



MACHAKOS UNIVERSITY

University Examinations 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION (SCIENCE)

SCH 300: COMPARATIVE STUDY OF s AND p BLOCK ELEMENTS

DATE: 9/8/2021

TIME: 8.30-10.30 AM

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:
- Fluorine exhibits only -1 oxidation state whereas other halogens exhibit $+1$, $+3$, $+5$ and $+7$ oxidation states (2 marks)
 - BeCl_2 is covalent and BaCl_2 is ionic and both are in the same group (2 marks)
 - In aqueous solution Be^{2+} ions exist as $[\text{Be}(\text{H}_2\text{O})_4]^{2+}$ while Mg^{2+} ions exist as $[\text{Mg}(\text{H}_2\text{O})_6]^{2+}$ (4 marks)
 - Explain why magnesium hydroxide is a much more effective antacid than calcium or barium hydroxide (2 marks)
- b)
- Explain why colour is imparted to the flame by alkali metals and state why Be and Mg metals do not show these features (3 marks)
 - Briefly explain why boron forms only $\text{B}(\text{OH})_3$ while thallium forms two hydroxides: thallic hydroxide $\text{Tl}(\text{OH})_3$ and thallic hydroxide $\text{Tl}(\text{OH})$ (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 Boron and its compounds (4 marks)
- e) i State why the properties of beryllium are more similar to aluminium than to magnesium (2 marks)
- ii Give balanced equations for the following reactions: (4 marks)
- (a) $\text{Be}_2\text{C}_{(s)} + \text{H}_2\text{O}_{(l)} \rightarrow$
- (b) $\text{Al}_4\text{C}_3(s) + \text{H}_2\text{O}_{(l)} \rightarrow$
- (c) $\text{Be} (s) + 2\text{OH}^- (\text{aq}) + 2\text{H}_2\text{O} (l) \rightarrow$
- (d) $\text{Al} (s) + 2\text{OH}^- (\text{aq}) + 6\text{H}_2\text{O} (l) \rightarrow$

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. $\text{BCl}_3 + \text{H}_2\text{O} \rightarrow$
- ii. $\text{SiCl}_4 + \text{H}_2\text{O} \rightarrow$
- iii. $\text{B}_2\text{H}_6 + \text{O}_2 \rightarrow$

- 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: NH_3 (107.8°) $> \text{PH}_3$ (99.5°) $> \text{AsH}_3$ (91.8°) $\approx \text{SbH}_3$ (91.3°) $> \text{BiH}_3$ (90°) (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 PCl_5 act as the oxidising or reducing agent? Briefly explain (2 marks)
 - State two uses of ClO_2 (2 marks)

QUESTION FOUR (20 MARKS)

- $[\text{SiF}_6]^{2-}$ is known whereas $[\text{SiCl}_6]^{2-}$ is unknown (2 marks)
 - Give the resonance structures of NO_2 and N_2O_5 (3 marks)
 - Explain why phosphorus shows higher degree of catenation properties than nitrogen (2 marks)
- Explain why white phosphorus is more reactive than red phosphorus
 - State any five differences between the forms of phosphorus in (i) above (6 marks)
- Describe the manufacture of H_2SO_4 by contact process (4 marks)
- Use reaction equations to show how you will prepare: (3 marks)
 - Cl_2 from HCl
 - HCl from Cl_2

QUESTION FIVE (20 MARKS)

- Explain why noble gases have comparatively large atomic sizes (2 marks)
 - List three uses of argon gas (3 marks)
- Explain why the bond angle in PH_4^+ is higher than in PH_3 (4 marks)
- Explain what is meant by diagonal relationship (1 mark)
 - Using diagonal relationship state any four similarities between B and Si (4 marks)
- Explain why glass made from B and Al are of higher quality than those made from Na_2O and K_2O (2 marks)
- Using relevant equations explain the chemical process involved in recovering sodium metal from its ore (4 marks)

Periodic Table of the Elements 2006																		He					
H 1.01	2																	13	14	15	16	17	18
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																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)													

Examination Irregularity is punishable by expulsion