LAD H1 (pg 1 of 9) Double Replacement Reactions - Precipitation type *TEACHER*

Materials DO NOT CONTAMINATE THE DROPPING Bottles

1. potassium phosphate K_3PO_4 (212.27)
2. sodium hydroxide NaOH (40)
3. potassium iodide KI (166)
4. sodium carbonate Na_2CO_3 (106)

A. silver nitrate $AgNO_3$ (169.87)
B. cobalt(II) chloride $CoCl_2$ (134.45)
C. copper(II) sulfate $Cu(SO_4)_2$ (159.61)

Disposal:

Dump the solutions in the well plate into the disposal bucket. Then the well-plates can be washed in the soapy tub in the sink. Dry off and wipe EACH WELL PLATE with a damp paper towel to remove any remaining precipitate that may be stuck to the plastic well plate.

PreLAD: write the formulas below, and do the preLAD on page 3.

1 potassium phosphate ___K_3PO_4___

2 sodium hydroxide ___NaOH___

3 potassium iodide ___KI___

4 sodium carbonate ___Na_2CO_3___

A silver nitrate ___$Ag(NO_3)$___

B cobalt(II) nitrate ___$Co(NO_3)_2$___

C copper(II) nitrate ___$Cu(NO_3)_2$___

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

1. What is a salt?

   Any ionic compound

2. What is a soluble salt?

   a salt that dissolves to a "reasonable degree" usually to at least 0.1 M *(though we are not concerned with quantifying solubility here)*

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

   A solution is a homogeneous mixture. Solute is the substance present in smaller quantity, in this lab, the solid. Solvent is the substance present in larger quantity, in this lab, the water.

4. What is an *aqueous* solution?

   a solution in which the solvent is water.

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

   test it in the lab, look it up on the solubility chart

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

   looks clear, insoluble will be cloudy and/or solid on the bottom

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

   the ions separate

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

   if the solution is no longer clear, a substance is considered insoluble. ppt will be cloudiness or solid sinking to the bottom

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

   alkali ions are +1 ions formed when metals in the first column lose one electron, alkali salt is made of an alkali ion and a nonmetal ion, nitrate ion is the covalently bonded group of 1 nitrogen atom and 3 oxygen atoms and 1 electron to produce the NO_3^- ion, nitrate salts are made of a nitrate ion and a metal cation.

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

    all nitrate salts are soluble

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

    all alkali salts are soluble

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

    a precipitate is the formation of an insoluble salt from two aqueous solutions

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

    Since solutions 1, 2, 3, and 4 are all alkali salts, any combination of them would not produce a precipitate. Since solutions A, B, and C are nitrate salts, any combination would not produce a precipitate.

Data Collection: *Move the plastic well-plate over white and black backgrounds 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 molecule.

PreLAD:

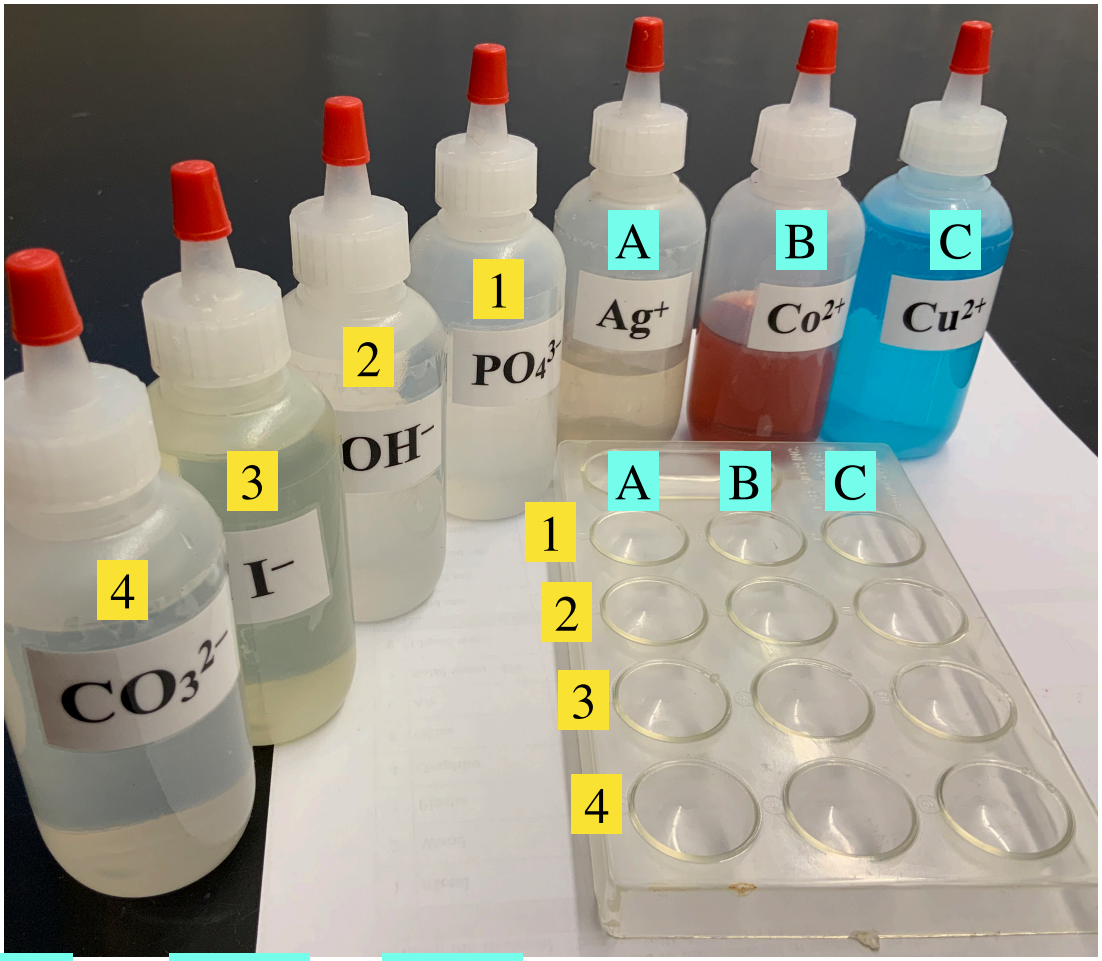
1. Along the side of the data chart below, write ONLY the symbol and charge for the anions for compounds 1−4
2. Along the top of the data chart below write ONLY symbol and charge for the cations for compounds A−C
3. Go to page 4 and work on the new concepts, skills, and ideas page. Most of the information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

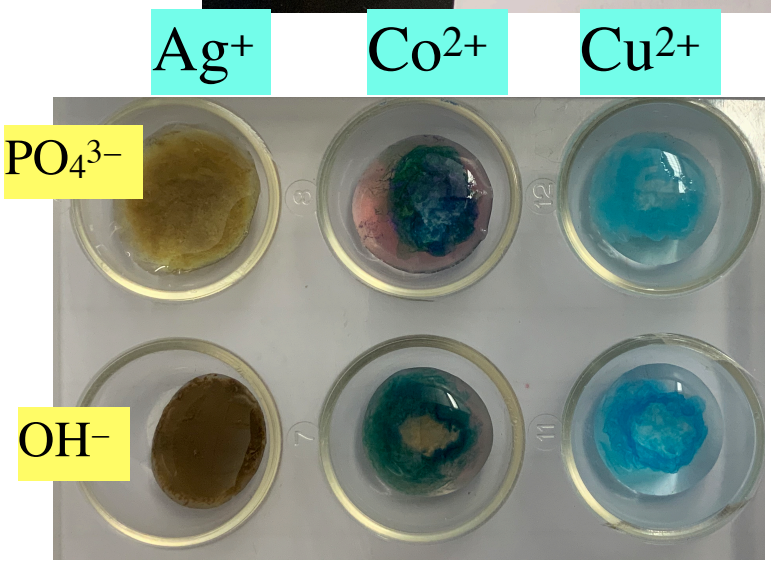
During the Lab:

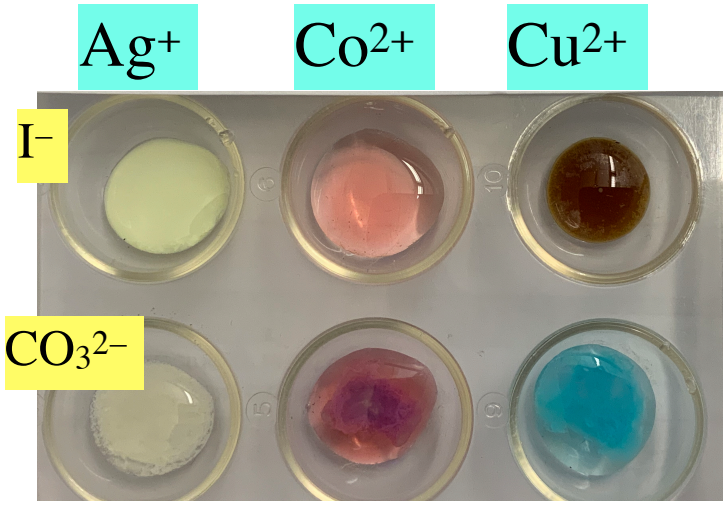
4. If a precipitate occurs, write PPT. Record the color of the precipitate. If no precipitate occurs, write NR (for no reaction)
5. Write only the formula of the precipitate in the box. Do NOT write the entire chemical equation in the box.

	A silver nitrate Ag^{+}	B cobalt(II) nitrate Co^{2+}	C copper(II) nitrate Cu^{2+}
1 potassium phosphate PO_4^{3-}	ppt Ag_3PO_4	ppt $Co_3(PO_4)_2$	ppt $Cu_3(PO_4)_2$
2 sodium hydroxide OH^-	ppt AgOH	ppt $Co(OH)_2$	ppt $Cu(OH)_2$
3 potassium iodide I^-	ppt AgI	NO ppt	ppt CuI_2
4 sodium carbonate CO_3^{2-}	ppt Ag_2CO_3	ppt $CoCO_3$	ppt $CuCO_3$

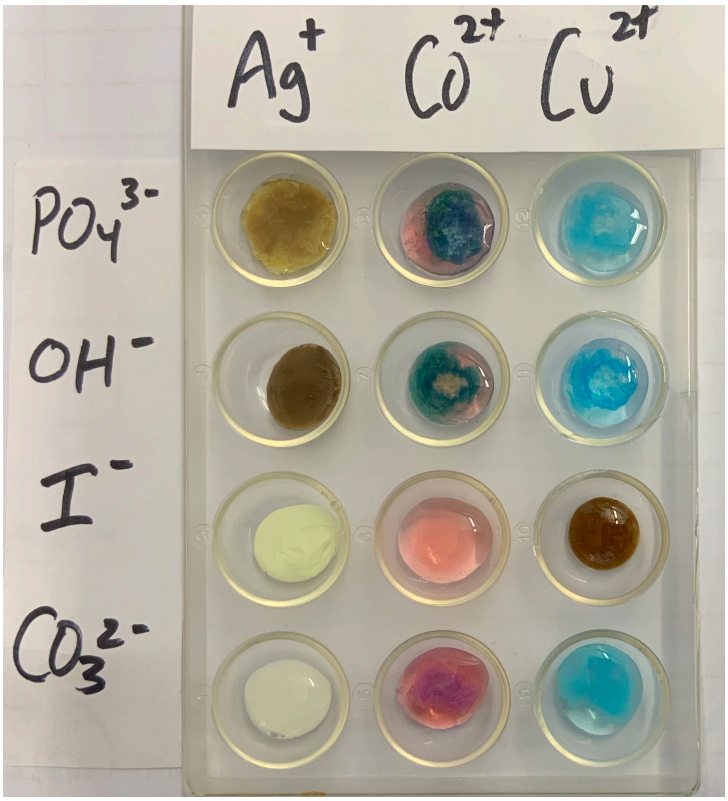
Be efficient, uncap each solution only ONCE.
Hold your well plate in the SAME orientation as your data table.
drop in all the A's or 1's first, then move on to the B's or 2's
Slide the tray over BOTH white and black background

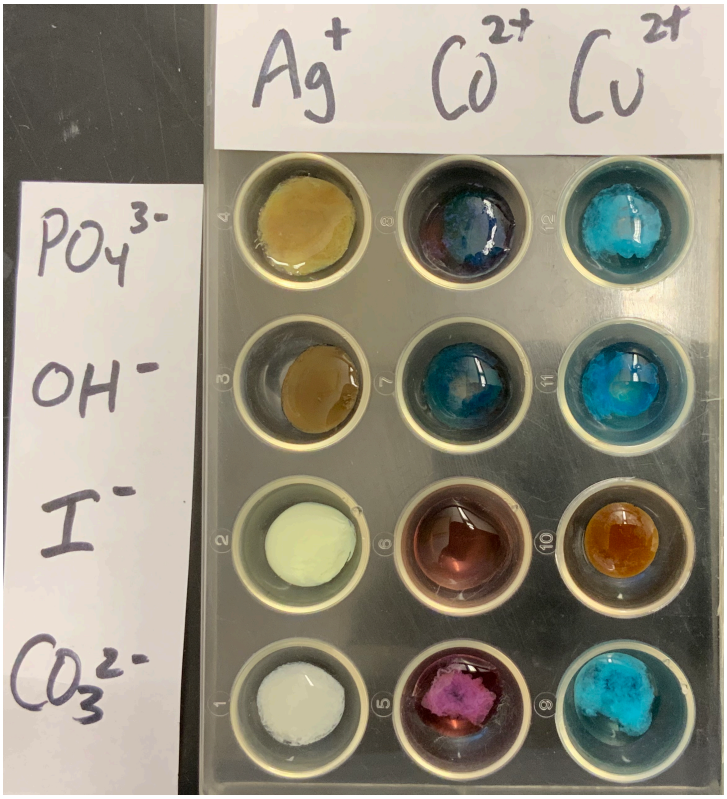


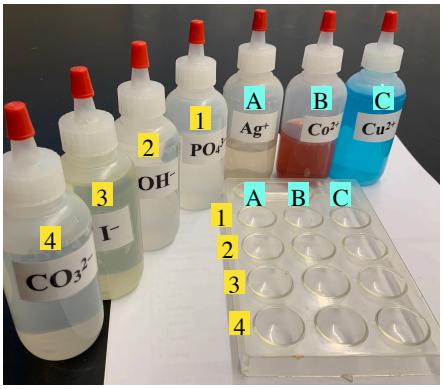




Slide the tray over BOTH white and black backgrounds







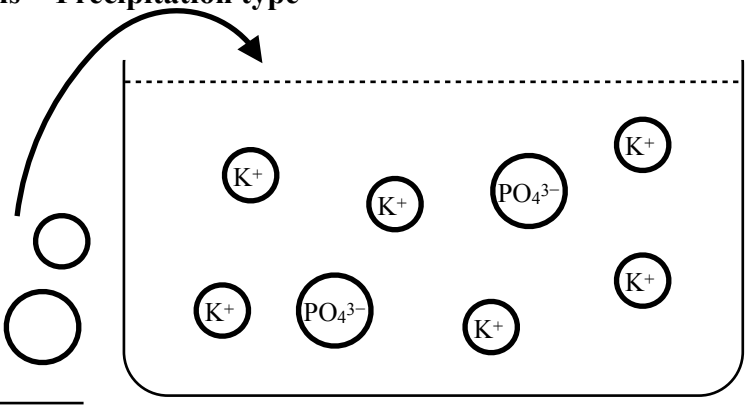
PostLab: Writing Balanced Overall Equations *Circle the precipitate.*

1 + A	$3\ AgNO_3 + 2\ K_3PO_4 \rightarrow Ag_3PO_{4(s)} + 3\ KNO_3$
2 + A	$AgNO_3 + NaOH \rightarrow AgOH + KNO_3$
3 + A	$AgNO_3 + KI \rightarrow AgI + KNO_3$
4 + A	$2\ AgNO_3 + Na_2CO_3 \rightarrow Ag_2CO_{3(s)} + 2\ NaNO_3$
1 + B	$3\ Co(NO_3)_2 + 2\ K_3PO_4 \rightarrow Co_3(PO_4)_2 + 6\ KNO_3$
2 + B	$Co(NO_3)_2 + 2\ NaOH \rightarrow Co(OH)_2 + 2\ NaNO_3$
	Net Ionic Equations
3 + B	NR No Reaction
4 + B	$Co^{2+} + CO_3^{2-} \rightarrow CoCO_3$
1 + C	$3\ Cu^{2+} + 2\ PO_4^{3-} \rightarrow Cu_3(PO_4)_2$
2 + C	$Cu^{2+} + 2\ OH^- \rightarrow Cu(OH)_2$
3 + C	$Cu^{2+} + 2\ I^- \rightarrow CuI_2$
4 + C	$Cu^{2+} + CO_3^{2-} \rightarrow CuCO_3$

LAD H1 (pg 7 of 9) Double Replacement Reactions - Precipitation type

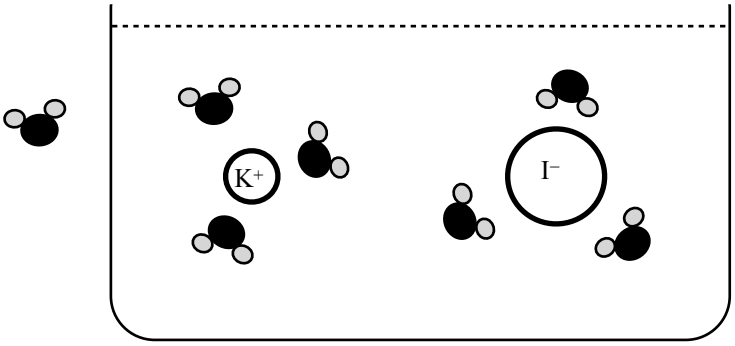
Particulate views of the lab

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 .



$K_3PO_4 \rightarrow K^+ + PO_4^{3-}$

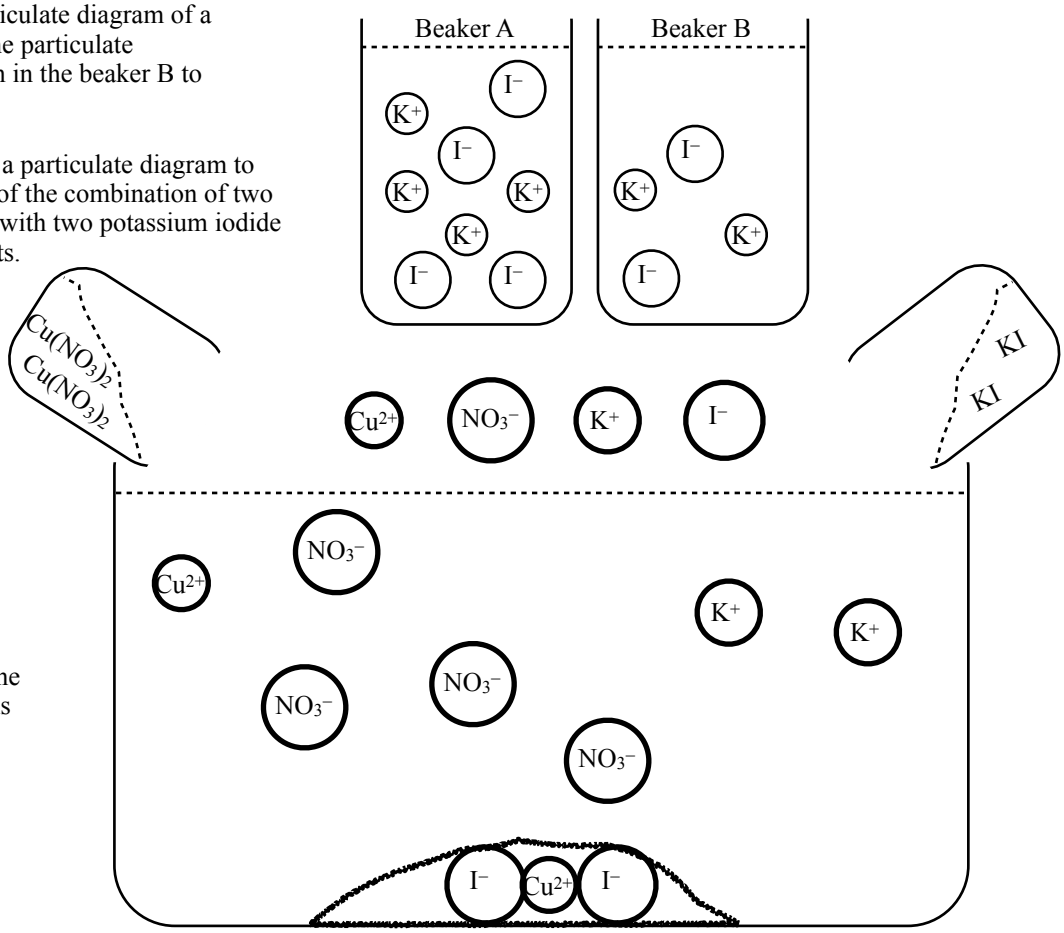
3. Label one of the ions K^+ and the other ion I^- as appropriate based on their size, and situate at least three water molecules around each ion as they would appear due to *solvation* or *hydration*.



4. If the beaker A represents a particulate diagram of a 0.30 M solution of KI, sketch the particulate diagram of a 0.15 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+B) 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 $Cu(NO_3)_2 + KI \rightarrow CuI_2 + KNO_3$

net ionic equation $Cu^{2+} + I^- \rightarrow CuI_2$

Co^{2+}	Cu^{2+}	Ag^{+}
Co^{2+}	Cu^{2+}	Ag^{+}
Co^{2+}	Cu^{2+}	Ag^{+}
Co^{2+}	Cu^{2+}	Ag^{+}
Co^{2+}	Cu^{2+}	Ag^{+}
Co^{2+}	Cu^{2+}	Ag^{+}
Co^{2+}	Cu^{2+}	Ag^{+}
Co^{2+}	Cu^{2+}	OH^{-}
Co^{2+}	Cu^{2+}	OH^{-}
Co^{2+}	Ag^{+}	OH^{-}
Co^{2+}	Ag^{+}	OH^{-}
Cu^{2+}	Ag^{+}	OH^{-}
Cu^{2+}	Ag^{+}	OH^{-}

OH^-	I^-	CO_3^{2-}
OH^-	I^-	PO_4^{3-}
OH^-	I^-	PO_4^{3-}
OH^-	CO_3^{2-}	PO_4^{3-}
OH^-	CO_3^{2-}	PO_4^{3-}
I^-	CO_3^{2-}	PO_4^{3-}
I^-	CO_3^{2-}	PO_4^{3-}
I^-	CO_3^{2-}	PO_4^{3-}
I^-	CO_3^{2-}	PO_4^{3-}
I^-	CO_3^{2-}	PO_4^{3-}
I^-	CO_3^{2-}	PO_4^{3-}
I^-	CO_3^{2-}	PO_4^{3-}
I^-	CO_3^{2-}	