# LAD H1 (pg 1 of 5) Double Replacement Reactions - Precipitation type Name_____Per___

## Introduction:

Solubility is an intensive property between one substance (the solute) and a liquid (the solvent) that describes the degree to which the solute will dissolve in the solvent. Remember that the term "salt" is a general term for any ionic compound. Some salts are soluble in water and some are not. If a salt dissolves in water, the resulting solution is considered an aqueous solution. The solubility of salts must be individually tested and chemists have compiled charts of information that show which salts are considered soluble and those which are insoluble (i.e. not soluble).

The general term SOLUBLE means able to be dissolved to a "reasonable" degree. INSOLUBLE means NOT able to be dissolved to any reasonable degree. Of course different salts can dissolve in water in different amounts. The "solubility of a substance" is actually a quantitative property describing the maximum amount of solute that can dissolve in a particular amount of water, the solvent, at a particular temperature. Temperature is important because it does affect the amount of solute that can dissolve. In this lab all solutions will be at room temperature. In this lab, insoluble will mean any substance in the water that is visible to the naked eye.

In this lab soluble salts will be combined with other soluble salts. If the combination is soluble, then we will say there is no reaction (NR). If the combination results in the formation of an insoluble salt, then we will consider this a chemical reaction. An insoluble salt that is formed this way is called a precipitate. In this lab a salt will be considered insoluble if a solid substance can be seen in the remaining solvent.

Twelve combinations will be tested. Four aqueous solutions (1, 2, 3, 4) which all contain soluble alkali salts, will be individually combined with three other aqueous solutions (A, B, C) which all contain soluble nitrate salts.

| | | | | **Two solubility facts to remember:** |
|---|---|---|---|---|
| 1 | potassium phosphate | A | silver nitrate | ➞ ALL nitrate salts are soluble |
| 2 | sodium hydroxide | B | cobalt(II) nitrate | ➞ ALL alkali salts are soluble |
| 3 | potassium iodide | C | copper(II) nitrate | |
| 4 | sodium carbonate | | | |

## Procedure: *Goggles must be worn at all times during the lab.*

Use the chart on page 3 to record the results of testing each combination.

PLEASE DO NOT CONTAMINATE THE DROPPERS BY TOUCHING THE TIP OF THE DROPPER TO A DIFFERENT SOLUTION WHEN DROPPING THE SOLUTIONS INTO THE WELL-PLATE.

When testing, use 3 or 4 drops of each solution. Check the results by sliding the well plate over the black desk AND over a white piece of paper to help see any precipitates that may have been formed.

## Disposal:

Dump the solutions from the well plate into the disposal bucket. Then rinse the tray with water at the sink, and wipe EACH depression with a damp paper towel to clear out any precipitate that may have stuck to the plastic well plate.

**PreLAD:** write the formulas below, and continue with the preLab on page 3.

1 potassium phosphate _____

2 sodium hydroxide _____

3 potassium iodide _____

4 sodium carbonate _____

A silver nitrate _____

B cobalt(II) nitrate _____

C copper(II) nitrate _____

## PostLab: Writing Balanced *Overall* Equations *Circle the precipitate.*

| | |
|---|---|
| **1 + A** | |
| **2 + A** | |
| **3 + A** | |
| **4 + A** | |
| **1 + B** | |
| **2 + B** | |
| | **Writing Balanced *Net Ionic* Equations** |
| **3 + B** | |
| **4 + B** | |
| **1 + C** | |
| **2 + C** | |
| **3 + C** | |
| **4 + C** | |

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**Data:** ***Move the plastic well-plate over white and black backgrounds (and the X) to maximize your viewing experience.***

Since alkali and nitrate salts are always soluble, those ions can NEVER be a part of any precipitate. The non-alkali, non-nitrate ion in each of the reactants are the ions that become can potentially become part of the precipitate compound.

### PreLAD:

1. Along the side of the data chart below, write ONLY the symbol and charge for the ***anions*** for compounds 1−4
2. Along the top of the data chart below write ONLY symbol and charge for the ***cations*** for compounds A−C
3. Go to page 4 and work on the new concepts, skills, and ideas page. Most of the information that you might need to answer these questions is either on page 1 or already within your fund of chemistry knowledge.

### During the Lab:

4. If a precipitate occurs, write PPT. Record the color of the precipitate. If no precipitate occurs, write NR (for no reaction)
5. Write only the formula of the precipitate in the box. Do NOT write the entire chemical equation in the box.

| | **A** | **B** | **C** |
|---|---|---|---|
| **1** | | | |
| **2** | | | |
| **3** | | | |
| **4** | | | |

## LAD H1 (pg 4 of 5) Double Replacement Reactions - Precipitation type

### New Concepts, Skills & Ideas – Work on these before, during, and after the lab.

1. What is a *salt*?

2. What is a soluble salt?

3. What is a *solution*? What is a solute and solvent?

4. What is an aqueous solution?

5. What are two ways that you can determine if a salt is soluble?

6. What does a soluble salt look like in water? What does an insoluble salt look like in water?

7. At the particle level, what actually happens to a soluble salt when that salt dissolves in water?

8. In this lab, what is our definition of insoluble? What do you see in the dish if a precipitate forms?

9. Who are the alkali ions? What is an alkali salt? Who is the nitrate ion? What is a nitrate salt?

10. In addition to the nitrate, what do all nitrate salts have in common?

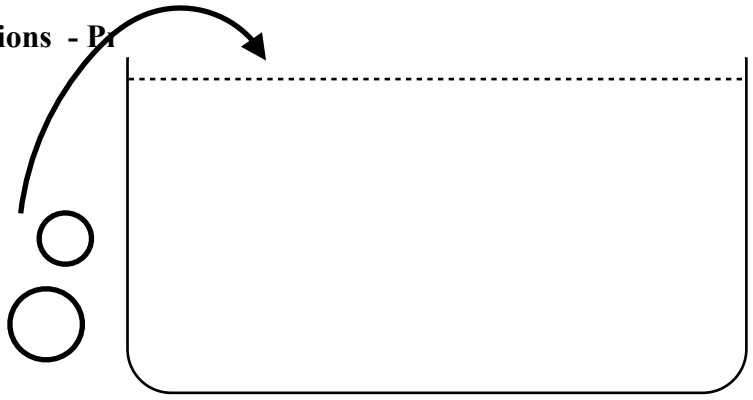
11. In addition to the alkali ion, what do all alkali salts have in common?

12. What is a precipitate? What is needed for a precipitate to form from two aqueous solutions?

13. Explain why we did not bother to mix sol'n 1, 2, 3, or 4 with each other, and why we did not combine solutions A, B or C?

## Particulate views of the lab

1. In the larger beaker to the right, sketch the particulate view of what **two** formula units of $K_3PO_4$ would look like in aqueous solution. Water will not be shown in this sketch with the exception of the little dashy line. Label the two circles to represent the appropriate ions. Use as many as necessary.
2. On the line below, write a balanced chemical equation (with lowest whole number ratios) to represent this dissolution process for $K_3PO_4$ .



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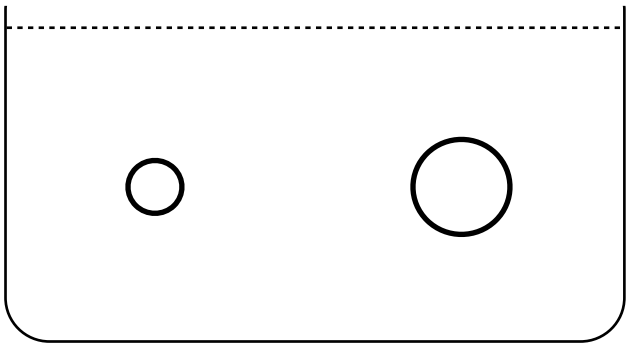
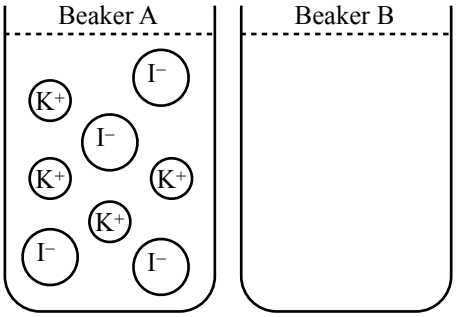
3. Label one of the ions $K^+$ and the other ion $I^-$ as appropriate based on their size, and situate at least three water molecules around each ion as they would appear due to *solvation* or *hydration*.

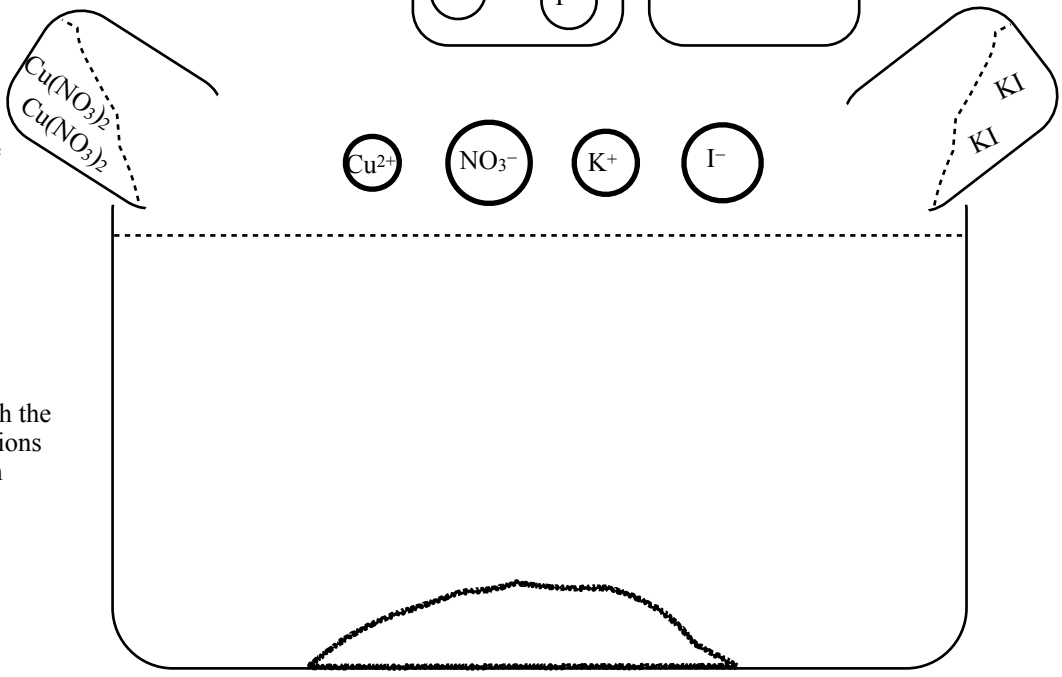


4. If the beaker A represents a particulate diagram of a 0.40 M solution of KI, sketch the particulate diagram of a 0.2 M KI solution in the beaker B to the right.




5. In the large beaker below, draw a particulate diagram to represent a particulate diagram of the combination of two copper(II) nitrate formula units with two potassium iodide (Lab reaction 3+C) formula units.

   Represent an appropriate number of resulting precipitate ions under the representative "pile" at the the bottom, and represent the appropriate number of ions remaining in solution. For clarity, water molecules should NOT be represented.




6. On the lines below, write both the "overall" and net ionic equations to represent this precipitation reaction.

overall equation

_____

net ionic equation

_____