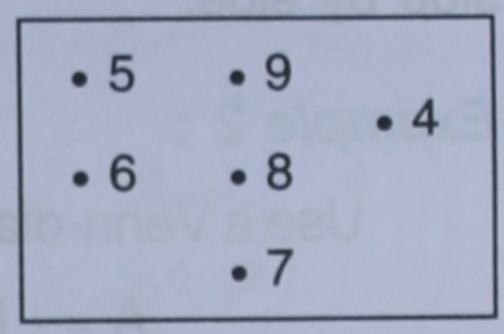
CHAPTER 30

VENN DIAGRAMS

(Using Geometrical Figures to Represent Sets)

30.1 VENN-DIAGRAMS



Venn diagrams are closed figures inside which are marked some points. The closed figure represents a set and the points marked inside it represent the elements of the set.

The closed figure given alongside represents the set = { 4, 5, 6, 7, 8, 9 }.

The closed geometrical figures used to represent sets are called Venn diagrams; after the name of an English Mathematician **John Venn,** who introduced these figures for set representation.

Though there is no restriction on what the shape of the figure should be, a circle or a rectangle is most commonly used to represent a set.

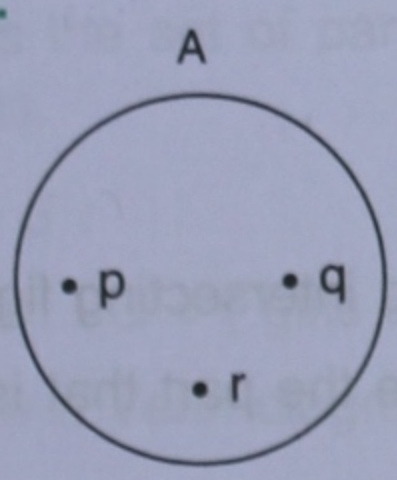
***Example* 1 :**

Represent the following sets by Venn diagrams :

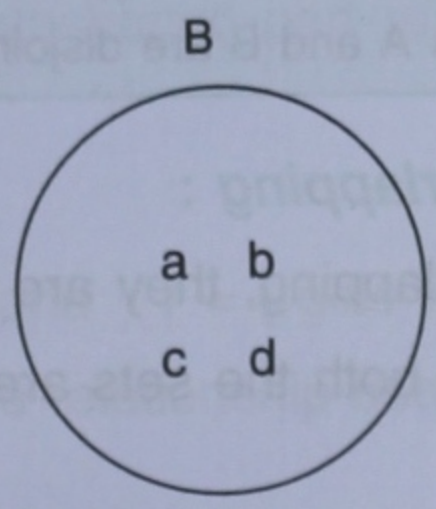
(i) Set A = {p, q, r} (ii) Set B = {a, b, c, d} (iii) Set C = {1, 2, 3, 4}

***Solution* :**

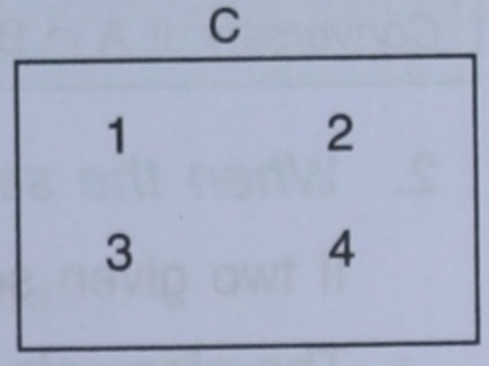
(i)



(ii)



(iii)



(Ans.)

As is clear from Example 1 given above :

1. The name of the set is written near the boundary of the drawn figure.
2. The names of the elements of the set are written near the points that are marked inside the figure.

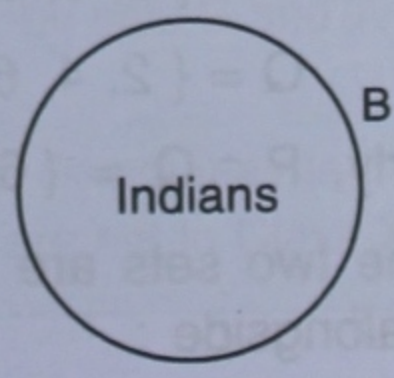
   Sometimes these points are not marked, and only the elements are written inside the closed figure.

Note : If the number of elements is large and it is not possible to enter the names of all the elements inside the figure, the **well-defined description** of the set is written inside the drawn figure.

For example :

If set B = {Indians},

Venn diagram for set B will be as shown alongside :



30.2 VENN-DIAGRAM TO SHOW THE RELATIONSHIP BETWEEN THE GIVEN SETS :

1. *When the sets are disjoint* :

If the two given sets are disjoint, they are shown by two separate figures drawn side by side.

Example 2 :

Use a Venn-diagram to show the relationship between sets A and B when :

A = { Natural numbers less than 5 }

and B = { Natural numbers more than 6 }

Solution :

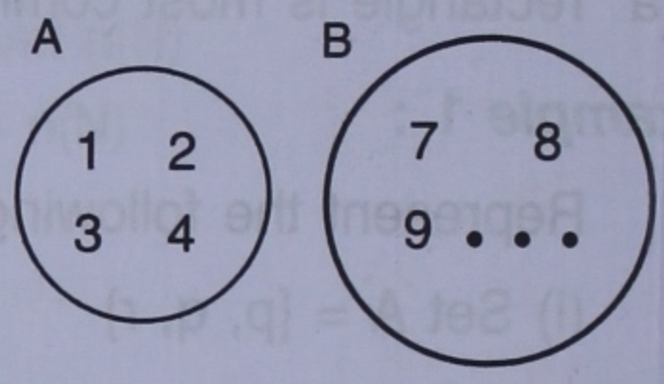
First of all, write the given sets in roster form.

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

and B = { 7, 8, 9, ... }

As the sets A and B are disjoint, they are represented by a Venn-diagram as shown alongside :

Sets A and B have no element in common, so they are disjoint sets.



(Ans.)

For any two disjoint sets A and B, $A \cap B = \phi$, the empty set.
Conversely, if $A \cap B = \phi$, the sets A and B are disjoint.

2. *When the sets are overlapping* :

If two given sets are overlapping, they are shown by two intersecting figures.

The elements common to both the sets are written inside the part that is common to the figures drawn.

Example 3 :

Given P = { multiples of 3 less than 20 }

and Q = { multiples of 2 up to 20 }

Show the relationship between these sets by a Venn-diagram.

Sets P and Q have elements 6, 12 and 18 in common; thus P and Q are overlapping sets.

Solution :

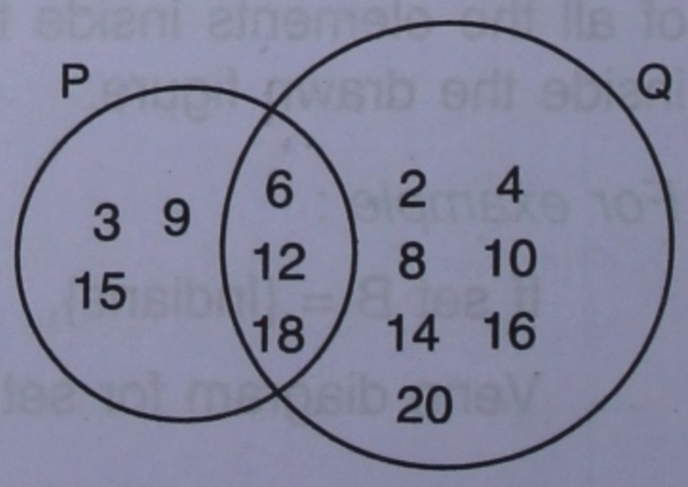
On writing the given sets in roster form, we get :

P = { 3, 6, 9, 12, 15, 18 }

and Q = { 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 }

Clearly, $P \cap Q = \{6, 12, 18\}$

∴ The two sets are represented by a Venn-diagram as drawn alongside :



When *all the elements of one set are present in the second set*, the Venn-diagram for the two sets is obtained by drawing *one circle inside another circle*.

For example :

Let A = { even numbers up to 10 }

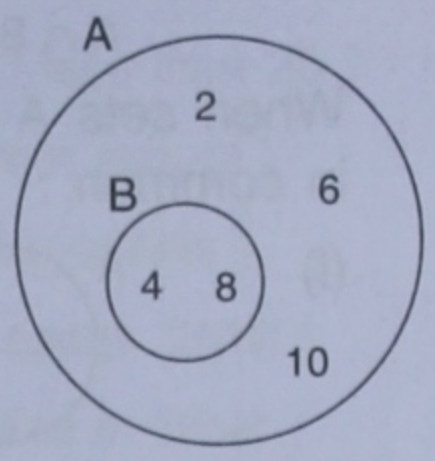
and B = { multiples of 4 up to 10 }

Clearly, A = { 2, 4, 6, 8, 10 }

and B = { 4, 8 }

All the elements of set B belong to set A.

Therefore, the Venn-diagram showing the relationship between sets A and B will be as drawn alongside :



Example 4 :

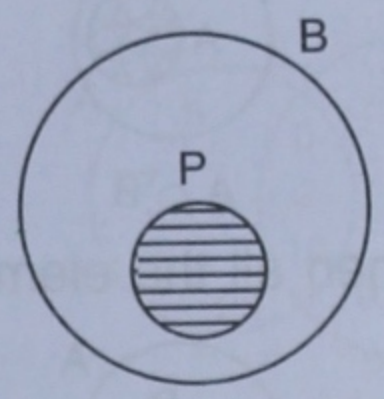
Draw a Venn-diagram showing the relationship between sets B and P, where

B = { Birds } and P = { Parrots }

Solution :

Draw one circle to represent the set of birds, *i.e.* set B.

Since all parrots are birds, draw a smaller circle showing set P inside the circle drawn for set B.



(Ans.)

Note : In the Venn-diagram drawn above for example 4, the shaded part represents the set of parrots and the unshaded part represents all other birds that are not parrots.

Example 5 :

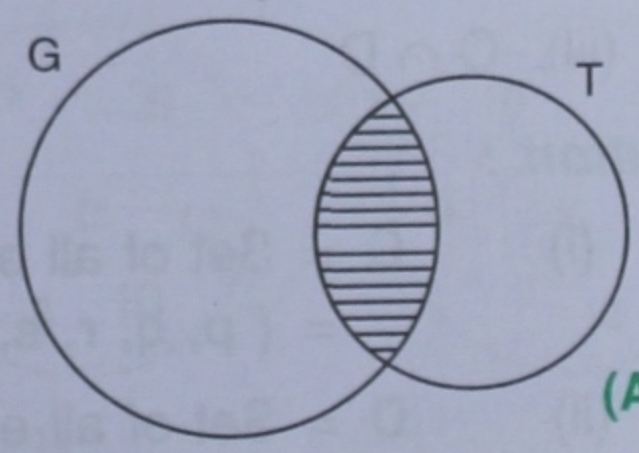
Given : G = { girls of class X } and T = { girls who play tennis }.

Draw a Venn-diagram to show the relationship between the given sets G and T.

Solution :

It is obvious that all the girls of Class X cannot play tennis and all the girls who play tennis cannot be in Class X.

∴ The required Venn-diagram representing the relationship between sets G and T is as shown alongside :



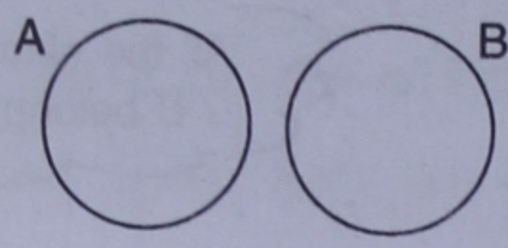
(Ans.)

In Example 5 given above, the shaded portion, which is common to the sets G and T, represents the girls of Class X who play tennis as well.

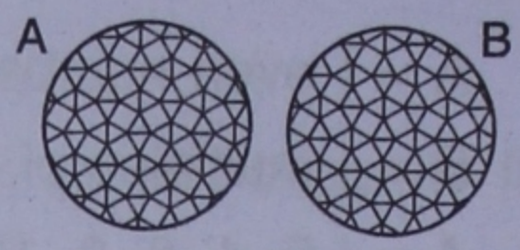
The unshaded portion in set G represents the girls of Class X who do not play tennis, and the unshaded portion in set T represents the girls who play tennis but are not in Class X.

Summary :

1. Drawing Venn diagram when sets A and B are disjoint, *i.e.* they do not have any element in common :

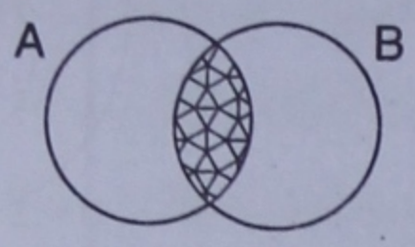
(i) 

$A \cap B$ = The empty set

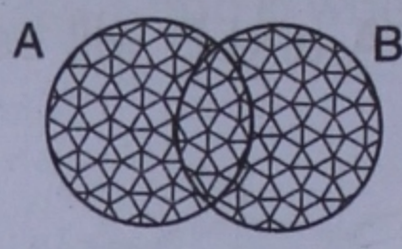
(ii) 

$A \cup B$ = The shaded region.

2. When sets A and B are overlapping, *i.e.* the two sets have at least one element in common :

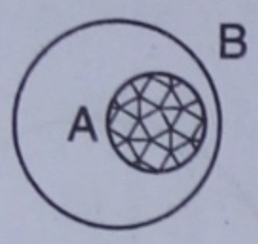
(i) 

$A \cap B$ = The shaded region

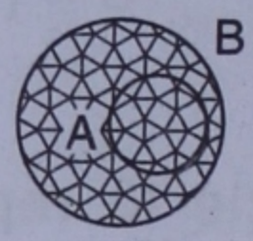
(ii) 

$A \cup B$ = The shaded region.

3. When set A is contained in set B, *i.e.* all the elements of set A are in set B :

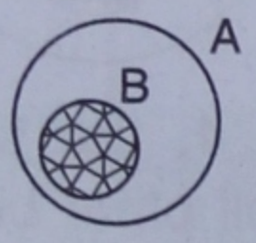
(i) 

$A \cap B$

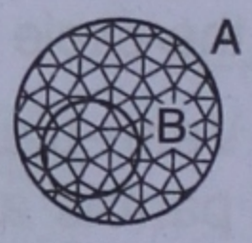
(ii) 

$A \cup B$

4. When all the elements of set B are in set A :

(i) 

$A \cap B$

(ii) 

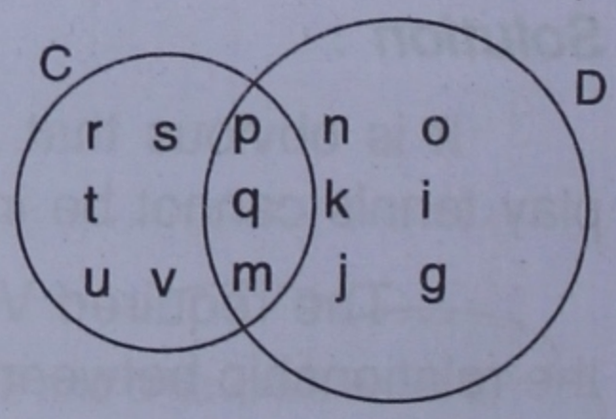
$A \cup B$

30.3 USING A GIVEN VENN DIAGRAM

A given Venn-diagram can be used to find different sets.

Example 6 :

From the adjacent Venn-diagram, find the following sets :



(i) C (ii) D

(iii) $C \cap D$ (iv) $C \cup D$

Solution :

(i) C = Set of all elements inside the circle representing set C
= { p, q, r, s, t, u, v, m } (Ans.)

(ii) D = Set of all elements inside the circle representing set D
= { g, j, k, i, n, o, p, q, m } (Ans.)

(iii) $C \cap D$ = Set of elements common to both the sets C and D
= { p, q, m } (Ans.)

(iv) $C \cup D$ = Set of elements that are in set C or in set D or in both
= { p, q, r, s, t, u, v, m, g, j, k, i, n, o } (Ans.)

EXERCISE 30

1. Show by Venn-diagrams the relationship between the following pairs of sets :

(i) A = { Letters of the English alphabet up to 'h' }
B = { All vowels of the English alphabet }

(ii) C = { Even numbers less than 10 } and D = { Odd numbers less than 10 }

(iii) M = { Multiples of 5 less than 30 } and N = { Multiples of 3 less than 20 }

(iv) U = { All girls of your school } and V = { All boys of your school }

(v) R = { Boys who play hockey } and S = { Boys who play cricket }

(vi) A = { People who speak Hindi } and B = { People who speak Tamil }

(vii) E = { People who live in India } and F = { People who live in Bihar }

(viii) P = { Men } and Q = { Kings }

(ix) C = { All animals } and D = { People who wear shirts }.

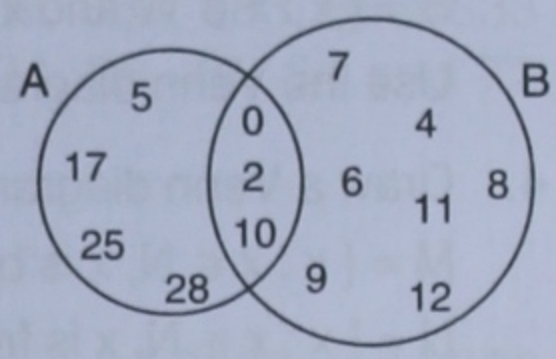
2. From the given Venn diagram, find the following sets :

(i) A (ii) B

(iii) $A \cup B$ (iv) $A \cap B$

(v) n(A) (vi) n(B)

(vii) $n(A \cup B)$ (viii) $n(A \cap B)$



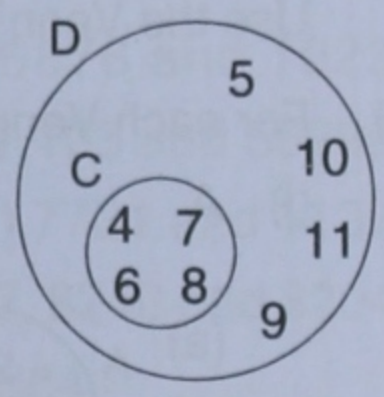
3. From the given Venn diagram, find the following sets :

(i) C

(ii) D

(iii) $C \cup D$

(iv) $C \cap D$



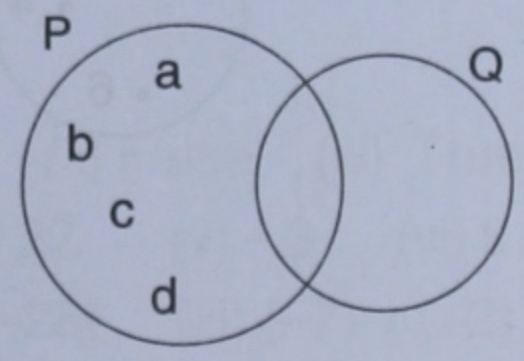
4. Use the given Venn diagram to find the following sets :

(i) P

(ii) Q

(iii) $P \cup Q$

(iv) $P \cap Q$



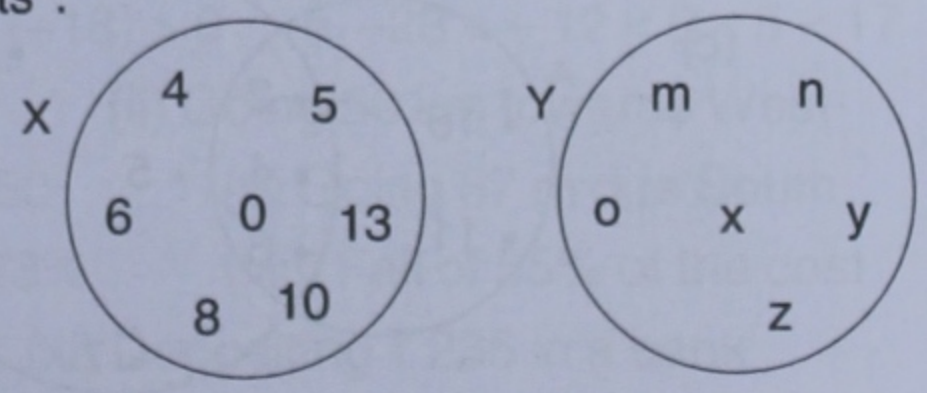
5. From the disjoint sets shown alongside, find the sets :

(i) X

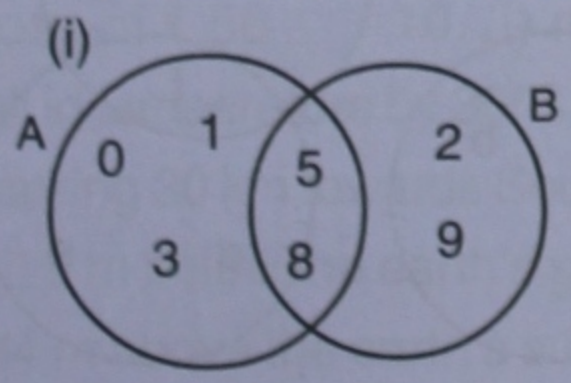
(ii) Y

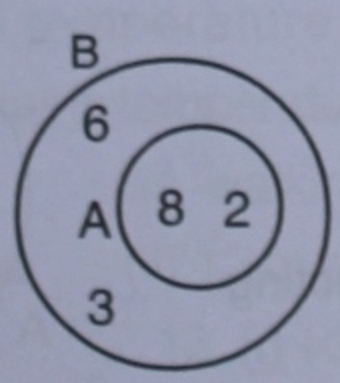
(iii) $X \cup Y$

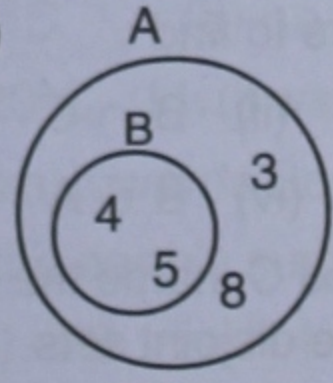
(iv) $X \cap Y$

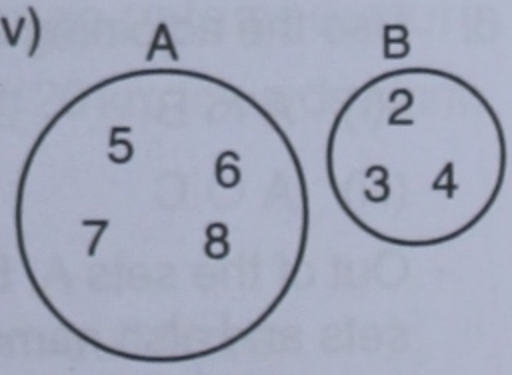


6. For each of the following Venn diagrams, write the set $A \cup B$:

(i)


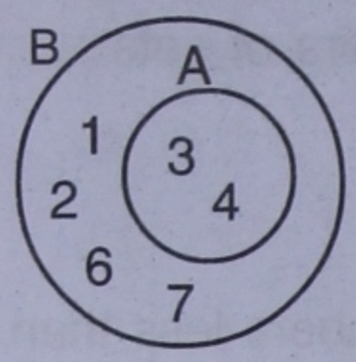
(ii)


(iii)


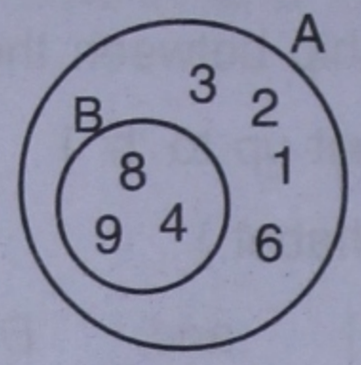
(iv)


7. For each of the following Venn diagrams, write the set $A \cap B$:

(i)



(ii)



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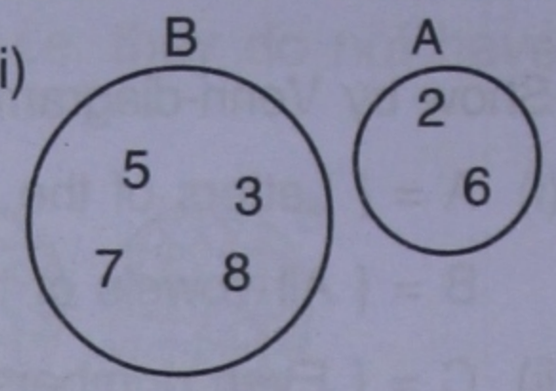
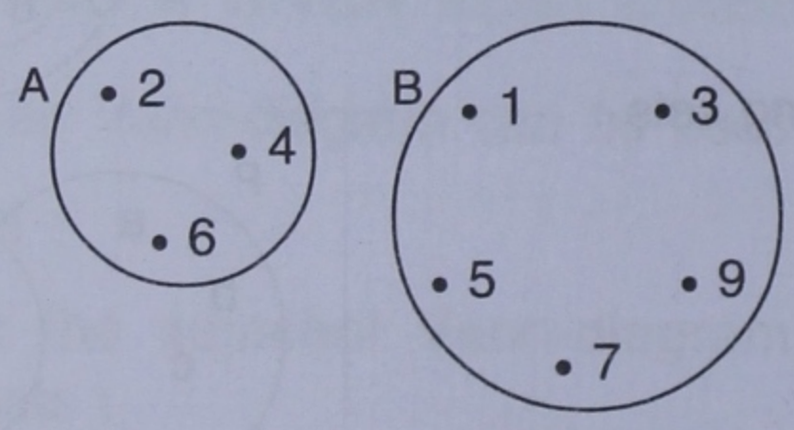


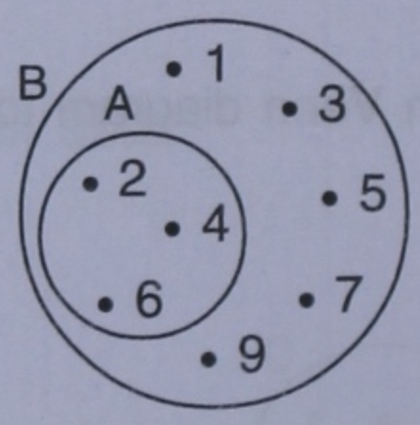
Revision Exercise (Chapter 30)

1. If $A = \{ 2, 4, 6, 8, 10 \}$ and $B = \{7, 9, 11 \}$, draw a Venn diagram to show the relationship between the given sets. Use the Venn diagram drawn to find $A \cap B$ and $A \cup B$.
2. Let $P = \{$ natural numbers between 4 and 12 $\}$ and $Q = \{$ natural numbers between 8 and 15 $\}$. Draw a Venn diagram to show the relationship between sets P and Q. Use the Venn diagram drawn to find $P \cap Q$ and $P \cup Q$.
3. Draw a Venn diagram to represent the relationship between sets A and B, where
   $A = \{ x : x \in N$ and x is less than 8 $\}$
   $B = \{ x : x \in W$ and x is less than 6 $\}$
   Use the Venn diagram drawn to find $A \cap B$ and $A \cup B$.
4. Draw a Venn diagram to show the relationship between sets M and N, where
   $M = \{ x : x \in N$, x is between 6 and 10 $\}$
   $N = \{ x : x \in N$, x is from 6 to 10 $\}$
   Use the Venn diagram drawn to find $M \cap N$ and $M \cup N$.
5. For each Venn diagram given below, find the sets :
   (i) A (ii) B (iii) $A \cup B$ (iv) $A \cap B$

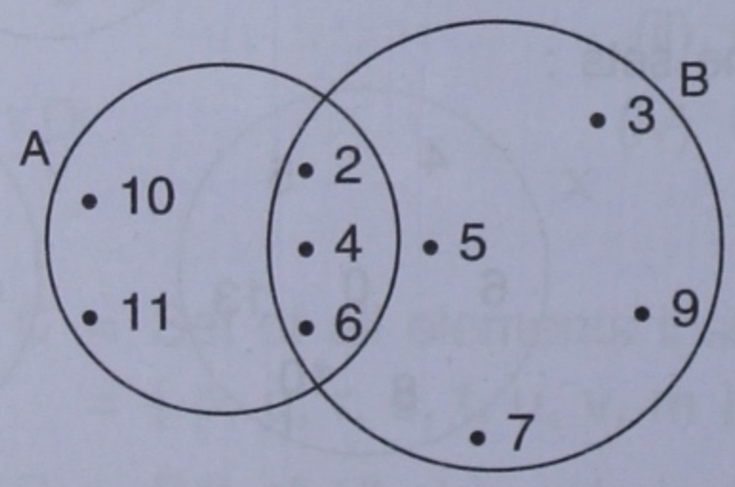
(a)



(b)



(c)



6. Use the adjoining figure to find :
   (i) $A \cap B$ (ii) $B \cap C$
   (iii) $A \cup C$ (iv) $B \cup A$
   Out of the sets A, B and C, name the intersecting sets and also name the disjoint sets.