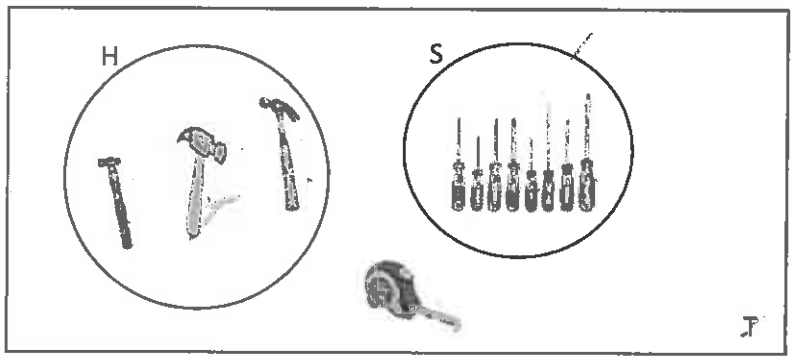
In set theory, Venn diagrams are often used show the relationship between sets and their subsets.

Example 1

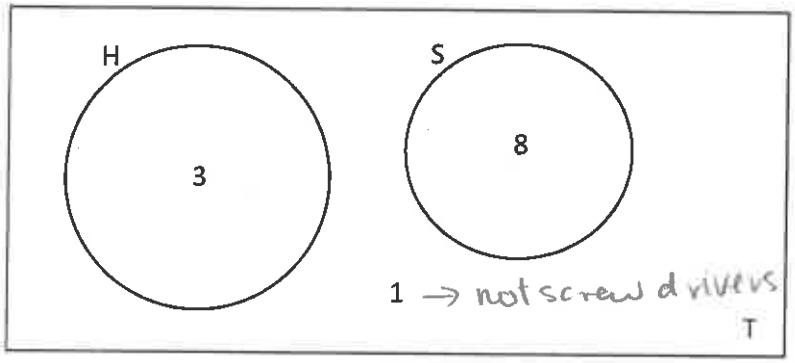
Suppose Claire has a set of tools, T, which consists of 3 hammers, 8 screwdrivers, and a measuring tape. Notice that the subsets have been represented by circles within the universal set T. Also note that the position and size of the circles does not matter – they are just a visual to help differentiate one subset from another.



a) Use set notation to complete the last column of the following table.
The first one is done for you.

the number of elements in the universal set of tools, T, is 12	$n(\mathrm{T}) = 12$
the set of screw drivers, S, is a subset of the universal set, T	$S \subset T$
the number of elements in the subset, S, is 8	$n(S) = 8$
the number of elements in the set of hammers, H, is 3	$n(H) = 3$
The set of hammers is a subset of the universal set T	$H \subset T$

b) The following Venn diagram shows the **number** of elements in the universal set T and in the subsets H and S.



S = screw drivers
H = hammers
T = tools

$n(H' \cup S') = 1$

Determine the following:

i) $n(H) = 3$

$n(H)$ → means, number of elements in subset H

ii) $n(S) = 8$

$n(S)$ – number of elements in subsets

iii) $n(T) = 12$

c) H′ means "not in set H".
H′ is read as "H prime".
H′ is called the **complement of H.** – do not belong to H

Determine the following:

$n(H')$ How many elements in the set that are NOT hammers

i) $n(H') = 9$ → not hammers

ii) $n(S') = 4$ → not screw drivers

Example 2

Use the map of Canada and the following information to answer the questions.

C = {All the provinces and territories of Canada}

W = {Western provinces}

T = {Territories}

- 13 provinces + territories
- 4 - western Provinces
- 3 - Territories

Determine the following:

a) $n(C) = 13$

b) $n(W) = 4$

c) $n(T) = 3$

d) List the elements of set W. { BC, Alberta, Saskatchewan, Manitoba } Provinces
{ BC, AB, SK, MB }

e) List the elements of W'. (NOT Western provinces) name
{ YT, NWT, NU, ON, QC, NB, NS, PEI, NL }

f) Determine $n(W')$. = 9 number

g) Is T a subset of C? Explain. Yes. Because the territories are within Canada

h) Is T a subset of W? Explain. No, the territories are not in Western Canada
Not in Western CDN

i) Is W' a subset of C? (OWTAR... is a subset) yes!

j) Is T a subset of W'? Yes - The territories are part of the other non-western provinces
on T',

k) Are T and W disjoint sets? Explain.
yes, because T - territories
W - Provinces
are separate subsets

Abbreviations
AB
BC
MB
NB
NL
NS
NT
NU
ON
PE
QC
SK
YT

Disjoint sets have **no elements in common.**

A set with no elements is called an ***empty set.***

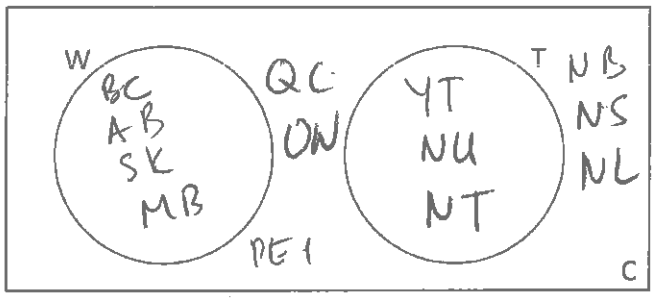
Symbols used include { } or $\emptyset$.

l) Let set S be defined as the set of Canadian provinces south of Mexico. What is unusual about this set?

no Canadian Provinces south of Mexico { } or $\emptyset$

(example 2 continued...)

m) Place the abbreviation for each Canadian province or territory in the correct part of the Venn diagram below.



(notice that since the sets W and T are *disjoint*, the circles do not overlap)

Example 3

a) Complete each of the following statements to show the members of each set.

Universal Set

U = { set of whole numbers from 1 to 10}

= { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 }

Subsets

E = { set of even numbers less than 10}

= { 2, 4, 6, 8 }

O = { set of odd numbers less than 10}

= { 1, 3, 5, 7, 9 }

P = {set of prime numbers less than or equal to 10}

= { 1, 2, 3, 5, 7 }

M = {multiples of 4}

= { 4, 8 }

b) Use set notation to indicate which of the above sets are subsets. ⊂ subset

O ⊂ U, P ⊂ U, P ⊂ U, M ⊂ U, M ⊂ E

Example 4

a) Given the Universal Set U = {all integers from 1 to 20} show the elements of the following sets, using set notation.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

F = {multiples of 5 from 1 to 20}
= {5, 10, 15, 20}

A = {multiples of 3 from 1 to 20}
{3, 6, 9, 12, 15, 18}

S = {all multiples of 7 from 1 to 20}
{7, 14}

T = {multiples of 10 from 1 to 20}
{10, 20}

b) Is each of the following statements true or false? Justify your answers.

i) $F \subset T$ False. → All (numbers) elements in F are NOT in T
{5, 10, 15, 20} {10, 20}

ii) $T \subset F$ True - The (numbers) elements in T {10, 20} are in F {5, 10, 15, 20}

iii) $F \subset U$ True All numbers in F {5, 10, 15, 20} are in the universal set {1 to 20}

iv) F' = {multiples of 10 from 1 to 20} False - There are other numbers from 1 to 20 that are not multiples of 10 → 1, 2, 3 ...
Not multiples of 5
NOT {5, 10, 15, 20}

v) For this example, the set of integers from 21 to 30 is { }.
↑ empty set
This is true. There are no numbers in the set that are between 21 and 30