



MACHAKOS UNIVERSITY

University Examinations 2022/2023

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATIONS FOR

BACHELOR OF EDUCATION (SCIENCE)

BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY)

BACHELOR OF EDUCATION (SPECIAL NEEDS)

SCH 300: COMPARATIVE STUDY OF S AND P BLOCK ELEMENTS

DATE:

TIME:

INSTRUCTIONS:

- i) The paper consists of **TWO** sections, section **A** and section **B**.
- ii) Section **A** is **compulsory** (30 marks).
- iii) Answer any **two** questions from section **B** (each 20 marks).
- iv) There is a periodic table on the last page.

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

- a) The grid below shows part of the periodic table. Use it to answer the questions that follow.

The letters do not represent actual symbols.

N					S	U	V	
P	R				T		W	
Q								

- i) Elements P and Q are s-block elements. Explain. (1 mark)
- ii) Which of the elements in the periodic table has the highest atomic radius? Explain (2 marks)
- iii) Identify the most reactive non-metal in the periodic table. Explain your answer (2 marks)
- v) Compare and explain the atomic radius of P and T. (2 marks)
- vi) The second ionization energy of R is higher than its first ionization energy. Explain. (2 marks)
- vii) Element N and R are diagonally related due to their similarities in atomic and ionic radii. State three similarities between N and R compounds. (3 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 hydroxides in water increase down the group. (2 marks)
- d) (i) Write the electron configuration of the following elements/ions (4 marks)
1. Cu
 2. Xe
 3. P^{3-}
 4. Ca^{2+}
- (ii) Compare and contrast the radius of Ca atom and Ca^{2+} ion. (2 marks)

- e) Write a balanced equation for the following reactions: (5 marks)
- (i) Mg_3N_2 with H_2O
 - (ii) Li with N_2
 - (iii) Heating LiNO_3
 - (iv) NF_3 with H_2O
 - (v) SeCl_4 with AgF
- f) 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) Calculate the effective nuclear charge on
- (i) a 3d electron in ${}_{34}\text{Ge}$ (2 marks)
 - (ii) the outermost electron in ${}_{15}\text{P}$ (2 marks)
- b) Briefly discuss any five (5) chemical properties of group alkali metals (10 marks)
- c) State any three uses of the following compounds
- (i) Calcium oxide / Quicklime (3 marks)
 - (ii) Plaster of paris, $\text{CaSO}_4 \cdot \text{H}_2\text{O}$ (3 marks)

QUESTION THREE (20 MARKS)

- a) The chemistry of Beryllium resembles that of Aluminum and differs from the other group II elements. Illustrate this with suitable examples. (10 marks)
- b) Boron chloride, BCl_3 is electron deficient;
- (i) What are electron deficient compounds? (2 marks)
 - (ii) 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:
- (i) Alkaline earth metals are better electric and heat conductors than alkali metals along a given period. (2 marks)
 - (ii) A mixture of dilute KOH and aluminium pieces is used to open blocked drains. (2 marks)

- (iii) Both Gallium and Aluminium are group 13 elements with Ga having more occupied shells than Al. However, Ga has a smaller atomic radius than Al. (3 marks)
- (iv) BeO is almost insoluble but BeSO₄ is soluble in water. (3 marks)
- b) By using relevant chemical equations, classify the following oxides as neutral, acidic, basic or amphoteric.
- (i) Al₂O₃ (2 marks)
- (ii) NO₂, (2 marks)
- (iii) NO (1 mark)
- (iv) P₂O₅ (2 marks)
- (v) Sb₂O₃ (3 marks)

QUESTION FIVE (20 MARKS)

- a) Define the following terms:
- (i) Covalent radii (1 mark)
- (ii) Ionic bond (1 mark)
- (iii) Oxidation number (1 mark)
- (iv) Ionization energy (1 mark)
- (v) Isoelectronic species (ions/atoms) (1 mark)
- (vi) Polarisation (1 mark)
- b) Explain the following statements:
- (i) Xenon has a closed shell configuration but forms compounds with fluorine. (2 marks)
- (ii) The boiling point of noble gases increases down the noble gas family. (2 marks)
- (iii) Noble gases have zero electron affinity. (2 marks)
- (iv) Halogens are coloured and on moving from F₂ gas to I₂ solid, the colour of halogens becomes darker. (2 marks)
- (v) Generally, halogens are non-metals. However, fluorine shows non-metallic characteristics while Astatine shows some metallic properties as well. (2 marks)
- c) Aluminium (III) chloride forms a dimer structure with both covalent and dative bonds among its atoms. Draw its octet structure and clearly label the bonds. (4 marks)

1													18																										
1	H	1.0079	2											13	14	15	16	17	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	3	4	5	6	7	8	9	10	11	12	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				
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				
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					
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)								
													81	Tl	204.38	82	Pb	207.2	83	Bi	208.98	84	Po	(209)	85	At	(210)	86	Rn	(222)									
													49	In	114.82	50	Sn	118.71	51	Sb	121.76	52	Te	127.60	53	I	126.90	54	Xe	131.29									
													66	Dy	162.50	67	Ho	164.93	68	Er	167.26	69	Tm	168.93	70	Yb	173.04	71	Lu	174.97									
													98	Cf	(251)	99	Es	(252)	100	Fm	(257)	101	Md	(258)	102	No	(259)	103	Lr	(262)									
													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
													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)

* Lanthanide series

Actinide series