PRECIPITATES AND SOLUBILITY RULES

Reminder – Goggles must be worn at all times in the lab!

PRE-LAB DISCUSSION:

Generally, solubility is thought of as the tendency of a substance (solute) to dissolve in another substance (solvent). For qualitative purposes, we use such terms as “soluble,” “insoluble” and “slightly soluble” to describe these tendencies.

Ionic compounds (salts and bases) dissolve in water by a process known as DISSOCIATION. In this process, the crystal lattice of the solid breaks down and free ions move throughout the solution. The total number of positive charges is equal to the total number of negative charges in an ionic solution.

If aqueous (water) solutions of two different ionic compounds are mixed, one of two things will occur. If all of the ions remain free (soluble), then nothing will happen. That is, the mixture of solutions will remain clear, or transparent. However, if two oppositely charged ions are attracted to one another strongly enough, they may bond together to form an ionic compound that is insoluble in water. In such cases, a precipitate forms.

In this experiment, aqueous solutions of several different ionic compounds will be used. Different combinations of solutions will be mixed and the results observed. For those mixtures in which precipitates form, the identity of the precipitate will be determined from the balanced chemical equation. You will then attempt to make some generalizations about the solubility of the various ions.

PURPOSE:

To observe the formation of various precipitates and, based on our observations, formulate a hypothesis regarding general solubility rules.

PROCEDURE:

1. Your instructor will provide you with the following solutions:

Aluminum sulfate	$Al_2(SO4)_3$	Sodium hydroxide	NaOH
Barium chloride	$BaCl_2$	Calcium acetate	$Ca(C_2H_3O_2)_2$
Silver nitrate	$AgNO_3$	Zinc sulfate	$ZnSO_4$
Sodium carbonate	Na_2CO_3	Sodium chloride	NaCl
Sodium phosphate	Na_3PO_4	Sodium sulfate	Na_2SO_4

2. Get a couple of drop plates from your lab drawer. Make sure that they are clean and dry before you start.
3. Use the reaction grids below, and arrange your dropping bottles so you have the five solutions in the correct order across the top of your drop plate, and the other five solutions down the left side of the drop plate.
4. Now, mix three drops of each compound listed across the top with three drops of each compound listed on the left. Be careful not to contaminate the dropping bottles – do not touch them to the solutions in the spot plate depressions. There are 15 combinations for each solution set. In each rectangular box, write “ppt” is a precipitate forms for that combination. If no precipitate forms, write “NR” (no reaction). Be sure you carefully wash and dry your drop plate between sets of reactions.
5. When you are done with all of the reactions, clean and dry the spot plates before returning them to your lab drawer

PRE-LAB ASSIGNMENT

1. Write and balance the 30 ionic equations that represent the reactions performed in this lab. The first equation has been done for you.

$BaCl_2$	+	$2AgNO_3$	→	$Ba(NO_3)_2$	+	2AgCl
$BaCl_2$	+	Na_2CO_3	→			
$BaCl_2$	+	Na_3PO_4	→			
$BaCl_2$	+	Na_2SO_4	→			
$BaCl_2$	+	NaOH	→			
NaOH	+	$AgNO_3$	→			
NaOH	+	Na_2CO_3	→			
NaOH	+	Na_3PO_4	→			
NaOH	+	Na_2SO_4	→			
Na_2SO_4	+	$AgNO_3$	→			
Na_2SO_4	+	Na_2CO_3	→			
Na_2SO_4	+	Na_3PO_4	→			

Na_3PO_4	+	$AgNO_3$	→
Na_3PO_4	+	Na_2CO_3	→
Na_2CO_3	+	$AgNO_3$	→
$AgNO_3$	+	$Al_2(SO_4)_3$	→
$AgNO_3$	+	$BaCl_2$	→
$AgNO_3$	+	$ZnSO_4$	→
$AgNO_3$	+	$FeCl_3$	→
$AgNO_3$	+	NaCl	→
NaCl	+	$Al_2(SO_4)_3$	→
NaCl	+	$BaCl_2$	→
NaCl	+	$ZnSO_4$	→
NaCl	+	$FeCl_3$	→
$FeCl_3$	+	$Al_2(SO_4)_3$	→
$FeCl_3$	+	$BaCl_2$	→
$FeCl_3$	+	$ZnSO_4$	→
$ZnSO_4$	+	$Al_2(SO_4)_3$	→
$ZnSO_4$	+	$BaCl_2$	→
$BaCl_2$	+	$Al_2(SO_4)_3$	→

RESULTS:

	$AgNO_3$	Na_2CO_3	Na_3PO_4	Na_2SO_4	NaOH
$BaCl_2$					
NaOH					
Na_2SO_4					
Na_3PO_4					
Na_2CO_3					

	$Al_2(SO_4)_3$	$BaCl_2$	$ZnSO_4$	$FeCl_3$	NaCl
$AgNO_3$					
NaCl					
$FeCl_3$					
$ZnSO_4$					
$BaCl_2$					

Using the solubility table printed to the right, study the two products in each of your 30 reactions that you balanced in your pre-lab and circle the precipitates (insoluble substance) formed, if any, in each of the reactions.

Solubilities of Compounds at 25°C and 101.3 kpa

	acetate	bromide	carbonate	chlorate	chloride	hydroxide	iodide	nitrate	oxide	perchlorate	phosphate	sulfate	sulfide
aluminum	S	S	X	S	S	I	S	S	I	S	I	S	d
ammonium	S	S	S	S	S	X	S	S	X	S	S	S	S
barium	S	S	I	S	S	S	S	S	sS	S	I	I	d
calcium	S	S	I	S	S	S	S	S	sS	S	I	sS	I
copper(II)	S	S	X	S	S	I	S	S	I	S	I	S	I
iron(II)	S	S	I	S	S	I	S	S	I	S	I	S	I
iron(III)	S	S	X	S	S	I	S	S	I	S	I	sS	d
lithium	S	S	sS	S	S	S	S	S	S	S	sS	S	S
magnesium	S	S	I	S	S	I	S	S	I	S	I	S	d
potassium	S	S	S	S	S	S	S	S	S	S	S	S	S
silver	sS	I	I	S	I	X	I	S	I	S	I	sS	I
sodium	S	S	S	S	S	S	S	S	S	S	S	S	S
strontium	S	S	I	S	S	S	S	S	S	S	I	I	I
zinc	S	S	I	S	S	I	S	S	I	S	I	S	I

Key: S = soluble; sS = slightly soluble; I = insoluble; d = decomposes in water; X = no such compound