

KABARAK



UNIVERSITY

UNIVERSITY EXAMINATIONS
2010/2011 ACADEMIC YEAR
FOR THE DEGREE OF BACHELOR OF EDUCATION
SCIENCE

COURSE CODE: CHEM 221

**COURSE TITLE: COMPARATIVE STUDY OF s AND p
BLOCK ELEMENTS**

STREAM: SESSION V

DAY: MONDAY

TIME: 2.00 – 4.00 P.M.

DATE: 11/04/2011

INSTRUCTIONS:

- Attempt all questions

PLEASE TURN OVER

QUESTION ONE (20 MARKS)

- a) Define the following terms
- Catenation (2marks)
 - Allotropy (2marks)
 - Electron affinity (2marks)
 - Effective nuclear charge (2marks)
- b) There exists a diagonal relationship between the group-1 element **Li** group-2 element **Mg**. List any three similarities between Li and Mg (3marks)
- c) How do p-block elements differ from s-block elements? (2marks)
- d) Study the table below and explain the following observations.

	B	Al	Ga	In	Tl	
Atomic radius (pm)	85	143	135	167	170	
Ionic radius (pm) M^{3+}	27	53.5	62.0	80.0	88.5	
Density ($g\ cm^{-3}$)	2.35	2.70	5.90	7.31	11.85	
Ionization energy (kJ mol ⁻¹)	I	800	577	578	558	590
	II	2429	1816	1979	1820	1971
	III	3659	2744	2962	1704	2877
Electronegativity	2.0	1.5	1.6	1.7	1.8	
Melting point (K)	2453	933	303	430	576	
Boiling point (K)	3923	2740	2676	2353	1730	

- The atomic radius of Ga is lower than that of Al. (2marks)
- Ionization energy decreases sharply from B to Al and then the ionization energy of Ga is unexpectedly higher than that of Al. (2marks)
- There is a general increase in ionization energy from the 1st to 2nd to 3rd of each of the above elements. (3marks)

QUESTION TWO (20MARKS)

- a) Give an explanation why the first ionization energies of the group 15 element (N, P, As, Sb, Bi) are higher than the corresponding members of the group 14 elements. (4marks)
- b) Explain the quickest way of detecting H_2S ? (2marks)
- c) Give the products of the reaction between phosphorus pentoxide and water and state the observation that would be made from this reaction. (3marks)
- d) Give an explanation for the following properties of HF
- HF has an abnormally high boiling point. (2marks)
 - HF is a very weak acid in dilute aqueous solution but is a strong acid in concentrated solution (5 to 15M). (2marks)
- e) List any two properties of beryllium, the first member of the alkaline earth metal that make it differ from the rest of the members. (3marks)
- f) Explain one way in which Al and Be resemble although they don't belong to the same group? (4marks)

QUESTION THREE (15MARKS)

- a) The ionization value IE_1 of magnesium (Mg), an alkaline Earth metal is 737 kJ mol^{-1} higher than that of its alkali metal counterpart Sodium (Na) 496 kJ mol^{-1} . How can you explain the lowering of IE_2 value of the alkaline Earth metal over the Alkali metal?. [(Mg = 1450 kJ mol^{-1} , Na= 4562 kJ mol^{-1})]? (4marks)
- b) Account for the fact that divalent cations of the alkaline Earth metals form stronger lattices than monovalent cations. Given,
 $H_{\text{sublimation}} = 150 \text{ kJ mol}^{-1}$, $IE_{.1} = 737 \text{ kJ mol}^{-1}$, $IE_{.2} = 2188 \text{ kJ mol}^{-1}$ $H_{\text{atomisation}} = 150 \text{ kJ mol}^{-1}$, $EA = -348 \text{ kJ mol}^{-1}$,
 $H_{\text{hydration}(1)} = -735 \text{ kJ mol}^{-1}$, $H_{\text{hydration}(2)} = -2670 \text{ kJ mol}^{-1}$, for the formation of MgCl and $MgCl_2$ in water. (4marks)
- c) Outline the factors that govern the solubility of a salt in water? (3marks)

- d) Ammonia has a higher boiling point than phosphine and the boiling point increases down the group as shown in the table below. Explain the abnormally high boiling point of ammonia.

Molecule	NH ₃	PH ₃	AsH ₃	SbH ₃	BiH ₃
Boiling point (K)	238.5	185.5	210.6	254.6	290

(4marks)

QUESTION FOUR (15MARKS)

- a) Explain the following observations
- Oxygen unexpectedly has low electron affinity. (2marks)
 - Oxygen has unexpectedly low ionization energy than N. (2marks)
 - Fluorine has unexpectedly less electron affinity than chlorine.(2marks)
- b) Show the hybridization in IF₇. Hence deduce the structure of this compound. (6marks)
- c) Enumerate any three uses of the noble gases. (3marks)