Lower Merion High School Chemistry

Solubility Table

Lab #9

Not all reactions that we can write actually occur. For instance, carbon burns to form carbon dioxide.

$$C + O_2 \rightarrow CO_2$$

You could also write that carbon dioxide decomposes into carbon and oxygen

$$CO_2 \rightarrow C + O_2$$

but we don't expect to suddenly breathe out chunks of carbon. For some reactions we just have to assume that they will occur, but for double displacement reactions we can predict very accurately whether or not they will occur.

Predicting Double Displacement Reactions

Understanding double displacement reactions requires a mental picture of what is actually going on in the solutions. When an ionic compound dissolves, it breaks up into its ions. For instance sodium chloride dissolved in water is really a solution of sodium ions and chloride ions running around SEPARATELY in the solution. Reactions occur when ions that began in two different solutions get together and form a compound that does NOT have its ions separated. This can be an insoluble ionic compound, water, or a gas (such as H_2S).

An example:

$NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$ Silver chloride is a white solid that does not dissolve in water. If you do this reaction, two clear liquids produce a white solid.

What is really happening:

$$Na^+ + Cl^- + Ag^+ + NO_3^- \rightarrow Na^+ + NO_3^- + AgCl$$

The ions that make up AgCl are no longer separate. So...something has changed.

A counter example:

$NaBr + KNO_3 \rightarrow NaNO_3 + KBr$ is the same as:

$$Na^+ + Br^- + K^+ + NO_3^- \rightarrow Na^+ + NO_3^- + K^+ + Br^-$$

Both products are soluble. Since everything on the right is identical to everything on the left, nothing has happened. We say no reaction occurred.

You will have the opportunity to experiment with this idea in class. For the reactions that you are doing in class, a reaction will be obvious with the formation of an insoluble compound or a gas. These insoluble compounds will appear as solids, making the solution cloudy. The gas will appear as bubbles.

Your goal here is to make a solubility chart. This is a grid that has positive (metal) ions on the side and negative ions on the top. Each square in the grid corresponds to the ionic compound made from the metal of its row and the nonmetal of its column. If a compound is soluble (dissolves in water) an **S** is entered into the square, if the compound is insoluble, an **I** is entered. If the compound is a gas, a **G** is entered in the square. No double displacement reaction will produce two insoluble products. No double displacement reaction with the solutions given will produce an insoluble compound and a gas.

When the chart is completed, you will be able to use it to predict whether a reaction will occur or not by looking up the products on the chart. If one of the products is insoluble (or if one of the products is water or a gas) then the reaction will occur.

Materials:

You will be provided with the following solutions:

NaCl	KI	$Zn(C_2H_3O_2)_2$	Na_2CrO_4
$Cu(C_2H_3O_2)_2$	H_2SO_4	Na_2CO_3	$Ca(NO_3)_2$
$Mg(NO_3)_2$	NaOH	$MgSO_4$	$Pb(NO_3)_2$
K_2SO_4	$Ba(NO_3)_2$	K_3PO_4	$FeCl_3$

Procedure:

Self designed.

	Cl^{-1}	SO_4^{-2}	PO_4^{-3}	CO_3^{-2}	NO_3^{-1}	$C_2H_3O_2^{-1}$	CrO_4^{-2}	I^{-1}	OH^{-1}
Ba^{+2}									
Ca^{+2}									
Cu^{+2}									
Fe^{+3}									
H^{+1}									
Pb^{+2}									
Mg^{+2}									
K^{+1}									
Na^{+1}									
Zn^{+2}									