Lab 6: Qualitative Analysis

Report:

You work for a lab that tests water samples and are given an unknown solution that may contain one or more of the following cations (positively charged ions): Ag⁺ (silver ion), Cu²⁺ (copper ion), and/or Ba²⁺ (barium ion). You are to submit a report detailing what you did to analyze the water and state your findings. Make sure that you:

1. Write all observations of the reactions you carried out in Part One.
2. Explain your separation scheme. What is it, and how does it work?
3. Discuss your “known” solution (from Part Two) and how well your separation scheme worked.
4. What is the number of your unknown and which cations did you find in the unknown?

In addition, your boss found some bottles of salts in the back storeroom where the labels had worn off. You are asked to identify what these salts are using flame tests (Part Four). In a second report, make sure that you:

1. List the colors you observed in the flame tests for the known salts.
2. Address whether or not the anion in a salt affects the color observed in a flame test (and explain how you know this).
3. Identify the unknown salts as identified by the flame tests.

Procedure:

Part One: Precipitation Reactions
You will be given six aqueous (water-based) solutions of salts. These are: silver nitrate (AgNO₃), barium nitrate (Ba(NO₃)₂), copper nitrate (Cu(NO₃)₂), sodium chloride (NaCl), sodium sulfate (Na₂SO₄), and sodium carbonate (Na₂CO₃). React all possible combinations of each solution. Take some time to figure out the most efficient method for this. Because of the large number of chemicals, you will carry out the reactions drop-wise, using pipets and your microscale tray. To avoid confusion, you might want to make a sketch of your tray on paper so that you know which chemicals are in each well. Do this lab with a partner. Record all observations.

Part Two: Making and Testing an “Unknown” Solution
1. Add about 2 mL of each of the cation solutions (silver nitrate, barium nitrate, and copper nitrate) to a test tube.
2. Use your results from Part One to determine a scheme to test for each of the cations. You can use a centrifuge to aid in the separation of the solution from the solid. Record all observations.

Part Three: Determining the Cations in an Unknown Solution
1. Obtain an “unknown” water sample from the instructor. It may contain one, two, or all three of the cations. Write down the number of the unknown.
2. Use the procedure you developed in Part Two to test for the cations. Record all observations.
Part Four: Flame Tests
1. Wear gloves before obtaining the nichrome wire. This will keep the sodium on your hands from affecting your results.
2. Clean the nichrome wire. First, rinse with deionized water. Next, dip the loop into the $6.0 \ M \ HCl$ solution. Place the loop into the flame of the Bunsen burner for about a minute. Pay attention to the color of the clean nichrome wire in the flame.
3. Place a small amount of each salt on separate watch glasses and add a bit of water.
4. Perform a flame test on each solution by first heating the loop of the nichrome wire in the Bunsen burner. Hold the watch glass with the solution to be tested next to the intake of the Bunsen burner and place the hot loop into the solution. Record your observations.
5. Clean the wire as described in step 1 above, and test each of the remaining salts.
6. Obtain two unknown salts from your instructor and perform flame tests on each (cleaning the wire between unknowns). Record all observations (make sure to record the number of your unknowns).

Paper Idea III:
Write a paper on one specific scientific technique that is used in identifying compounds. These include mass spectroscopy, thin layer chromatography, or spectrophotometry (choose one of these). Explain how the technique works and how it is used in a crime lab.

Note: Do not merely answer these questions given in the description in the given order, but write a coherent paper that addresses these issues. The paper must be typed, should not be longer than 5 pages (double spaced, reasonable margins), and must include at least 2 references (web references are fine). The work must be your own.