Chemistry of Our Environment - Lab

DOS FAMILIAS

PURPOSE:

The purpose of this experiment is to show a sequence of chemical reactions. Using the property of solubility of the products of these reactions, one can devise a scheme which allows identifications of an unknown liquid containing one group II cation (alkaline earth metal) and one group VII anion (halogen).

PROCEDURE:

PART A: REACTIONS OF KNOWN CHEMICALS

1) In separate small labeled test tubes add 1 mL (12 drops) of calcium nitrate, magnesium nitrate, strontium nitrate, and barium nitrate and 1 mL of your unknown solution.

2) To each test tube add 1 mL (12 drops) of 1M H₂SO₄ (sulfuric acid) and stir with a glass rod. (Rinse your stirring rod with a stream of water from your wash bottle in between each test, in order to avoid contamination from one test tube to the next).

3) Record your results in the data table for cations provided, noting if a precipitate is formed, as well as any physical characteristics which may later identify it.

4) In 5 clean test tubes (these can be the same ones you used above, as long as they have been rinsed well with distilled water) (also remember to discard all wastes properly as your instructor tells you), add fresh Group II cations (alkaline earth metals) and add 1 mL of 1M Na₂CO₃ (sodium carbonate). Record your observations.

5) Again add fresh alkaline earth reagent to 5 clean test tubes. Add 1 mL of 0.25M (NH₄)₂C₂O₄ (ammonium oxalate) and record your results.

6) Make a mixture of 5 mL of 1M K₂CrO₄ (potassium chromate) and 5 mL of 1M CH₃COOH (acetic acid). Add 2 mL of this mixture to separate test tubes containing 1 mL of fresh alkaline earth reagent and your unknown. Stir and record your results.

7) Test the solubilities of the Group VII anions (halogens) as follows: To three clean test tubes add 0.1M NaCl, NaBr and NaI. To each of these add 0.1M Ag(NQ₃) (silver nitrate). Stir and record your observations in the anion table provided. Do not discard these.

8) Some of the silver salt precipitates can be dissolved with varying strengths of ammonia (NH₃). Centrifuge the three test tubes in step 7 and decant the liquid.

9) Add 2 mL of 6M NH₃ to each test tube, stir and record your observations. Add 2 additional mL of 6M NH₃ to any remaining precipitate and stir.
10) Centrifuge each test tube that still contains any precipitate and add 2 mL of 15M NH₃ to any precipitate, stir and record your results.

PART B: IDENTIFICATION OF AN UNKNOWN

1) Based on your results from both the anion and cation tests, comparing your unknown results to those for the known cations and anions, determine what cation and what anion is present in your unknown.

2) Determine the chemical formula of the compound formed by your unknown cation and anion.

3) **Bonus Question:** For Part A, what would be the minimum number of tests on the unknown that could be performed that would absolutely guarantee the determination of the identity of the cation.

1. **Solubilities of the Salts of the Alkaline Earths Cations**

<table>
<thead>
<tr>
<th></th>
<th>Mg²⁺</th>
<th>Ca²⁺</th>
<th>Sr²⁺</th>
<th>Ba²⁺</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 M H₂SO₄</td>
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<td></td>
<td></td>
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<tr>
<td>1 M Na₂CO₃</td>
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<tr>
<td>0.25 M (NH₄)₂C₂O₄</td>
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<tr>
<td>1 M K₂CrO₄ and 1 M Acetic Acid</td>
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</tbody>
</table>

P = precipitate forms; S = no precipitate

Note the color, amount or any other characteristic of the precipitates.

2. **Solubilities of the Salts of the Halide Anions**

<table>
<thead>
<tr>
<th></th>
<th>Cl⁻¹</th>
<th>Br⁻¹</th>
<th>I⁻</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>AgNO₃</td>
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Precipitate from first part of 2. and 6 M NH₃ or NH₄OH
| Any remaining precipitate from second step and 15 M NH₃ or NH₄OH |

Again note solubility and any other distinguishing characteristics.