

KABARAK



UNIVERSITY

UNIVERSITY EXAMINATIONS

2010/2011 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION

SCIENCE

COURSE CODE: CHEM 221

COURSE TITLE: CHEMISTRY OF S AND P BLOCK

STREAM: Y2 S2

DAY: TUESDAY

TIME: 2.00 – 4.00 PM

DATE: 29/11/2010

INSTRUCTIONS:

- Attempt all questions
- Periodic Table provided

PLEASE TURN OVER

QUESTION ONE (20MARKS)

- a) Define the following terms
- i. Catenation **(2marks)**
 - ii. Allotropy **(2marks)**
 - iii. Electron affinity **(2marks)**
 - iv. Effective nuclear charge **(2marks)**
- b) Give the "big 6" elements that form the fundamental building blocks of life? **(3marks)**
- c) Explain the difference between p-block elements and 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	

- i. The atomic radius of Ga is lower than that of Al. **(2marks)**
- ii. Ionization energy decreases sharply from B to Al and then the ionization energy of Ga is unexpectedly higher than that of Al. **(2marks)**
- iii. 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) Explain why the first ionization energies of the group 15 element (N, P, As, Pb, Bis) are higher than the corresponding members of the group 14 elements. **(4marks)**
- b) Explain a quick way of detecting H₂S? **(2marks)**
- c) Explain what is observed when phosphorous reacts with water and name the products formed. **(3marks)**
- d) Explain the following properties of HF
- i. HF has an abnormally high boiling point. **(2marks)**
 - ii. HF is a very weak acid in dilute aqueous solution but is a strong acid in concentrated solution (5 to 15M). **(2marks)**
- e) Outline any two properties of beryllium that make it differ from the rest of the alkaline earth metals. **(3marks)**
- f) Explain how Al and Be resemble each other although they don't belong to the same group? **(4marks)**

QUESTION THREE (15MARKS)

- a) The ionization value IE₁ 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. Explain the lowering of IE₂ 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_{sublimation} = 150 kJ mol⁻¹, I.E.₁= 737 kJ mol⁻¹, I.E.₂= 2188 kJ mol⁻¹ H_{atomisation} = 150 kJ mol⁻¹, EA = -348 kJ mol⁻¹,
H_{hydration(1)} = -735 kJ mol⁻¹, H_{hydration(2)}= -2670 kJ mol⁻¹, for the formation of MgCl and MgCl₂ 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 then 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
- i. Oxygen unexpectedly has low electron affinity. **(2marks)**
 - ii. Oxygen has unexpectedly low ionization energy than N. **(2marks)**
 - iii. Fluorine has unexpectedly less electron affinity than chlorine. **(2marks)**
- b) State the hybridization in IF_7 . Hence deduce the structure of this compound. **(6marks)**
- c) Briefly discuss on the uses of noble gases. **(3marks)**