

**C125 Laboratory**  
**Experiment #3: Chemical Activity and Chemical Reactions**  
**Examples**

There are no calculations associated with this report. However, the examples which follow are meant to help you compare chemical activities and to write net ionic equations. An understanding of these processes is necessary to complete the report for Experiment #3.

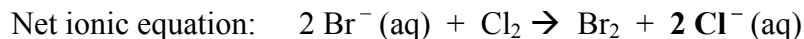
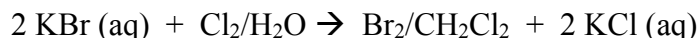
GENERAL INFO~

I. CHEMICAL ACTIVITY

Use the following general rule and a net ionic equation to determine which of a pair of substances is the more active:

***CHEMICAL ACTIVITY: THE MORE ACTIVE  
OF A PAIR WANTS TO EXIST AS AN ION***

Use the given net ionic equation below to compare the activities of chlorine and bromine:

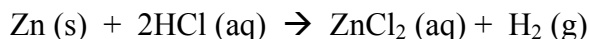
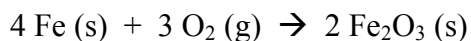


Chlorine is more active than bromine.

\*(Notice that the state of chlorine goes from molecular  $\text{Cl}_2$  to ionic  $\text{Cl}^-$ .)

II. CHEMICAL REACTION TYPE:

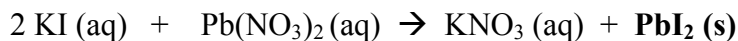
Use the following four classifications of chemical reactions to help you determine the type of reaction occurring:



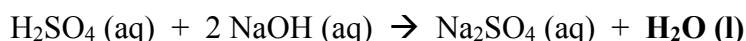
\*(A metal plus acid yields a salt and hydrogen gas – at room temperature.)

#### 4. DOUBLE REPLACEMENT or METATHESIS: $AX + BY \rightarrow AY + BX$

PRECIPITATION: a reaction which produces at least one INSOLUBLE product ... (s). The following example double displacement reaction yields a precipitate of lead (II) iodide:



NEUTRALIZATION: When an acid and a base react, salt and water (neutral) are produced. The following example double displacement reaction illustrates an acid-base reaction:



### III. CHEMICAL EQUATION WRITING

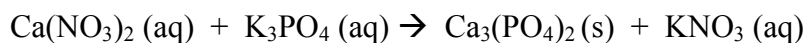
#### STEPS:

1. IDENTIFY REACTANTS AND PRODUCTS  
(check reagent bottles)
2. FORMULAE CORRECTLY WRITTEN
3. BALANCE CHEMICAL EQUATION NOTING ALL SPECIES – include states of matter: (s), (l), (g), (aq). Make sure that the number of atoms of each type on the reactant side = the number of atoms of each type on the product side.
4. TOTAL IONIC EQUATION – break any aqueous compound (aq) into its ions; all other states, (s), (l), (g), remain intact.
5. CANCEL SPECTATOR IONS – spectator ions are those species which are identical on both the reactant and the product side of the equation
6. NET IONIC EQUATION – after the spectator ions are eliminated, the net ionic equation results from all species remaining.

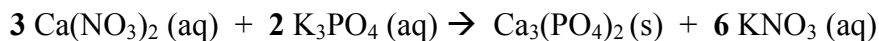
#### EXAMPLE 1:

Calcium nitrate reacts with potassium phosphate to produce a precipitate. Write the balanced chemical equation and the net ionic equation. Classify this reaction. Determine the driving force.

1. Balanced chemical equation:  
Use solubility rules, pg 139 or in workshop book to determine which substance is INSOLUBLE, or the PRECIPITATE. (*All phosphates are insoluble except for Group I and ammonium compounds.*)

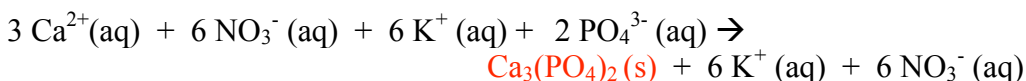


The number of atoms of each type on the reactant side (left) needs to be the same as the number of atoms of each type on the product side (right):



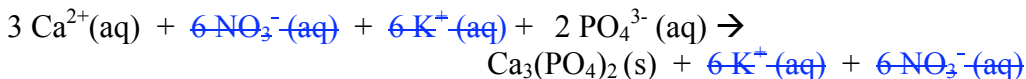
## 2. TOTAL IONIC EQUATION:

All aqueous species (aq) separate into ions when dissolved in water. Rewrite the aqueous species as ions. All solids (s), liquids (l), and gases (g) remain intact.



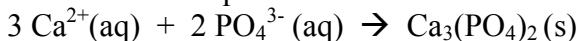
## NET IONIC EQUATION:

Eliminate the species which are EXACTLY alike on both sides:



The eliminated species are called SPECTATOR IONS. They are part of the chemical system but are not themselves part of the chemical change (in this case, the precipitation).

\*The net ionic equation is:



3. The type of reaction is DOUBLE DISPLACEMENT or METATHESIS. (See description above. The format of this reaction is  $\text{AX} + \text{BY} \rightarrow \text{AY} + \text{BX}$ )

## 4. DRIVING FORCE

There are three driving forces with which we will be concerned in C125: precipitation, gas formation, and neutralization. Once the net ionic equation is properly written, the driving force may be easily identified. In the example above, a solid, or precipitate, was formed. Therefore, the driving force of the above reaction was PRECIPITATION.

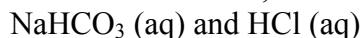
If the driving force is formation of a gas, a gas will be present as a product in the net ionic equation. If the driving force is neutralization, the reactants will be acid + base and one of the products will be water.

### EXAMPLE 2:

Baking soda, which is a white solid, is placed in a test tube. Clear and colorless 1 M hydrochloric acid is added. Vigorous bubbling is observed. Enough hydrochloric acid is added until the bubbling ceases. The resultant solution left in the test tube is clear and colorless. Write the balanced chemical equation and the net ionic equation for this reaction. Classify the reaction and determine the driving force.

a. The label on the baking soda named the solid: sodium hydrogen carbonate with a formula:  $\text{NaHCO}_3$ . Checking the hydrochloric acid label it was noted that its formula is  $\text{HCl}$ .

The reactants are:  $\text{NaHCO}_3$  (s) and  $\text{HCl}$  (aq). Please note: The baking soda must dissolve before it can react. The acid exists in water. The water dissolves the baking soda then it is able to react. Therefore, the states of the reactants actually are:



b. Bubbling occurs. Common gases evolved are hydrogen ( $\text{H}_2$ ), carbon dioxide ( $\text{CO}_2$ ), water vapor ( $\text{H}_2\text{O}$ ). Some research (ie the acidic nature of the gas – Exp 3, Series 4) or experience with carbonates would suggest that the gas evolved is carbon dioxide. Therefore, carbon dioxide is one of the products. Hydrochloric is an acid so it is often involved in neutralization reactions. This is the case since baking soda is basic (why it is used to calm upset stomachs). Neutralization reactions produce water + salt + other products? .

c. Write a reasonable reaction:



Note: The formula of the salt is determined by finding the cations and anions remaining after production of water and the gas.

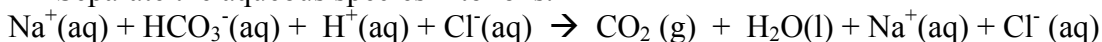
d. Balance the equation:

The equation is balanced as written.



e. Write the total ionic equation.

Separate the aqueous species into ions.

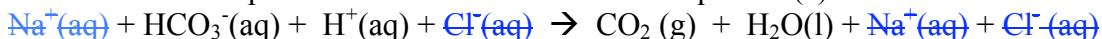


f. Recall from C125 prelab, Exp #3, that when carbonic acid decomposes, its products are carbon dioxide and water:



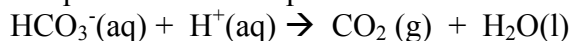
g. Notice in the reactants:  $\text{HCO}_3^-(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{H}_2\text{CO}_3(\text{aq})$

h. Eliminate the spectator ions from the total ionic equation (e).



Spectator ions are:  $\text{Na}^+$  and  $\text{Cl}^-$

i. Net ionic equation: Gather up the terms not eliminated.



j. This reaction is a neutralization reaction because an acid + a base yielded water and a salt. It falls under the format:  $\text{AX} + \text{BY} \rightarrow \text{AY} + \text{BX}$  and is classified as a double displacement reaction. The driving force is neutralization.