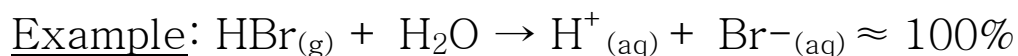


CHEM 110 CHAPTER 4 LECTURE NOTES: PROPERTIES OF AQUEOUS SOLUTIONS

*Substances dissolved in water have unique characteristics including the following:*

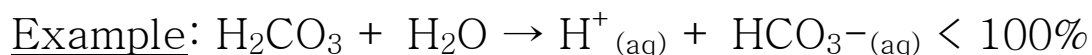
1. Strong vs. Weak Electrolytes:

- a. Some substances break down  $\approx 100\%$  into ions in  $\text{H}_2\text{O}$  and are termed “strong electrolytes.”



HBr is termed a strong electrolyte and a strong acid due to nearly all the HBr separating into ions.  $\text{H}^+$  ions define HBr as an acid (hydrobromic).

- b. Weak Electrolytes  $< 100\%$  break down into ions



Due to  $\text{H}_2\text{CO}_3$  (carbonic acid) not separating  $\approx 100\%$  into ions, it is termed a weak electrolyte and a weak acid.

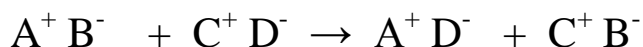
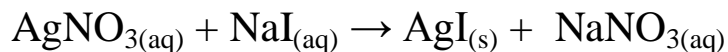
Be familiar with precipitation reactions and solubility guidelines for common ionic compounds (pgs. 121 + 122 of text). You will be given an Ion Solubility Table to use for the exam.

## Precipitations Reactions are Double Displacement Reactions!

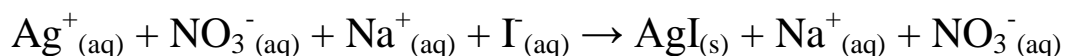
### Example 1:

silver (I) nitrate + sodium iodide  $\rightarrow$  silver (I) iodide + sodium nitrate

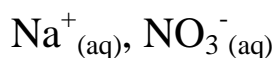
### Balanced Equation:



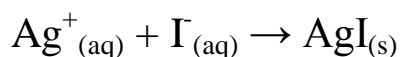
### Overall Ionic Equation:



Spectator Ions: These do NOT form solid.



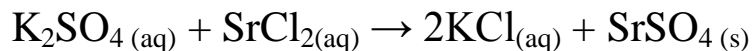
Net Ionic Equation: Shows ions forming solid.



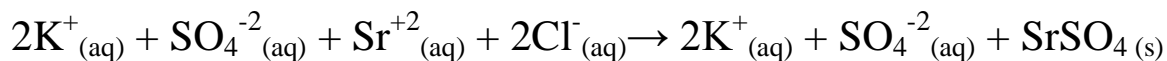
### Example 2:

potassium sulfate + strontium chloride  $\rightarrow$  potassium chloride + strontium sulfate

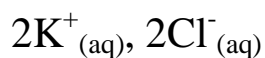
### Balanced Equation:



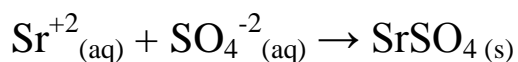
Overall Ionic Equation:



Spectator Ions: These do NOT form solid.

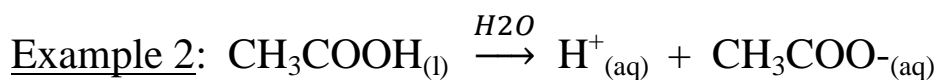
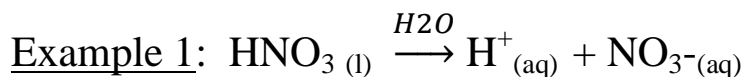


Net Ionic Equation: Shows ions forming solid.

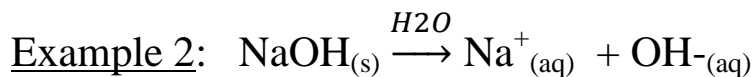
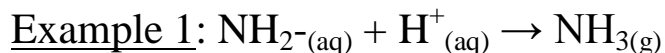


## ACIDS VS. BASES

2. **Acids** are substances that produce  $\text{H}^+_{(\text{aq})}$  ions when placed in  $\text{H}_2\text{O}$ .



3. **Bases** or **Alkalis** are substances that accept  $\text{H}^+_{(\text{aq})}$  ions from acids and can produce  $\text{OH}^-_{(\text{aq})}$  (hydroxide) ions in  $\text{H}_2\text{O}$ .



**Strong acids and bases break down nearly 100% into ions.**

## NEUTRALIZATION REACTIONS

4. Acids and bases typically react to form a salt (ionic compound) and H<sub>2</sub>O.

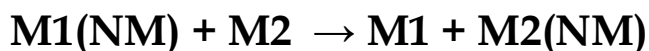


This is a special type of metathesis (double replacement) reaction.



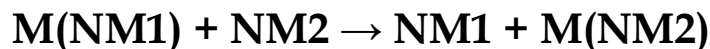
NOTE: The activity series (electromotive series) as related to single replacement reactions is also important to understand.

### General Form of Single Replacement Reactions:



where M1 and M2 represent two different metals and NM represents a non-metal ion.

OR



where NM1 and NM2 represent two different non-metals and M represents a metal ion.

## MOLARITY

- a) Means of representing the concentration of a solution.
- b) Symbol = M
- c) Formula for finding:

$$M = \frac{\text{Moles of Solute}}{\text{Liters of Solution}}$$

$$\text{Where moles of solute} = \frac{\text{grams of solute}}{\text{gram formula (molar) mass}}$$

NOTE: Liters of solution is the total volume of the solution including the solute added.

*Solutions of desired molarity are often prepared accurately in volumetric flasks.*

### **Solution Stoichiometry Methods: See Figure 4.18 of Text for Procedures**

*Suppose you are given grams of A, but want to find the volume of B needed to react with it.*

- **First, convert grams of A to moles.**
- **Second, multiply moles of A by mole ratio of unknown (B): known (A) using balanced chemical equation.**
- **Last, divide moles of B by molarity of B to obtain liters of B needed to react.**

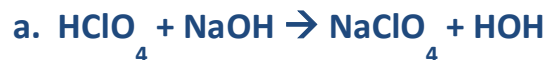
## Titration Problems

- Need to balance equation first!
- Determine the volume (convert to L) of titrant added from buret.
- *Use L of titrant and molarity of known to determine moles of known.*
- Multiply moles of known by mole ratio (from balanced equation) to obtain moles of unknown.
- **Convert moles of unknown to desired unit (usually L or grams).**
- **For liters use M formula; for grams use molar mass.**

### # 81 a, b.

Usually acid-base reactions are involved.

- **1:1 reaction**



#### **2:1 reaction**

