



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION (SPECIAL NEEDS EDUCATION)

BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY)

BACHELOR OF EDUCATION (SCIENCE)

SCH 300: COMPARATIVE STUDY OF S AND P BLOCK ELEMENTS

DATE: 30/8/2022

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).
- Periodic table attached in the last page.

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

- a) Giving an appropriate equation in each case, state two ways that small crystalline amount of boron can be obtained. (4 marks)
- b) Most Aluminium salts are acidic in solution. Starting with $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ show how the ion forms an acidic solution. (3 marks)
- c) Explain why the solubility of alkaline earth metal, carbonates and sulphates in water decrease down the group. (2 marks)
- d) State five ways in which Lithium shows similarities to Magnesium in its chemical behaviour. (5 marks)
- e) When Potassium metal dissolves in liquid ammonia the solution can acquire different colours. Provide the colour and explain the reasons for this type of colour change. (3 marks)
- f) Sodium (Z=11), Aluminium (Z=13), Phosphorus (Z=15) and Chlorine (Z=17) are period three elements. Write the Electron configuration for (4 marks)

Na

Al^{3+}

P^{3-}

Cl

- g) State and explain the trend in atomic radius of the elements in (f) above. (2 marks)
- h) Write a balanced chemical equation between: (5 marks)
- KO_2 with H_2O
 - Mg with N_2
 - Na with liquid NH_3
 - NF_3 with H_2O
 - SeCl_4 with AgF
- i) Alkali metals are prepared by electrolysis of their fused chlorides and not through electrolysis of their solutions. Explain this statement. (2 marks)

SECTION B (ANSWER ANY TWO QUESTIONS)

QUESTION TWO (20 MARKS)

- a) Explain the following statements:
- A solution of Na_2CO_3 is alkaline. (3 marks)
 - Alkali metals are prepared by electrolysis of their fused chlorides and not through reduction, displacement nor electrolysis of their solutions. (4 marks)
 - Biologically, sodium is found to be more useful than potassium. (4 marks)
- b) State three applications of the following compounds:
- Calcium Hydroxide, Slaked lime, $\text{Ca}(\text{OH})_2$. (3 marks)
 - Cement ($\text{CaO} \cdot \text{SiO}_2$, $\text{CaO} \cdot \text{Al}_2\text{O}_3$) (3 marks)
 - Plaster of paris, $\text{CaSO}_4 \cdot \text{H}_2\text{O}$ (3 marks)

QUESTION THREE (20 MARKS)

- a) Chemistry of Beryllium, (Be) resembles that of Aluminum, (Al) and differs from other group II elements.
- List two similarities between Be and other group II elements (2 marks)
 - State three differences between Be and other group II elements. (2 marks)
 - Illustrate with suitable examples, the resemblance in the chemistry of Be and Al. (6 marks)
- b) Boron chloride, BCl_3 is said to be electron deficient.
- Explain what electron deficient compounds are. (2 marks)
 - By using Lewis structures, draw the structure of AlCl_3 and SiCl_4 and indicate which of the two is an electron deficient compound. (8 marks)

QUESTION FOUR (20 MARKS)

- a) Explain the following trends:
- There is a phenomenal decrease in ionisation enthalpy from carbon ($Z=6$) to silicon ($Z=14$). (3 marks)
 - A mixture of dilute NaOH and aluminium pieces is used to open blocked waste water drain. (2 marks)

- iii. Both Gallium (Ga) and Aluminium (Al) are group 13 elements with Ga having more occupied shells than Al. However, Ga has a smaller atomic radius than Al. (3 marks)
- iv. The increasing order of the thermal stability of alkaline earth metal carbonates is $\text{MgCO}_3 < \text{CaCO}_3 < \text{SrCO}_3 < \text{BaCO}_3$. (2 marks)
- b) By using relevant chemical equations, classify the following oxides as neutral, acidic, basic or amphoteric.
- i. CO , (1 mark)
- ii. B_2O_3 , (2 marks)
- iii. SiO_2 , (2 marks)
- iv. CO_2 , (2 marks)
- v. Al_2O_3 (3 marks)

QUESTION FIVE (20 MARKS)

- a) Define the following terms:
- i. Van der waal bond (2 marks)
- ii. Ionic radius (2 marks)
- iii. Oxidation number (2 marks)
- iv. Electron affinity (2 marks)
- v. Electronegativity (2 marks)
- b) Describe the biological importance of any two alkaline earth metals. (6 marks)
- c) Nitrogen and Phosphorus bond with halogens forming different structures. Draw and name the structure of NCl_3 and PCl_5 respectively. (4 marks)

1																							18																														
1	H	1.0079											2	He	4.0026																																						
3	Li	6.941	4	Be	9.0122											5	B	10.811	6	C	12.011	7	N	14.007	8	O	15.999	9	F	18.998	10	Ne	20.180																				
11	Na	22.990	12	Mg	24.305	3											13	Al	26.982	14	Si	28.086	15	P	30.974	16	S	32.065	17	Cl	35.453	18	Ar	39.948																			
19	K	39.098	20	Ca	40.078	21	Sc	44.956	22	Ti	47.867	23	V	50.942	24	Cr	51.996	25	Mn	54.938	26	Fe	55.845	27	Co	58.933	28	Ni	58.693	29	Cu	63.546	30	Zn	65.409	31	Ga	69.723	32	Ge	72.64	33	As	74.922	34	Se	78.96	35	Br	79.904	36	Kr	83.798
37	Rb	85.468	38	Sr	87.62	39	Y	88.906	40	Zr	91.224	41	Nb	92.906	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	57-71	*	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)	89-103	#	104	Rf	(261)	105	Db	(262)	106	Sg	(266)	107	Bh	(264)	108	Hs	(270)	109	Mt	(268)	110	Ds	(281)	111	Rg	(272)	112	Uub	(285)	113	Uut	(284)	114	Uuq	(289)	115	Uup	(288)	116	Uuh	(291)	118	Uuo	(294)				
													* Lanthanide series																																								
57	La	138.91	58	Ce	140.12	59	Pr	140.91	60	Nd	144.24	61	Pm	(145)	62	Sm	150.36	63	Eu	151.96	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									
													# Actinide series																																								
89	Ac	(227)	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)									