



MACHAKOS UNIVERSITY

University Examinations 2023/2024 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATIONS FOR
BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY

BACHELOR OF EDUCATION (SPECIAL NEEDS)

BACHELOR OF EDUCATION (SCIENCE)

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).

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.

								A
B						C	D	E
F	G					H	J	L
M								

- i) Elements E and L are p-block elements. Explain. (1 mark)
- ii) Which of the elements shown in the periodic table above has the least atomic radius? Explain (2 marks)
- iii) Identify the most reactive non-metal. Explain (2 marks)
- iv) Compare and explain the atomic radius and ionic radius of J. (2 marks)
- v) The bond dissociation of D molecule is less than in J molecule. Explain. (2 marks)
- vi) Element B and G are diagonally related due to their similarities in atomic and ionic radii. State three similarities between B and G compounds. (3 marks)
- b) State and explain the trend in atomic radius of elements across period III. (3 marks)
- c) Fluorine differs considerably with other halogens. List any two attributes for this characteristic. (2 marks)
- d) (i) Write their Electron configuration of the following elements/ions (4 marks)
- Rb
- I
- S^{2-}
- Al^{3+}
- (ii) Compare and contrast the radius of Na atom and Na^{1+} ion. (2 marks)
- e) By using relevant chemical equations, classify the following oxides as neutral, acidic, basic or amphoteric.
- (i) Al_2O_3 (2 marks)
- (ii) NO_2 , (2 marks)
- (iii) NO (1 mark)
- 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) 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 (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) Halogens are coloured and on moving from F_2 gas to I_2 solid, the colour of halogens becomes darker. (2 marks)
 - (iv) 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)
- d) Boron chloride, BCl_3 is an electron deficient compound. Explain. (2 marks)

QUESTION THREE (20 MARKS)

- a) Calculate the effective nuclear charge on a 3d electron in $_{33}As$ (2 marks)
- b) The outermost electron in $_{17}Cl$ (2 marks)
- c) Briefly discuss any five (5) chemical properties of group alkali metals (10 marks)
- d) State any three uses of the following compounds Quicklime, CaO (3 marks)
- e) Plaster of paris, $CaSO_4 \cdot \frac{1}{2}H_2O$ (3 marks)

QUESTION FOUR (20 MARKS)

- a) Define the following terms and use explain its occurrence in an atom/ion or a compound:
- (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. (10 Marks)

QUESTION FIVE (20 MARKS)

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

