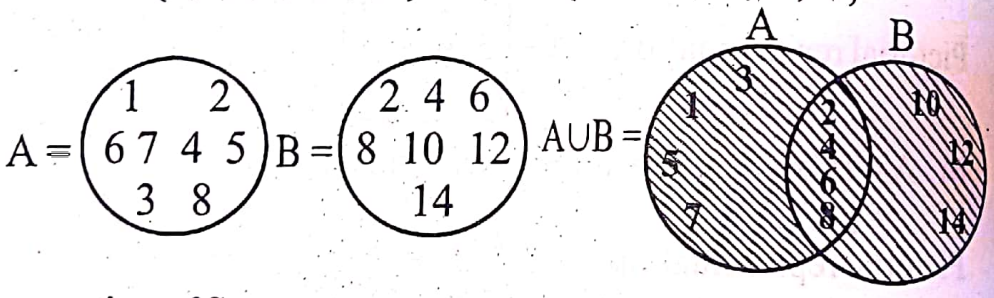
B = [No. of students of 2nd B.Com. of college X]

Pictorial representation :



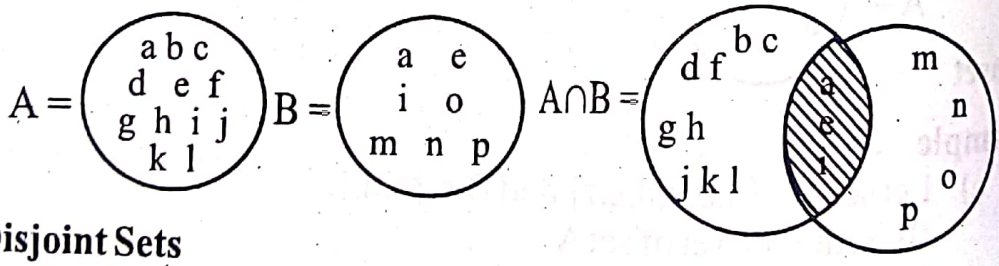
Union of Sets

Let A = {1,2,3,4,5,6,7,8} and B = {2,4,6,8,10,12,14}



Intersection of Sets

Let A = [a,b,c,d,e,f,g,h,i,j,k,l] and B = [a,e,i,m,n,o,p]

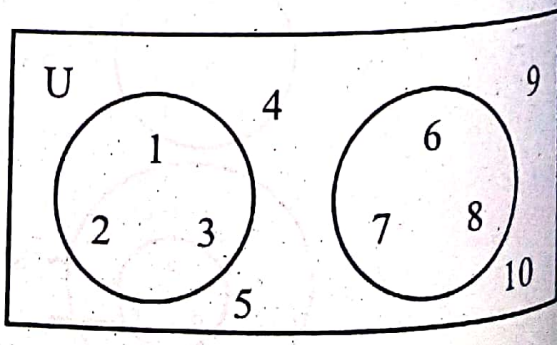


Disjoint Sets

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

A = {1,2,3} and B = {6,7,8}

A∩B = Shaded area



A ∩ B = ∅

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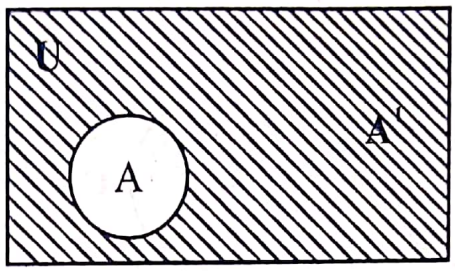
Complement of a Set

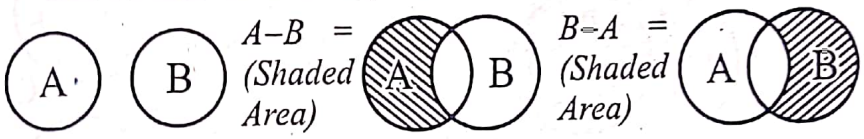
Let 'U' he an universal set and set 'A' be the subset of the universal set.



The complement of $A = A^1$ = the shaded area

Difference of Sets

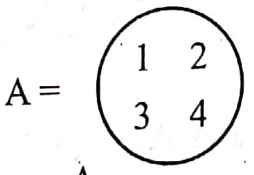
Let 'A' and 'B' be two sets.

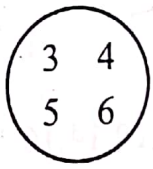


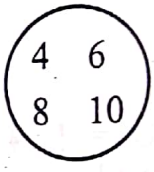
WORKED PROBLEMS

1. If $A = \{1,2,3,4\}$, $B = \{3,4,5,6\}$ and $C = \{4,6,8,10\}$ find (a) $A \cup B$ (b) $A \cup C$ (c) $A \cap B$ (d) $B \cap C$ (e) $A \cap B \cap C$ with the help of Venn diagrams.

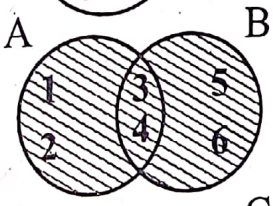
Solution : Given,



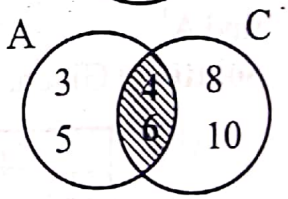




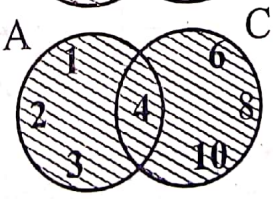
(a) $A \cup B =$



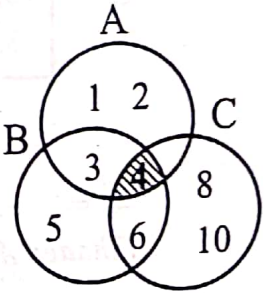
(d) $B \cap C =$



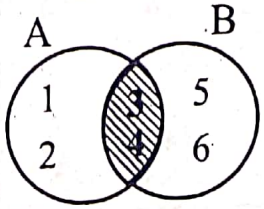
(b) $A \cup C =$



(e) $A \cap B \cap C =$



(e) $A \cap B =$



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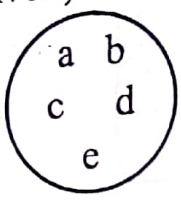
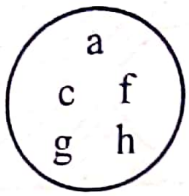
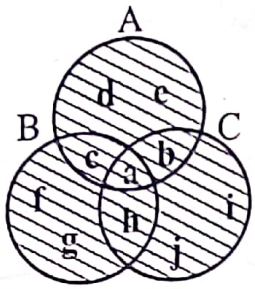
2. If A = {a,b,c,d,e}, B = {a,c,f,g,h} and C = {a,b,h,i,j}, find (a) A∪B∪C (b) A∩B (c) A∩C (d) B∩C (e) A∩B∩C

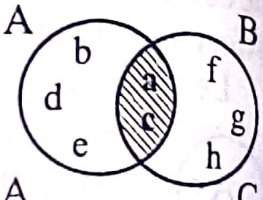
Solution : Given,

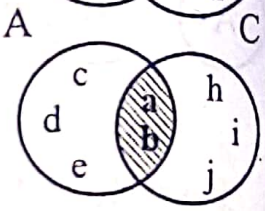
A = 

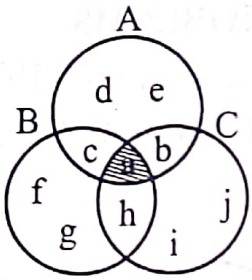
B = 

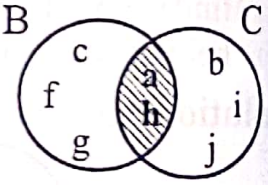
C =

(a) A∪B∪C = 

(b) A∩B = 

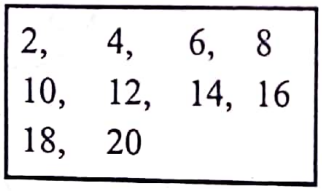
(c) A∩C = 

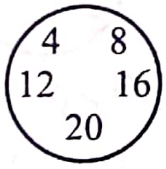
(e) A∩B∩C = 

(d) B∩C = 

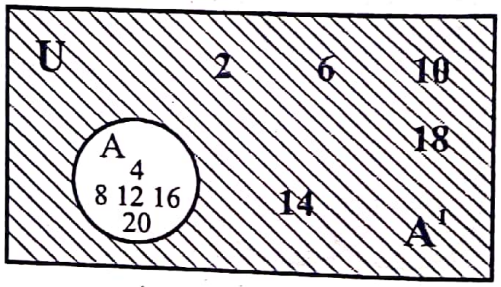
3. If U = {2,4,6,8,10,12,14,16,18,20} and A = {4,8,12,16,20} find A^1

Solution : Given,

U = 

A = 

A^1 = *(Shaded Area)*



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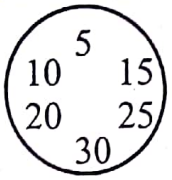
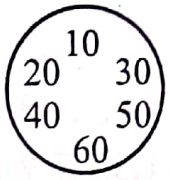
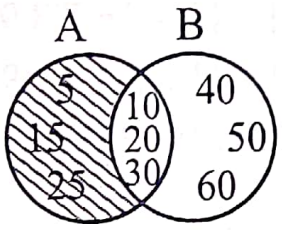
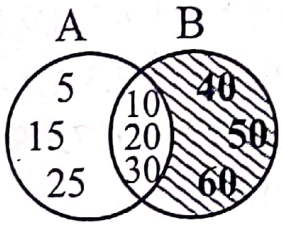
4. If A = {5,10,15,20,25,30} and B = {10,20,30,40,50,60} find (a) A–B and (b) B–A.

Solution : Given

A = 

B = 

A–B= 

B–A= 

A–B= (Shaded Area) *B–A= (Shaded Area)*

5. If A = {1,2,3,4} and B = {2,4,6,8} show (i) A∪B (ii) A∩B (iii) A–B and (iv) B–A with the help of Venn diagrams.

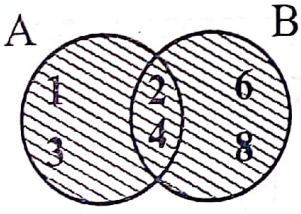
Solution : Given A = {1,2,3,4} and B = {2,4,6,8}

(A∪B) = {1,2,3,4} ∪ {2,4,6,8} = {1,2,3,4,6,8}

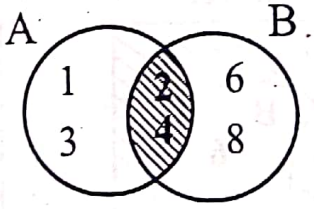
(A∩B) = {1,2,3,4} ∩ {2,4,6,8} = {2,4}

(A–B) = {1,2,3,4} – {2,4,6,8} = {1,3}

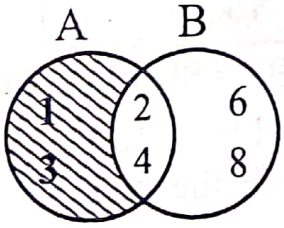
(B–A) = {2,4,6,8} – {1,2,3,4} = {6,8}



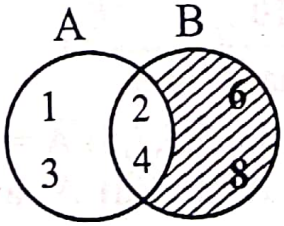
(A∪B) (Shaded area)



(Shaded area) (A∩B)



(A–B) (Shaded area)



(B–A) (Shaded area)

6. If U = {1,2,3,4,5,6,7,8,9,10} A = {1,2,3,4} and B = {2,4,6,8} find (a) $A^1 \cup B$ (b) $A \cup B^1$ (c) $A^1 \cup B^1$

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(d) $(A \cup B)^1$ with the help of Venn diagrams.

Solution : Given $U = \{1,2,3,4,5,6,7,8,9,10\}$ $A = \{1,2,3,4\}$ and $B = \{2,4,6,8\}$

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

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

a) $(A^1 \cup B) = \{5,6,7,8,9,10\} \cup \{2,4,6,8\} = \{2,4,5,6,7,8,9,10\}$

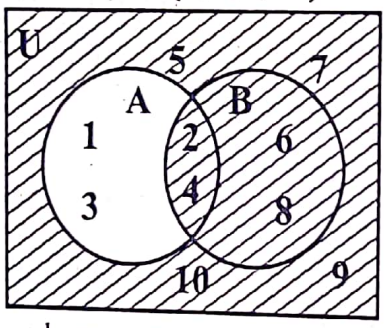
b) $(A \cup B^1) = \{1,2,3,4\} \cup \{1,3,5,7,9,10\} = \{1,2,3,4,5,7,9,10\}$

c) $(A^1 \cup B^1) = \{5,6,7,8,9,10\} \cup \{1,3,5,7,9,10\} = \{1,3,5,6,7,8,9,10\}$

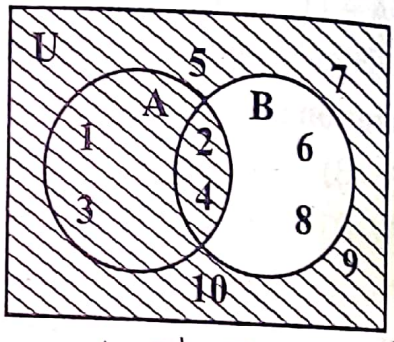
d) $(A \cup B)^1$

$A \cup B = \{1,2,3,4,\} \cup \{2,4,6,8\} = \{1,2,3,4,6,8\}$

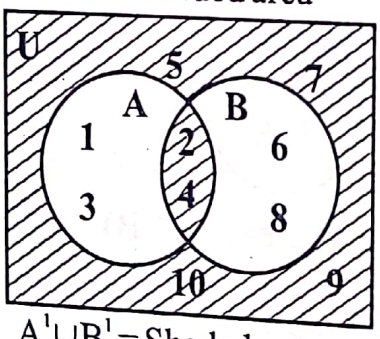
$(A \cup B)^1 = \{5,7,9,10\}$



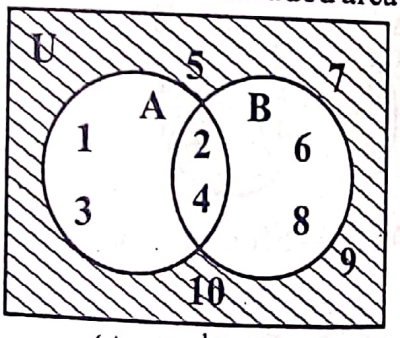
$A^1 \cup B$ = Shaded area



$A \cup B^1$ = Shaded area



$A^1 \cup B^1$ = Shaded area



$(A \cup B)^1$ = Shaded area

7. If $U = \{1,2,3,4,5,6,7,8\}$ $A = \{2,3,4,6,8\}$ and $B = \{3,6,8\}$ find (i) $A \cup B$ (ii) $A \cap B$ (iii) A^1 and (iv) B^1 with the help of Venn diagrams.

Solution : Given

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

(i) $A \cup B = \{2,3,4,6,8\} \cup \{3,6,8\} = \{2,3,4,6,8\}$

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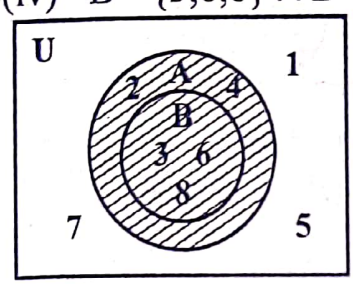
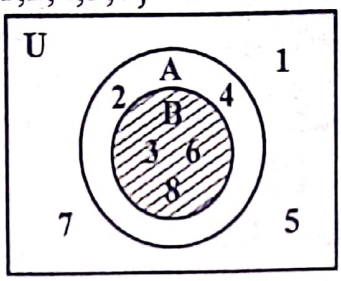
(ii) $A \cap B = \{2,3,4,6,8\} \cap \{3,6,8\} = \{3,6,8\}$

(iii) $A = \{2,3,4,6,8\} \therefore A^1 = \{1,5,7\}$

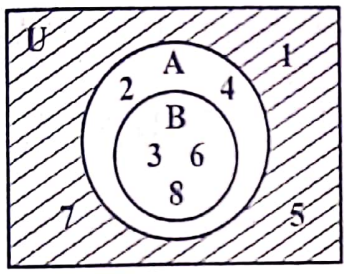
(iv) $B = \{3,6,8\} \therefore B^1 = \{1,2,4,5,7\}$



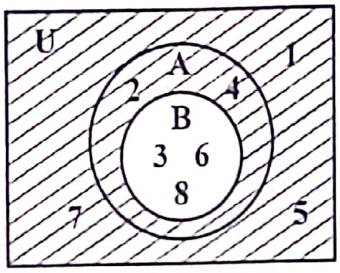
$A \cup B$ = Shaded area



$A \cap B$ = Shaded area



A^1 = Shaded area



B^1 = Shaded area

8. If $A = \{1,3,5,7\}$, $B = \{2,3,4,5\}$, $C = \{2,4,6,8\}$ and $D = \{4,5,6\}$ find
(i) $A \cup (C \cap D)$ (ii) $B \cap C \cap D$ (iii) $B \cap (C \cup D)$
(iv) $A \cap (B \cup C)$ show the same with Venn diagrams.

Solution : Given $A = \{1,3,5,7\}$ $B = \{2,3,4,5\}$, $C = \{2,4,6,8\}$ and $D = \{4,5,6\}$

$A \cup (C \cap D)$

$(C \cap D) = \{2,4,6,8\} \cap \{4,5,6\} = \{4,6\}$

$A \cup (C \cap D)$ $\{1,3,5,7\} \cup \{4,6\} = \{1,3,4,5,6,7\}$

$B \cap C \cap D = \{2,3,4,5\} \cap \{2,4,6,8\} \cap \{4,5,6\} = \{4\}$

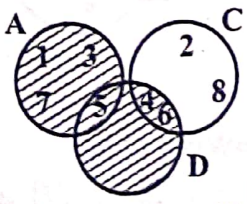
$B \cap (C \cup D) = \{2,3,4,5\} \cap [\{2,4,6,8\} \cup \{4,5,6\}]$

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

$A \cap (B \cup C) = \{1,3,5,7\} \cap [\{2,3,4,5\} \cup \{2,4,6,8\}]$

$= \{1,3,5,7\} \cap \{2,3,4,5,6,8\} = \{3,5\}$

(i) $A \cup (C \cap D)$



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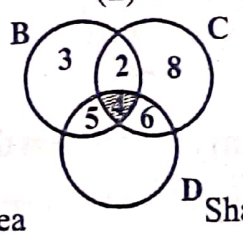
(ii) $B \cap C \cap D$



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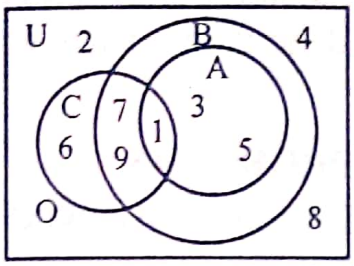
Solution : Given U = {0,1,2,3,4,5,6,7,8,9} A = {1,3,5}

B = {1,3,5,7,9} and C = {1,6,7,9}



Cartesian Product of Sets

When two sets are multiplied resulting in multiple sets of two elements each, where the first element is from the first set and the second element is from the second set, the multiplication is called Cartesian product of sets.

The Cartesian product is represented as follows :

$A \times B = \{(x, y) \mid x \in A \text{ and } y \in B\}$

Ordered Pair : Sets having two elements each where the elements are written in a particular order are called orderd pairs.

For example : If A = {a,b,c} and B = {1,2}

The Cartesian product of sets A B and BA is as shown below:

$A \times B = \{(a,1), (a,2), (b,1), (b,2), (c,1), (c,2)\}$

$B \times A = \{(1,a), (1,b) (1,c), (2,a), (2,b), (2,c)\}$

Properties of Cartesian product

1. $A \times B$ is not equal to $B \times A$ unless set A and B are equal sets. Hence, normally, Cartesian product of two sets is not commutative.
2. The set will contain two element only which are called ordered pairs.
3. The first element is from the first set and the second element is from the second set.
4. If sets A and B are disjoint, then $A \times B$ and $B \times A$ are also disjoint.
5. If the first set consists of 'm' elements and the second set consist

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of 'n' elements then, the product set A×B will contain m×n elements.

6. If one of the sets is a null set, then set A×B will also be a null set.
7. If one of the sets in infinite and the other is a non-empty set, then A×B will also be an infinite set.

WORKED PROBLEMS

1. If A = {1,2,3} and B={4,5}, find Cartesian product of sets A and B.

Solution : Given A = {1,2,3} and B = {4,5}

Cartesian product of sets A and B is a set containing ordered pains whose first element is from set A and second element is from set B.

A×B = {(1,4), (1,5), (2,4), (2,5), (3,4), (3,5)}

2. If A = {3,5,7} B = {6,7,8} and C = {7,8,9} find (i) (A∩B)×(B∩C) and show that A×(B∩C) = (A×B) ∩ (A×C) (Mysore university, B.Com., Oct. 2009)

Solution : Given A = {3,5,7}, B = {6,7,8} and C = {7,8,9}

(i) (A∩B) × (B∩C)

(A∩B) = {3,5,7} ∩ {6,7,8} = {7}

(B∩C) = {6,7,8} ∩ {7,8,9} = {7,8}

(A∩B) × (B∩C) = {7} × {7,8}

= {(7,7), (7,8)}

(ii) A×(B∩C) = (A×B) ∩ (A×C)

(B∩C) = {6,7,8} ∩ {7,8,9} = {7,8}

A×(B∩C) = {3,5,7}×{7,8}

= {(3,7), (3,8), (5,7), (5,8), (7,7), (7,8)} .....(1)

(A×B) = {3,5,7} × {6,7,8}

= {(3,6), (3,7), (3,8), (5,6), (5,7), (5,8), (7,6), (7,7), (7,8)}

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$(A \times C) = \{3,5,7\} \times \{7,8,9\}$

$= \{(3,7), (3,8), (3,9), (5,7), (5,8), (5,9), (7,7), (7,8), (7,9)\}$

$(A \times B) \cap (A \times C) = \{(3,7), (3,8), (5,7), (5,8), (7,7), (7,8)\}$ ..... (2)

Equation (1) = (2), therefore, $A \times (B \cap C) = (A \times B) \cap (A \times C)$

3. If $A = \{1,4\}$, $B \{2,3\}$ and $C = \{3,5\}$, find (i) $(A \times B) \cap (A \times C)$

(ii) $(A \times B) \neq (B \times A)$ (Mysore University B.Com., June 2011)

Solution : Given $A = \{1,4\}$, $B = \{2,3\}$ and $C = \{3,5\}$

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

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

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

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

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

$(A \times B) \cap (A \times C) = \{(1,2), (1,3), (4,2), (4,3)\} \cap \{(1,3), (1,5), (4,3), (4,5)\}$

$= \{(1,3), (4,3)\}$

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

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

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

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

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

Equation (1) $\neq$ (2), Therefore, $(A \times B) \neq (B \times A)$

4. If $A = \{2,5,7,8\}$ $B = \{3,4,5,6\}$ and $C = \{1,3,5,7\}$ find

(a) $(A-B) \times (B-C)$ (b) $B \times (A-C)$ (c) $(A \cap C) \times (B \cap C)$

(Mysore University, B.Com., Dec. 2011)

Solution : Given $A = \{2,5,7,8\}$, $B = \{3,4,5,6\}$ and $C = \{1,3,5,7\}$

a) $(A-B) \times (B-C)$

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$(A-B) = \{2,5,7,8\} - \{3,4,5,6\} = \{2,7,8\}$

$(B-C) = \{3,4,5,6\} - \{1,3,5,7\} = \{4,6\}$

$(A-B) \times (B-C) = \{2,7,8\} \times \{4,6\}$

$= \{(2,4)\,(2,6)\,(7,4)\,(7,6)\,(8,4)\,(8,6)\}$

b) $B \times (A-C)$

$(A-C) = \{2,5,7,8\} - \{1,3,5,7\}$

$= \{2,8\}$

$B \times (A-C) = \{3,4,5,6\} \times \{2,8\}$

$= \{(3,2)\,(3,8)\,(4,2)\,(4,8)\,(5,2)\,(5,8)\,(6,2)\,(6,8)\}$

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

$(A \cap C) = \{2,5,7,8\} \cap \{1,3,5,7\} = \{5,7\}$

$(B \cap C) = \{3,4,5,6\} \cap \{1,3,5,7\} = \{3,5\}$

$(A \cap C) \times (B \cap C) = \{5,7\} \times \{3,5\}$

$= \{(5,3)\,(5,5)\,(7,3)\,(7,5)\}$

5. If $A = \{6,7,8\}$ $B = \{2,5,9\}$ and $C = \{4,5,6\}$ find
a) $A \times (B-C)$ (b) $(A-C) \times (C-B)$ and (c) $B \times (A \cap C)$
(Mysore University B.Com., June 2012)

Solution : Given $A = \{6,7,8\}$ $B = \{2,5,9\}$ and $C = \{4,5,6\}$

a) $A \times (B-C)$

$(B-C) = \{2,5,9\} - \{4,5,6\} = \{2,9\}$

$A \times (B-C) = \{6,7,8\} \times \{2,9\}$

$= \{(6,2)\,(6,9)\,(7,2)\,(7,9)\,(8,2)\,(8,9)\}$

b) $(A-C) \times (C-B)$

$(A-C) = \{6,7,8\} - \{4,5,6\} = \{7,8\}$

$(C-B) = \{4,5,6\} - \{2,5,9\} = \{4,6\}$

$(A-C) \times (C-B) = \{7,8\} \times \{4,6\}$

$= \{(7,4)\,(7,6)\,(8,4)\,(8,6)\}$

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

$(A \cap C) = \{6,7,8\} \cap \{4,5,6\} = \{6\}$

$B \times (A \cap C) = \{2,5,9\} \times \{6\}$

$= \{(2,6)\,(5,6)\,(9,6)\}$

6. If $M = \{2,6,7\}$, $N = \{3,5,8\}$ and $P = \{1,6,5\}$ find

(a) $(M-N) \times (N-P)$ (b) $(M \times N) \cup (N \times P)$

(c) $(M \cap N) \times (N \cap P)$ (Mysore University B.Com., June 2014)

Solution : Given $M = \{2,6,7\}$, $N = \{3,5,8\}$ and $P = \{1,6,5\}$

a) $(M-N) \times (N-P)$

$(M-N) = \{2,6,7\} - \{3,5,8\} = \{2,6,7\}$

$(N-P) = \{3,5,8\} - \{1,6,5\} = \{3,8\}$

$(M-N) \times (N-P) = \{2,6,7\} \times \{3,8\}$

$= \{(2,3)\,(2,8)\,(6,3)\,(6,8)\,(7,3)\,(7,8)\}$

b) $(M \times N) \cup (N \times P)$

$(M \times N) = \{2,6,7\} \times \{3,5,8\}$

$= \{(2,3)\,(2,5)\,(2,8)\,(6,3)\,(6,5)\,(6,8)\,(7,3)\,(7,5)\,(7,8)\}$

$(N \times P) = \{3,5,8\} \times \{1,6,5\}$

$= \{(3,1)\,(3,6)\,(3,5)\,(5,1)\,(5,6)\,(5,5)\,(8,1)\,(8,6)\,(8,5)\}$

$(M \times N) \cup (N \times P) = \{(2,3)\,(2,5)\,(2,8)\,(6,3)\,(6,5)\,(6,8)\,(7,3)\,(7,5)$
$(7,8)\,(3,1)\,(3,6)\,(3,5),\,(5,1)\,(5,6)\,(5,5)\,(8,1)\,(8,6)\,(8,5)\}$

c) $(M \cap N) \times (N \cap P)$

$(M \cap N) = \{2,6,7\} \cap \{3,5,8\} = \{\}$

$(N \cap P) = \{7,5,8\} \cap \{1,6,5\} = \{5\}$

$(M \cap N) \times (N \cap P) = \{\} \times \{5\} = \{\}$

7. If $X = \{7,8,9\}$ $Y = \{6,7\}$ and $Z = \{5,7\}$ show that

(i) $(X \cap Y) \times Z = \{X \times Z) \cap (Y \times Z)$

(ii) $(X-Y) \times Z = (X \times Z) - (Y \times Z)$ (Mysore University, B.Com., June 2015)

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Solution : Given $X = \{7,8,9\}$, $Y = \{6,7\}$ and $Z = \{5,7\}$

(i) $(X \cap Y) \times Z = (X \times Z) \cap (Y \times Z)$

$(X \cap Y) = \{7,8,9\} \cap \{6,7\} = \{7\}$

$(X \cap Y) \times Z = \{7\} \times \{5,7\} = \{(7,5)(7,7)\}$ ..... (1)

$(X \times Z) = \{7,8,9\} \times \{5,7\}$

$= \{(7,5)(7,7)(8,5)(8,7)(9,5)(9,7)\}$

$(Y \times Z) = \{6,7\} \times \{5,7\} = \{(6,5)(6,7)(7,5)(7,7)\}$

$(X \times Z) \cap (Y \times Z) = \{(7,5)(7,7)(8,5)(8,7)(9,5)(9,7)\} \cap$
$\{(6,5)(6,7)(7,5)(7,7)\}$

$= \{(7,5)(7,7)\}$ ..... (2)

Equation (1) = (2), Therefore $(X \cap Y) \times Z = (X \times Z) \cap (Y \times Z)$

(ii) $(X - Y) \times Z = (X \times Z) - (Y \times Z)$

$(X - Y) = \{7,8,9\} - \{6,7\} = \{8,9\}$

$(X - Y) \times Z = \{8,9\} \times \{5,7\}$

$= \{(8,5)(8,7)(9,5)(9,7)\}$ ..... (1)

$(X \times Z) = \{7,8,9\} \times \{5,7\}$

$= \{(7,5)(7,7)(8,5)(8,7)(9,5)(9,7)\}$

$(Y \times Z) = \{6,7\} \times \{5,7\}$

$= \{(6,5)(6,7)(7,5)(7,7)\}$

$(X \times Z) - (Y \times Z) = \{(7,5)(7,7)(8,5)(8,7)(9,5)(9,7) -$
$\{(6,5)(6,7)(7,5)(7,7)\}$

$= \{(8,5)(8,7)(9,5)(9,7)\}$ ..... (2)

Equation (1) = (2), Therefore, $(X - Y) \times Z = (X \times Z) - (Y \times Z)$

Number of Elements in a Set

Let $A = \{1,2,3,4\}$ and $B = \{3,4,5,6\}$

Then, $A \cup B = \{1,2,3,4,5,6\}$

$A \cap B = \{3,4\}$

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Number of elements in set $A = n(A) = 4$ .....(1)

Number of elements in set $B = n(B) = 4$ .....(2)

Number of elements in set $A \cup B = n(A \cup B) = 6$ .....(3)

Number of elements in set $A \cap B = n(A \cap B) = 2$ .....(4)

From (1), (2), (3) and (4) above, it can be written as,

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

This is the basic formula to find the number of elements in a set. The other formulae that can be derived from the above formula are,

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

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

The above formulae hold good when there are two sets viz., A and B. If the number of sets is three viz., A, B and C, the formula would be,

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

WORKED PROBLEMS

1. If $n(A) = 9$, $n(B) = 8$ and $n(A \cap B) = 5$, find $n(A \cup B)$

Solution : It is known that $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$= 9 + 8 - 5$

$= 17 - 5 = 12$

2. In a group of 65 students, 40 like Cricket, 10 like both cricket and tennis. How many like tennis only and not Cricket ? How many like tennis ?

Solution : Total number of students $= n(C \cup T) = 65$

No. of students who like Cricket $= n(C) = 40$

No. of students who like both Cricket and tennis $= n(C \cap T) = 10$

It is known that

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

$n(C \cup T) = n(C) + n(T) - n(C \cap T)$

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$65 = 40 + n(T) - 10$

$65 = 30 + n(T)$

$\therefore n(T) = 65 - 30 = 35$

$\therefore$ 35 students like tennis.

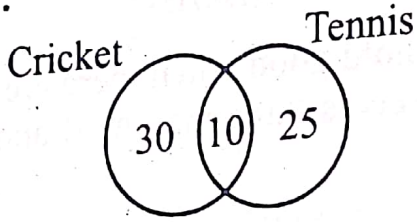
No. of students who like only tennis but not cricket $= n(T - C)$

$n(T - C) = n(T) - n(C \cap T)$

$= 35 - 10 = 25$

$\therefore$ 25 students like only tennis

Venn diagram :



3. 62 factories in a country manufacture pens and 48 manufactur ink and pens. Same of the factories manufacture ink only. Fin their number, if the total number of factories in the countr manufacturing pens or ink is 132. (Prove your answer with th help of Venn diagrams. Mysore University B.Com., April 2002).

Solution : Given,

Number of factories manufacturing pens $= n(P) = 62$

Number of factories manufacturing both ink & pens $= n(I \cap P) =$ 48

Total number of factories $n(I \cup P) = 132$

It is known that

$n(I \cup P) = n(I) + n(P) = n(I \cap P)$

$132 = n(I) + 62 - 48$

$132 = n(I) + 14$

$n(I) = 132 - 14 = 118$

Therefore, the number of factories manufacturing ink $= 118$.

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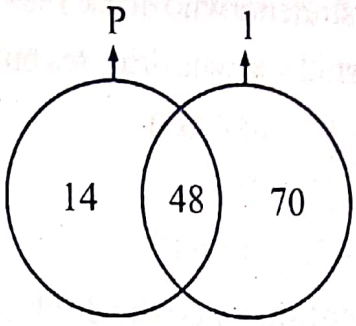
Venn diagram



Given

$n(P) = 62$

$n(I \cap P) = 48$

$n(I) = 118$

$n(I \cup P) = 132$

4. There are 70 cycles in a cycle stand. 50 cycles have carriers, 35 have bells and carriers, while some have bells but no carriers. Find the number of the last group.

Solution : Given,

Number of cycles having carriers $= n(C) = 50$

Number of cycles having both bells and carriers $= n(B \cap C) = 35$

Total number of cycles $= n(B \cup C) = 70$

It is known that

$$\begin{aligned} n(B \cup C) &= n(B) + n(C) - n(B \cap C) \\ 70 &= n(B) + 50 - 35 \\ 70 &= n(B) + 15 \\ \therefore n(B) &= 70 - 15 \\ &= 55 \end{aligned}$$

Number of cycles, having bell $= 55$

Number of cycles having bells but no carriers $= n(B-C)$

$n(B-C) = n(B) - n(B \cap C)$

$= 55 - 35 = 20$

Number of cycles having only bells but not carriers $= 20$

5. In a group of 40 students who drink tea or coffee or both. 26 drink tea of whom 16 drink tea but not coffee. How many drink coffee but not tea ?

Solution : Given,

Total number of students $= n(T \cup C) = 40$

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Number of students who drink Tea = $n(T) = 26$

Number of students who drink tea but not coffee = $n(T - C) = 16$

$n(T) = n(T - C) + n(T \cap C)$

$26 = 16 + n(T \cap C)$

$\therefore n(T \cap C) = 26 - 16 = 10$

The number of students who drink both tea and coffee = $n(T \cap C) = 10$

It is known that

$$\begin{aligned} n(T \cup C) &= n(T) + n(C) - n(T \cap C) \\ 40 &= 26 + n(C) - 10 \\ 40 &= n(C) + 16 \\ \therefore n(C) &= 40 - 16 = 24 \end{aligned}$$

Number of students who drink coffee = $n(C) = 24$

Number of students who drink coffee but not tea = $n(C - T)$

$$\begin{aligned} n(C - T) &= n(C) - n(C \cap T) \\ &= 24 - 10 \\ &= 14 \end{aligned}$$

6. In a certain town, there are 2000 people. Out of them 900 read news paper 'A' and 1200 read newspaper 'B'. 400 people read both the papers. Find out the number of people who read each paper separately and those who do not read either.

Solution :

Number of people who read news paper 'A' = $n(A) = 900$

Number of people who read news paper 'B' = $n(B) = 1200$

Number of people who read both the news papers = $n(A \cap B) = 400$

Number of people who read news paper = $n(A \cup B)$

It is known that,

$$\begin{aligned} n(A \cup B) &= n(A) + n(B) - n(A \cap B) \\ &= 900 + 1200 - 400 \\ n(A \cup B) &= 1700 \end{aligned}$$

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Number of people who read only news paper 'A' = $n(A-B)$

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

$= 900 - 400 = 500$

Number of people who read only news paper 'B' = $n(B-A)$

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

$= 1200 - 400 = 800$

Number of people who

do not read any news paper = (Total population) –

(Number of people who read news paper)

$= 2000 - 1700 = 300$

7. An investigation conducted in a college library of 460 students revealed that 262 students used college library books, 218 had their own books and 220 used borrowed books, 115 used both college library and their own books, 96 used their own books and borrowed books, while 69 used college library books and borrowed books. Assuming that all students use books, find the number of students using books (a) from all sources and (b) from only one source.

Solution : Given, Total number of students = 460

Let the number of students using college library books be 'A' i.e., $n(A) = 262$

Let the number of students using their own books be 'B' i.e., $n(B) = 218$

Let the number of students using borrowed books be 'C' i.e., $n(C) = 220$.

Also given that $n(A \cap B) = 115$

$n(B \cap C) = 96$

$n(A \cap C) = 69$

$n(A \cup B \cup C) = 460$

It is known that,

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

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$$460 = 262 + 218 + 220 - 115 - 96 - 69 + n(A \cap B \cap C)$$

$$460 = 420 + n(A \cap B \cap C)$$

$\therefore n(A \cap B \cap C) = 460 - 420 = 40$

40 students use books from all sources.

Number of students using only college library books

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

$$= 262 - 115 - 69 + 40 = 118$$

Number of students using their own books only

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

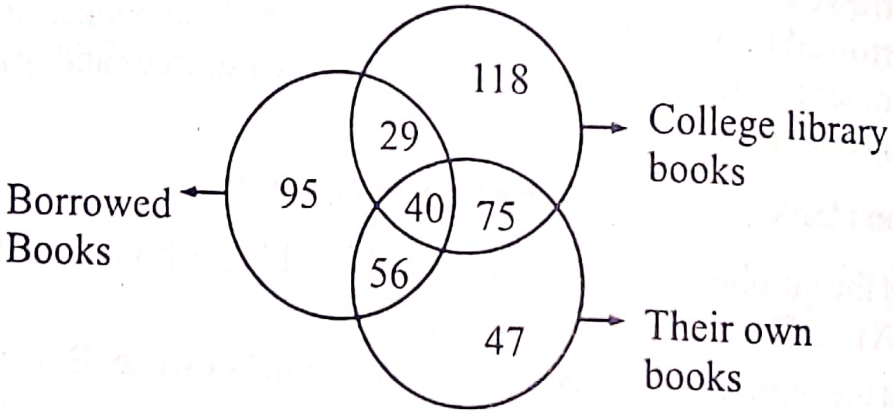
$$= 218 - 115 - 96 + 40 = 47$$

Number of students using borrowed books only

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

$$= 220 - 69 - 96 + 40 = 95$$

The pictorial representation of the solution appears as follows:



8. A company studies the product preferences of 20,000 consumers. It was found that each of the product A,B,C was liked by 7020, 6230 and 5980 respectively and all the products were liked by 1500. Products A and B were liked by 2580 ; products A and C were liked by 1200 and products B and C were liked by 1950. Prove that the study results were not correct. (Mysore University, B.Com., April 1998).

Solution : Given,

Total number of consumers surveyed i.e., $n(A \cup B \cup C) = 20,000$

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Number of consumers who liked product A i.e., $n(A) = 7020$
Number of consumers who liked product B i.e., $n(B) = 6230$
Number of consumers who liked product C i.e., $n(C) = 5980$
Number of consumers who liked product A and B i.e., $n(A \cap B) = 2580$
Number of consumers who liked product A and C i.e., $n(A \cap C) = 1200$
Number of consumers who liked product B and C i.e., $n(B \cap C) = 1950$
Number of consumers who liked product A,B and C i.e., $n(A \cap B \cap C) = 1500$

It is known that

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

$$20,000 = 7020 + 6230 + 5980 - 2580 - 1200 - 1950 + 1500$$

$$20,000 = 15,000$$

Hence, the study results are not correct.

9. In a factory, all the employees must join at least one of the three schemes viz., pension scheme, provident fund or insurance scheme. On a particular day of a year, there were 780, 950 and 600 employees in pension, provident fund and insurance schemes respectively. Out of the total number of employees 250 had opted for provident fund and insurance ; 400 had opted for insurance and pension ; 180 had opted for pension and provident fund schemes ; and 80 employees had opted for all the schemes. Find the total number of employees in the factory (Mysore University, B.Com., Nov. 1998).

Solution : Let the number of employees in pension scheme be 'A', number of employees in provident fund be 'B' and number of employees in insurance scheme be 'C'. Then.

$n(A) = 780, n(B) = 950, n(C) = 600$ $n(A \cap B) = 180,$

$n(B \cap C) = 250, n(A \cap C) = 400$ and $n(A \cap B \cap C) = 80$

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Total number of employees in the factory = $n(A \cup B \cup C)$

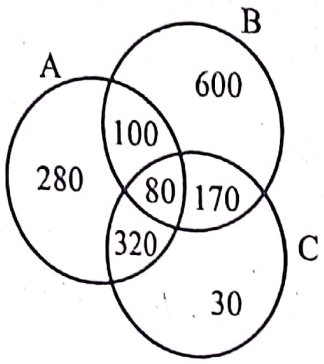
It is known that,

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

$$= 780 + 950 + 600 - 180 - 400 - 250 + 80 = 1580$$

Hence, the total number of employees in the factory is 1580.

Venn diagram



10. Mysore sports club offers three types of games to the members namely basket ball, foot ball and cricket. Out of 100 members, 30 play basket ball, 38 play foot ball and 40 play cricket. 10 members play both basket ball and foot ball, 14 play foot ball and cricket and 11 members play basket ball and cricket and 6 members play all the three games. Find how many do not play any of the above games and also find how many members play only one game. (Mysore University, B.Com., Nov. 2002).

Solution : Let the number of members who play basket ball be 'B'.

Let the number of members who play foot ball be 'F'.

Let the number of members who play cricket be 'C'.

Then, $n(B) = 30, n(F) = 38, n(C) = 40$

$n(B \cap F) = 10, n(F \cap C) = 14, n(B \cap C) = 11$ and $n(B \cap F \cap C) = 6$

Number of members who do not paly any game $\Big\}$ $\Big[$ Total numbers of members $\Big]$ $-$ $\Big[$ Number of members who play at least one game $\Big]$

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$$= N - n(B \cup F \cup C)$$
$$= 100 - [n(B) + n(F) + n(C) - n(B \cap F) - n(F \cap C) - n(B \cap C) + n(B \cap F \cap C)]$$
$$= 100 - [30 + 38 + 40 - 10 - 11 - 14 + 6]$$
$$= 100 - 79 = 21$$

Therefore 21 members do not play any game.

Number of members who play only one game } = [Number of members playing only basket ball + Number of members playing only foot ball + Number of members playing only cricket]

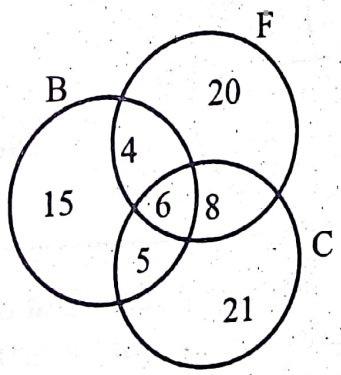
Number of members playing only basket ball
$$= n(B) - n(B \cap F) - n(B \cap C) = n(B \cap F \cap C)$$
$$= 30 - 10 - 11 + 6 = 15$$

Number of members playing only foot ball
$$= n(F) - n(F \cap B) - n(F \cap C) + n(B \cap F \cap C)$$
$$= 38 - 10 - 14 + 6 = 20$$

Number of members playing only cricket
$$= n(C) - n(C \cap F) - n(C \cap B) + n(B \cap F \cap C)$$
$$= 40 - 14 - 11 + 6 = 21$$

Therefore, number of members who play only one game.
$$= 15 + 20 + 21 = 56$$

Venn diagram



11. Out of 880 cement dealers at Bangalore, 224 deal ACC, 240 deal Diamond and 336 deal Birla. 64 deal with ACC and Birla, 80 deal

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with Diamond and Birla and 40 deal with ACC and Diamond. If 640 were dealing with at least one of the three, find how many deal with all the given three. Show by Venn diagram. (Mysore University, B.Com., April 2003)

Solution : Let, the number of dealers dealing with ACC be 'A'

Let the number of dealers dealing with Diamond be 'D'

Let, the number of dealers dealing with Birla be 'B'

Then, $U = 880, n(A) = 224, n(D) = 240, n(B) = 336$

$n(A \cap B) = 64$, $n(D \cap B) = 80$, $n(A \cap D) = 40$ and $n(A \cup D \cup B) = 640$

It is known that,

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

$$640 = 224 + 240 + 336 - 64 - 80 - 40 + n(A \cap D \cap B)$$

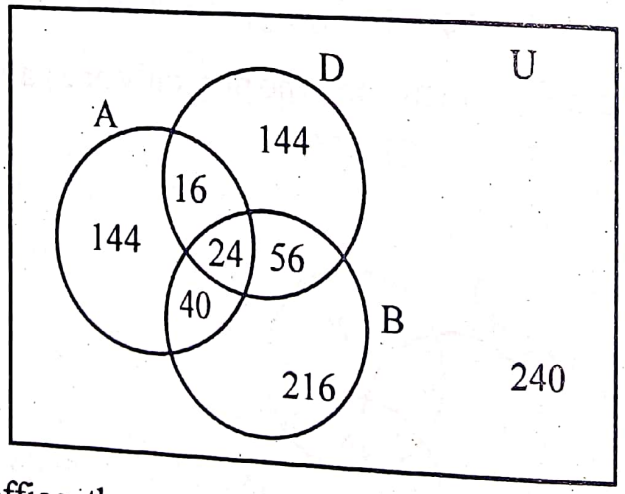
$$640 = 616 + n(A \cap D \cap B)$$

$$\therefore n(A \cap D \cap B) = 640 - 616$$

$$= 24$$

Therefore, 24 cement dealers deal with all the three brands.

Venn diagram



12. In an office, there are 400 employees. Out of these 150 are men, 276 are University graduates, 212 are married. Male University graduates are 94, married university graduates are 151, married men are 119 and married male university graduates are 72. Find the number of single women who are not university graduates.

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