Chemistry I Name _____

Date _____ Per _____

Qualitative Analysis Lab:
Using the Solubility of Ionic Substances To Identify Unknowns

Purpose: In this experiment you will first test **known** ions to determine their results for specific reactions. Then you will test an **unknown** using all of the different chemical tests to determine what ions and/or chemicals are present in the sample. This technique is used in most chemical labs as a primary test method since it is relatively straightforward and inexpensive.

Note: Make sure all your test tubes are thoroughly rinsed between tests since any contamination could cause an error in your results. Also, your solutions should be clear since a cloudy appearance could be considered a precipitate.

Read through the procedure and data table before you start.

1. First test all the known reactants that are provided. Record your results in the data table under “Known Results”.

2. Your instructor will assign you an unknown to test. It can have none, any, or all of the ions you tested in it, Run each of the tests on your unknown, being careful to clean out your test tube between tests. Record your results in the data table under “Unknown Results”.

3. Make sure your lab area is clean. Wipe down the area with a paper towel. Then finish filling out the data table, answer all the questions, and complete the conclusion.

ION TESTED FOR	PROCEDURE
NH_4^{+1} (0.1 M)	To 5 mL of the solution to be tested, add 1 mL 6M NaOH and warm gently. A piece of moist litmus paper held at the mouth of the test tube (but not touching) should turn blue. Odor of ammonia may be detected.
Ba^{+2} (0.1 M)	To 2 mL of the solution to be tested, add 1 mL of 0.1 M Na_2SO_4 solution. Look for a white precipitate.
Ca^{+2} (0.1 M)	(a) To 2 mL of solution, add 1 mL .1 M Na_2CO_3 solution. Look for a white precipitate. (b) To a fresh 2 mL sample of solution, add 1 mL 4% ammonium oxalate, $(NH_4)_2C_2O_4$ solution. This precipitate may take several minutes to appear. Be patient!
Fe^{+3} (0.01 M)	(a) To 2 or 3 mL of solution, add 3 drops of concentrated HNO_3 and carefully heat to boiling. Cool. Add a few drops of 0.1 M potassium ferrocyanide solution. A rich blue ("prussian blue") color should appear (b) Take a fresh 2-3 mL sample of the solution and treat it with the acid as above. Add a few drops of potassium thiocyanate solution this time. A rich red-orange color appears.
Cl^{-1} (0.1 M)	To 2 mL of the solution to be tested, add 1 drop 5%$AgNO_3$, then add 1 drop of conc. HNO_3. The white precipitate that remains is AgCl. If the precipitate dissolved when the HNO_3 was added, Cl^{-1} was not present.
CO_3^{-2} (0.1 M)	(a) To 3 mL of solution to be tested add 1 mL 3M HCl. The production of gas (CO_2) when acid is added to either a solid or solution containing CO_3^{-2} or HCO_3^- is a common identification procedure. It happens so quickly that it is often overlooked. In dilute solutions the effervescence may be difficult to see. (b) To a fresh 2 mL sample of solution add 1 mL of 0.1M $CaCl_2$ solution. (Ca^{+2} does not precipitate HCO_3^-.)
SO_4^{-2} (0.1 M)	To 2 mL of the solution, add 1 mL of 0.1 M $BaCl_2$ solution, then add 5 drops of 3 M HCl. $BaSO_4$ is insoluble in HCl, but other barium compounds, like $BaCO_3$ or $Ba_3(PO_4)_2$ will dissolve.
PO_4^{-3}(0.1 M)	To 1 mL of solution, add 3 drops of conc. HNO_3 and warm in a hot water bath at 50-60ºC. Add 1 mL of molybdate reagent. Return the test tube to the warm water bath. If PO_4^{-3} was present, you should see a yellow precipitate.

Note: "warm gently" means in a hot water bath. Be very careful not to let the liquid get hot enough to boil.