

# Common (Arrhenius) Acids and Bases

Arrhenius Acids:

**Produce hydrogen ion ( $H^+$ ) or hydronium ion ( $H_3O^+$ ) in water solution**

React with bases to produce salt and water

React with metals to produce salt and hydrogen gas

Taste sour

Turn litmus (an indicator) red

Turn phenolphthalein (an indicator) colorless (clear)

Conduct electricity in water solutions

# Common (Arrhenius) Acids and Bases

## Arrhenius Bases:

**Produce hydroxide ions ( $\text{OH}^-$ ) in water solution**

React with acids to produce salt and water

Taste bitter

Turn litmus (an indicator) blue

Turn phenolphthalein (an indicator) red

Conduct electricity in water solution

# Brønsted-Lowry Acids & Bases

## A Bronsted-Lowry acid is a proton donor

A proton is the same as  $\text{H}^+_{(aq)}$  or  $\text{H}_3\text{O}^+_{(aq)}$

A hydrogen atom is one proton and one electron.

A hydrogen ion is formed when a hydrogen atom loses one electron - what is left is one proton  $\Leftrightarrow \text{H}^+$

When hydrogen ions are in water a hydronium ion will be formed  $\Leftrightarrow \text{H}^+_{(aq)} + \text{H}_2\text{O}_{(l)} \rightarrow \text{H}_3\text{O}^+_{(aq)}$

A Bronsted-Lowry acid is **exactly** the same as an Arrhenius acid.

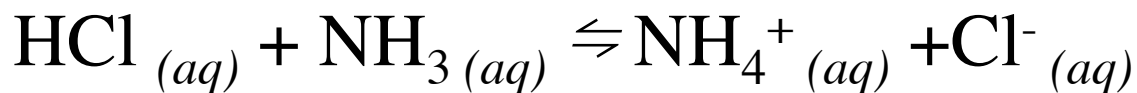
# Bronsted-Lowry Acids & Bases

**A Bronsted-Lowry base is a proton acceptor**

All Arrhenius bases are also proton acceptors  $\Rightarrow$



**Some** proton acceptors (Bronsted-Lowry bases) do not have hydroxide ions  $\Rightarrow$



The hydrochloric acid is still the acid, the ammonia is the base even though there are no hydroxide ions.

# Bronsted-Lowry Acids & Bases

Bronsted-Lowry acid base reactions always produce another acid and base in a reversible reaction

The “new” acid is called a conjugate acid

The “new” base is called a conjugate base

The acid on one side of the equation and the base on the other side are called a conjugate acid-base pair

# Brønsted-Lowry Acids & Bases

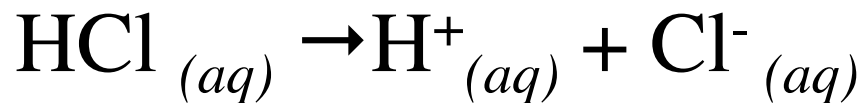
Many substances can act as either an acid or as a base. These substances are called **amphoteric**.

Since some things are amphoteric there is an extra consideration when predicting equations with these substances. There will always be two possible equations - to simplify our problems we will consider the stronger acid to be the acid.

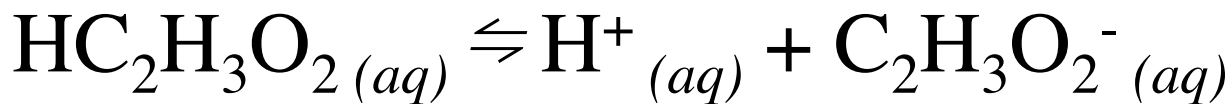
To determine which substance is a stronger acid we need some kind of table listing acid strengths.

# Brønsted-Lowry Acids & Bases

A strong acid (or base) is one that ionizes completely:

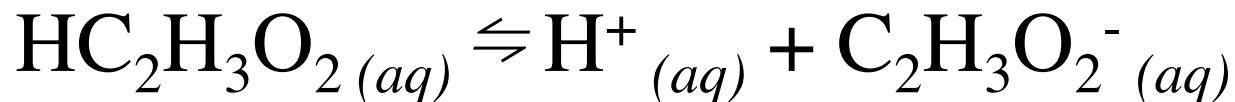


A weak acid (or base) is one that only partially ionizes:



The stronger the acid (or base) the larger the equilibrium constant (more ionization).

# Brønsted-Lowry Acids & Bases



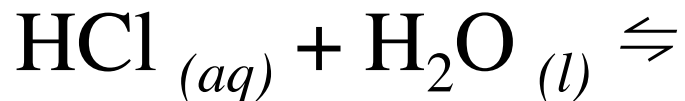
$$K_a = \frac{[\text{H}^+] [\text{C}_2\text{H}_3\text{O}_2^-]}{[\text{HC}_2\text{H}_3\text{O}_2]}$$

The larger the acid (or base) constant ( $K_a$  or  $K_b$ ) the more ions are formed, the stronger the acid (or base)



# Brønsted-Lowry Acids & Bases

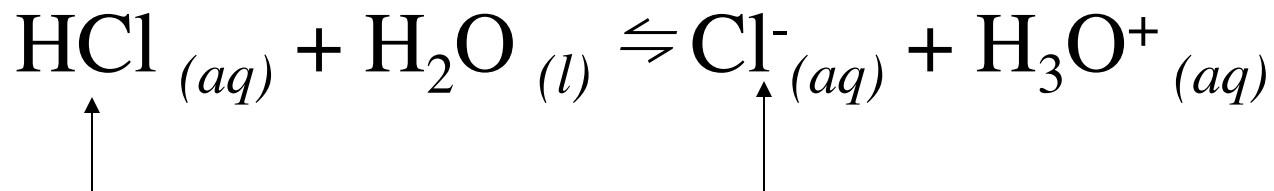
Example Problem: Predict the products, name all the compounds or ions, identify the conjugate acid-base pairs:



HCl will be the acid (it is a stronger acid)

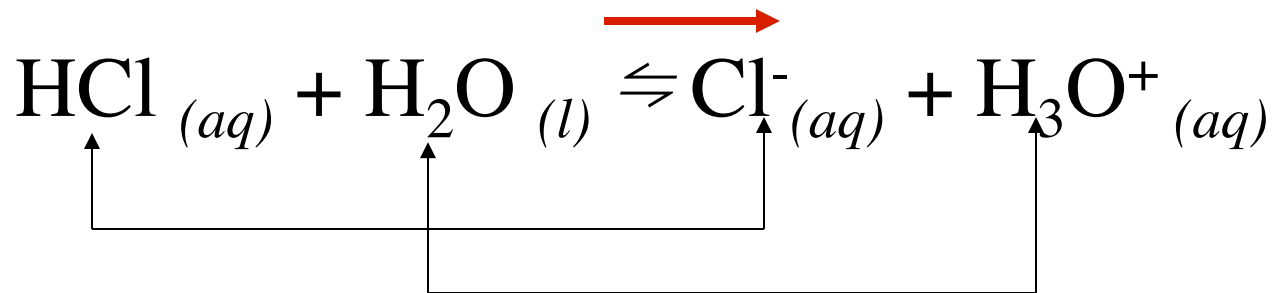
Water will be the base. Only one proton ( $\text{H}^+$ ) will be transferred for each reaction (all the coefficients will be one).

# Brønsted-Lowry Acids & Bases



Hydrochloric acid is the acid on the left side of the equation, chloride ion is the base on the right side of the equation. They form one acid-base pair.

# Brønsted-Lowry Acids & Bases



Water is the base on the left side and hydronium ion is the acid on the right side. They form the other acid-base pair.

Hydrochloric is a stronger acid than hydronium ion and water is a stronger base than chloride ion so the right side (weaker side) will have greater concentration than the left.