

CHAPTER 36 VENN-DIAGRAM

36.1 BASIC IDEA

John Venn, a British Mathematician, developed the idea of using diagrams (closed geometrical figures) to represent sets. These diagrams are called Venn-diagrams.

Usually, a rectangle is used to represent the universal set (E) and circles or oval shaped figures inside the rectangle are used to represent sets under discussion.

In the adjoining figure, the universal set & is represented by a rectangle, whereas two sets A and B are represented by circles.

The shaded portion shows the set $A \cap B$.

The name of the set is written near the boundary of the figure representing the set and its elements inside the figure.

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36.2 TO DRAW A VENN-DIAGRAM Example 1 :

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

set $A = \{2, 4, 6, 8, 10\}$ and set $B = \{3, 6, 8, 9\}$ Draw a suitable Venn-diagram to show the relationship between the given sets.

Solution :

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Steps : 1. Draw a rectangle to represent the universal set. 2. Since the sets are joint, draw two overlapping circles

to represent sets A and B. 3. In the common portion of the two circles drawn, write

the elements 6 and 8 which are common to sets A

and B. 4. Write the remaining elements (2, 4 and 10) of set A

in the remaining portion of circle A and the remaining elements (3 and 9) of set B in the remaining portion

of circle B. 5. Finally, write the elements (1, 5 and 7) of the universal set, which are neither in A

nor in B, outside the two circles as shown.

(Ans) Note : To draw a Venn-diagram for a set with a very large number of elements in it, draw a closed figure and write a brief description of the set.

Thus, for the set $A = \{x: x \text{ is a student of Sophia School}\}$

students The Venn-diagram will be as shown alongside :
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36.3 USING VENN-DIAGRAMS TO SHOW THE RELATIONSHIP BETWEEN THE

DIFFERENT SETS 1. The adjoining figure shows two disjoint sets, i.e., the sets which do not have any element in common. Clearly, $A \cap B = 0$.

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lines.

2. The adjoining figure shows two joint or overlapping sets.

It is clear that: (i) $A \cap B$ = portion common to A and B both

= portion marked by slant lines. (ii) $A - B$ = portion of A, which is not in B

= portion marked by horizontal (iii) $B - A$ = portion of B, which is not in A

= portion marked by vertical

lines.

3. In the adjoining figure, the names of the two sets A and

B are written near the boundary of the same circle, this shows :

Set A = Set B.

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4. In the adjoining figure, the circle representing set B is completely inside the circle representing set A. This shows that set B is a proper subset of set A, i.e.,

BCA 5. In the similar manner, study the shaded portion of each of the following Venn-diagrams:

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(0)

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[Complement of set A, i.e., A']

[Complement of set B, i.e., B']

(iii)

(iv)

[Complement of A union B, i.e., $(A \cup B)'$]

[Complement of A intersection B, i.e., $(A \cap B)'$] 6. The shaded portion in the given figure shows :

A-B or, $A \setminus B$ or, only A.

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7. The shaded portion in the adjoining figure shows :

B-A or, AB or, only B.

FINDING THE ELEMENTS OF VARIOUS SETS FROM
THE GIVEN VENN

DIAGRAM

Example 2 :

15 From the adjoining venn-diagram, find : (i) $A \cup B$

(ii) $A \cap B$

(iii) $A -$

B (iv) $B - A$

(v) $(A \cap B)'$

(vi) $(A \cup B)'$

Solution :

(1) $A \cup B$ {elements, which are in A or in B or in both}

= {2, 4, 6, 7, 9, 10}

Ans.) (ii) $A \cap B$ = {elements, which are common to both

the sets A and B}

$$= \{4, 9\}$$

Ans.) (iii) $A - B = \{\text{elements, which are in A and not in B}\}$

$$= \{2, 6\}$$

Ans.) (iv) $B - A = \{\text{elements, which are in B and not in A}\}$

$$= \{7, 10\}$$

Ans.) (v) (

$A \cap B) = \{\text{elements of the universal set, which are not in } A \cap B\}.$

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

Ans.) (vi) $(A \cup B) = \{\text{elements of the universal set, which are not in } A \cup B\}$

$$= \{1, 3, 5, 8\}$$

Ans.) Example 3 :

Draw a Venn-diagram to show the relationship between the following sets :

Universal set = {integers), $A = \{\text{whole numbers}\}$

and $B = \{\text{natural numbers}\}$. Solution :

Since, every natural number is always a whole number,

B is a subset of A and so the diagram will be :

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(Ans.)

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EXERCISE 36(A)

1. From the adjoining Venn-diagram, find :

(i) $A \cup B$

(ii) $A \cap B$ (iii) $A - B$

(iv) $(A \cup B)'$

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2. From the adjoining Venn-diagram, find :

(1) A

(ii) B

4)3 2) (iii) AUB

(iv) (

A B) (v) Is $A' B' = ($

A B) ? 3. Use the given Venn-diagram to find :

(1) A-B (ii) B' (ii) AB

(iv) Is $A - B = A B'$? 4. Referring to the given Venn-

diagram, find the following sets :

(i) 5

(ii) AUB (ii) AB

(iv) A B (v) BA

(vi) (

A B) (vi) (A U B)

(viii) A-B (ix) Only B. 5.

From the adjacent Venn-diagram, find the following

sets :

(1) $A \cup B$

(ii) $A \cap B$ (iii) $A \cap B$

(iv) $B \cap A'$ (v) $A - B$

(vi) $(A \cap B)'$

(vii) $(A \cup B)$.

(viii) $B - A$ 6. From the Venn-diagram, given alongside, find :

(i) X

(ii) Y (iii) $n(X)$

(iv) $n(Y)$ (v) $X \cup Y$

(vi) $X \cap Y$ (vii) $X - Y$

(viii) $Y \cap X$

0 (ix) Only Y

(x) Y (xi) X

(xii) $(X \cup Y)$ 7. Draw Venn-diagrams to show the relationship between the following pair of sets :

- (i) $H = \{\text{Boys who play hockey}\}$ and $F = \{\text{Boys who play football}\}$ (ii) $T = \{\text{People who drink tea}\}$ and $C = \{\text{People who drink coffee}\}$ (iii) $A = \{\text{Multiples of 2 upto 10}\}$ and $B = \{\text{Multiples of 4 upto 10}\}$ (iv) $N = \{\text{Negative integers}\}$

and $P =$

{Positive integers} (v) $P =$ {Prime factors of 28}

and $Q =$

{Prime factors of 42} (vi) $S =$ {All schools in India}

and $I =$ {All I.C.S.E. schools in India} (vii) $R =$ {Letters of the word READ} and $D =$ {Letters of the word DEAR} 8.

$I =$ {2, 4, 6, 8, 10, 12, 14, 16, 18, 20},

$A =$ {Multiples of 3 upto 20} and $B =$ {Multiples of 4 upto 20} Draw a Venn-diagram to show the relation between these sets. Also, write the sets $A \cup B$ and $A \cap B$

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9. State the sets represented by the shaded portions of the following Venn-diagrams :

(ii)

(iii)

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10. Draw Venn-diagrams to show the relation between the sets in given situations :

(i) BCA

(ii) PCQ CR

iii) $A \cap B = A$ (iv) $P \cap Q = \emptyset$

(v) $R \cap S \neq \emptyset$

vi) $A \cap B = A$ (vii) $\Delta = \{\text{all triangles}\}$,

$A = \{\text{isosceles triangles}\}$ and $B = \{\text{equilateral triangles}\}$ (viii) All kings are men. 11. If $A \cap B = \{2, 7\}$, only $B = \{12, 22, 32\}$ and $A \cup B = \{2, 7, 12, 17, 22, 27, 32\}$,

list the elements of each of the following sets (using Venn-diagram only): A) (i) A

(ii) A-B

36.5 USING VENN-DIAGRAMS TO SOLVE

PROBLEMS Example 4:

In a class of 50 students, 30 study Hindi, 25 study English and 11 study both the languages. Draw a Venn-diagram to express this.

From the Venn-diagram find, how many students do not study any of these two languages. Solution :

Let H represents a set of students who study Hindi, .. $n(H) = 30$, and E represents a set of students who study English, : $n(E) = 25$.

Therefore, the intersecting part of the two sets represents those students who study both the languages. Thus, $n(H \cap E) = 11$.

The Venn-diagram will be as shown alongside :

Clearly, no. of students studying only Hindi

$$9 | = n(H) - n(H \cap E).$$

$$= 30 - 11 = 19. \text{ No. of students studying only English}$$

$$= n(E) - n(H \cap E) = 25 - 11 = 14 \therefore \text{Total number of students who study Hindi or English or both}$$

$$= 19 + 11 + 14 = 44 = n(A \cup B) = 44.$$

Since, the total number of students = 50 \therefore No. of students who do not study any of these two

languages, i.e., $n(A \cup B)$ '

$$= 50 - 44 = 6$$

nor

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(Ans.) (Ans.)

E 75

14

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Example 5:

In a class of 40 students, 28 play cricket and 26 play hockey. If each student takes part in atleast one game, find using Venn-diagram how many play:

(i) both the games ?

(ii) only cricket?

Solution :

Let C denotes the set of students who play cricket, H denotes the set of students who play hockey and x students play both the games, i.e., $n(C \cap H) = x$

No. of students who play only cricket = $28 - x$ and no. of students who play only hockey = $26 - x$.

Since, the total number of students = 40 $(28 - x) + x + (26 - x) = 40$

$$28 - x + x + 26 - x = 40$$

40

$$x = 14 \text{ (i) . No.}$$

of students who play both the games = 14

Ans.) (ii) No. of students who play only cricket = $28 - x = 28 - 14 = 14$

Ans.) Alternative method (when use of Venn-diagram is not necessary) :

Since, $n(C \cup H) = 40$, $n(C) = 28$ and $n(H) = 26$

$n(C \cup H) + n(C \cap H) = n(C) + n(H)$ | $40 + n(C \cap H) = 28 + 26$

$$n(C \cap H) = 54 - 40 = 14 \text{ .. No. of students who play both the games} = n(C \cap H) = 14$$

$n(C \cap H) = 54 - 40 = 14$.. No. of students who play both the games = $n(C \cap H) = 14$

Ans.) and, no. of students who play only cricket = $n(C) - n(C \cap H)$

$$= 28 - 14 = 14$$

(Ans.)

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-EXERCISE 36(B) 1. Draw a Venn-diagram to illustrate the sets A and B, such that $n(A) = 28$, $n(B) = 17$

and $n(A \cap B) = 9$. Use this Venn-diagram to find :

(i) $n(A \cup B)$

(ii) $n(A - B)$

(iii) $n(B - A)$

2. Draw a Venn-diagram to illustrate the

sets P and Q, such that $n(P \cap Q) = 60$; $n(P) = 42$ and $n(Q) = 35$. Use the Venn-

diagram drawn to find : (i) $n(P \cup Q)$

(ii) $n(P-Q)$

(iii) $n(Q-P)$

3. For the two sets M and N, $n(M \cap N) = 0$, $n(M) = 50$ and $n(N) = 40$. Draw a suitable

Venn-diagram and use it to find $n(M \cup N)$.

4. In a group of people who are 35 in number; 20 drink tea and 22 drink coffee. Find,

how many drink tea and coffee both, if every person drinks atleast one of these. 5. 48 girls can either stitch or cook or can do both. If 33 girls can stitch and 22 can only

stitch, find how many can only cook? 6. When a survey was taken of 75 families in a locality, it was found that 60 of them

view the T.V. programme and 30 listen to the radio.

Find : (i) how many families do both, i.e., view a T.V. as well as listen to the radio ? (ii) how many view only the T.V. programme ?

7. 200 children appeared for a combined examination in Physics and Mathematics. 71

passed in only Mathematics and 65 passed in only Physics. If all the children have

passed atleast in one subject, find how many have passed in both the subjects. 8. All the people in a

locality read the magazine Femina or Illustrated Weekly or both. If

110 read Femina, 90 read Illustrated Weekly and 40 read both, find : (i) how many people are there in the locality ?

(ii) how many people read only Femina ? 9. In a group of 20 children, 5 play hockey only and 12 play hockey. Find, how many

can play only cricket, if each child plays atleast one of these two games. 10. In a certain school, 65 percent of the pupil purchased tickets to a cricket match and 75 percent to a football match. What is the least percentage of pupil who purchased

tickets for both. 11. Given : $n(A \cup B) = 47$, $n(A) = 30$ and $n(B) = 22$.

Find : (i) $n(A \cap B)$ (ii) $n(\text{only } B)$. 12. Given : $n(\text{only } A) = 35$, $n(\text{only } B) = 18$ and $n(A \cup B) = 72$.

Find $n(\text{only } A)$

$A \cap B$). 13. If A and B are disjoint sets, what is the value of $n(A \cap B)$?

Further, if $n(A) = 43$ and $n(B) = 52$;

find $n(A + B)$. 14. If $M \cap N = 0$, $n(M \cap N) = 18$ and $n(N) = 13$; find $n(M)$. 15.

If $n(P \cup Q) = 75$, $n(P \cap Q) = 23$ and $n(Q) = 40$; find : (i)

$n(P)$ (ii) $n(\text{only } P)$.

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