4^{th} – 5^{th} WEEKs

Analysis of Cation Group 2:

- Cation group 2- Each student complete the procedure for their own UNKNOWN sample analysis
- Cation group 2 is the largest group in qualitative analysis. It is studied in two subgroups named Subgroup 2A and Subgroup 2B to give the analyst a smaller number of cations to deal with at one time. Therefore, this experiment takes at least two-three weeks to be completed.
- First, the unknown cation group 2 sample is precipitated and then separated into two subgroups.

  Subgroup 2A: Pb^{2+} - Hg^{2+} - BiO^{+}- Cu^{2+}- Cd^{2+}

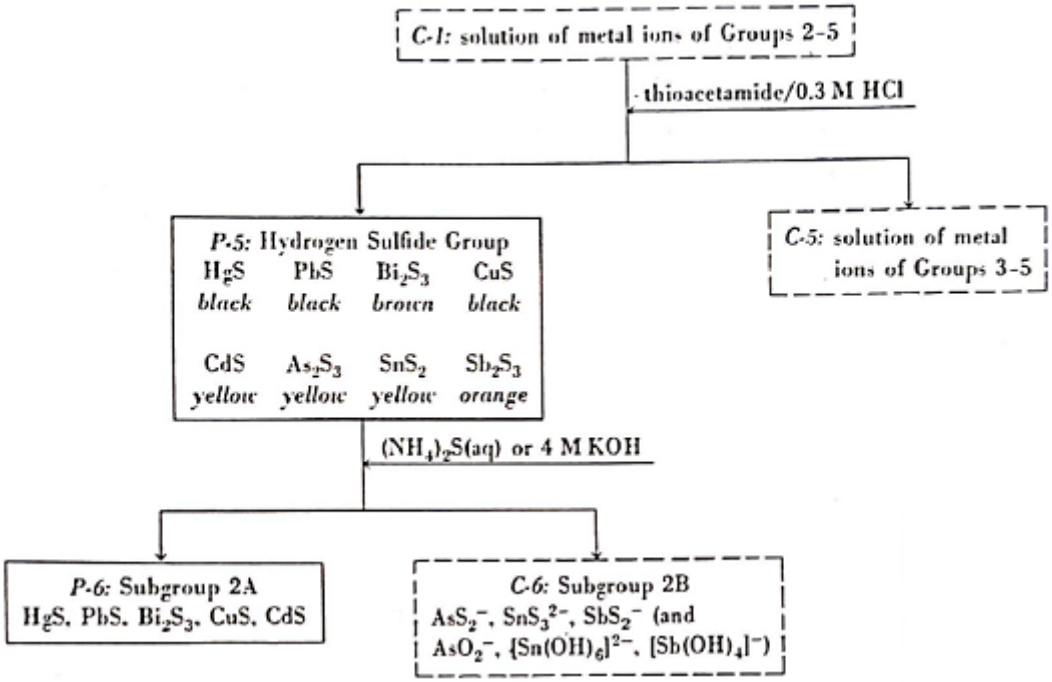
  Subgroup 2B: AsO_2^{-}- AsO_4^{3-}- Sn^{2+}- Sn(IV)- SbO^{+}
- After the separation of subgroups, different procedures are applied to each subgroup.
- Three analysis schemes are given below.

In all analysis schemes, precipitates are enclosed in boxes with solid lines, solutions are contained in boxes with dashed lines.

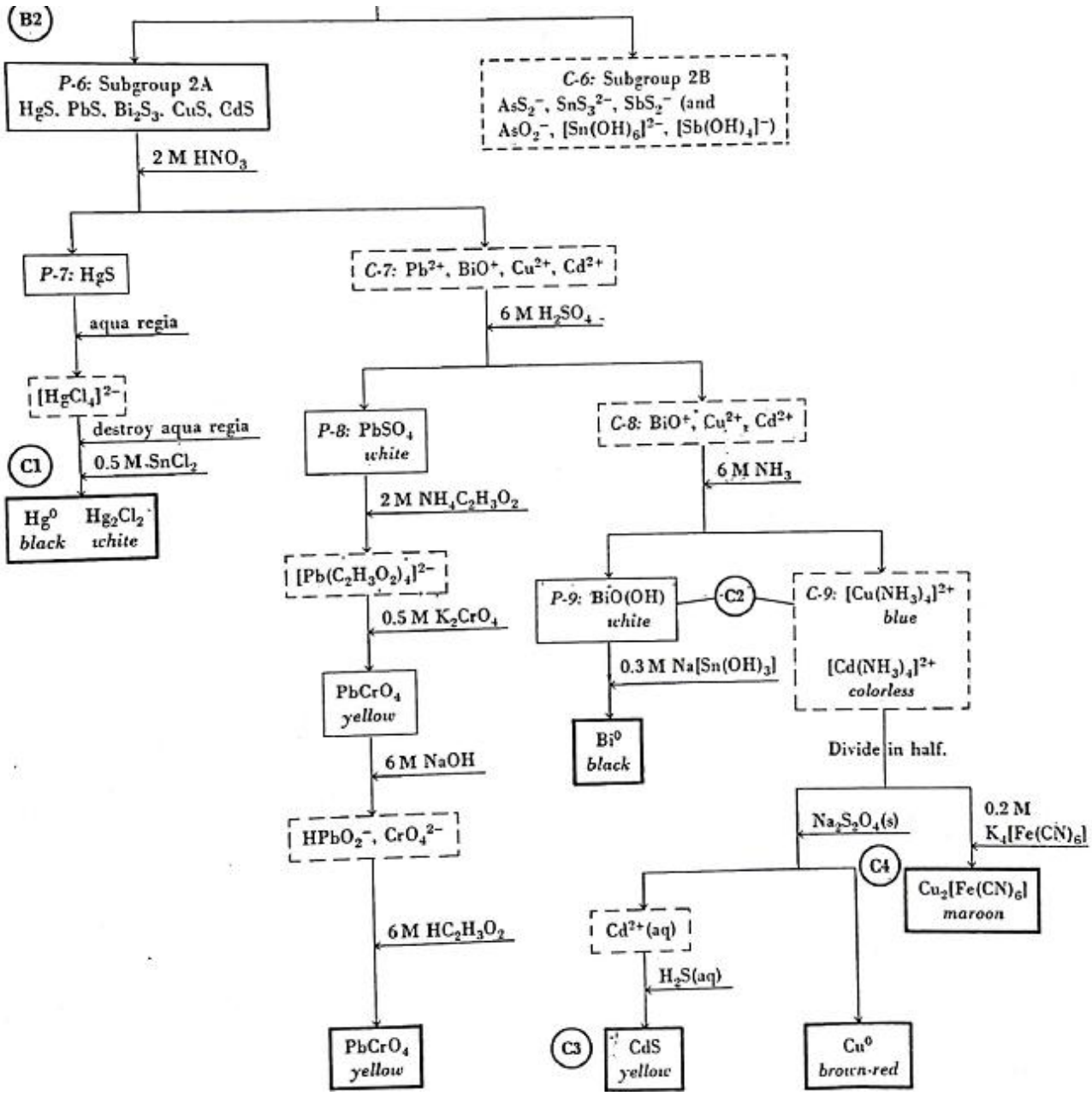
Cation Group 2: The Hydrogen Sulfide Group-

Pb^{2+} - Hg^{2+} - BiO^{+}- Cu^{2+}- Cd^{2+}- AsO_2^{-}- AsO_4^{3-}- Sn^{2+}- Sn(IV)- SbO^{+}

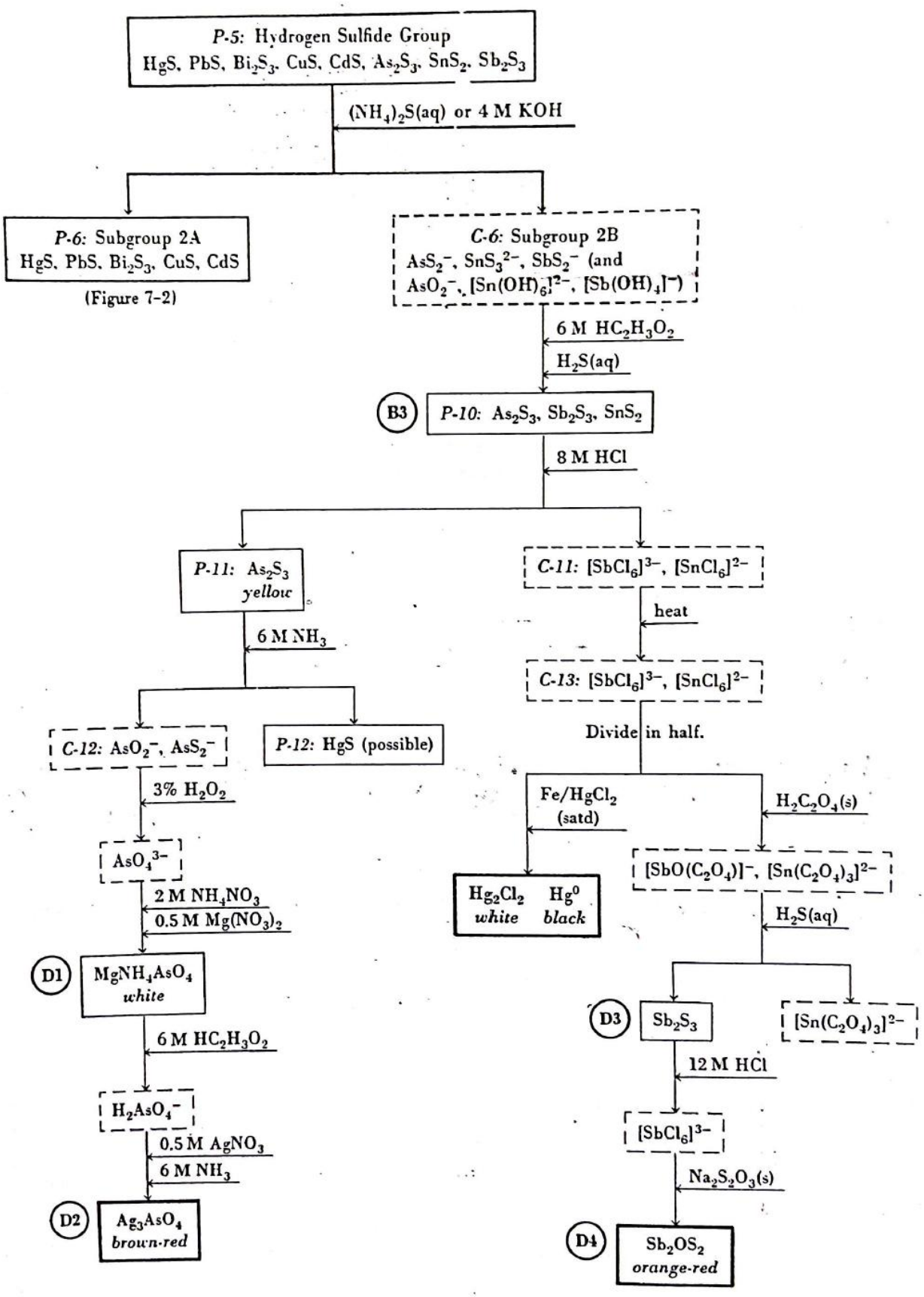
The cations of the hydrogen sulfide group form very sparingly soluble sulfides that are precipitated when a moderately acidic solution is saturated with hydrogen sulfide.



Qualitative analysis flowchart for The Hydrogen Sulfide Group: Precipitation and separation into two subgroups



Qualitative analysis flowchart for The Hydrogen Sulfide Subgroup 2A



Qualitative analysis flowchart for The Hydrogen Sulfide Subgroup 2B

Some examples for precipitation reactions

$Hg^{2+}(aq) + H_2S(aq) \longrightarrow HgS(s) + 2\ H^+(aq)$

$Pb^{2+}(aq) + H_2S(aq) \longrightarrow PbS(s) + 2\ H^+(aq)$

$2\ BiO^+(aq) + 3\ H_2S(aq) \longrightarrow Bi_2S_3(s) + 2\ H_3O^+(aq)$

$Cu^{2+}(aq) + H_2S(aq) \longrightarrow CuS(s) + 2\ H^+(aq)$

$Cd^{2+}(aq) + H_2S(aq) \longrightarrow CdS(s) + 2\ H^+(aq)$

$2\ HAsO_2(aq) + 3\ H_2S(aq) \longrightarrow As_2S_3(s) + 4\ H_2O(aq)$

$2\ H_3AsO_4(aq) + 5\ H_2S(aq) \longrightarrow As_2S_3(aq) + 2\ S(s) + 8\ H_2O$

$[SnCl_6]^{2-}(aq) + 2\ H_2S(aq) \longrightarrow SnS_2(s) + 4\ H^+(aq) + 6\ Cl^-(aq)$

$2\ SbO^+(aq) + 3\ H_2S(aq) \longrightarrow Sb_2S_3(s) + 2\ H_3O^+(aq)$

Some examples for the separation of subgroups

$2\ As_2S_3(s) + 4\ OH^-(aq) \longrightarrow AsO_2^-(aq) + 3\ [AsS_2]^-(aq) + 2\ H_2O$

$3\ SnS_2(s) + 6\ OH^-(aq) \longrightarrow [Sn(OH)_6]^{2-}(aq) + 2\ [SnS_3]^{2-}(aq)$

$2\ Sb_2S_3(s) + 4\ OH^-(aq) \longrightarrow [Sb(OH)_4]^-(aq) + 3\ [SbS_2]^-(aq)$

Some examples for identification reactions

$BiO(OH)\,(s) + 3Sn(OH)_3^-\,(aq) + 3OH^-\,(aq) + 2H_2O \longrightarrow 2Bi(s) + 3Sn(OH)_6^{2-}\,(aq)$

$2Cu^{2+}\,(aq) + Fe(CN)_6^{4-}\,(aq) \longrightarrow Cu_2Fe(CN)_6\,(s)$

$2HgCl_4^{2-}(aq) + Sn^{2+}\,(aq) \longrightarrow Hg_2Cl_2(s) + SnCl_6^{2-}(aq)$

$2SbO^+(aq) + 3S_2O_3^{2-}\,(aq) + 4H^+ \longrightarrow Sb_2OS_2(s) + 4SO_2(g) + 2H_2O$

$H_2AsO_4^-\,(aq) + 3Ag^+\,(aq) + 2NH_3 \longrightarrow Ag_3AsO_4\,(s) + 2NH_4^+\,(aq)$

REPORT FOR QUALITATIVE ANALYSIS

Name-Surname:		**Number:**	
Sample No	**2**	**Date**	
Sample Name	**Cation group 2**		
Ions expected to be observed	**To be filled by the assistant**		
Analysis of ion under study	**Procedure and Observation**	**Precipitation-Identification reactions for the ion**	
Result			

List of some reagents used in experiments are given below:

0.3 M Hydrochloric acid solution (HCl)
2 M thioacetamide (CH_3CSNH_2)
6 M Ammonia solution (NH_3)
0.3 M Freshly prepared sodium stannite solution ($NaSn(OH)_3$)
6 M Nitric acid solution (HNO_3)
4 M Potassium hydroxide (KOH)
0.5 M tin(II) chloride ($SnCl_2$)