

Republic of Iraq
Ministry of Higher Education and Scientific Research
Al-Mustansiriyah University
Collage of Science
Department of Chemistry



Practice Qualitative Chemical Analysis

First Grade - First Term

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THE PERIODIC TABLE OF THE ELEMENTS																	
1 1A H Hydrogen 1.008	2 2A He Helium 4.003	3 Li Lithium 6.941	4 Be Beryllium 9.012	5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180	11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.987	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.922	34 Se Selenium 78.972	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.29
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanide Series	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222
87 Fr Francium 223	88 Ra Radium 226	89-103 Actinide Series	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [281]	111 Rg Roentgenium [272]	112 Cn Copernicium [285]	113 Uut Ununtrium [288]	114 Fl Flerovium [289]	115 Uup Ununpentium [291]	116 Lv Livermorium [293]	117 Uus Ununseptium [294]	118 Uuo Ununoctium [296]
57 La Lanthanum 138.905	58 Ce Cerium 140.12	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium [145]	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967			
89 Ac Actinium 227	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium 237	94 Pu Plutonium 244	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 247	98 Cf Californium 251	99 Es Einsteinium 252	100 Fm Fermium 257	101 Md Mendelevium 258	102 No Nobelium 259	103 Lr Lawrencium [262]			
		Alkali Metal	Alkaline Earth	Transition Metal	Basic Metal	Semimetal	Nonmetal	Halogen	Noble Gas	Lanthanide	Actinide						

Experiment no (2)

Separation and analysis of group 2 cations (arsenic- copper group)

Copper group (Cu^{+2} , Cd^{+2} , Hg^{+2} , Pb^{+2} , Bi^{+3}) IIA

Arsenic group (Sb^{+3} , As^{+3} , Sn^{+4}) IIB

Theoretical bases

Ions of this group share the possibility of precipitation and separation on the form of sulphides from a solution of 0.3 M for HCl. The H_2S gas is used as a precipitation agent or Aqueous Solution of thioacetamide (CH_3CSNH_3) It will be a source of H_2S gas release. Thioacetamide it dissolves easily with water and then aqueous analysis especially when the temperature is higher than the room temperature and according to the equation



There is another way to generate H_2S gas continuously using HCl concentrated in a kipp device where the reaction can be easily controlled starting or stopping the reaction as soon as the gas faucet is opened and closed, and according to the equation



Precipitation using a thioacetamide solution is much easier and better than using a very toxic H_2S gas. The use of H_2S gas in the precipitation requires the entry of gas in the solution inside the gas cabinet and pay attention to the gas in the solution in order not to lose part of the precipitate solution. Using the thioacetamide solution requires adding enough drops of this solution to (the group or ion) solution to be precipitate and then heating the solution produced inside the test tube in a water bath until the complete precipitate phase. It is important to note here that not only are the group 2 sulfides are not dissolved in water, but a number of heavy element ions that are precipitate as sulfides, which fall within the five groups in the qualitative analysis . The second group of positive ions (copper-arsenic group) includes eight ions that are precipitate and separated as Sulfides form. Of the HCl acid solution H_3O^+ concentration in it ranges from 0.2-0.3 M The precipitation factor used is

either H_2S or solution thioacetamide (TA) After the precipitation of this group in the above conditions will be easily isolated from the rest of the subsequent groups (Third, fourth and fifth). Here is a large difference in the solubility product of the large difference between the values of water-constrained constants in the table below. Two groups of sulphides are precipitate in the acidic solution (group 2 ions sulfides) and the other is precipitate from a basic solution.

The following table shows the insoluble sulphides of some positive ions of the second and third groups with the values of the solubility product constants.

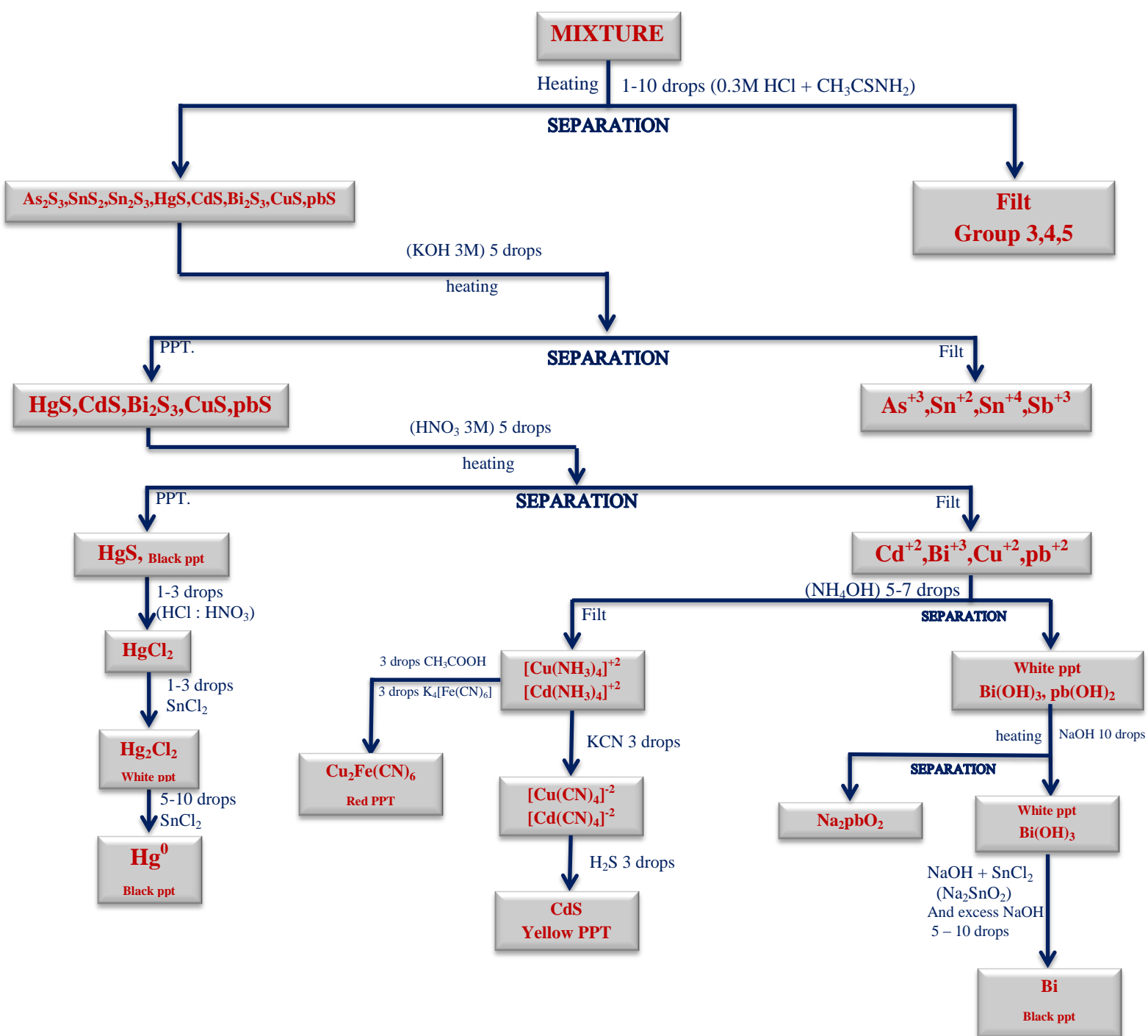
Ks.p	The sulphide	Ks.p	The sulphide
1.4×10^{-15}	MnS	3.6×10^{-29}	CdS
3.7×10^{-19}	FeS	8.5×10^{-45}	CuS
7.0×10^{-23}	CoS	3.0×10^{-55}	HgS
1.2×10^{-23}	ZnS	1.6×10^{-72}	Bi ₂ S ₃
1.4×10^{-24}	NiS	1.9×10^{-85}	Sb ₂ S ₃

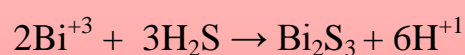
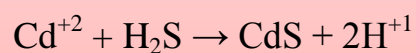
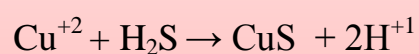
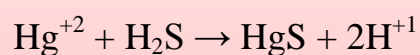
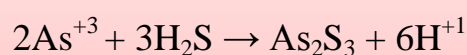
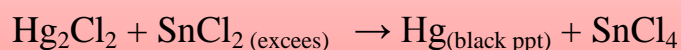
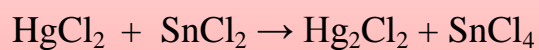
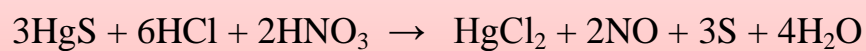
Procedure:

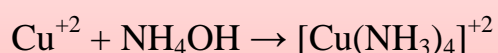
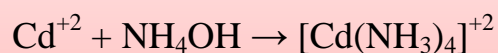
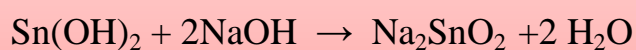
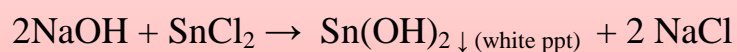
1. We have a mix of group 2 cations (arsenic- copper group) add 3 drops thioacetamide (TA) solution and 3 drops HNO_3 .
2. Preheat in water bath About a quarter of an hour a black Precipitate (I) appears convert to a brown color by heating.
3. separate the filtrate (I) from the Precipitate (I).
4. Precipitate (I) Consists of (HgS) Add (Aqua regia) And heated in a water bath with stirring The precipitate dissolves and we obtain the Hg^{+2} ion. After that, add drops of SnCl_2 solution (reduced agent) until it turns into a black precipitate from Hg^0 and stop adding it Thus we have detected the presence of mercury ion (Hg^{+2}) in the mix.
5. The filtrate (I) contains of this ions (Cu^{+2} , Cd^{+2} , Pb^{+2} , Bi^{+3}) add (3-5) drops of ammonia solution. A white precipitate appears a consist of $\text{Bi}(\text{OH})_3$ and $\text{Pb}(\text{OH})_2$.

6. Separate the filtrate (II) from the Precipitate (II).
7. Add 2 drops of NaOH solution with stirring to the *Precipitate* (II) and place it in the centrifuge to obtain a precipitate (III) and filtrate (III).
8. The white precipitate (III) is $\text{Bi}(\text{OH})_3$ added to its sodium stannite reagent and turns into a black color indicating the presence Bi^{+3} ion.
9. **Preparation of sodium stannite reagent** from the reaction of 3 drops of NaOH solution with an increase of SnCl_2 solution until a white precipitator is formed to indicate the formation of sodium stannite reagent.
10. The filtrate (III) Consists of Na_2PbO_4 add K_2CrO_4 potassium chromate solution to turn into PbCrO_4 yellow color indicating the presence Pb^{+2} ion.
11. The filtrate (II) contains $\text{Cu}[\text{NH}_3]_4^{+2}$, $[\text{Cd}(\text{NH}_3)_4]^{+2}$ divided it into two parts (AII) and (BII).
12. Add 3 drops from KCN solution to The filtrate)AII (to turn into solution contain of $[\text{Cu}(\text{CN})_4]^{+2}$ and $[\text{Cd}(\text{CN})_4]^{+2}$ add to it 3 drops of thioacetamide (TA) solution and then heat in water bath until a yellow precipitate is formed from CdS compound indicating the presence Cd^{+2} ion
13. Add 3 drops from acetic acid CH_3COOH solution and 3 drops from Potassium ferrocyanide $\text{K}_4[\text{Fe}(\text{CN})_6]$ solution to The filtrate (BII) to turn into red solution due to formation of $\text{Cu}_2[\text{Fe}(\text{CN})_6]$ complex indicating the presence Cu^{+2} ion

SEPARATION AND ANALYSIS OF THE SECOND GROUP II



الكشف العام لأيونات الطائفة الثانية (مجموعة النحاس)الكشف العام لأيونات الطائفة الثانية (مجموعة الزرنيخ)الكشف التأكيدي لأيون الزئبق

الكشف التأكيدي لأيون النحاسالكشف التأكيدي لأيون الكاديومتحضير قصديرية الصوديومالكشف التأكيدي لأيون البزموت