



# **MAASAI MARA UNIVERSITY**

**REGULAR UNIVERSITY EXAMINATIONS**

**2021/2022 ACADEMIC YEAR**

**FIRST YEAR FIRST SEMESTER**

**SCHOOL OF PURE, APPLIED AND HEALTH  
SCIENCES (SPAHS)**

**BACHELOR OF SCIENCE IN CHEMISTRY &  
BACHELOR OF EDUCATION (SCIENCE)**

**COURSE CODE: CHE 1103 – 1/CHE 1100-1**

**COURSE TITLE: BASIC INORGANIC CHEMISTRY**

**DATE: 1<sup>ST</sup> APRIL, 2022**

**TIME: 1430-1630**

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**INSTRUCTIONS TO CANDIDATES**

1. Answer Question **ONE** and any other **TWO** questions in section **B**
2. No writing on the Question paper
3. Use of mobile phone in the exam room is prohibited
4. Constants to use: Rydberg's –  $1.097 \times 10^7 \text{m}$ , Planks –  $6.626 \times 10^{-34} \text{Js}$ , speed of light –  $3.0 \times 10^8 \text{m/s}$

## QUESTION ONE

[30 MARKS]

- a) Define the following terms;
- i. Atomic orbital [1 marks]
  - ii. Pfund transition series [1 marks]
  - iii. Ground state [1 marks]
  - iv. Zeeman's effect [1 marks]
- b) Using a well labelled diagram, explain the working principle of a Mass spectrometer [5 marks]
- c) Highlight any four limitations of Bohrs model of an atom [2 marks]
- d) Match the following atomic models with the scientist who discovered them [1 mark];
- i. Nuclear model
  - ii. Planetary model
- e) Use a well labelled diagram to describe Rutherford's gold foil experiment and its contribution to the development of the atomic structure [5 marks]
- f) Calculate the amount of energy emitted during a Balmer series occurring in the Visible region of 486nm [5 marks]
- g) Draw the shapes of the following atomic orbitals;
- i. S orbital [1/2 mark]
  - ii.  $P_x$  orbital [1/2 mark]
  - iii.  $d_{xz}$  orbital [1/2 mark]
  - iv.  $d_x^2 - y^2$  orbital [1/2 mark]
- h) For the element  $Z = 17$ ;
- i. Determine the four quantum numbers for electrons in the shell  $n = 3$  [2 marks]
  - ii. Write its box profile electronic configuration [2 marks]
- i) State the following rules;
- i. Heisenbergs uncertainty principle [1 mark]
  - ii. De Brogli's rule [1 mark]
- j) Describe how you can compare atomic radii of elements across the period with their nuclear charge [1 mark]

## QUESTION TWO

[10 MARKS]

- a) State the following;
- i. Pauli's principle [1 mark]
  - ii. Aufbau's principle [1 mark]
  - iii. Hundz rule [1 mark]
- b) Determine the noble gas and box profile electronic configurations for the following elements (without using a periodic table);
- i. Element  $Z = 45$  [2 marks]
  - ii. Element  $Z = 75$  [2 marks]
- c) Why is the first ionisation energy beryllium is higher than boron? [3 Marks]

## QUESTION THREE

[10 MARKS]

Describe the contributions of the following scientists to the development of the atomic model;

- a) J.J. Thompson [3 marks]
- b) John Dalton [3 marks]
- c) Robert Millikan [4 marks]

## QUESTION FOUR

[10 MARKS]

- a) Calculate the amount of energy contained in an electron in the last principal quantum number of the element Francesium ( $Z = 87, n = 7$ ) [3 marks]
- b) Calculate the energies and frequencies for an electron falling from  $n=5$  in a Paschen series transition [5 marks]
- c) Describe the trends in reactivity down Group VA [2 marks]

**QUESTION FIVE****[10 MARKS]**

- a) What do you understand by classical and quantum chemistry? **[1 mark]**
- b) Name any two scientists that emerged from Neils Bohrs limitations in his descriptions of the atomic model. What contributions and rules did each of these scientists formulate? **[4 marks]**
- c) State the factors that are significant in the changes of atomic radii. **[1 Mark]**
- d) Explain the variation of atomic radius
- i) Across the period **[1½ mark]**
- ii) Down Group VA **[1½ mark]**
- e) What are hydrogenic atoms? State two examples of hydrogenic atoms **[2 marks]**

**QUESTION SIX****[10 MARKS]**

- a) Determine the group, period and block for each of the following elements.
- i.  $1s^2 2s^2$  **[1½ Mark]**
- ii.  $1s^2 2s^2 2p^5$  **[1½ Mark]**
- iii.  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$  **[1½ Mark]**
- iv.  $1s^2 2s^2 2p^6 3s^2 3p^3$  **[1½ Mark]**
- b) Describe 2 limitations of Dalton's postulate, citing examples **[2 marks]**
- c) Explain why  $Mg^{2+}$  is smaller when compared to  $Na^+$  **[2 Marks]**

**QUESTION SEVEN****[10 MARKS]**

- a) Write the electron configuration for the element  $Z = 25$  **[3 marks]**
- b) Explain the variation of ionisation energy across the third period **[3 Marks]**

Element	Na	Mg	Al	Si	P	S	Cl	Ar
IE (kJ/mol)	496	738	578	786	1012	1000	1251	1521

- c) How does the boiling point down the Group VII change? **[2 Marks]**
- d) 'Metallic character increases from top to bottom in a group and decreases from left to right in a period of the periodic table'. Explain this quotation **[2 Marks]**

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