Set → a collection of things where you can tell exactly what is and isn't part of the collection.

- We usually use capital letters to stand for sets.

Element (or member) → one of the things that is part of a set.

<u>Ways of writing sets</u>

- Always put braces { } around sets.

Roster Notation → Just list the elements in the set (useful for small sets)

- Can use … to show members being left out.
  - { Algona, Emmetsburg, Estherville, Spencer, Spirit Lake }
  - { 4, 7, 13 }
  - { Mon., Tues. … Fri. }
  - { 2, 4, 6, 8, 10 … }

Set-Builder Notation → Give a rule that tells what elements are in the set

- { x | x is an instructor at ILCC }
- The vertical line is read "where" or "such that".
- We read this as "the set of all x where x is an instructor at ILCC".
- Another example:

$$\{ x \mid x < 10, x \geq 0, \text{and x is even} \}$$

<u>Element notation</u>

- ∈ means "is an element of"
- P ∈ A means p is one of the members in set A.

Equal Sets → Have exactly the same elements.

$\{ x \mid x < 10, x \geq 0, \text{and x is even} \} = \{ 0, 2, 4, 6, 8 \}$

Equivalent Sets → have the same number of elements.

- { a, b, c } and { p, q, r } are equivalent.

Cardinality means the number of elements in a set

- Notation n(A)
- For example n({p, q, r, s}) = 4

You should **<u>not</u>** repeat elements in a set. If elements are repeated in an example, ignore the repeats.

- { 1, 2, 2, 3, 4, 4, 4, 5 } is not right.
- Instead put { 1, 2, 3, 4, 5}

Empty Set → A set with no members

- { } and Ø are symbols for the empty set
- { x | x is an odd number divisible by 2 } = { }

The symbol **N** means the set of **<u>natural numbers</u>**, which is { 1, 2, 3, 4, 5, … }

<u>Universal set</u> → a set that contains **EVERY** possible element that could be part of a given situation.

- Everything you are allowed to use for a problem.

<u>Complement</u> → "Everything but"

- all the elements in the universal set **<u>except</u>** what is in a given set.
- NOTATION: A'

EXAMPLE: Suppose the universal set is
{x | x is a day of the week }. If A = { Mon., Tues., Wed.}, what is A'?

A' = { Thur., Fri., Sat., Sun.}

EXAMPLE:

U = { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 }
A = { 2, 4, 6, 8, 10 }
What is A'?

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

Subset

- Notation: $\subseteq$
- A $\subseteq$ B means every element of A is also an element of B.
- Everything in A is **contained in** B.

So …
{ Iowa, Wisconsin } $\subseteq$ { x | x is a state of the USA }

- Every set is a subset of itself.

{ 1, 2, 3, 4 } $\subseteq$ { 1, 2, 3, 4 }

- The empty set is a subset of everything.

Ø $\subseteq$ { 1, 2, 3, 4 }

Proper Subset → A subset that isn't the set itself.

- Notation: $\subset$

{ 1, 2 } $\subset$ { 1, 2, 3, 4, 5 }

- Proper subsets have to be **smaller** than the original set.

Notation → $\not\subseteq$ means "not a subset"

- Could have totally different elements

{a, b} $\not\subseteq$ {1, 2, 3}

- 1st set could be bigger than 2nd.

{a, b, c } $\not\subseteq$ {a, b}

How many subsets does a set have?

- If n(A) = 2, then A has 2^2 or 4 subsets.
- If n(A) = 3, then A has 2^3 or 8 subsets.
- If n(A) = 4, then A has 2^4 or 16 subsets.

In general, every set has 2^n subsets, where "n" is the number of elements in the set.

There will always be $2^n - 1$ **proper** subsets.

UNION

- Symbol $\cup$
- Combining ***EVERYTHING*** in 2 or more sets

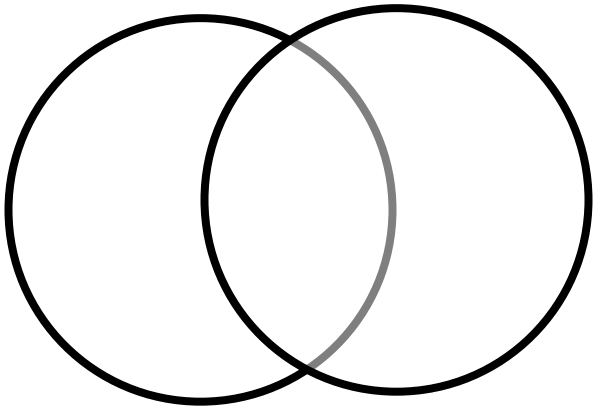
$A \cup B =$ { x | $x \in A$, $x \in B$, or x is in both A and B }

- Example:

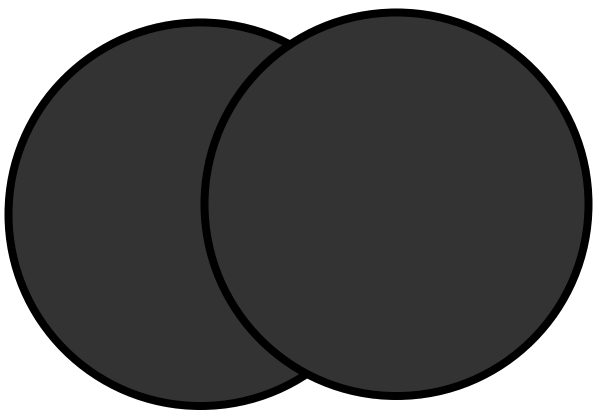
P = { 1, 2, 3, 4, 5 }
Q = { 5, 6, 7 }

$P \cup Q$ = { 1, 2, 3, 4, 5, 6, 7 }

1st Set   2nd Set



Union

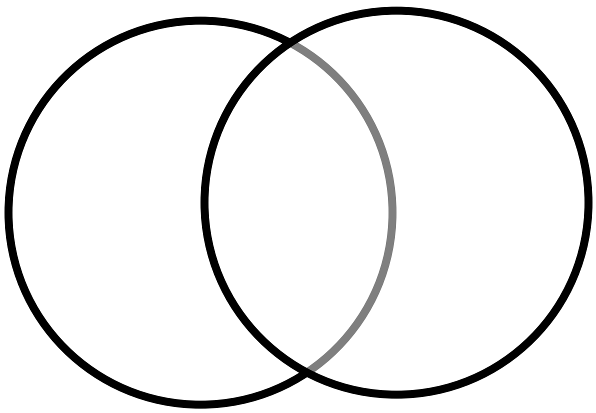


<u>Intersection</u>

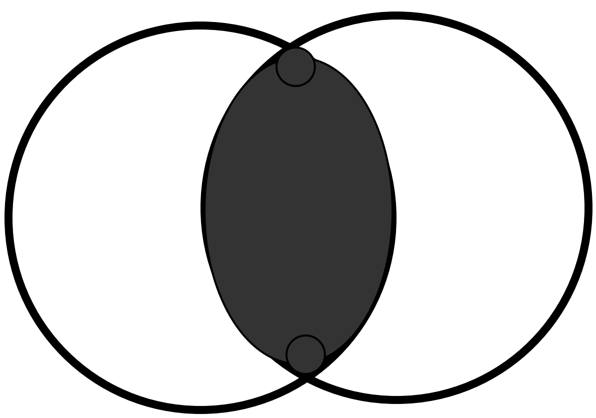
- Symbol $\cap$
- The things that are in 2 or more sets *AT THE SAME TIME*.
- What **<u>overlaps</u>** between different sets

$A \cap B = \{ x \mid x \in A \text{ and } x \in B \}$

1^{st} Set $\quad$ 2^{nd} Set



Intersection



- Example:

  P = { 1, 2, 3, 4, 5 }
  Q = { 5, 6, 7 }
  $P \cap Q$ = { 5 }

- Example:

  E = { 1, 2, 3, 4, 5 }
  F = { 6, 7, 8, 9, 10 }
  $E \cap F$ = Ø
  (E and F are called **disjoint** sets.)