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# KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS  
2017/2018 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER  
MAIN EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE)

**COURSE CODE:** SCH 310

**COURSE TITLE:** COMPARATIVE STUDY OF S AND P BLOCK  
ELEMENTS

**DURATION:** 2 HOURS

**DATE:** 18<sup>TH</sup> JANUARY 2018 **TIME:** 2 – 5PM

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## INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 3 printed pages. Please Turn Over



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## SECTION A (30 MARKS)

### QUESTION 1 (CUMPULSORY QUESTION)

- 1.(a) Outline differences between S and P block elements in the periodic table.(3mks)
- (b) Explain the trend of the atomic radius, first i.e electron affinity and electronegativity across the periodic table. (4mks)
- (c) Explain each of the following observations;
- Beryllium and Aluminium exhibit similar characteristics yet they belong to different groups of the periodic table.(1mk)
  - Fluorine exhibits only -1 oxidation state whereas other halogens exhibit +1, +3, +5, +7 oxidation state also. (1mk)
  - Group 2 elements show greater ionization energy than group 1 elements. (1mk)
- (d) Water (H<sub>2</sub>O) and hydrogen sulphide (H<sub>2</sub>S) are compounds of group six elements. (O and S). Explain why water is a liquid at room temperature whereas H<sub>2</sub>S is a gas. (2mks)
- (e) Oxides of nitrogen from high flying aircraft can lead to depletion of ozone layer. By use of chemical equations, show how this is possible. (3mks)
- (f) An unknown element is a metalloid and has a valence configuration of  $ns^2np^3$ .
- How many valence electrons does this element have? (1mk)
  - What group member in the period table does the element belong to? (1mk)
  - What are some possible identities of this element? (3mks)
  - By help of a chemical equation, give the formula of compound this element will form on reaction with chlorine. (2mks)
- (g) Predict the products of each of the following reaction and then balance each equation. (3mks)
- $\text{SiO}_2 + \text{HF} \longrightarrow$
  - $\text{XeF}_6 + \text{H}_2\text{O} \longrightarrow$
  - $\text{Na}_2\text{S}_2\text{O}_3 + \text{I}_2(\text{s}) \longrightarrow$
- (h) Write the Lewis structure for  $[\text{BeF}_2]^{2-}$  and predict the geometric shape of the complex. (2mks)

## QUESTION 2 (20 MARKS)

- a) Describe in details the extraction process of Aluminium from its principal ore outlining the role of each chemical used. (6 mks)
- b) State 3 reasons why it is not possible to obtain  $F_2$  by electrolysis of aqueous HF or anhydrous HF (3mks)
- c) Describe how you would prepare a Grignard reagent from Mg and two different uses of the reagent in preparative reactions. (3mks)
- d)
  - (i) The Pauling's electronegativity values for oxygen and silicon are 3.5 and 1.8 respectively. Comment on the bond type between O and Si. (1mk)
  - (ii) State any two major applications of phosphates. (1mk)
- e) The first step in the manufacture of nitric acid from ammonia involves the exothermic oxidation of ammonia to nitrogen oxide (NO) and steam.
  - i. Write the equation for the reaction of ammonia with oxygen to form nitrogen oxide steam. ( $1^{1/2}$ )
  - ii. Predict qualitatively the conditions of temperature and pressure for maximum yield of nitrogen oxide. ( $1^{1/2}$ )
  - iii. Describe with equations how nitrogen oxide produced by this process is converted to nitric acid. (3mks)

## QUESTION 3 (20MARKS)

- (a)
  - i. Define the term bond angle.(1mk)
  - ii. Explain why Beryllium chloride is a linear molecule whereas Tin chloride is a trigonalplanar. (3mks)
- (b). Compare the stability of oxosalts of group 1 and group 2 elements with reference to;
  - i. Nitrates (1mk)
  - ii. Carbonates (2mks)
- (c) With reference to reactions with alkalis and acids, show the difference in nature of Aluminium hydroxide with that of Magnesium hydroxide.(4mks)
- (d)  $CO_2$  and  $SiO_2$  are both acidic but  $SiO_2$  is a solid of high melting point whereas  $CO_2$  is a gas at room temperature. Explain. (2mks)
- (e)
  - i. Explain the term Silicones.(2mks)
  - ii. List four applicants of Silicones.(4mks)

#### QUESTION 4 (20 MARKS)

(a) Sulphur catenates more than group (VI) elements.

i. Define the term catenation. (1/2mk)

ii. Give example of species in which Sulphur catenates. (1/2mk)

(b) Beryllium chloride is a substantially covalent but the compounds of group 2A become more ionic on going down the group, such that Barium sulphate is almost purely ionic. Explain this observation. (2mks)

(c) The following table shows the physical data for the halogen hydrides.

Halogen hydrides	Boiling point ( $^{\circ}\text{C}$ )	$K_a$	Bond dissociation energy KJ/mol
Hydrogen fluoride	19.5	154	562
Hydrogen chloride	-85.0	157	431
Hydrogen bromide	-67.0	157	366
Hydrogen iodide	-35.0	$10^{11}$	298

i. Account for the boiling point of the hydrogen halides. (2mks)

ii. Arrange the hydrogen halides in order of increasing acidity and account for the order. (2mks)

iii. Explain why a solution of hydrogen chloride in methyl benzene does not conduct electricity, while in aqueous solution it behaves as a strong electrolyte. (1mk)

(d) Explain why Aluminium chloride is a covalent whereas Aluminium fluoride is ionic. (2mks)

(e) The behaviour of the hydrides of the elements Na-Ar with water is summarised below;

NaH	MgH <sub>2</sub>	AlH <sub>3</sub>	SiH <sub>4</sub>	PH <sub>3</sub>	H <sub>2</sub> S	HCl
React forming H <sub>2</sub> gas and an alkaloid solution			No reaction	Reacts forming a slight alkaline solution	Reacts to form a slightly acidic solution	Reacts to form an acidic solution

i. Write equations to summarise the reactions of NaH and MgH<sub>2</sub> with water. (2mks)

ii. Suggest a reason why SiH<sub>4</sub> has no reaction with water.

iii. Write an equation to account for the formation of a slightly alkaline solution when PH<sub>3</sub> reacts with water. (2mks)

iv. Write an equation to account for the formation of an acidic solution when HCl reacts with water. (2mks)

(f) Beryllium shows certain properties that are not typical of the rest of the group. Mention two of these properties and suggest reasons why the difference should occur. (3mks)

### QUESTION 5 (20 MARKS)

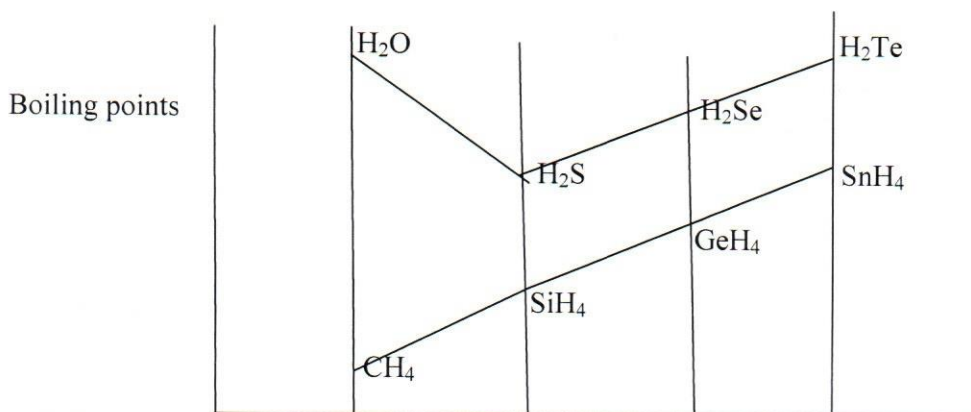
(a) The table below shows the effect of adding water to the chloride of elements in the third period.

Chloride	NaCl	MgCl <sub>2</sub>	AlCl <sub>3</sub>	SiCl <sub>4</sub>	PCl <sub>5</sub>
Adding water	Dissolves	Dissolves	Vigorous reaction	Vigorous reaction	Vigorous reaction

i. Discuss the trend in the pH of the resultant solution.(5mks)

ii. Write the equation for the reaction between Silicon tetrachloride and water. (2mks)

(b) The following is a plot of the boiling points of hydrides of group (VI)A (16) elements.



period

Explain the following facts;

i. The boiling points of group (VI) (16) hydrides are higher than those of group (IV) A (14) hydrogen.(1mk)

ii. The boiling point of water is much higher than the boiling point of other group (vi) A(16) hydrides.(2mks)

iii. The bond angle of ammonia ( $107^\circ$ ) is larger than the bond angle Phosphine ( $93^\circ$ )

(c) i. H<sub>2</sub>S<sub>2</sub>O<sub>4</sub> and H<sub>3</sub>PO<sub>3</sub> are dibasic acids sketch the molecular structures of the acids.(2mks)

ii. State and explain the difference in the acids in (i) above which is a consequence of structure difference. (2mks)

iii. Chloride, NCl<sub>3</sub>, PCl<sub>3</sub> and PCl<sub>5</sub> exist but NCl<sub>5</sub> does not. Account for this observation. (2mks)