LAD C1 (pg 1 of 4) **Law of Conservation of Mass** Name________________________

Intro to Solubility & Double Replacement Reactions

Introduction:

The law of conservation of mass which states that the mass of the products will always equal the mass of the reactants after a chemical reaction, was one of the few pieces of hard evidence behind the original theory of atoms. This lab will attempt to demonstrate this law. One of the postulates of Dalton's Atomic Theory states that chemical reactions are simply a rearrangement of atoms to make new molecules, so it should make sense that the mass of the original arrangement (reactants) would have the same mass as the final rearrangement (products). The reaction in this lab will be between two "salts." (Salt is a general term for any ionic compound, that is to say, a compound made out of a metal and a nonmetal.) The reactant salts are potassium iodide, and lead(II) nitrate. The product salts formed are yellow lead(II) iodide and white potassium nitrate.

PRELAD:

1. Make a data/results table using your previously shared Google Sheet. Make a new tab. *(Hint: there should be 13 rows in your table.)*
2. Read the New Concepts, Skills & Ideas questions on page 2 & 3 and work on the questions (in pencil). You will continue to work on these questions while working on the lab.
3. Re-read the introduction and then write the equation in words that represents the chemical reaction that occurs in this LAD. In class together, we will put in the chemical formulas, and then you will **balance** the equation.

   words:__________________ + __________________ → __________________ + __________________
   reactants products

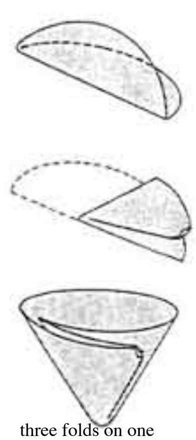
   symbols__________________ + __________________ → __________________ + __________________

General Procedure: Day # 1 *Goggles are not optional.*

1. Using a permanent marker, write your initials on[1] a clean 100 ml beaker[2], and determine the mass of this 100 ml beaker. Then use the tare button to measure more than ~1 g but less than ~1.5 g of lead(II) nitrate[3] into one beaker, and a measure an equal mass (within 0.2 g) of potassium iodide into the other beaker (no need to weigh the 50 ml beaker itself). While the amounts do not have be any particular amount, it is important that the amounts are approximately equal and then record whatever is the exact amount. Learn to be efficient in your massing technique by using the scoop and the "tap-tap" method **as demonstrated in class.**

ALERT, ALERT: *It is important to avoid contaminating the reactants – do not move a stirring rod or scoop from one substance to the without rinsing it off.[4]*

2. Dissolve the salts each in about[5] 15 ml of **deionized** water.[6] (No need to accurately measure or record this amount – just approximate it using the lines on the side of the beaker.) Set the beakers on the lab bench and swirl **as demonstrated in class**. If you use a stirring rod, do not transfer from one beaker to the other, and rinse off into the beaker when finished.
3. Try to avoid using too much water for the next several steps or it will take you far too long to filter. Once the salts have dissolved, pour the smaller beaker into the larger beaker. Rinse the "emptied" beaker with a wee bit more deionized water and add this rinse water to the "full" beaker.[7] Swirl (DO NOT SPILL) the beaker containing the two solutions. Observe carefully for evidence of a possible reaction. **It is best NOT to stir with a stirring rod[8], use a glass rod not the scoop if you must.**
4. Use a pencil (why not pen?) to write your initials on the edge of a piece of filter paper and then mass the filter paper. Fold the filter paper into quarters as demonstrated in the diagram to the right. Be sure the folds are creased well and tightly flattened down, and wet the paper with deionized water, after placing it in the funnel. The moisture will hold the paper in place, and then you are ready to start filtering.[9]
5. Put your name on a clean dry 125 ml flask, then determine its mass. Put the flask below the funnel to catch the filtrate. Raise or lower the ring on the ring stand to be sure the stem of the funnel is just inside the flask, but will not get submerged by the *filtrate*.[10] **Allow the products to settle to the bottom of the beaker before filtering.** Pour the liquid into the filter paper slowly after the liquid starts to drain through, pour the solid into the paper. The entire contents may not be able to fit into the filter paper at one time, be patient and be sure not to pour the solution near the top of the filter paper. After getting as much of the solid as possible out of the beaker and into the filter paper, use the squirt bottle to rinse the beaker, pouring the rinse water into the filter paper. **Learn how to tip and squirt at the same time to facilitate getting most of the solid out of the beaker as demonstrated in class.**
6. Some of the lead(II) iodide will stick to the 100 ml beaker. This is ok because you will weigh the filter paper tomorrow in the beaker, thus you will "capture" the mass of any lead(II) iodide still stuck on the beaker.



three folds on one side to make the cone

7. Gently **rinse** the solid in the filter paper with a wee bit more wash water to wash all dissolved particles in the original solution through the paper and not leave any of those dissolved particles behind on the wet precipitate or wet filter paper.[11]

8. Remove the filter paper and place it into the 100 ml beaker. Put the filter paper/beaker and the 125 ml flask with the filtrate on the tray provided on the center lab bench. They will be placed in the oven overnight to dry.

General Procedure: Day # 2

Determine the mass of the dried filter paper while sitting in the 100 ml beaker with the dried yellow lead(II) iodide on it. Determine the mass of the 125 ml flask with the dried white potassium nitrate in it.

Disposal & Clean-up:

Return the vials with the original samples to your tray leaving any unused salt in the vials.
After day 2, the salt in the 125 ml flask and the yellow salt in the filter paper should be placed in the plastic tub on the center lab bench. All other glassware should be returned to the trays on your lab bench.

Processing the Data / Calculations

1. Calculate the mass of each of the two products; lead(II) iodide (this is the yellow stuff on the filter paper) and potassium nitrate (this is the stuff in the flask). A simple subtraction of the containers they were in will take care of this calculation.
2. Calculate the sum of the total mass of the reactants and calculate the sum of the total mass of products.
3. Calculate any difference between the sum of the product mass and the sum of the reactant mass. (Take note as to which is lower, the sum of the reactants or the sum of the products products.)
4. Calculate % error, using the sum of the reactants as the theoretical value, and the sum of the products as the experimental value.

Report the mass of each of both reactants and the mass of each of both products to the class data table using the data entry page on our website.

New Concepts, Skills & Ideas - *Work on this during the Lab while waiting for the filtering process.*

Each one of these excerpts is from the lab. Read the excerpt and its corresponding question, so that you can be thinking of the answers while performing the lab.

1. "...Using the permanent marker, write your initials on clean, dry 50 ml, 100 ml beakers and an 125 ml flask. Determine the mass of all three containers." − Why might it be important to write your name on the beaker **before** massing?

2. "100 ml beaker." − Do the gradations on the side reach 100 ml? Why might it called a 100 ml beaker?

3. "more than ~1 g but less than ~1.5 g of lead(II) nitrate." While the amounts do not have be <u>exactly</u> the amount directed, what is the most important issue?

4. "...Be sure and clean the scoop or stirring rod between different chemicals." − Why is it necessary to clean the scoop or stirring rod between chemicals?

5. "...Dissolve the salts each in <u>about</u> 10-15 ml of deionized water." − What is meant by the word "about"? Do you need to record this amount of water on your data table?

6. "...15 ml of deionized water." -What is deionized water? (Google it) How is it different from tap water? How do you refill the squirt bottle if it becomes low? In this Lab, why might it be important to use deionized water instead of tap water?

7. "...rinse the 'emptied' beaker with a bit more deionized water and add this rinse water to the "full" beaker." -Why is it important that all the wash water gets into the "full" beaker? What's in the wash water?

8. "...Swirl (DO NOT SPILL) the beaker containing the two solutions." − What is meant by the term "swirl", and why is it so important not to spill? Why might it be better to swirl rather than using the stirring rod?

9. "...Wet the filter paper with squirt water so that it will stay in the funnel." − Why is it helpful to wet the paper before adding the material to be filtered? Why does this extra water **not** change the lab results?

10. "...Put the 125 ml flask below the funnel to catch the filtrate. Be sure the stem of the funnel will not get submerged by the filtrate." − Why is it a good idea to not have the funnel stem "dragging" in the filtrate?

11. "...Gently rinse the solid in the filter paper." − In this lab, what chemical are you trying to rinse off the solid and the filter paper?

Post-LAD Questions

1. The remains on the filter paper:
   a. What was the color of the solid lead(II) iodide on the filter paper?

   b. Filter paper obviously has holes in it, what can you conclude about the size of the holes in the paper compared to the size of the yellow solid stuck on the paper?

2. Understanding this double replacement reaction:
   a. What happens to a soluble ionic compounds when the ionicule dissolves?

   b. On Day 1 when you dissolved lead(II) nitrate and potassium iodide, how did this help them react and form the products?

   c. Why do you suppose this reaction is categorized as a **double replacement** reaction?

3. The remains in the flask:
   a. What color was the filtrate as it was draining into your flask on day 1?

   b. On day 2, was there solid in the flask? Where did the solid come from?

   c. When the colorless solution draining into your flask was dried, what would you expect to be the color of any remaining solids?

   d. What was the color of the solid in the flask? What does the color tell us about what must have been in the flask, even if in only tiny quantities?

4. Why was it not important to know the actual amount of water that the reacting salts were dissolved in, and also not necessary to measure the amount of extra squirt water used to rinse the beaker and filter paper?

5. What two changes give evidence that a chemical reaction occurs in this lab?

6. State the law of conservation of mass.

Error Discussion: to be done together in class while we look at the class data.

7. Once again, define the words accuracy and precision. Use these words correctly in a couple of sentences to describe some of the results.

8. What is systematic error? Is there any pattern to the error with the results, or do they seem to show random error?