Separations Based on Qualitative Analysis

Qualitative analysis is used to identify the substances present in a given sample.

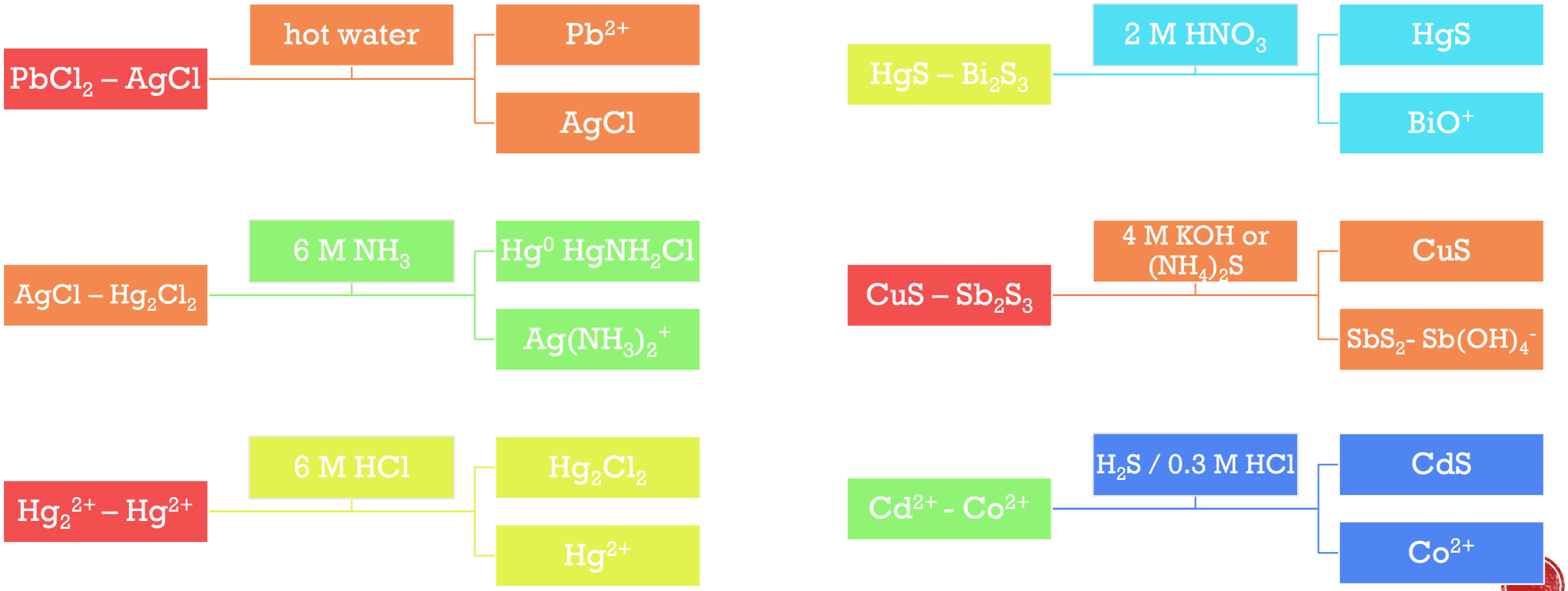
- The type of qualitative analysis employed depends on the characteristics of the material being analyzed.
- Inorganic qualitative analysis establishes the presence or absence of ions in aqueous solution.
- In qualitative inorganic analysis, cations are initially separated by precipitating them from solution in groups.
- The reagent used to precipitate a group of cations is called the **group reagent**.

Group No	Group Name	Alternate Name	Ions Included
1	Chloride Group	Silver Group	Pb^{2+} Hg_2^{2+} Ag^{+}
2	Hydrogen Sulfide Group	Copper-Arsenic Group	Hg^{2+} Pb^{2+} Bi^{3+} Cu^{2+} Cd^{2+} AsO_2^{-} AsO_4^{3-} Sn^{2+} Sn^{4+} Sb^{3+}
3	Ammonium Sulfide Group	Aluminum-Nickel Group	Mn^{2+} Fe^{2+} Fe^{3+} Ni^{2+} Co^{2+} Al^{3+} Cr^{3+} CrO_4^{2-} Zn^{2+}
4	Carbonate Group	Barium-Calcium Group	Ba^{2+} Sr^{2+} Ca^{2+} Mg^{2+}
5	Soluble Group	Sodium Group	Na^{+} K^{+} NH_4^{+}

- The successful analysis of cations in each of the five groups requires essentially complete removal of ions in previous groups.
- The first group separation of inorganic qualitative analysis is that of the **chloride group**:
  - Pb^{2+} Hg_2^{2+} and Ag^{+} ions are the only ones of the cationic species considered that form sparingly soluble chlorides in acidic solution.
- The solution remaining from chloride group precipitation has its acidity adjusted to 0.3 M H^{+} and then is saturated with H_2S, producing a solution with a very low [S^{2-}] to precipitate the **hydrogen sulfide group**.
  - Those sulfides have quite low solubility product constant.

- The solution remaining from the hydrogen sulfide group precipitation is made alkaline with an ammonium ion-ammonia buffer and treated again with H2S to precipitate the ions of the **ammonium sulfide group**.
  - The resulting precipitate consists of sulfides that are more soluble than those of the hydrogen sulfides and of insoluble hydroxides.
- The solution that remains is made alkaline with aqueous ammonia and treated with a solution of ammonium carbonate to precipitate the ions of the **carbonate group**.
  - This precipitate consists of sparingly soluble carbonates.
  - After it is separated from the remaining solution, it is dissolved in acetic acid and each ion of the group is confirmed.

Describe a Chemical Reagent to Distinguish Between the Pairs of Solutions or Solids



FILTRATION

- Small grain precipitate
- Filtration can be carried out in two different ways as **normal filtration** and **vacuum filtration**.

Normal Filtration

The main points:

- Draining speed is very important. A long neck funnel is used to ensure high filtration speed.
- Before filtering, the filter paper is made ready for folding. Then, a corner of the quadrupled filter paper is torn and placed in the funnel.
- The filter paper is wetted by spraying water with dirt so that there is no air gap between the funnel and the filter paper.
- The mixture to be filtered must be relieved. As the filter pores are blocked immediately in a cloudy mixture, the rate of filtration is very low.

Vacuum Filtration

- In order to accelerate the filtration process, air is discharged using a water trompe or vacuum pump.
- In the vacuum filtration process, **erlen nuche** is used as the collection vessel. As a strainer, the Büchner funnel, the Hirsch funnel and one of the various strainer can be used.