Name: Key
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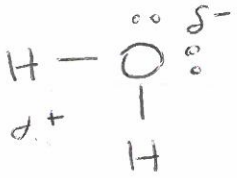
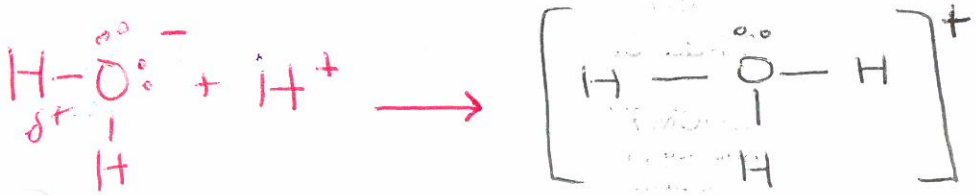
Chemistry 12
ACID BASE Lesson #3+4
H_3O^+ and BRØNSTED-LOWRY ACIDS AND BASES

The water molecule is a *POLAR MOLECULE* that has a *DIPOLE* with one end being slightly **positive** and the other end being slightly **negative**. This characteristic can be illustrated with a LEWIS DOT STRUCTURE:



Any H^+ ion in water is so strongly attracted to the negatively charged side of the water molecule that following structure exists:



We refer to this structure as the **HYDRONIUM ION** or **HYDRATED PROTON**, NOTE: H^+ is often referred to as the PROTON. (remember this)

THEREFORE:

$H^+(aq)$ is actually $H_3O^+(aq)$

Example 1. In Chemistry 11 when we wrote the ionization reaction for HCl (g), the reaction looked like this:

$$HCl(g) \longrightarrow H^+(aq) + Cl^-(aq)$$

Now we can re-write this as:

$$HCl(g) + H_2O \longrightarrow H_3O^+(aq) + Cl^-(aq)$$

BRØNSTED LOWRY THEORY OF ACIDS AND BASES

As we saw in lesson #1 the Arrhenius definitions of acids and bases are slightly flawed. They do not account for acids and bases that exist in EQUILIBRIUM reactions, so a different definition had to be established.

ACID- any substance that DONATES a "PROTON"

BASE- any substance that ACCEPTS a "PROTON"

Examine a typical Bronsted-Lowry acid base reaction:

B A A B

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

NH_3 is the base as it accepts the proton to form NH_4^+ while
H_2O is the acid as it donates the proton to form OH^-

Example 2. In the following reaction which reactant is the acid and which is the base?

A B B A

$CH_3COOH + H_2O \leftrightarrow CH_3COO^- + H_3O^+$

acid base

Notice that in the first example water is an acid while in the second example it is a base.

Any substance that can act as either an acid or a base is said to be

AMPHIPROTIC

Apart from **water** there are TWO GUIDELINES that you can use to identify an AMPHIPROTIC substance:

1. HAS A REMOVABLE Hydrogen
2. POSSESSES A NEGATIVE Charge

Therefore the following substances are all amphiprotic:

$H_2PO_4^-$, HPO_4^{2-}, HSO_4^-, HS^-, HCO_3^-

* all have removable PROTONS + a NEGATIVE charge.

In every Bronsted-Lowry reaction there is an acid and a base on BOTH sides of the equation.

Example 3. Label the species on both sides of the reaction as either an acid or a base.

ACID BASE Base acid

$HF + SO_3^{2-} \leftrightarrow F^- + HSO_3^-$

1. Identify the reactant by seeing what it becomes on the product side
2. Identify the product
3. Each side must have both an ACID + BASE

Seatwork/HOMEWORK: Exercises 10 –14
PLO's: J6-J9