2 Sets

By studying this lesson you will be able to

- identify sets,
- identify the elements of a set,
- write a set by listing the elements that belong to the set,
- write a set in terms of a common property of the elements of the set so that the elements can be clearly identified, and
- represent a set by a Venn diagram.

2.1 Introduction to Sets

The figure shows the types of vegetables that a certain vendor has for sale. The only types of vegetables that the vendor has are carrots, beans, pumpkins and ladies fingers. Accordingly, we can state with certainty whether the vendor has a certain type of vegetable for sale or not.

What has been given above is a collection of several items. Such a collection can be called a group. In our day to day life we have to make decisions on groups, that is, on such collections of items.

Let us consider the following groups.

- The districts that belong to the Southern Province of Sri Lanka
- The odd numbers between 1 and 10
- The vowels in the English alphabet
- The types of birds that are endemic to Sri Lanka, that have been identified by the year 2014
- The students who sat the Grade Five Scholarship Examination in 2014

The items that belong to these groups too can be clearly identified.

A group consisting of such items that can be clearly identified is called a **set**.

Various types of items can belong to a set. Numbers, physical objects, living beings and symbols too can belong to a set. A set can be expressed by writing down all the items in a certain group or by giving a common property or several common properties by which the items in the group can be clearly identified.

It can be stated with certainty whether a particular item belongs or does not belong to a set which has thus been specified.

The items that belong to a set are defined as its elements.

Accordingly, the district of Galle belongs to the set consisting of the districts of the Southern Province, while neither the district of Gampaha nor the district of Kalutara belongs to this set.

Three more examples of sets are given below.

- The set consisting of the even numbers between 1 and 10
- The set consisting of the symbols a, d, g, 5, 2
- The set consisting of the vehicles that were registered in Sri Lanka in 2014

The elements that belong to the above sets can be clearly identified.

Let us now consider the following.

- The tall students in a class
- Popular singers of Sri Lanka

The items that belong to such groups cannot be clearly identified since the common properties given above are subjective and debatable.

Therefore a set cannot be identified by considering such properties.

Exercise 2.1

(1) Place a ✓ next to each of the expressions which clearly define a set, and a × next to those which do not clearly define a set.

(i) Those who obtained more than 100 marks in the Grade 5 Scholarship examination held in 2013
(ii) Talented singers
(iii) Districts of Sri Lanka
(iv) Beautiful flowers
(v) Numbers between 0 and 50 which are multiples of 6
(vi) People who are fortunate

2.2 Writing a set

Let us now learn two methods of writing a set.

- **Writing a set by listing the elements of the set within curly brackets**

A set can be expressed by writing the elements of the set separated by commas, within curly brackets, when it is possible to list all the elements of the set.

The set consisting of the elements 9, 1, 3 is written as $\{9, 1, 3\}$.

➤ When writing a set in this form, the order in which the elements appear within the curly brackets is not important.

Thus, the above set can be written as $\{1, 3, 9\}$ or $\{9, 3, 1\}$ or $\{1, 9, 3\}$ etc.

The set consisting of the elements a, b, d, 9, 1, 3 can be written as $\{1, 3, 9, a, b, d\}$ or $\{1, a, 3, b, 9, d\}$ or $\{a, 1, 3, b, 9, d\}$ etc.

➤ Capital letters of the English alphabet are usually used to name sets.

Let A be the set of even numbers between 0 and 10. Then it can be written as follows. $A = \{2, 4, 6, 8\}$

Let B be the set of letters of the word "integers". Let us express B by writing its elements within curly brackets.

$B = \{i, n, t, e, g, r, s\}$.

Here the element “e” is written just once.

That is, even if an element appears several times within a group, it is written only once when it is written as an element of a set.

- **Writing a set by specifying common properties of its elements by which the elements of the set can be clearly identified**

A set can be expressed by writing a common property or common properties of the elements within curly brackets.

The set consisting of the even numbers between 1 and 10 can be written as {Even numbers between 1 and 10}.

The set consisting of the types of birds endemic to Sri Lanka that have been identified by the year 2014 can be written as {Types of birds endemic to Sri Lanka that have been identified by the year 2014}.

Since there are a large number of such types of birds, it is difficult to write this set by listing all the different types within curly brackets.

The set consisting of all odd numbers greater than 0, can be written as{Odd numbers greater than 0}.

Although this set cannot be expressed by writing down all its elements within curly brackets, it can be written as {1, 3, 5, 7, …}

If the elements of a set are in a certain order, when writing the set, the first few elements can be written, and to indicate the remaining elements an ellipsis (three periods) can be used within the curly brackets, after the first few elements.

Accordingly, the set of positive integers can be written as {1, 2, 3, 4, … }.

The set consisting of the types of birds endemic to Sri Lanka that have been identified by 2014 cannot be written in this manner.

Example 1

(i) Write the set A = {Prime numbers between 0 and 15} by writing all the elements that belong to A within curly brackets.

(ii) Are 1 and 17 elements of the set A?

(i) $A = \{2, 3, 5, 7, 11, 13\}$

(ii) Since 1 is not a prime number and 17 is a prime number which is greater than 15, they do not belong to A. Therefore they are not elements of A.

Example 2

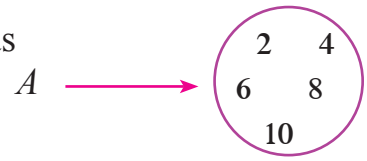
B = {The positive integers that are multiples of 3}. Write the elements of B within curly brackets.

$B = \{3, 6, 9, 12, 15, 18, ...\}$

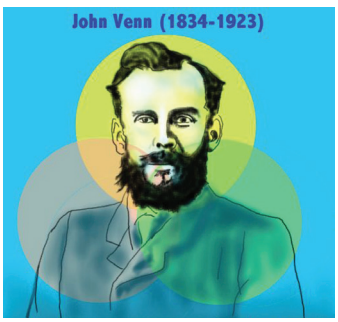
2.3 Representing a set by a Venn diagram

Let us write down the elements of the set A = {Even numbers from 1 to 10}.
$A = \{2, 4, 6, 8, 10\}$.

Let us represent this set by a closed figure as shown.

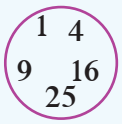


When a set is represented in the above manner by a closed figure, such a figure is defined as a **Venn diagram.** The elements of the set are written inside the closed figure. Expressing a set in this manner as a closed figure is defined as, **representing a set by a Venn diagram.**



This method of representing a set by a figure was introduced by the English mathematician **John Venn**. Therefore such a closed figure is called a Venn diagram.

Example 1

A set P has been represented here by a Venn diagram. $P \rightarrow$ 

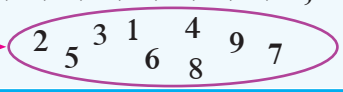
(i) Write down the set P by writing its elements within curly brackets.
(ii) Write P in terms of a common property by which the elements of P can be clearly identified.

↳ (i) $P = \{1, 4, 9, 16, 25\}$
(ii) $P = \{$Square numbers from 1 to 25$\}$

Example 2

A is the set of positive whole numbers from 1 to 9.

(i) Write down the set A in terms of a common property of its elements.
(ii) Write down the set A by listing its elements.
(iii) Represent the set A by a Venn diagram.

↳ (i) $A = \{$ Positive whole numbers from 1 to 9$\}$
(ii) $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$
(iii) $A \rightarrow$ 

Exercise 2.2

(1) (a) Express each of the following sets by writing all the elements of each set within curly brackets.
(i) $A = \{$Days of the week$\}$
(ii) $B = \{$Prime numbers between 0 and 10$\}$
(iii) $C = \{$Multiples of 4 between 0 and 25$\}$
(iv) $D = \{$Letters of the word "diagram"$\}$
(v) $E = \{$Districts of the western province$\}$
(vi) $F = \{$Digits of the number 21 412 $\}$
(vii) G = {Multiples of 6 from 1 to 10}

(b) For the sets defined above, state whether the following statements are true or false.
(i) "Saturday" is an element of A. (ii) "p" is an element of D.
(iii) All the elements of C are even numbers.
(iv) Any multiple of 3 from 1 to 10 is an element of G.

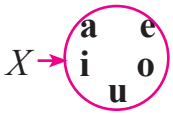
(2) Express each of the following sets in a different form by writing all the elements of each set within curly brackets.
Represent each of these sets by a Venn diagram too.

(i) P = {Prime numbers less than 10}
(ii) Q = {Colours of a rainbow}
(iii) R = {Letters of the word "number"}
(iv) S = {Whole numbers between 0 and 7}
(v) T = {Districts of the Southern Province}

(3) $K = \{4, 8, 12, 16, 20\}$

(i) Represent the set K by a Venn diagram.
(ii) Write down the set K in terms of a common property of its elements by which the elements can be clearly identified.

(4) The set X has been represented by a Venn diagram here.



(i) Express the set X in a different form by writing the elements of X within curly brackets.
(ii) Write down the set X in terms of a common property of its elements by which the elements can be clearly identified.

(5) Represent the set of multiples of 5 between 6 and 25.

(i) by writing down a common property by which the elements of the set can be clearly identified,
(ii) by writing all the elements of the set within curly brackets,
(iii) by a Venn diagram.

Summary

- A group of items that can be clearly identified is defined as a set.
- The items in a set are called its elements.
- A set can be expressed by writing the elements of the set separated by commas within curly brackets.
- An element of a set is written just once when the set is expressed in terms of its elements.
- A set can be expressed by writing a common property or common properties of the elements by which the elements can be clearly identified, within curly brackets.
- A set can be represented by a Venn diagram.