12.3 - Introduction to Acids and Bases

Review!

1. What element do all acids contain?

   Hydrogen Ion: H^+

2. What polyatomic ion do bases contain?

   Hydroxide Ion: OH^-

3. What are the two products of an acid base reaction?

   Water and an ionic compound (called a salt)

Properties of Acids and Bases

Physical:

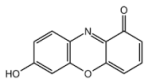
Acids taste tart or sour: lemons, vinegar

Acids turn blue litmus* paper red (Demo)

Bases taste bitter and feel slippery: ever eaten soap?

Bases turn red litmus* paper blue (Demo)

* - Litmus is a pH sensitive compound historically extracted from lichens. First used in the 1300's, the chromophore (color sensitive compound) in litmus is 7-hydroxyphenoxozone.



Don't identify chemicals by taste or feel!

See Acid/Base Resource: P. 8.

Properties of Acids and Bases

Both acids and bases are electrolytes.

Acids can react with metals to produce hydrogen gas and a metal salt.

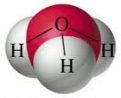
Demo: $Zn + HCl \rightarrow ZnCl_2 + H_2$

Acids react with carbonates to produce carbon dioxide, water, and a salt (ionic compound). Demo: Limestone ($CaCO_3$) + HCl.

Hydronium and Hydroxide Ions

Water hydrolyzes (breaks up) into hydroxide and hydrogen ions.

The hydrogen ions merge with water forming hydronium ions (H_3O^+).



Hydronium ion
H_3O^+

In a neutral solution (pH = 7), these ions are equal.

In acids, (pH < 7) hydronium outnumbers hydroxide.

In bases (pH > 7) hydroxide outnumbers hydronium.

Arrhenius model of acids/bases

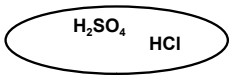
Svante Arrhenius in 1883 proposed a model that defined acids as substances that contain hydrogen atoms which ionize in water.

Bases contain hydroxide ions.

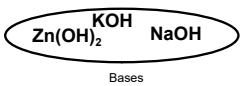
H^+ H^+ H^+ OH^- OH^- OH^-

4. You do!

Move the following chemicals into the acid or base corrals!



Acids



Bases

Brønsted-Lowry Model

Focuses on H^+ transfer: an acid is a H^+ donor; a base is a H^+ acceptor.

Example: HCl and water:

$$HCl + H_2O \longrightarrow H_3O^+ + Cl^-$$

Here, water is a base because it accepts the H^+ ion.

Conjugates

In accepting H^+, a base becomes a Conjugate Acid.

In giving up a H^+, an acid becomes a Conjugate Base.

5. Example: $HCl + H_2O \longleftrightarrow H_3O^+ + Cl^-$

Can give up hydrogen. Can accept Hydrogen

From our example, on the product side, the hydronium can give up H^+, and the chloride can accept one.

6. Ammonia Example

Ammonia (NH_3) acts as a base in aqueous solution, because it absorbs a hydrogen from water, becoming the ammonium ion.

$$NH_3 + H_2O \longleftrightarrow NH_4^+ + OH^-$$

Which is the conjugate acid, and which is the conjugate base of this reaction?

6. Ammonia Example

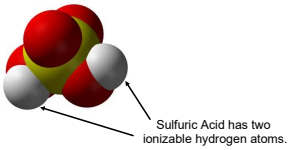
The different components can be paired up:
Acid – conjugate base pair: water - hydroxide ion.
Base – conjugate acid pair: ammonia - ammonium ion.

Base Acid Conjugate Acid Conjugate Base

$NH_3 + H_2O \longleftrightarrow NH_4^+ + OH^-$

Mono and Polyprotic acids

Monoprotic acids have one ionizable hydrogen ion.
Polyprotic – "many protons", such as:
Diprotic = two. Ex: sulfuric acid.
Triprotic = three. Ex: phosphoric acid.



7. Why is acetic acid (vinegar)(CH_3COOH) monoprotic?
- The H atoms connected to carbon don't dissociate.

Homework

12.3 Problems.
Due: Next Class.