

School of Basic and Applied Sciences

Course Code : BSCC2003

Course Name: INORGANIC CHEMISTRY II



S-BLOCK ELEMENTS

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PREREQUISITE

- Electronic configuration of elements
- Periodic trends

The logo of Galgotias University is a stylized, circular emblem. It features a central blue swoosh that curves upwards and to the right, surrounded by other curved, overlapping shapes in shades of yellow, orange, and pink, creating a sense of motion and energy.

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LEARNING OUTCOME

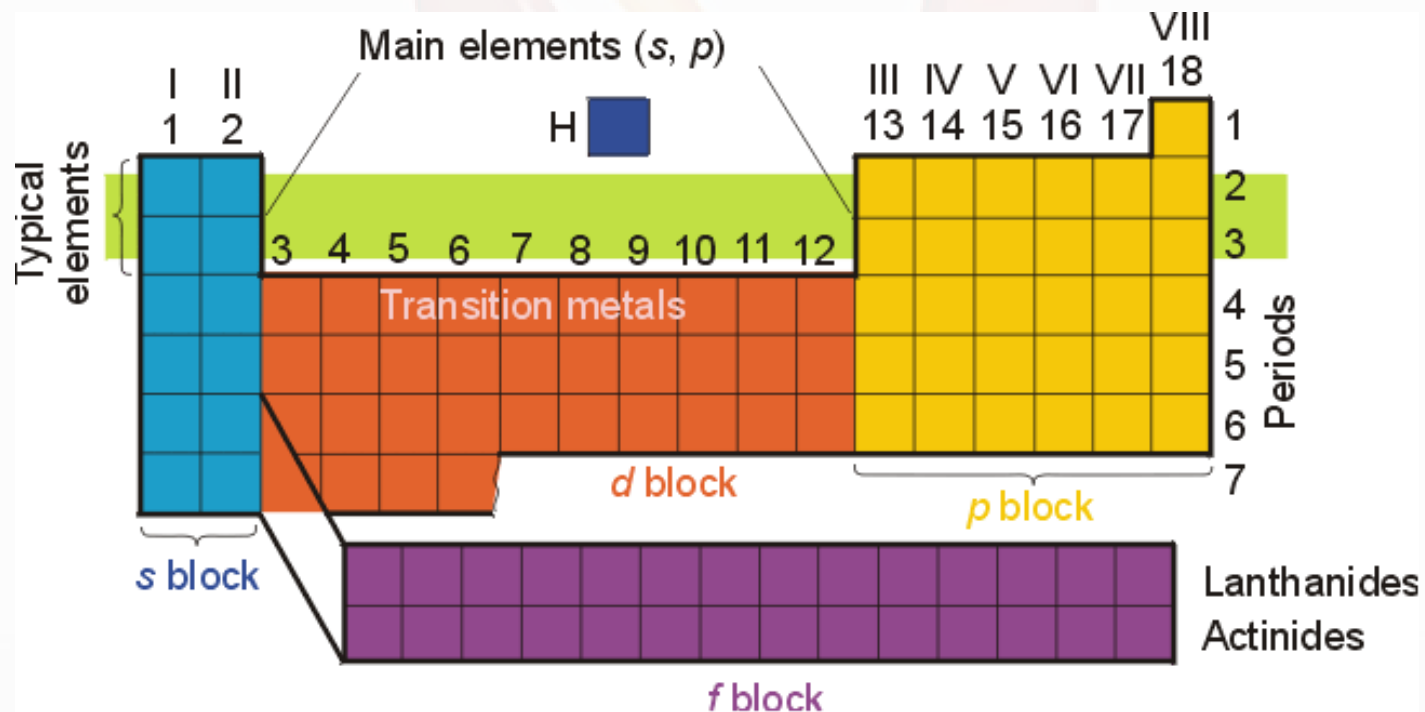
- Knowledge of s-block elements
- Properties and complex formation

The logo of Galgotias University is a stylized, multi-colored swirl or 'G' shape. It features a gradient of colors including yellow, orange, red, and blue, with a white center. The swirl is composed of several curved segments that create a sense of motion and depth.

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Selected Aspects of Main Group Chemistry

For the rest of the course, we will look at some aspects of the chemistry of main group compounds. The basic principles that you have learned concerning atoms, molecules and bonding (covalent and ionic) can be used to understand the reactivity and structures that are observed for elements and compounds throughout the periodic table. We only have time to look at some examples from the groups that comprise the Main group (the s-block and the p-block elements).



Group 1 - Alkali metals

Group 2 - Alkaline earth metals

Annotations:

- Group 1 (Alkali metals):** Elements 1, 3, 11, 19, 37, 55, 87. New Designation: 1; Original Designation: IA.
- Group 2 (Alkaline earth metals):** Elements 4, 12, 20, 38, 56, 88. New Designation: 2; Original Designation: IIA.

Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Period	s-block		d-block										p-block						
Period	1		Transition Metals										Non-Metals						
Period	IA		IIA - VIIIB										IIIA - VIIIA						
1	1 H 1.0094	2 He 4.00260																	
2	3 Li 6.941	4 Be 9.0122											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.179	
3	11 Na 22.990	12 Mg 24.305	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948											
4	19 K 39.098	20 Ca 40.08	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80	
5	37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.91	54 Xe 131.29	
6	55 Cs 132.91	56 Ba 137.33	57 La to 71	58 Hf 178.49	59 Ta 180.95	60 W 183.85	61 Re 186.21	62 Os 190.2	63 Ir 192.22	64 Pt 195.08	65 Au 196.97	66 Hg 200.59	67 Tl 204.38	68 Pb 207.2	69 Bi 208.98	70 Po (209)	71 At (210)	72 Rn (222)	
7	87 Fr (223)	88 Ra 226.03	89 Ac to 103	90 Unq (261)	91 Unp (262)	92 Unh (263)	93 Uns (264)	94 Uno (265)	95 Une (266)	96 Uun (267)									
Metals																		Phases	
																		Solid	
																		Liquid	
																		Gas	

	d-block														f-block															
Rare Earth Elements	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97	89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

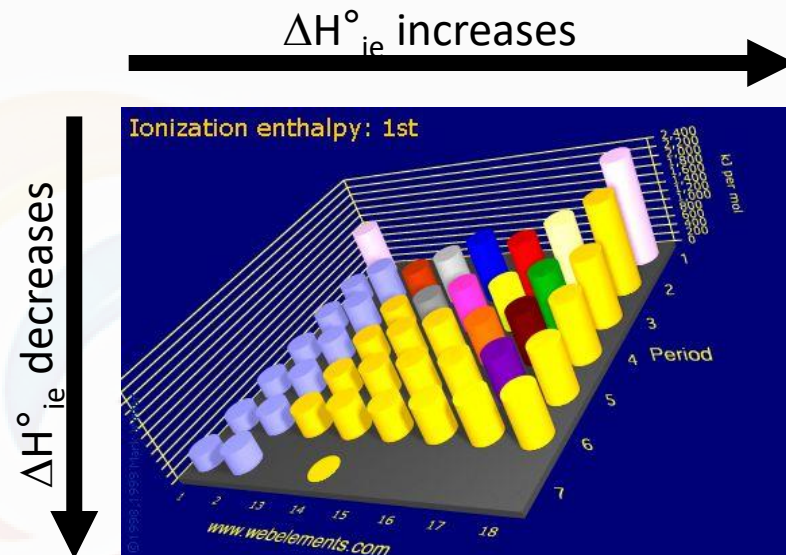
(Mass Numbers in Parentheses are from the most stable of common isotopes.)

Much of the important chemistry of the alkali and alkaline earth metals can be understood on the basis of their low ionization enthalpies (or electronegativities) and the favourability of ionic bonding.

Group 1 - Alkali metals

Group 2 - Alkaline earth metals

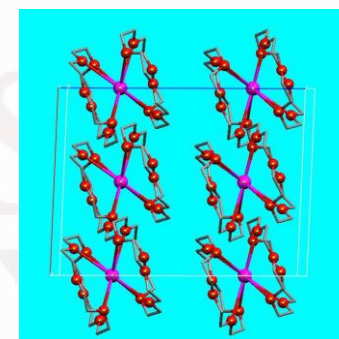
The s-block elements lose their electrons more easily than the other element in the main group so they are usually strong reducing agents and most tend to form ionic compounds. The stabilization that is provided by the crystal lattice (or hydration) energy of the salts they make helps to favour many reactions.



One of the stranger consequences of the low ionization enthalpy is observed when some of the group 1 metals are dissolved in appropriate solvents, such as liquid ammonia:



At low concentration this is a blue solution that contains solvated electrons! If the reaction warms up or is catalyzed, the free electron reacts with the solvent to reduce some of the protons in the solvent to produce hydrogen gas

$$2\text{e}^-_{(am)} + 2(\text{NH}_3)_{(l)} \rightarrow \text{H}_2(g) + 2(\text{NH}_2)^-_{(am)}$$


X-ray crystal structure of $[\text{Cs}^+\text{L}_2][\text{e}^-]$

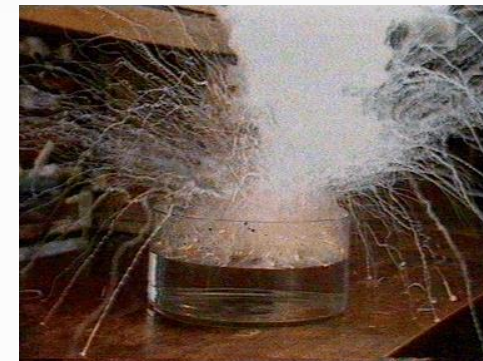
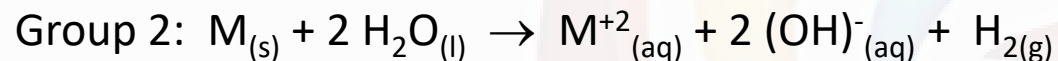
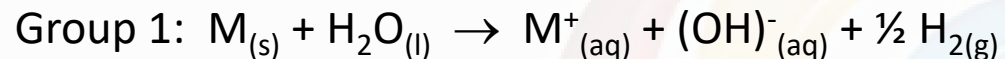
This demonstrates the reducing ability of the alkali metals and is a very common and useful property of these elements.

Group 1 - Alkali metals

Group 2 - Alkaline earth metals

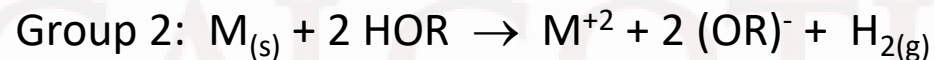
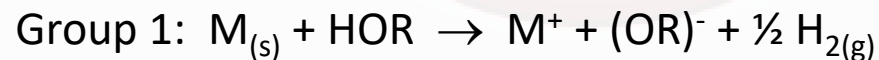
The s-block metals are used as reducing agents for an immense number of different types of compounds.

Reactions of the elements with water:

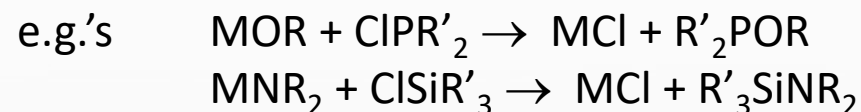


These reactions are very exothermic and increase in violence from the lightest to the heaviest elements in the group (enough to ignite the H_2 for the heavier elements). The non-reversible nature of this reaction means that such metals are very useful for drying many kinds of solvents.

More generally:



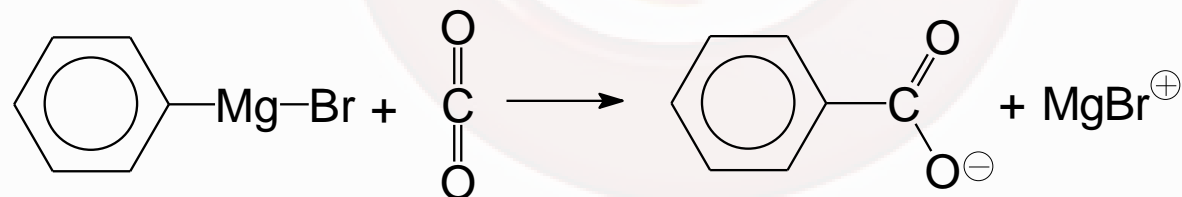
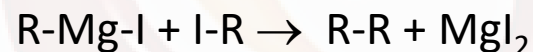
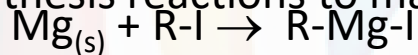
These reactions make metal alkoxides that are very useful for the synthesis of other products using *metathesis* reactions. Metathesis indicates that the reagents exchange ligands with one another. Such reactions are especially favourable when it produces a metal halide because of the large exothermicity provided by the lattice or hydration energies.



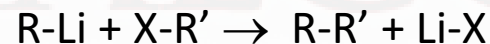
Group 1 - Alkali metals

Group 2 - Alkaline earth metals

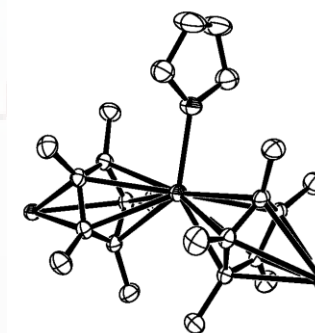
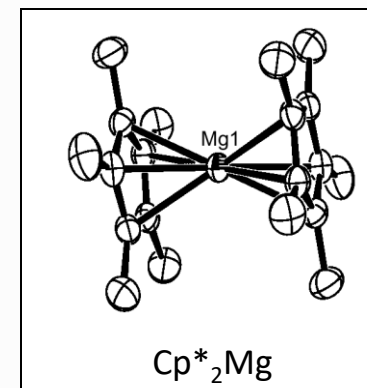
One of the most important discoveries in synthetic chemistry was made by Victor Grignard (Nobel Prize 1912) following the initial work of others. He showed that the reaction of Mg with organic iodides (RI, later applied to other halides) results in the insertion of the Mg into the R-I bond. This provides a reagent of the form R-Mg-I that can be used in nucleophilic or metathesis reactions to make new carbon-carbon bonds.



Analogous and more reactive reagents can be made with Li and Na.



Such compounds were among the first that were recognized to contain bonds between metals and carbon. These were thus some of the initial examples of *organometallic* chemistry (one of the most studied branches of inorganic chemistry today).



REFERENCE_s

Cracknell, A. P. (1969). The Fermi surface. I. s-block and p-block metals. *Advances in Physics*, 18(76), 681-818.

Saxena, A. K., Maguire, J. A., & Hosmane, N. S. (1997). Recent advances in the chemistry of heterocarborane complexes incorporating s-and p-block elements. *Chemical reviews*, 97(6), 2421-2462.

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Englich, U., & Ruhlandt-Senge, K. (2000). Thiolates, selenolates, and tellurolates of the s-block elements. *Coordination Chemistry Reviews*, 210(1), 135-179.



THANK YOU

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