

EXPERIMENT 15B

GROUP IV ANALYSIS (Ba^{2+} , Ca^{2+} , Sr^{2+})

Carry out the procedures on a “known” solution that contains all the Group IV ions. Then obtain an **unknown** from your instructor and use the same procedures to determine the Group IV ion (s) present.

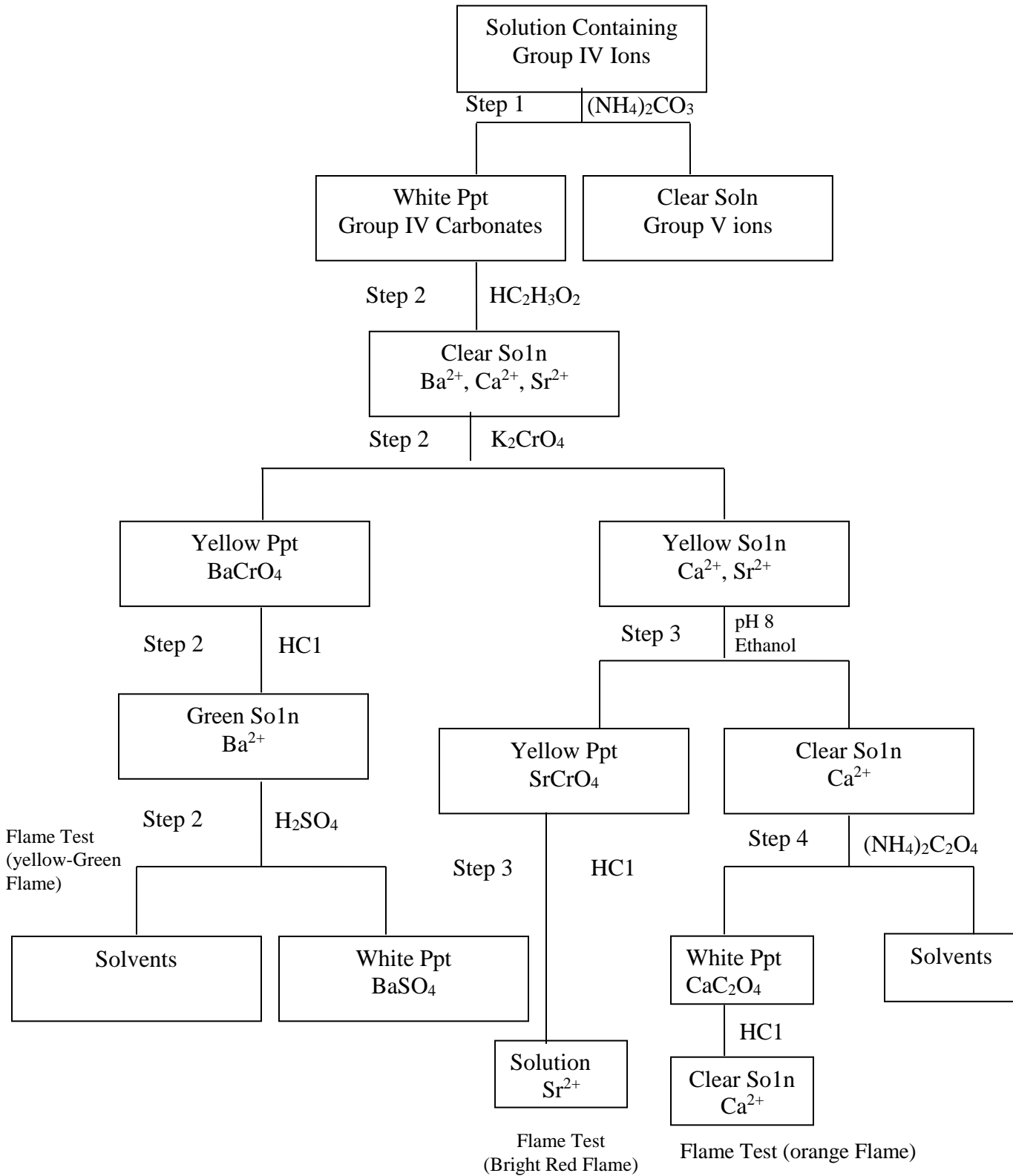
PROCEDURES:

1. Evaporate 2 mL of the solution to dryness in a casserole. Heat slowly enough to avoid spattering. After drying, heat strongly for a minute, then air cool the casserole. After cooling, dissolve the residue in 10 drops of 1.0 M HCl and neutralize to a pH of 8 with 6.0 M aqueous ammonia. Add 5 drops of 1.0 M $(\text{NH}_4)_2\text{CO}_3$, or more if needed, to completely precipitate the Group IV carbonates. Separate out the white precipitate.
2. Dissolve the white precipitate from Step 1 in a solution made acidic (pH=5) with 5 drops of 6 M $\text{HC}_2\text{H}_3\text{O}_2$ and 10 drops of 1 M $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$. Test for Ba^{2+} by adding 8 drops of 1M K_2CrO_4 . The formation of a yellow precipitate of BaCrO_4 is sufficient evidence of the presence of barium. However, if there is some doubt at this point, additional test may be performed. Separate out the BaCrO_4 precipitate and save the supernatant for Step 3.

Dissolve the precipitate in 5 drops, or more if necessary, of 12 M HCl. Perform a flame test on this solution. If barium is present a short-lived yellow-green color will be imparted to the flame. (Flame tests are described in the Introduction.) It is a good idea to prepare a small amount of solution containing no other cation than Ba^{2+} and flame test that for comparison. After the flame test, add 2 drops of 3 M H_2SO_4 . The formation of a white precipitate of BaSO_4 also confirms barium.

3. Add 15 M aqueous ammonia drop wise to the solution saved from Step 2 until the solution turns from light orange to yellow in color. Test to make sure the solution is basic (pH = 8), then double its volume by adding an equal volume of ethyl alcohol. The formation of a yellow precipitate at this point indicates SrCrO_4 . Separate out the precipitate and save the solution for Step 4. Dissolve the precipitate in as little 2 M HCl as possible and perform a flame test on the resulting solution. A bright red flame confirms the presence of strontium ion.
4. The solution saved from Step 3 will contain calcium ions if they are present in your original sample. The calcium may be confirmed in two ways.
 - a. Add 4 drops of 0.4 M $(\text{NH}_4)_2\text{C}_2\text{O}_4$ and heat in a water bath for several minutes (5) minutes. The formation of a white precipitate of CaC_2O_4 confirms Ca.
 - b. Separate out the precipitate, then dissolve it in a minimum amount of 12 M HCl. Perform the flame test again and look for an orange flame to confirm the presence of calcium ion. Again, it would be good to test at the same time a solution known to contain only calcium ion for direct comparison. Flame colors can be confusing.

EXPERIMENT 15B—GROUP IV ANALYSIS—FLOW CHART



NAME _____ SECTION _____

**EXPERIMENT 15B – GROUP IV
REPORT SHEET**

UNKNOWN NUMBER _____ ANALYSIS _____

YOUR FLOW CHART: (Make the chart complete by showing all your steps, even washings, all reagents at proper concentrations and their amounts, color of precipitates, and any other information that was interesting and/or important.)