Experiment 2 – Identification of a Compound (Chemical Properties)

Pre-Lab Hints

1. a. Refer to Technique 2 in the front portion of your lab manual.
   Read the bottom paragraph, as well as the caption for Fig T.2b.
   Criterion means how you test to be sure that the glassware is clean.
   b. Refer to Technique 7A and Figure T.7a (front portion of your lab manual).
2. Refer to Technique 17A and Figure T.17a (front portion of your lab manual).
3. Refer to the five bullets in the Introduction section for the experiment.
4. Divide each number of drops by 20 drops per ml, which is used as the conversion factor.
5. Refer to the Solubility Rules in Appendix E (back of the lab manual) for formulas and for charges of ions that dissociate from these compounds. List only the ions. Include the correct charges.
6. For a, use the experimental results to determine each test tube's identity.
   For b and c, be sure to include both reactants and both products for each reaction.
   Determine coefficients by ensuring that both sides of the reactions have the same number of each atom. Again, you may use the Solubility Rules to determine charges and formulas for the ions. Be sure to include all phase subscripts (s and aq) as well.

Procedure Notes

- Use p for precipitate, not c for cloudy, if solids form or if product appears cloudy.
  The insoluble solid precipitate is what causes the product to appear cloudy.
- Use 1.0 M NaOH with all mixtures, except for NH_4Cl and your unknowns.
  Use 6.0 M NaOH with NH_4Cl and your unknowns.
- In general, use a well-plate throughout the experiment.
  But, use small test tubes (70 mm or 3 in) for both of your unknowns.
  Also, use small test tubes for NH_4Cl with NaOH (odor, but no visible sign of reaction) and for $AgNO_3$ with $MgSO_4$ (cloudy, has a slightly soluble precipitate).
- If a result is inconclusive, perform the reaction again in a small test tube.
- Do not use the same pipet to dispense more than one reagent.
  This mixes reagents and is a source of contamination and errors.
- Do not leave the caps off the bottles. Always replace the caps after use.
- Dispose of all products in the waste jar.
- Skip part B except for the unknown (last column).
  Use different unknowns for parts A and B.
- Be sure to record both of your three-digit unknown numbers on your report sheet.
- Refer to solubility rules here or in Appendix E of the lab manual to determine the formulas for your precipitates.
  Review the rules for Cl^{-1}, SO_4^{-2}, and OH^{-1}.

Lab Questions

1. Suppose you have an unlabelled solution which contains either KCl or K_2CO_3, and you need to test the solution to determine which of the two substances is dissolved.
   Review your experimental results with solutions containing Cl^{-1} and CO_3^{-2}.
   Which of the three test reagents from this experiment would give two different results with these two ions so than you can use it to determine the identity of the solution?
   Write the net ionic reaction that could be observed, and include the phase subscripts.
   (1 pt)

2. Suppose you have an unlabelled solution that contains either KCl or K_2SO_4, and you need a test to determine which of the two substances is dissolved.
   You need a cation whose result with Cl^{-1} is different from its result with SO_4^{-2}.
   Would you use Pb^{+2}, Ba^{+2}, or Na^{+1} to determine the identity of the solution?
   Use rules 1 and 4 for water-soluble salts in Appendix E to determine which cation will precipitate with one anion, but not the other. Write the identifying net ionic reaction for this precipitate. Include the correct coefficients, ionic charges, and phase subscripts.
   (1 pt)

3. Review your experimental results and the solubility rules.
   Also, review the table of acid-base reactions that create gaseous products.
   Write the balanced net ionic reactions for the following aqueous mixtures.
   Include the correct coefficients, ionic charges, and phase subscripts. (1 pt)
   a. $HBr_{(aq)}$ and $Na_2CO_{3(aq)}$
   b. $AgNO_{3(aq)}$ and $KCl_{(aq)}$

4. Suppose you have another unlabelled solution, and it contains one of the five dissolved compounds from the experiment, as in the column headings.
   So, you add a few drops to a solution of HNO_3 (nitric acid) and a lot of bubbling results from an odorless, nontoxic gas (not NH_3, H_2S, or SO_2).
   Then, you add a few drops to an $AgNO_3$ solution, and a precipitate forms.
   Mixing with a solution of KOH does nothing; there is no precipitate or odor.
   Mixing with a solution of K_3PO_4 does nothing either.
   Identify the dissolved compound. Explain the results for all four of the chemical tests.
   (2 pts)

5. Use your experimental results and the solubility rules to find reagents that could be used to distinguish between the ions in each of the following pairs.
   That is, the reagent must create a precipitate or gas with one of the two ions, but not react with the other ion.
   Explain the difference between the two results for each pair of ions. (2 pts)
   a. Pb^{+2} and Ba^{+2} (find an anion that precipitates with one and not the other)
   b. K^{+1} and Sr^{+2} (find an anion that precipitates with one and not the other)
   c. K^{+1} and NH_4^{+1} (find an anion that creates a gas with one of the cations)
   d. Br^{-1} and SO_4^{-2} (find a cation that precipitates with one and not the other)