Acids and Bases **Name**_____

Weak Acid or Base Neutralization Reactions

Read from **Lesson 4b:** [Neutralization Reactions Involving a Weak Acid or Base] in the **Chemistry Tutorial Section, Chapter 15** of **The Physics Classroom**

Reaction Types & pH Outcomes

Acid Type	Base Type	pH at Equivalence	Reason
Strong (e.g., HCl)	Strong (e.g., NaOH)	7.0	Neutral salt + water
Strong	Weak (e.g., NH_3)	< 7.0	NH_4^+ is a weak conjugate acid
Weak (e.g., HF)	Strong	> 7.0	F^- is a weak conjugate base
Weak	Weak	~7.0 (varies)	Depends on K_a vs. K_b of products

Examples: Reaction

Strong Acid + Weak Base

Molecular Equation:

$$HBr\ (aq) + CH_3NH_2\ (aq) \rightarrow Br^-(aq) + CH_3NH_3^+(aq)$$

Complete Ionic Equation:

$$H_3O^+(aq) + Br^-(aq) + CH_3NH_2\ (aq) \rightarrow H_2O\ (l) + CH_3NH_3^+(aq) + Br^-(aq)$$

Net Ionic Equation:

$$H_3O^+(aq) + CH_3NH_2\ (aq) \rightarrow H_2O\ (l) + CH_3NH_2^+(aq)$$

Weak Acid + Strong Base

Molecular Equation:

$$HNO_2\ (aq) + KOH\ (aq) \rightarrow KNO_2\ (aq) + H_2O\ (l)$$

Complete Ionic Equation:

$$HNO_2\ (aq) + K^+(aq) + OH^-\ (aq) \rightarrow K^+(aq) + NO_2^-\ (aq) + H_2O\ (l)$$

Net Ionic Equation:

$$HNO_2\ (aq) + OH^-\ (aq) \rightarrow NO_2^-\ (aq) + H_2O\ (l)$$

Weak Acid +Weak Base

Equation:

$$HCN\ (aq) + CH_3NH_2\ (aq) \rightarrow CN^-\ (aq) + CH_3NH_3^+(aq)$$

- Predicting the equivalence point pH requires comparing K_a of the conjugate acid ($CH_3NH_3^+$) and K_b of the conjugate base (CN^-) The relationship holds: $K_a \times K_b = 1.0\times10^{-14}$ for conjugate pairs.

K_a of $CH_3NH_3^+$ is 2.3×10^{-11}

K_b of CN^- is 1.6×10^{-5}

* CN^- is a stronger base than $CH_3NH_3^+$ is an acid; so, the equivalence pH is basic (> 7).

Acids and Bases

Questions

1. A 0.250 M solution of sulfurous acid reacts with a solution of lithium hydroxide.
   a. Write the correct molecular equation for the neutralization reaction between these two reactants.

   b. Write the correct net ionic equation for the neutralization reaction between these two reactants

   c. What is the pH after the complete neutralization of sulfurous acid? Which product affects the pH of the solution? Support your answer with a reaction.

   d. n Erlenmeyer flask contains 35.0 mL of the sulfurous acid solution. What volume of 0.375 M lithium hydroxide must be added to it for complete neutralization?

2. A 1.05 M solution of ammonia reacts with a solution of nitric acid.
   a. Write the correct molecular equation for the neutralization reaction between these two reactants.

   b. Write the correct net ionic equation for the neutralization reaction between these two reactants

   c. What is the pH after the complete neutralization of ammonia? Which product affects the pH of the solution? Support your answer with a reaction.

   d. An Erlenmeyer flask contains 98.0 mL of the ammonia solution. What volume of 0.169 M nitric acid must be added to it for complete neutralization?