Mr. Bracken
AP Chemistry

Name _____
Period _____

Acids & Bases Notes #1

General Properties of Acids:

Sour taste
Examples: Vinegar (acetic acid), Citric Acid

General Properties of Bases:

Bitter taste
Feel slippery
Examples: Bleach (sodium hypochlorite), Drain Cleaner (sodium hydroxide)

Arrhenius Definitions of Acids and Bases:

Arrhenius Acids: when dissolved in water, these increase the concentration of H^{1+} ions

Arrhenius Bases: when dissolved in water, these increase the concentration of OH^{1-} ions

$HCl\ (g)$ bubbled into water produces $H^{1+}\ (aq)$ and $Cl^{1-}\ (aq)$

$NaOH\ (s)$ dissolved in water produces $Na^{1+}\ (aq)$ and $OH^{1-}\ (aq)$

Arrhenius definitions work great for aqueous solutions but the aqueous aspect limits the usefulness of this definition.

Bronsted-Lowry Definitions of Acids and Bases

Bronsted-Lowry Acids: proton (H^{1+}) donors

Bronsted-Lowry Bases: proton acceptors

$$\mathbf{HCl\ (aq) + H_2O\ (l) \rightarrow H_3O^{1+}\ (aq) + Cl^{1-}\ (aq)}$$
(hydronium ion)

$$\mathbf{HCl\ (aq) \rightarrow H^{1+}\ (aq) + Cl^{1-}\ (aq)}$$

$H_3O^{1+}\ (aq)$ and $H^{1+}\ (aq)$ represent the same thing.

Many think the H_3O^{1+} is closer to reality, but the H^{1+} is more convenient.

Bronsted-Lowry Definitions allow for non-aqueous chemical reactions

$$\mathbf{HCl\ (g) + NH_3\ (l) \rightarrow NH_4^{1+}\ (aq) + Cl^{1-}\ (aq)}$$

$$\mathbf{NH_3\ (g) + H_2O\ (l) \leftrightarrows NH_4^{1+}\ (aq) + OH^{1-}\ (aq)}$$

Acids and Bases always work together to transfer a proton. You cannot have an acid unless something else will accept the proton.

Some substances can act as an acid or as a base, depending on the reaction. These are called **amphoteric substances.**

Consider H_2O:

$HCl\ (g) + H_2O\ (l) \rightarrow H_3O^{1+}\ (aq) + Cl^{1-}\ (aq)$ water acts like a base here

$NH_3\ (aq) + H_2O\ (l) \rightarrow NH_4^{1+}\ (aq) + OH^{1-}\ (aq)$ water acts like an acid here

Conjugate Acid – Base Pairs (Conjugate means "joined as a pair")

$$HX\ (aq) + H_2O\ (l) \leftrightarrows X^{1-}\ (aq) + H_3O^{1+}\ (aq)$$

$$CH_3O^{1-} + NH_3 \leftrightarrows CH_3OH + NH_2^{1-}$$

Polyprotic Acids:

Contain more than one ionizable hydrogen

Examples:

$\mathbf{H}_2SO_3$ has two protons that can be donated…… a "Diprotic Acid"

$\mathbf{H}_3PO_4$ has three protons that can be donated…… a "Triprotic Acid"

Big Ideas:

Protons do not come off at the same time!

$H_2SO_3\ (aq) + H_2O\ (l) \leftrightarrows H_3O^{1+}\ (aq) + HSO_3^{1-}\ (aq)$ $K_1 = 1.7 \times 10^{-2}$

$HSO_3^{1-}\ (aq) + H_2O\ (l) \leftrightarrows H_3O^{1+}\ (aq) + SO_3^{2-}\ (aq)$ $K_2 = 6.4 \times 10^{-8}$

Always easier to remove the first proton than the second (or third). $\mathbf{K_1 > K_2}$