

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 83.8
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 209	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 [284]	114 Fl Flerovium [289]	115 Uup Ununpentium [288]	116 Lv Livermorium [293]	117 Uus Ununseptium [294]	118 Uuo Ununoctium [294]
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						

Qualitative Analysis

Separation of ions to groups and identification

Identification steps at first time to groups by certain reagents and then detection each ion in group:

- 1- Identification of groups by certain reagent.
- 2- Identification of each ion in group by special reagent.

Properties of reagents used in the detection and separation of ions of different groups from each other:

- 1- Abilities to precipitate ions of group which belong to it from mixture.
- 2- Reagent must form pure precipitate with ions of element belong to its group without ions from other group.
- 3- The resulting precipitate must be easily separated from the other ions in solution.
- 4- Reagent must be stable, doesn't decomposed and easily to have it, low cost.

Analysis Of Cations

Several methods for the analysis of cations for metals were used descriptively.

The cations covered in this course will be restricted to those of silver, lead, mercury, copper, bismuth, cadmium, arsenic, tin, antimony, iron, manganese, cobalt, nickel, zinc, aluminum, chromium, barium, calcium, strontium, magnesium, sodium, potassium, and ammonium.

The outline will describe the method of precipitating and analyzing each group. To analyze a general unknown, it is necessary only that the solution left from the Group I precipitation be used as the unknown for the Group II analysis, the solution from the Group II precipitation for the

Group III unknown, etc. For the usual analysis, no more than 1 ml. of unknown should be taken. More will make the analysis difficult.

Precipitates of group	Precipitation agent	Ions	Groups
AgCl, Hg ₂ Cl ₂ , PbCl ₂	3M HCl	Ag ⁺¹ , Pb ⁺² , Hg ⁺² ₂ مجموعة الفضة	Group I
HgS, pbS, Bi ₂ S ₃ , CuS, CdS As ₂ S ₃ , Sb ₂ S ₃ , SnS ₂ , SnS	H ₂ S + 0.3M HCl	IIA= (Cu ⁺² , Hg ⁺² , Pb ⁺² , Bi ⁺³ , Cd ⁺²) مجموعة النحاس IIB =(As ⁺³ , Sb ⁺³ , Sn ⁺² , Sn ⁺⁴) مجموعة الزرنيخ	Group II
Cr(OH) ₃ , Al(OH) ₃ , Fe(OH) ₃ MnS, ZnS, NiS, CoS	NH ₃ + NH ₄ ⁺¹ H ₂ S+NH ₃ + NH ₄ ⁺¹	IIIA=(Fe ⁺³ , Cr ⁺³ , Al ⁺³) مجموعة الحديد IIIB =(Zn ⁺² , Mn ⁺² , Ni ⁺² , Co ⁺²) مجموعة الزنك	Group III
Ba(PO ₄) ₂ , Sr ₃ (PO ₄) ₂ , Ca ₃ (PO ₄) ₂ , Mg(NH ₄)PO ₄	(NH ₄) ₂ HPO ₄	Ca ⁺² , Ba ⁺² , Sr ⁺² , Mg ⁺² مجموعة الكالسيوم	Group IV
لا يوجد كاشف مرسب خاص بهذه المجموعة حيث أن لكل ايون كاشفه الخاص به		Na ⁺¹ , K ⁺¹ , NH ⁺¹ مجموعة العناصر القلوية	Group V