

1.1 A Sets and Set Notation

Terms that we should be familiar with by the end of this lesson:

- set
- element
- universal set
- subset
- Venn diagram
- complement
- empty set
- disjoint sets

We will first examine the grouping of data or information into sets.

Set

A collection of distinguishable objects.

Example 1

We can categorize the provinces and territories of Canada using sets.



Notation: If we refer to the provinces and territories in Canada as being set C , the number of provinces and territories in this set would be referred to as $n(C)$. Thus, $n(C) = 13$.

$$C = \{BC, AB, SK, MB, ON, QE, NB, NS, PEI, NL, YK, NWT, NU\}$$

$$n(C) = 13$$

Universal Set

A set of ALL the elements under consideration for a particular context. It is also called the sample space.

In our example, the **universal set** would include **all** of the provinces and territories.

Element

An object in a set.

In our example, each province and territory would be the **elements**.

Subset

A set whose elements all belong to another set.

In our example, the Atlantic Provinces would be a **subset**. It is a smaller set of the universal set of Canadian Provinces and Territories.

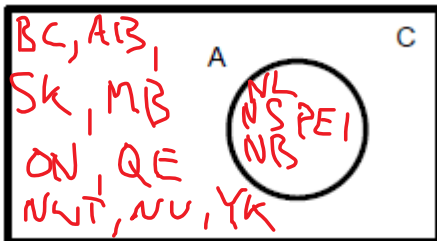
Notation: Suppose we use C to represent all of Canada, and A to represent the Atlantic Provinces. We can write:

This reads "A is a subset of C".

$A \subset C$
is a subset
belongs to

Venn Diagram

Venn Diagrams show the relation between sets and subsets. The following could be used for our example:



where C represents the universal set of Canada and A represents the subset of Atlantic provinces.

Complement

All the elements of a universal set that do not belong to a subset of it.

In our example, the **complement** of the subset of Atlantic Provinces would be the provinces and territories that do **not** belong to the Atlantic Provinces.

Notation: If A represents the subset of Atlantic Provinces, the complement provinces and territories NOT a part of the Atlantic Provinces would be called A' .

$$A = \{NL, NS, NB, PEI\}$$

$$A' = \{BC, AB, SK, MB, ON, QE, NU, NWT, YT\}$$

Empty Set

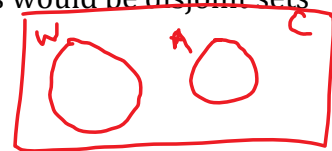
A set with no elements.

In our example, an **empty set** could be the set of Canadian Provinces south of Mexico. Since there are no such provinces, this would be considered to be an empty set.

Disjoint Sets

Two or more sets having no elements in common.

In our example, the Atlantic Provinces and the Western Provinces would be disjoint sets since there are no provinces common between the two.



Example 2

Consider the set M which consists of multiples of 3 from 1 to 100.

(A) Write this set out as a list.

$$M = \{3, 6, 9, 12, \dots, 93, 96, 99\}$$

① ②

(B) Write this set as an algebraic expression.

$$M = \{3x, x \mid 1 \leq x \leq 33, x \in \mathbb{N}\}$$

(C) Is one of these representations more efficient than the other?

(B) More complete, includes all numbers.

(D) What does $1 \leq x \leq 33$ represent?

x can only be from 1 to 33.

(E) Why is it important to state that x belongs to the natural numbers?

we don't need decimals or fractions.

Example 3

Set A consists of all natural numbers, while set B is the natural numbers from 1 to 5.

(A) Is it possible to explicitly list ALL the elements of both sets?

$$A = \{1, 2, 3, 4, 5, 6, 7, \dots\} \quad B = \{1, 2, 3, 4, 5\}$$

NO YES

(B) Which set is finite and which is infinite?

B A

(C) Is one set a subset of the other? Write this using proper notation.

B is a subset of A, $B \subset A$

(D) Which elements of the universal set do not belong to the subset?

$n > 5$ or $n \geq 6$, $n \in \mathbb{N}$
↑
belongs to

(E) What is the complement of set B (ie. B')?

or $B' = \{n > 5, n \in \mathbb{N}\}$
 $B = \{n \geq 6, n \in \mathbb{N}\}$

Your Turn:

1. Is it possible to write the set of months that have 32 days? What name is given to this?

NO. $\{\}$ \rightarrow empty set

2. Mary created the sets P {1, 3, 4} and Q {2, 3, 4, 5, 6}. John stated that $P \subset Q$ since the elements 3 and 4 are in both sets. Do you agree with John's statement? Explain.

No. There is no 1 in set Q.

3. Consider Set D: $D = \{\cancel{1}, \cancel{2}, 4, \cancel{5}, \cancel{6}, \cancel{7}, 8, \cancel{9}\}$ and set O: $O = \{1, 3, 5, 7, 9\}$.

(A) What is the universal set in this case, and what is the subset.

D O

(B) Write the relationship between both sets using proper notation.

$O \subset D$

(C) List the elements of the set O'.

$O' = \{2, 4, 6, 8\}$

(D) Make up a set P that is disjoint with sets D and O.

$P = \{10, 12, 14\}$ Many, many examples.