MACHAKOS UNIVERSITY

University Examinations 2021/2022

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR SUPPLEMENTARY/SPECIAL EXAMINATION FOR

BACHELOR OF EDUCATION (SPECIAL NEEDS EDUCATION)

BACHELOR OF EDUCATION (SCIENCE)

SCH 300: COMPARATIVE STUDY OF S AND P BLOCK ELEMENTS

DATE: 18/03/2022 **TIME: 2.00 – 4:00 PM**

INSTRUCTIONS

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks)
- Answer any **two** questions from section **B** (each 20 marks)
- Check for useful Tables behind the Question paper

SECTION A

QUESTION ONE (30 MARKS)

(a) Briefly explain the following observations:

(i) Noble gases have comparatively large atomic sizes **(2 marks)**

(ii) Hydroxides of group 1 are much more corrosive than group 2 hydroxides **(2 marks)**

(iii) In aqueous solution Be^{2+} ions exist as $[Be(H_2O)_4]^{2+}$ while Mg^{2+} ions exist as $[Mg(H_2O)_6]^{2+}$ **(4 marks)**

(iv) Magnesium hydroxide is a much more effective antacid than calcium or barium hydroxide **(2 marks)**

(b) (i) Explain why color is imparted to the flame by alkali metals and state why Be and Mg metals do not show these features **(3 marks)**

(ii) Briefly explain why boron forms only $B(OH)_3$ while thallium forms two hydroxides: thallic hydroxide ($Tl(OH)_3$ and thallous hydroxide (Tl(OH). **(3 marks)**

(c) Using relevant chemical equations, show **two** methods of preparation of diborane in the laboratory **(4 marks)**

(d) State any **four** Uses of silicone and its compounds **4 marks)**

(e) State why the properties of beryllium are more similar to aluminium than to magnesium **(2 marks)**

(f) Explain why BiH_3 is the strongest reducing agent amongst all the hydrides of Group 15 elements **(2 marks)**

(g) Give balanced equations for the following reactions: **(2 marks)**

i. $Be\ (s) + 2OH^-\ (aq) + 2H_2O\ (l) \rightarrow$

ii. $Al\ (s) + 2OH^-\ (aq) + 6H_2O\ (l) \rightarrow$

SECTION B

QUESTION TWO (20 MARKS)

(a) (i) State reasons why Li shows anomalous behaviour from other members of the group. **(2 marks)**

(ii) Explain the trend of hydration enthalpy of alkaline earth metals and compare it with that of alkali metals **(2 marks)**

(iii) Boron does not form BF_6^{3-} ion. Explain **(2 marks)**

(iv) State the reason why the sulphates of Be and Mg are soluble in water unlike for Ca, Sr and Ba sulphates **(2 marks)**

(b) (i) With relevant equations briefly discuss the extraction of aluminium from its ore (Bauxite) **(8 marks)**

(ii) State any **Four** uses of aluminium and its compounds **(4 marks)**

QUESTION THREE (20 MARKS)

(a) (i) Show how you will prepare orthoboric acid from borax in the laboratory **(2 marks)**

(ii) Explain why boric acid is considered as a weak acid **(2 marks)**

(b) Complete and balance the following reactions: **(6 marks)**

i. $BCl_3 + H_2O \rightarrow$

ii. $SiCl_4 + H_2O \rightarrow$

iii. $B_2H_6 + O_2 \rightarrow$

(c) Explain the stated trends in group 15 elements

i. Basicity decreases as $NH_3 > PH_3 > AsH_3 > SbH_3 < BiH_3$ **(2 marks)**

ii. Bond angle: NH_3 (107.8°) > PH_3 (99.5°) > AsH_3 (91.8°) ≈ SbH_3 (91.3°) > BiH_3 (90°) **(2 marks)**

iii. Explain why $R_3P = O$ exists but $R_3N = O$ does not (R = alkyl group) **(2 marks)**

iv. Can PCl_5 act as the oxidising or reducing agent? Briefly explain. (2 marks)

v. Define inert pair effect **(2 marks)**

QUESTION FOUR (20 MARKS)

(a) (i) $[SiF_6]^{2-}$ is known whereas $[SiCl_6]^{2-}$ is unknown **(2 marks)**

(ii) With relevant equations show how xenon fluorides XeF_2, XeF_4 and XeF_6 are prepared **(3 marks)**

(iii) Explain why phosphorus shows higher degree of catenation properties than nitrogen **(2 marks)**

(b) (i) Explain why white phosphorus is more reactive than red phosphorus. (3 marks)

(ii) State any five differences between the forms of phosphorus in (i) above. **(3 marks)**

(c) Describe the manufacture of H_2SO_4 by contact process **(4 marks)**

(d) Use reaction equations to show how you will prepare: **(3 marks)**

(i) Cl_2 from HCl

(ii) HCl from Cl_2

QUESTION FIVE (20 MARKS)

(a) (i) Explain why noble gases have comparatively large atomic sizes. **(2 marks)**

(ii) List three uses of argon gas **(3 marks)**

(b) Explain why the bond angle in PH_4^+ is higher than in PH_3 **(4 marks)**

(c) (i) Explain what is meant by diagonal relationship **(1 mark)**

(ii) Using diagonal relationship state any four similarities between B and Si. **(4 marks)**

(d) Explain why compounds of beryllium is covalent whereas those of other group 2 elements are predominantly ionic **(2 marks)**

(e) Using relevant equations explain the chemical process involved in recovering sodium metal from its ore **(4 marks)**