Mr. Bracken
AP Chemistry

Name _____
Period _____

Acids & Bases Notes #5: Titrations with Weak Acids & Strong Bases

Recall that buffer systems involve combinations of weak acids and weak bases.

Recall Molarity = $\frac{\text{moles}}{\text{Liter}}$ moles = (Molarity) x (Volume in Liters)

Recall that hydrolysis reactions occur when weak acids or weak bases are added to water.

$HF + H_2O \leftrightarrows H_3O^{1+} + F^{1-}$

$NH_3 + H_2O \leftrightarrows NH_4^{1+} + OH^{1-}$

Reactions involving strong acids or strong bases are written with a single arrow.

Equivalence Point = "Perfect Stoichiometry" between an acid and a base.

Perfect Stoichiometry Conditions:

$HC_2H_3O_2$	**+**	**NaOH**	**$\rightarrow$**	**$NaC_2H_3O_2$**	**+**	**H_2O**
0.24 moles		_____ moles		_____ moles		_____ moles

Limiting Excess Stoichiometry:

$HC_2H_3O_2$	**+**	**NaOH**	**$\rightarrow$**	**$NaC_2H_3O_2$**	**+**	**H_2O**
0.24 moles		0.16 moles		_____ moles		_____ moles

What is the limiting reactant in the above problem? _____

How many moles of leftover $HC_2H_3O_2$ will be present AFTER this reaction has occurred?

KOH	**+**	**HCl**	**$\rightarrow$**	**KCl**	**+**	**H_2O**
0.15 moles		0.36 moles		_____ moles		_____ moles

HNO_3	+	LiOH	→	$LiNO_3$	+	H_2O
0.28 moles in 0.100 Liters		0.12 moles in 0.150 Liters		_____ moles in _____ Liters		_____ moles in _____ Liters

How many leftover moles of HNO_3 will be present at the end of this reaction? _____

What will be the final volume of the mixed chemicals? _____

What will be the molarity of the "leftover" HNO_3 ? _____

What will be the final **pH** of the solution? _____

What will be the final <u>molarity</u> of the $LiNO_3$ that is produced in this reaction? _____

Sample Problems:

1. Calculate the pH of the solution that is formed if 55.0 mL of 0.250 M NaOH is added to 70.0 mL of 0.250 M $HC_2H_3O_2$. The Ka for $HC_2H_3O_2$ is 1.8×10^{-5}.

$HC_2H_3O_2$	+	OH^{1-}	→	$C_2H_3O_2^{1-}$	+	H_2O

pH = 5.30

2. Calculate the pH at the **equivalence point** in a titration involving 30.0 mL of 0.880 M $HC_2H_3O_2$ with 0.500 M NaOH.

$$\mathbf{HC_2H_3O_2} \quad + \quad \mathbf{OH^{1-}} \quad \rightarrow \quad \mathbf{C_2H_3O_2^{1-}} \quad + \quad \mathbf{H_2O}$$

pH = 9.11

3. Calculate the pH at the **equivalence point** in a titration reaction involving 0.150 M HCl and 100.0 mL of 0.250 M NH_3.

pH = 5.14

Four Types of Acid – Base Reaction Scenarios

I. <u>Strong & Strong</u>

Molarity Madness

Do limiting/excess stoichiometry, calculate leftover molarity of excess, determine pH or pOH

II. <u>Strong & Weak</u> (Strong in Excess)

Perform stoichiometry first, then immediately determine the pH of system.

Leftover strong dictates pH of system. Can ignore the effect of any subsequent hydrolysis process.

III. <u>Strong & Weak</u> (Weak in Excess)

1. Perform stoichiometry first to react all of the strong acid or strong base.
2. Now treat as buffer problem (RICE Chart) and calculate final pH of the system.

IV. <u>Strong & Weak</u> (Equivalence Point)

1. Perform stoichiometry first to react all of the strong acid or strong base.
2. Now treat as hydrolysis problem (RICE Chart) and calculate final pH of the system.