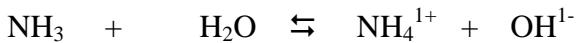


### Acids & Bases Notes #5: Titrations with Weak Acids & Strong Bases

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.



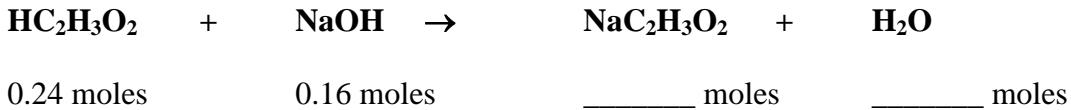
Reactions involving strong acids or strong bases are written with a single arrow.

**Equivalence Point** = “Perfect Stoichiometry” between an acid and a base.

**Perfect Stoichiometry Conditions:**

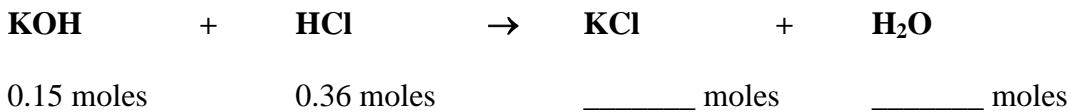


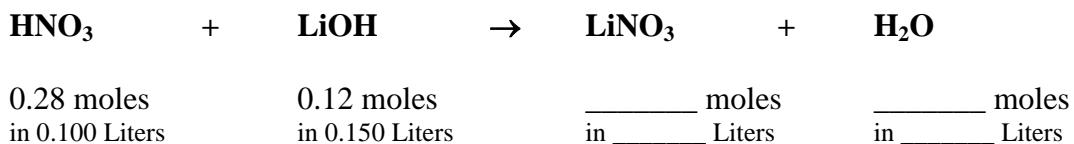
**Limiting Excess Stoichiometry:**



What is the limiting reactant in the above problem? \_\_\_\_\_

How many moles of leftover  $\text{HC}_2\text{H}_3\text{O}_2$  will be present AFTER this reaction has occurred?





How many leftover moles of  $\text{HNO}_3$  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”  $\text{HNO}_3$ ? \_\_\_\_\_

What will be the final **pH** of the solution? \_\_\_\_\_

What will be the final molarity of the  $\text{LiNO}_3$  that is produced in this reaction? \_\_\_\_\_

### **Sample Problems:**

- 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  $\text{HC}_2\text{H}_3\text{O}_2$ . The  $K_a$  for  $\text{HC}_2\text{H}_3\text{O}_2$  is  $1.8 \times 10^{-5}$ .



$$pH = 5.30$$

2. Calculate the pH at the **equivalence point** in a titration involving 30.0 mL of 0.880 M  $\text{HC}_2\text{H}_3\text{O}_2$  with 0.500 M NaOH.



$$pH = 9.11$$

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  $\text{NH}_3$ .

$$pH = 5.14$$

## **Four Types of Acid – Base Reaction Scenarios**

### **I. Strong & Strong**

Molarity Madness

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

### **II. Strong & Weak (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. Strong & Weak (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. Strong & Weak (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.