Double Replacement Reactions – Part I Net Ionic Equations

Name:_____ Period:____

PURPOSE: To observe and practice writing down molecular, complete ionic, and net ionic equations for double replacement reactions.

THEORY: Most reactions in chemistry can be classified as one of two kinds: double replacement (metathesis) reactions or single replacement reactions. In a double replacement reaction, typically two aqueous solutions containing ionized or dissociated species are mixed. Consequently ions in the solutions are brought into contact with one another, with the possibility of creating a new compound that is either water (an acid base reaction), a gas, or an insoluble salt.

Before one can understand why chemical reactions occur, one must gain experience predicting, observing, and recording the results of many different reactions. Typically there are three kinds of equations that can be written down for a chemical reaction:

1) The **molecular equation**, in which all species are written together as formula units or molecules, but the dissociation or ionization of compounds is not explicitly noted.
2) The **complete ionic equation**, which directly illustrates which species are ionized or dissociated in solution.
3) The **net ionic equation**, which allows one to quickly determine what occurred in the reaction, as it is created by deleting all spectator ions from the complete ionic equation.

Today you will observe many chemical reactions and practice writing down these equations for each one.

MATERIALS:

0.1M solutions of the following:
Barium chloride
Potassium iodide
Copper(II) sulfate
Lead(II) nitrate
Zinc nitrate
Magnesium nitrate
Sodium bromide
Silver nitrate
Sodium phosphate

1.0 M sodium hydroxide

24 well plate (see figure below)

Schematic Diagram of 24-well Plate

	1	2	3	4	5	6
A						
B						
C						
D						

Data Table I – Double Replacement Reactions. List the observations you see in each box below when the reactants specifed in the wells are mixed.

Well	Reactants (all aq)	Observations
A1	Silver nitrate and Potassium chloride	
A2	Silver nitrate and Sodium bromide	
A3	Lead(II) nitrate and Potassium iodide	
A4	Potassium chloride and Sodium bromide	
B1	Copper(II) sulfate and Barium chloride	
B2	Copper(II) sulfate and Sodium phosphate	
B3	Copper(II) sulfate and Sodium carbonate	
B4	Copper(II) sulfate and Sodium hydroxide	
B5	Copper(II) sulfate and Potassium chloride	

CALCULATIONS:

Double Replacement Reactions.

For each reaction that occurred, write down the molecular, complete ionic and net ionic equations for the reaction. Clearly show in your calculation which reaction well you are discussing. For example, for well A1 you should write:

Reaction for well A1:

ME : $AgNO_3(aq) + KCl(aq) \rightarrow AgCl(s) + KNO_3(aq)$

CIE:

NIE:

Show this process for each reaction. If no reaction occurs, clearly state that. For example, if nothing happened in well C6, say: Reaction for well C6: No Reaction, or NR

Reaction for well A2:

ME:

CIE:

NIE:

Reaction for well A3:

ME:

CIE:

NIE:

Reaction for well A4:

ME:

CIE:

NIE:

Reaction for well B1:
ME:

CIE:

NIE:

Reaction for well B2:
ME:

CIE:

NIE:

Reaction for well B3:
ME:

CIE:

NIE:

Reaction for well B4:
ME:

CIE:

NIE:

Reaction for well B5:
ME:

CIE:

NIE:

DISCUSSION: Answer the following questions neatly and in complete sentences below.

1) Let us say you have an unknown solution that is either sodium bromide or sodium chloride. Based on your experience in this lab, describe a method by which you could determine the identity of the anion in the solution.

2) Based on your experience in this lab, how would you know if a salt contained copper as the cation?

3) If you mixed 25.0 g of silver(I) nitrate with an unlimited amount of lithium iodide, how many **moles and grams** of solid product would you produce? Be sure to include a balanced net-ionic equation as part of answering the question.

CONCLUSION:

Procedure: Double Replacement Reactions

1) Obtain and 24 well –plate and rinse with distilled water. Dry with a towel.
2) Obtain 12 labeled beral pipets filled with the needed solutions (refer to your data table for which solutions you will need). If one of your pipets is empty, alert the instructor, who will direct you where to refill it. Each pipet should be at least one-half filled with solution initially.
3) For all of the following reactions, follow the directions **exactly** as to the number of drops added in each well. **DO NOT LET THE END OF ANY PIPET TOUCH ANY OF THE SOLUTIONS IN THE WELLS! IF THIS OCCURS, ALERT THE INSTUCTOR IMMEDIATELY! DO NOT PERFORM ANY UNAUTHORIZED EXPERIMENTS. DOING SO WILL RESULT IN A GRADE OF ZERO FOR THE LAB!**
4) **MOST OF THESE SOLUTIONS ARE TOXIC! IF ANY GETS ON YOUR PERSON, WASH THE AFFECTED AREA WITH COPIOUS AMOUNTS OF WATER. OF COURSE, WEAR APRON AND GOGGLES AT ALL TIMES!**

A – Reactions of chlorides, bromides, and iodides

5) Into wells A1 place **3** drops of silver nitrate solution. Add **5** drops of potassium chloride solution and record observations
6) Into well A2 place **3** drops of silver nitrate solution. Add **5** drops of sodium bromide solution and record observations
7) Into well A3 place **3** drops of lead(II) nitrate solution. Add **5** drops of potassium iodide solution and record observations.
8) Into well A4 place **3** drops of potassium chloride solution. Add **5** drops of sodium bromide solution and record observations.

B – Reactions of copper solutions

9) Into wells B1, B2, B3, B4, and B5, place **5** drops of copper(II) sulfate solution.
10) Into well B1 place **3** drops of barium chloride solution and record observations.
11) Into well B2 place **3** drops of sodium phosphate solution and record observations.
12) Into well B3 place **3** drops of sodium carbonate solution and record observations.
13) Into well B4 place **3** drops of sodium hydroxide solution and record observations.
14) Onto well B5 place **3** drops of potassium chloride solution and record observations.