



# 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 thallic 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)**
- $Be(s) + 2OH^-(aq) + 2H_2O(l) \rightarrow$
  - $Al(s) + 2OH^-(aq) + 6H_2O(l) \rightarrow$

## **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)
- $\text{BCl}_3 + \text{H}_2\text{O} \rightarrow$
  - $\text{SiCl}_4 + \text{H}_2\text{O} \rightarrow$
  - $\text{B}_2\text{H}_6 + \text{O}_2 \rightarrow$
- (c) Explain the stated trends in group 15 elements
- Basicity decreases as  $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3 < \text{BiH}_3$  (2 marks)
  - Bond angle:  $\text{NH}_3 (107.8^\circ) > \text{PH}_3 (99.5^\circ) > \text{AsH}_3 (91.8^\circ) \approx \text{SbH}_3 (91.3^\circ) > \text{BiH}_3 (90^\circ)$  (2 marks)
  - Explain why  $\text{R}_3\text{P} = \text{O}$  exists but  $\text{R}_3\text{N} = \text{O}$  does not (R = alkyl group) (2 marks)
  - Can  $\text{PCl}_5$  act as the oxidising or reducing agent? Briefly explain. (2 marks)
  - Define inert pair effect (2 marks)

### QUESTION FOUR (20 MARKS)

- (a) (i)  $[\text{SiF}_6]^{2-}$  is known whereas  $[\text{SiCl}_6]^{2-}$  is unknown (2 marks)  
(ii) With relevant equations show how xenon fluorides  $\text{XeF}_2$ ,  $\text{XeF}_4$  and  $\text{XeF}_6$  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  $\text{H}_2\text{SO}_4$  by contact process (4 marks)
- (d) Use reaction equations to show how you will prepare: (3 marks)
- $\text{Cl}_2$  from  $\text{HCl}$
  - $\text{HCl}$  from  $\text{Cl}_2$

### 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)**

**Periodic Table of the Elements 2006**

H 1.01																	He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 15.99	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3	4	5	6	7	8	9	10	11	12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	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 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (270)	109 Mt (268)	110 Ds (281)	111 Rg (272)							
			58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.97	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	
			90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	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 (262)	

