Name:______________________
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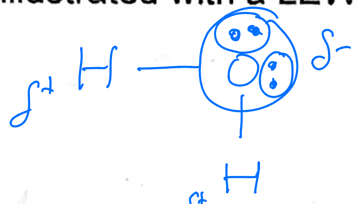
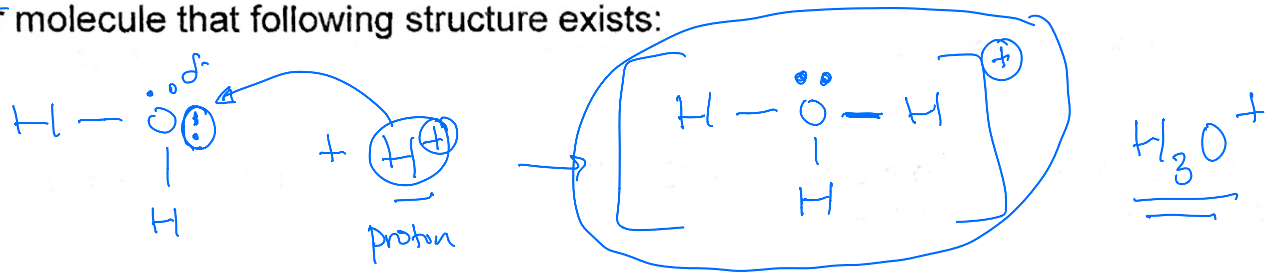
Chemistry 12
ACID BASE Lesson #3+4

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^+ (acid) 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:

$$H^+(aq) = H_3O^+(aq)$$

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

$$HCl(g) \xrightarrow{H_2O(l)} H^+(aq) + Cl^-(aq)$$

Now we can re-write this as:

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

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 (H^+)

BASE- any substance that accepts a proton (H^+)

Examine a typical Bronsted-Lowry acid base reaction:

B A

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

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

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

A B

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

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

H_2O

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

1. contain at least one removeable proton

2. be an anion (negative charge)

Therefore the following substances are all amphiprotic:

$H_2PO_4^-$, HPO_4^{2-}, HSO_3^-, HS^-, ~~HSO_4^-~~

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.

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

A B B A

1. Identify the reactants by seeing what they become on the product side
2. Identify the products by seeing what they become in the reverse rxn
3. If a species is an acid/base (SO_3^{2-}) on the reactant side (HF) it's product will be a base (F^-)/acid (HSO_3^-)

Seatwork/HOMEWORK: Exercises 10 –14

PLO's: J6-J9