



Grade 11



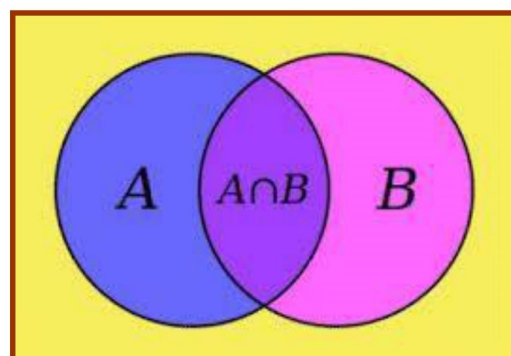
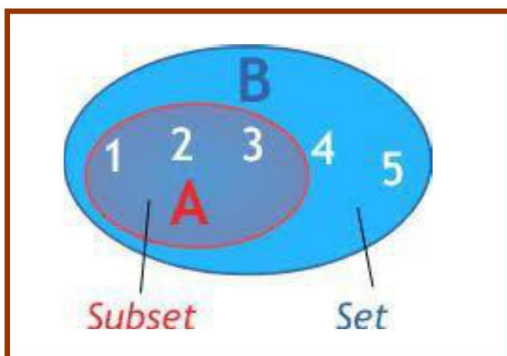
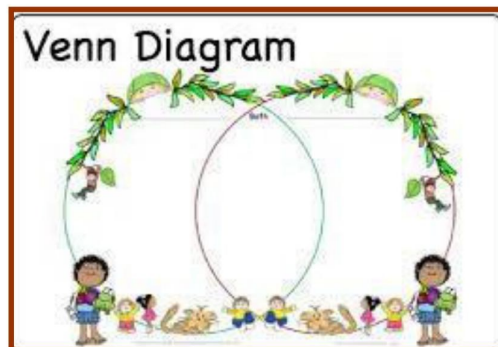
MATHEMATICS



24. Sets

By studying this lesson you will be able to :

1. Draw the various ways of representing three sets in a Venn diagram
2. Describe in words the set which is denoted by a shaded region in a Venn diagram of three sets
3. Represent using set notations a set which is denoted by a shaded region in a Venn diagram of three sets
4. Shade a region that has been described in words in a Venn diagram of three sets
5. Shade a region that has been given in set notations, in a Venn diagram of three sets
6. solve problems that can be represented using three sets, using Venn diagrams.





Note : Recalling previous knowledge

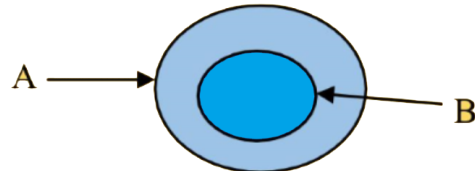
- **Null set (ϕ)**

A set which has no elements is called a Null set

- **Subsets (\subset)**

When two sets A and B are considered, if all the elements in set B are there in set A, then set B is known as a subset of set A

$$B \subset A$$

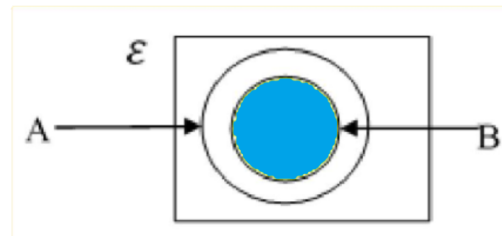
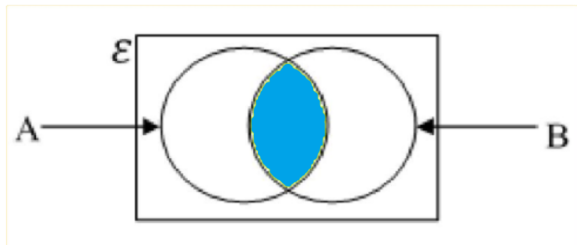


- **The universal Set (ϵ)**

A universal is a set which contains all the elements under consideration

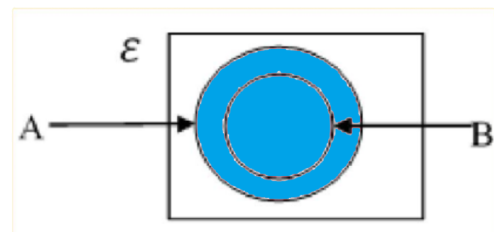
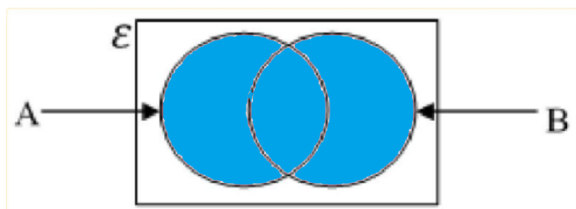
- **Intersection of sets ($A \cap B$)**

When two or more sets are considered, the set consisting of the elements which are common to all the sets is known as their intersection



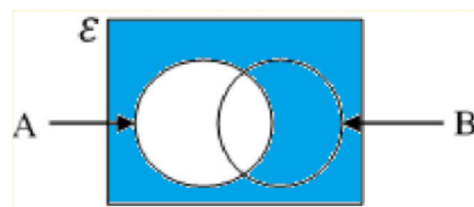
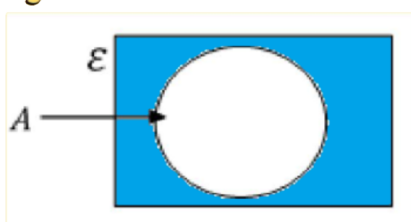
- **Union of sets ($A \cup B$)**

When two or more sets are considered, the set which consists all the elements in these sets is known as the union of these sets



- **Complement of a set (A')**

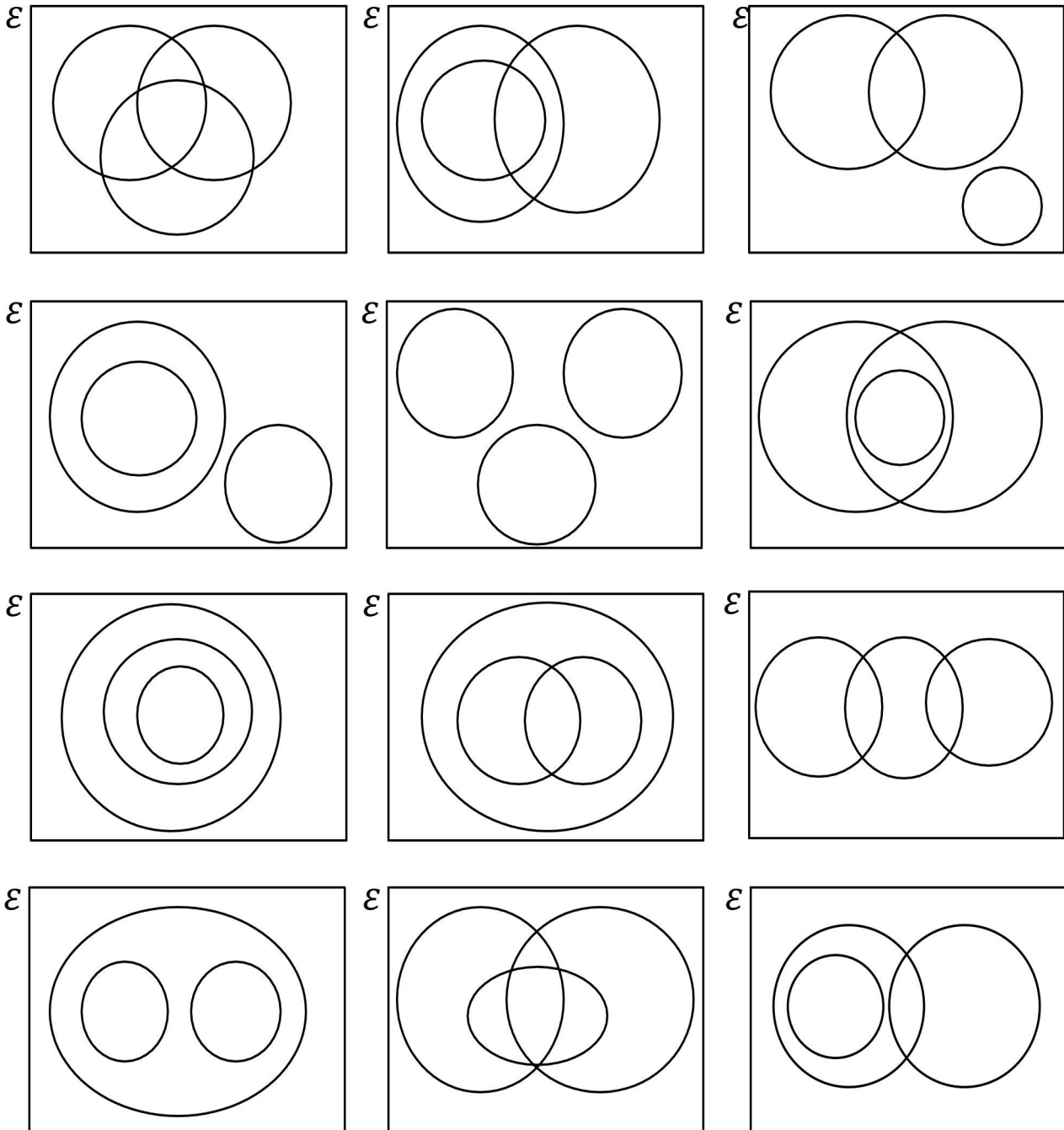
If A is subset of a universal set, the set of elements which do not belong to the set A, but belong to the universal set is known as the complement of A





Venn diagrams

The followings are different ways in which three none-empty subsets of a universal set can be represented in a Venn diagram.



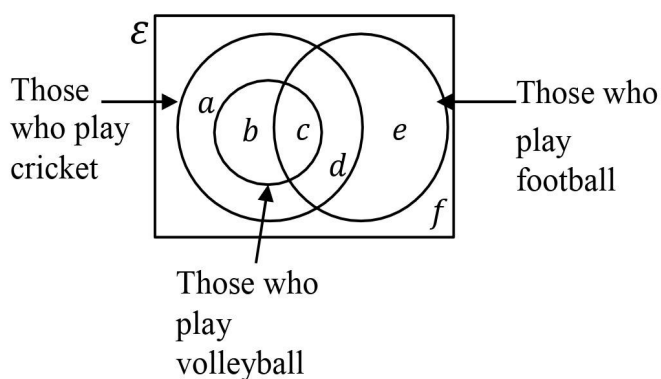
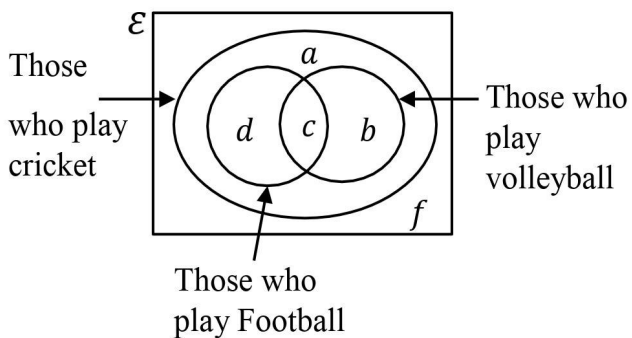
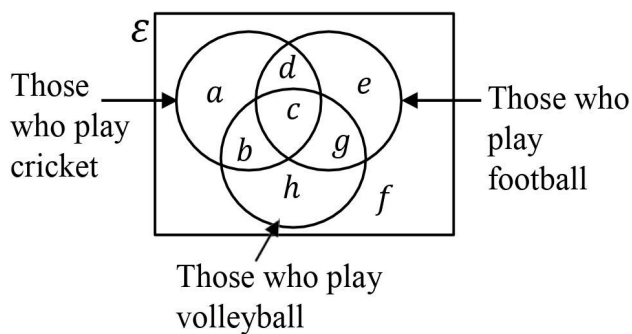
❖ Draw another way of representing three subsets in the Venn diagram given above



Describing the regions in a Venn diagram in words

We will consider the way of describing the regions in a Venn diagram using the examples given below

Three subsets of a universal set are represented in a Venn diagram as given below



We will identify the regions denoted by the English letters

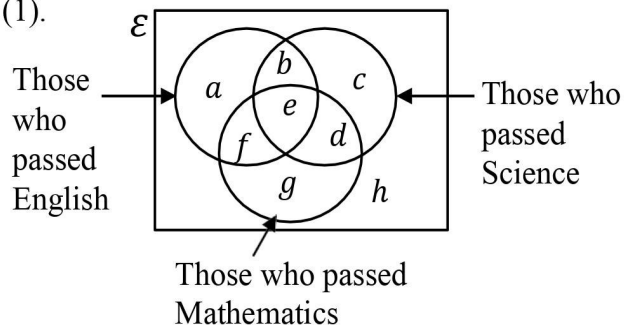
- a** – Those who play only cricket
- b** – Those who play only cricket and volleyball
- c** – Those who play all three games
- d** – Those who play only cricket and football
- e** – Those who play only football
- f** – Those who do not play any of these three games
- g** – Those who play only football and volleyball
- h** – Those who play only volleyball



Exercise 1

Describe in words, each region which are denoted by English letters.

(1).



a -

b -

c -

d -

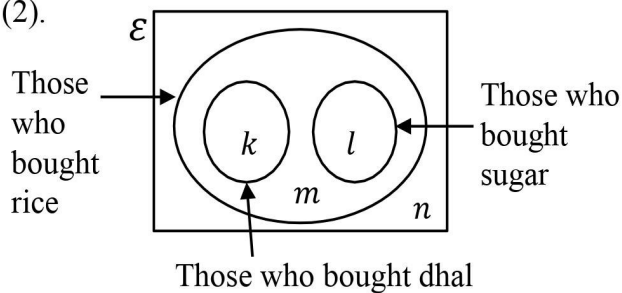
e -

f -

g -

h -

(2).



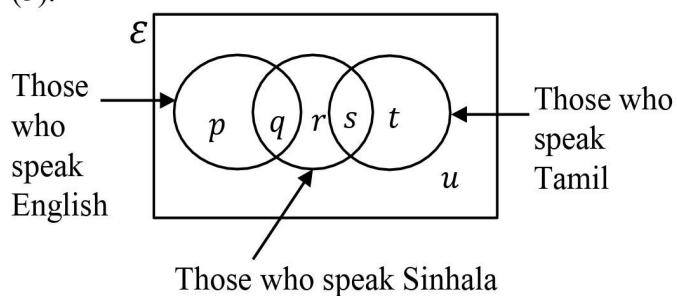
k -

l -

m -

n -

(3).



p -

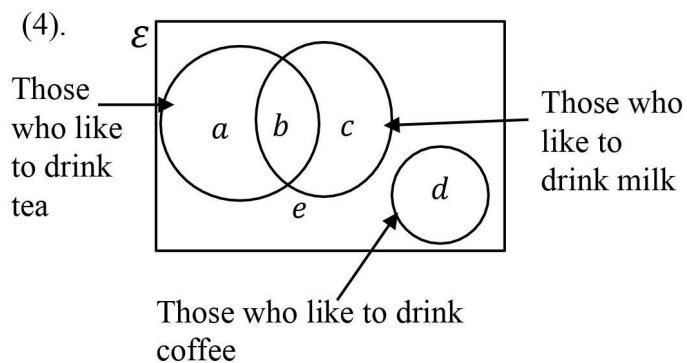
q -

r -

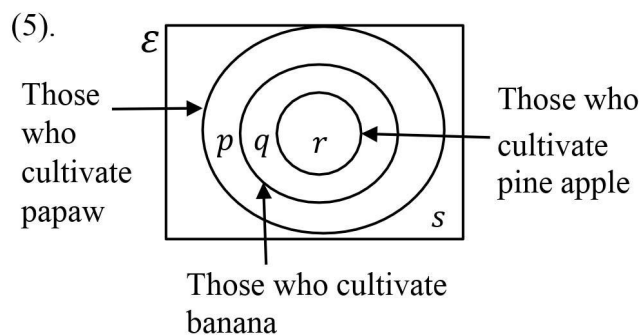
s -

t -

u -

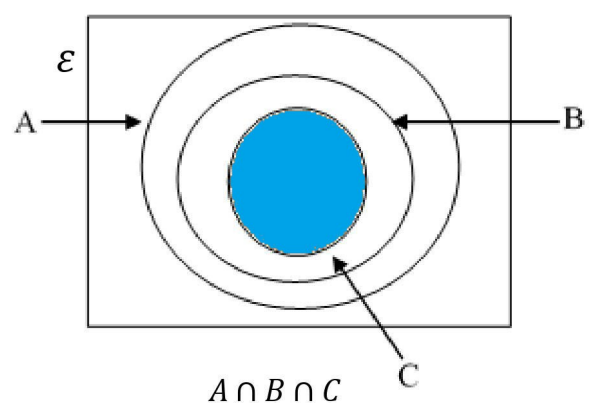
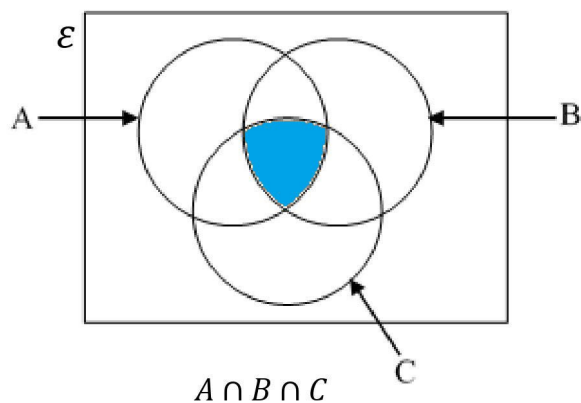


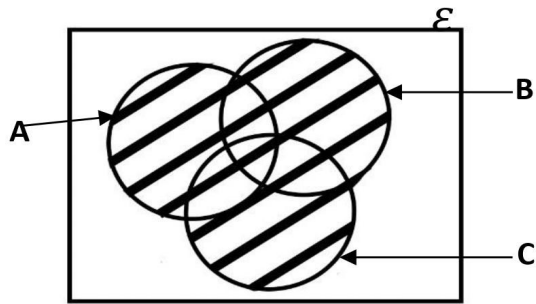
a -
b -
c -
d -
e -



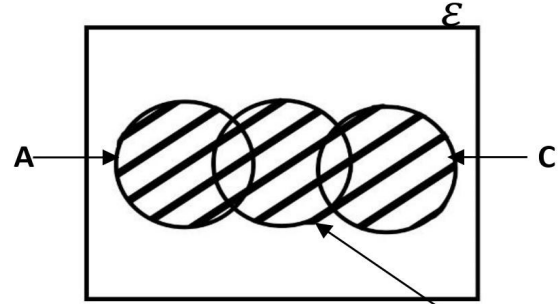
p -
q -
r -
s -

Expressing a subset denoted by a shaded region in a Venn diagram using set notations

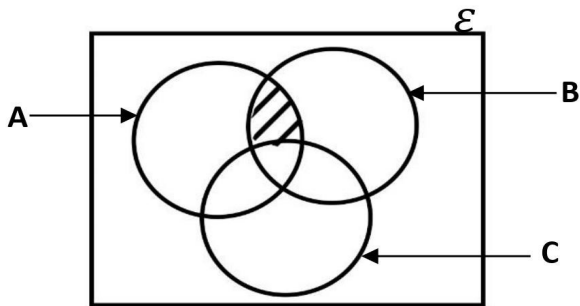




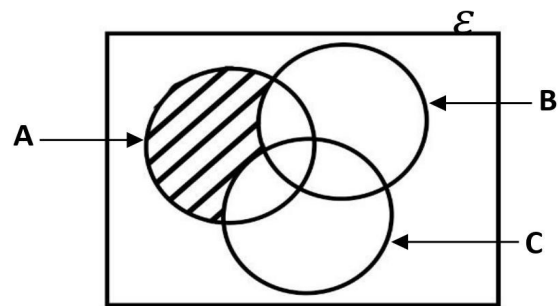
$$A \cup B \cup C$$



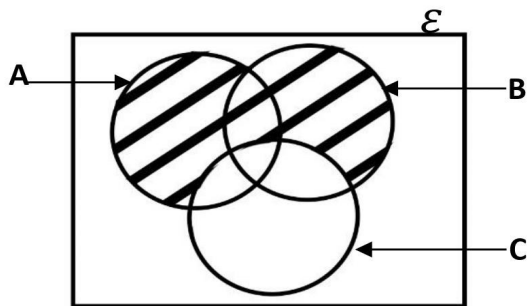
$$A \cup B \cup C$$



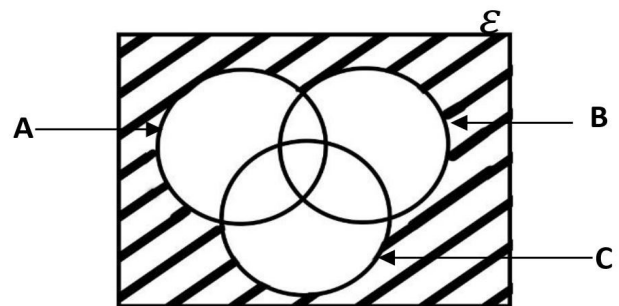
$$(A \cap B) \cap C'$$



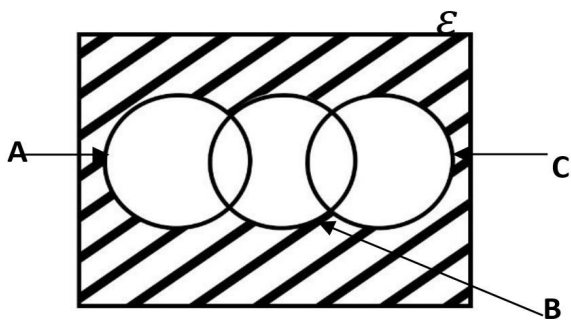
$$A \cap (B \cup C)'$$



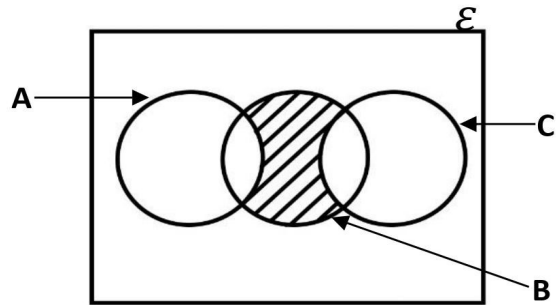
$$(A \cup B) \cap C'$$



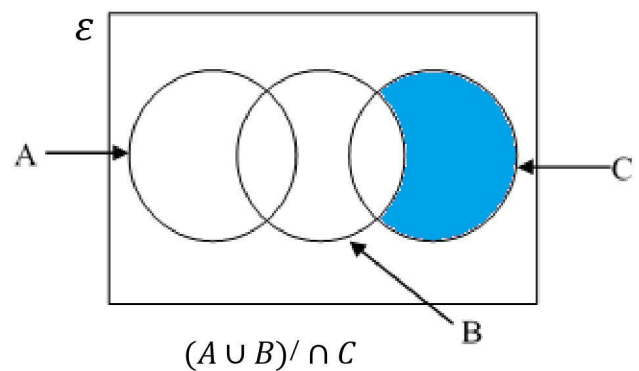
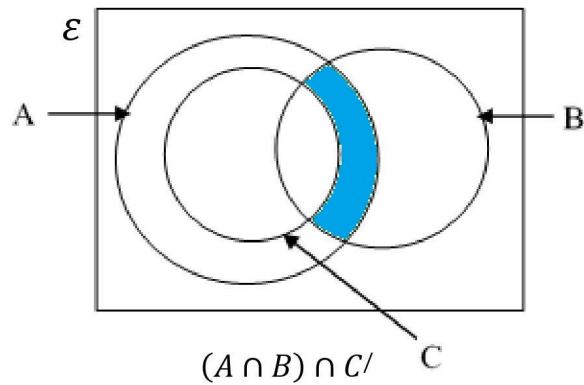
$$(A \cup B \cup C)'$$



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



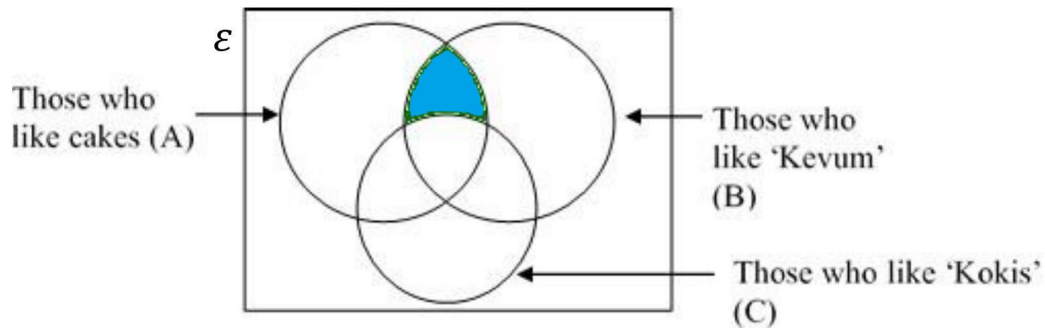
$$(A \cup C)' \cap B$$



Exercise 2

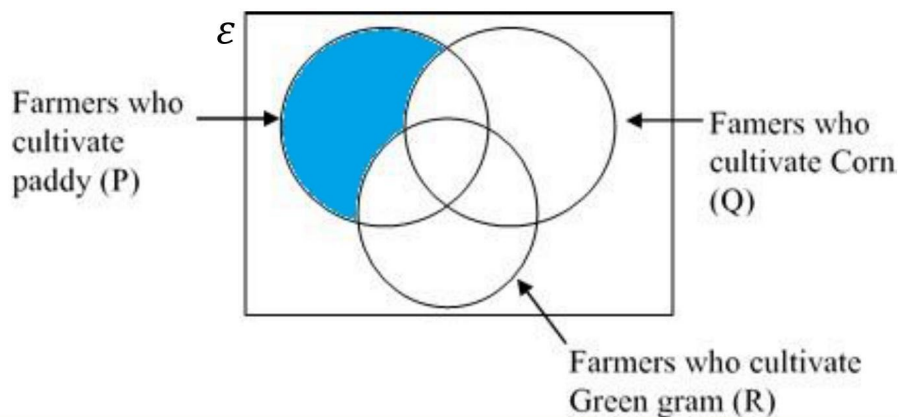
Describe in word the shaded region in each of the Venn diagrams given below and express the subset denoted by the shaded region using set notations

(1).



Answer : Those who like only cakes and 'Kevum;
 $(A \cap B) \cap C$

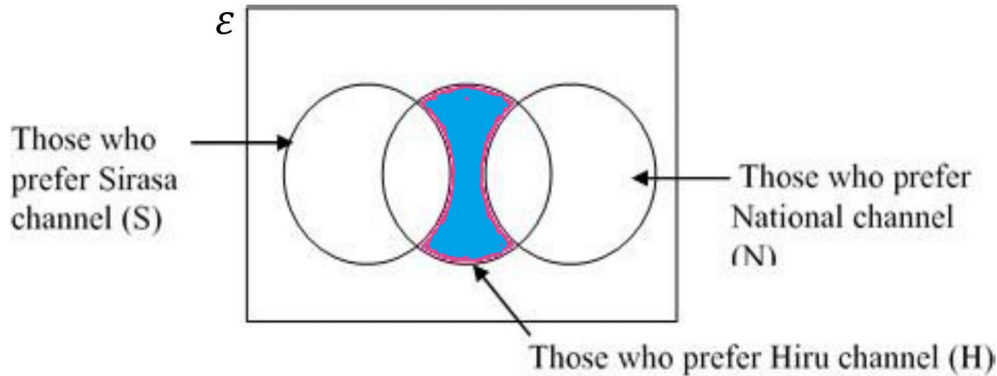
(2).



Answer : Farmers who cultivate only paddy
 $P \cap (Q \cup R)$

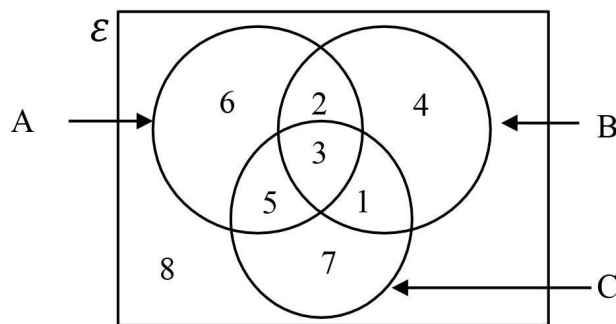


(3).



Answer : Those who prefer only 'Hiru' channel
 $(S \cup N) \cap H$

(4). According to the information given in the Venn diagram, find the followings



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

(ii). $(B \cup C) \cap A$

(iii). $(A \cup B \cup C) \cap C$

(iv). $[(A \cap B) \cap C]$

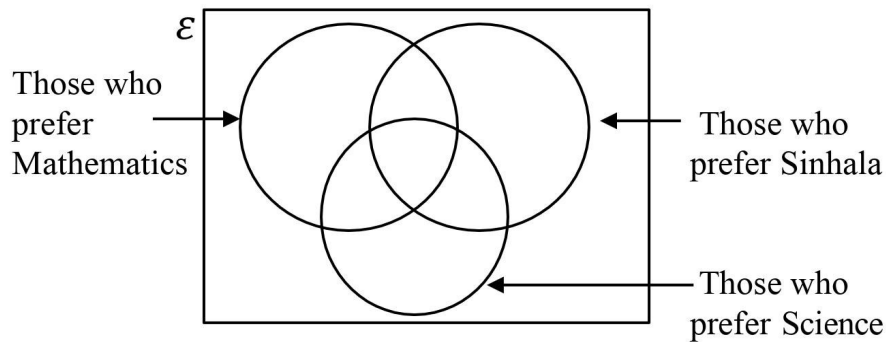
Answers : (i). 3
 (ii). $6 + 8 = 14$
 (iii). 8
 (iv). 2

Solving problems related to sets using Venn diagrams

Next we will consider how to solve problems using the regions in a Venn diagram, you identified above

(1). Out of 35 students in a class, 11 prefer Mathematics, 14 prefer Science and 18 prefer Sinhala.

8 students prefer Mathematics and Science, 9 prefer Sinhala and Science, 7 prefer Mathematics and Sinhala, while 5 students prefer all three subjects.



- Copy the Venn diagram and include the given information.
- Find the number of students who prefer only Mathematics
- Find the number of students who prefer only one subject
- Find the number of students who prefer at least two subjects
- Find the number of students who do not prefer Science

Answers :

(i). 1

(ii). 1

(iii). $1 + 7 + 2 = 10$

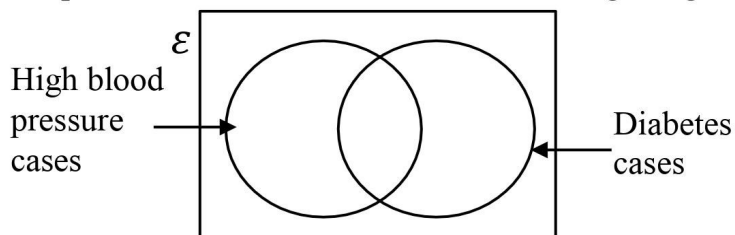
(iv). $2 + 5 + 3 + 4 = 14$

(v). $1 + 2 + 7 + 11 = 21$

(2). Followings are some information collected from a sample of 50 patients who have been admitted in a hospital

- 20 patients are high blood pressure cases
- 15 patients are both high blood pressure and diabetes cases
- 10 patients do not suffer from any of these two diseases

(i). Represent this information in the Venn diagram given below





(ii). How many patients do suffer from diabetes?

- Out of these 50 patients 25 are women and all of them suffer from diabetes. Also 7 women suffer from high blood pressure

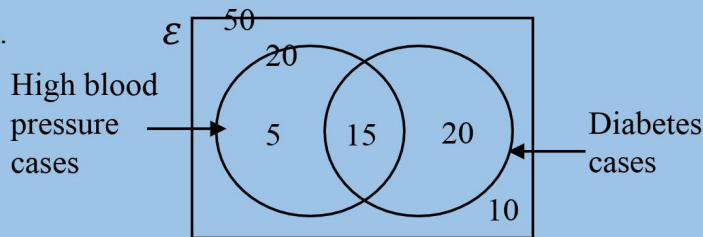
(iii). Copy the above Venn diagram again, include the subset which represent 'Women' in it and write down the number of elements in each region

(iv). How many male diabetes cases were reported?

(v). Shade the region which represents men who suffer from both high blood pressure and diabetes in the above Venn diagram

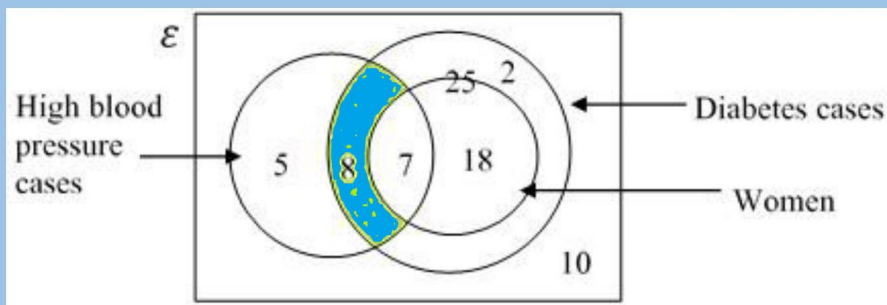
Answers :

(2). (i).



(ii). $15 + 20 = 35$

(iii).



(iv). $8 + 2 = 10$

(v). Shaded in the Venn diagram

(3). An incomplete Venn diagram drawn to represent information about the customers who arrived at a 'Sathosa' super market on a certain day, is given below

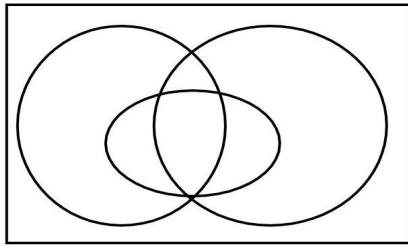
$E = \{\text{Customers who arrived at the super market}\}$

$A = \{\text{Those who were wearing face masks}\}$

$B = \{\text{Men who arrived at the super market}\}$

$C = \{\text{Those who were wearing spectacles}\}$

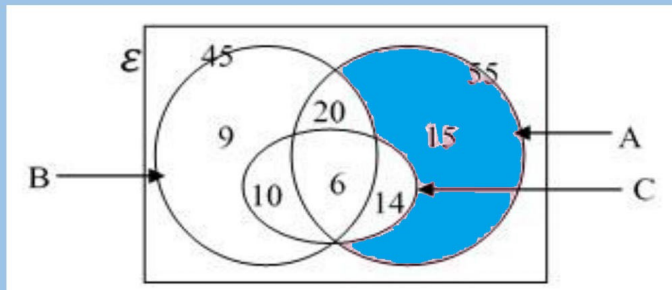
[Consider that $C \subset (A \cup B)$]



- Copy the Venn diagram and name the sets ε , A, B and C appropriately.
- Shade the region which represents women who were not wearing spectacles, but wearing face masks, in the Venn diagram
- The number of men who were not wearing spectacles, but wearing face masks is 20 and $(C \cap B)^c = 14$. Include this information in the Venn diagram.
- If 15 women were wearing face masks but not wearing spectacles, while 55 customers were wearing face masks, find the number of men who were wearing face masks
- If 30 customers were wearing spectacles while 45 men arrived at the super market, find the number of customers arrived at the super market on that day. (Consider that $(A \cup B)^c = \emptyset$)

Answers :

(i).



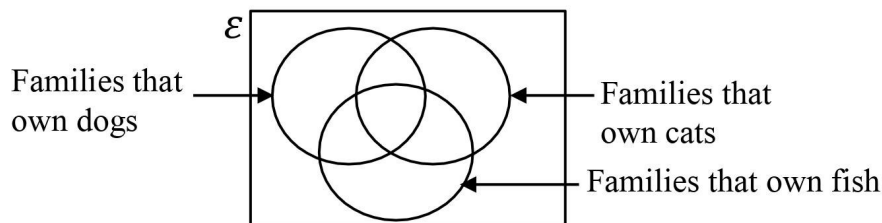
- Shaded in the Venn diagram
- 20 and 14 are marked in the Venn diagram
- $55 - (20 + 15 + 14)$
 $= 55 - 49$
 $= 6$
- $55 + 9 + 10$
 $= 74$

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❖ Now we will consider the ‘Sets’ question in G.C.E (O/L) 2019 paper and how the marks are awarded for its answers.

A survey was conducted on 115 families that own pets. Information on the families that own dogs, cats and fish as pets from these families and an incomplete Venn diagram drawn corresponding to it are given below.

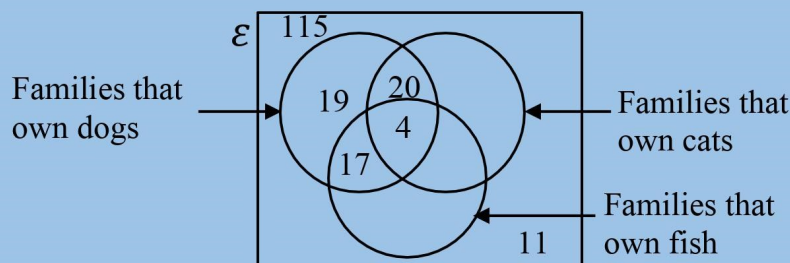


- 4 families own all the above three types of pets
- The number of families that own only dogs is 19
- 24 families own both dogs and cats while 21 families own both dogs and fish
- 11 families do not own any of the above three types of pets

- Copy the given Venn diagram onto your answer script, and include the above information in it.
- The number of families that own dogs is twice the number of families that own fish. Find the number of families that own fish, but do **not** own dogs
- How many families own only cats?
- The number of families that own only fish is twice the number of families that own cats and fish but **not** dogs. Find the probability of a family selected at random from those surveyed being a family that owns only fish

Answers :

(i).



Marking at least two of 4, 19, 11, 115 in the correct regions

Obtaining 20

Obtaining 17

2

1

1

4

Marking in two regions correctly – 2

Marking in one region correctly - 1



(ii). Number of families that own dogs	$= 24 + 17 + 19$			
	$= 60$	1		
\therefore Number of families that own fish but not dogs				
	$= 30 - 21$	1	3	
	$= 9$	1		
(iii). Number of families that own only cats	$= 115 - (60 + 9 + 11)$			
	$= 35$	1	1	
(iv). Number of families that own only fish	$= 9 \times \frac{2}{3}$			
	$= 6$	1		
(v). Probability of being a family that owns only fish		1	2	
	$= \frac{6}{115}$			
				10

- **Note :**
 - **Do exercise 24.1 and Exercise 24.2 in your Mathematics text book**