Lab 2 – Limiting & Excess Reagents

Purpose:

- Understand, and apply, the concepts of limiting and excess reagents for a particular double replacement reaction.

Pre-lab work:

1. Prepare your lab notebook as usual.

2. Complete the pre-lab questions on Moodle.

Materials:

Per team

- 2 x 100 mL beakers
- 50 mL beaker
- Watch glass
- Scoopula
- 100 mL volumetric flask
- 10 mL volumetric pipette
- 2 x test tubes
- Test tube rack
- Funnel
- Wash bottle of distilled water

Common Materials

- Ring stand & funnel rack
- Drying oven
- Crucible tongs
- Disposable transfer pipettes
- Na_2CO_3 stock solution in burette
- $CaCl_2 \cdot 2H_2O$ powder
- Filter paper

Protocol:

- **NOTE:** When preparing for this lab, consider time management.

Part A:

1. Label a dry filter paper with your initials in pencil near to one of its edges. Place the filter paper on a watch glass and weigh them. Record the mass of the filter paper and watch glass.
2. Label 2 x 100 mL beakers as: 1, and 2.
3. Weigh the amount of $CaCl_2 \cdot 2H_2O$ you were assigned into the 50 mL beaker.
4. Begin dissolving the $CaCl_2 \cdot 2H_2O$ in a minimal amount of solvent, and quantitatively transfer to the volumetric flask using a funnel.
5. Add enough distilled water to reach the calibration line marked on the flask.
6. Add 10 mL of the $CaCl_2$ solution to beaker #1 properly using a 10 mL volumetric pipette.
7. Using the indicated burette, add 10 mL of Na_2CO_3 stock solution into beaker #1. Be sure to record the concentration of the Na_2CO_3 solution, as well as the initial and final burette readings.
8. Place the filter paper in a funnel and sit the funnel in a funnel rack. Place beaker #2 under the funnel to collect the filtrate.

9. After wetting the filter paper with several drops of distilled water, filter the reaction mixture from beaker #1. Wash the precipitate in the filter paper several times with SMALL quantities of distilled water.
10. Open the filter paper containing the precipitate, place the paper back on the watch glass and put the filter paper with watch glass in the oven to dry for about 20 minutes.
11. Remove the filter paper and the watch glass carefully from the oven using crucible tongs. Cool the filter paper with the dried precipitate to room temperature and then weigh. Record the mass.

Part B: Testing the filtrate.

13. Obtain 2 test tubes and pour a small amount (~ 1 mL) of filtrate into each tube.
14. Using a disposable transfer pipette, transfer 20 drops of your $CaCl_2$ solution to one of the test tubes. Record any observations.
15. Clean the 50 mL beaker.
16. Use the cleaned 50 mL beaker and obtain 5 mL of the Na_2CO_3 stock solution.
17. Using a second disposable transfer pipette, transfer 20 drops of the stock Na_2CO_3 solution to the other test tube. Record any observations.

Follow-Up Work:

- Complete and submit the follow-up work *in teams of 4 (two pairs of lab partners)*.
- Complete *only* the following sections in the given order.
- Use the "Follow-Up Guidelines" for details on what to include for each section.
    - Title page
    - Purpose
        - Include the balanced chemical equation for this experiment.
    - Results
        - Include tables that state: 1) which reactant was - *theoretically* and *experimentally* – limiting;
          2) the amount of excess reagent that remains after the reaction is complete.
          3) the Percent Yield of the product;
          4) the Percent Atom Economy for this reaction.
    - Appendix
        - Include samples of all calculations. Include calculations of uncertainties.

Due date: Submit your Follow-Up as a SINGLE PDF in the appropriate folder on Moodle by the due date and time indicated by your instructor.