

UNIVERSITY EXAMINATIONS

1ST SEMESTER 2022/2023 ACADEMIC YEAR

**FIRST YEAR EXAMINATION FOR THE DEGREES OF
BACHELOR OF SCIENCE (GENERAL), BACHELOR OF
EDUCATION (SCIENCE), BACHELOR OF SCIENCE
(BMED), BACHELOR OF SCIENCE (BIOCHEMISTRY)**

CHEM 111: INORGANIC CHEMISTRY I

STREAM: R

TIME: 2 HRS

DAY: MONDAY [8.30AM – 10.30AM]

DATE: 05/12/2022

THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

INSTRUCTIONS: -

- i) answer all questions
- ii) periodic table provided

QUESTION ONE**(30 MARKS)**

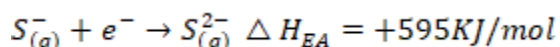
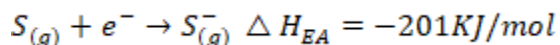
- a) Distinguish between the following terms. (4marks)
- i) Molarity and Normality
 - ii) Electronegativity and electron affinity
- b) List the **THREE** components of an atom and state their mass and charge (4.5marks)
- c) Calculate the percent by weight of each element present in $K_2S_2O_3$ (3marks)
- (K= 39.10, S=32.45, O=16.00)
- d) Explain the limitations of Rutherford's atomic model (2marks)
- e) Write the electronic configuration of the following elements (1.5marks)
- i) Al^{3+}
 - ii) K
 - iii) Cl
- f) Explain the reason for following observations;
- i) The atomic size increases down the group I and group VII elements (1mark)
 - ii) Ionization energy increases across the period in the periodic table (1mark)
- g) Write the Lewis structure of the following compounds.
- i) SO_2 (2marks)
 - ii) BeH_2 (2marks)
- h) Explain the **FOUR** quantum numbers used to describe the distribution of electrons in an atom (4marks)
- i) What is the wavelength of a photon emitted during a transition from $n_i=4$ state to $n_f=2$ in the hydrogen atom ($R=2.18 \times 10^{-18}J$, $C=3 \times 10^8 m/s$ and $h=6.63 \times 10^{-34}JS$) (3marks)
- j) State the following;
- i) Aufbau's principle (1mark)
 - ii) Pauli's exclusion principle (1mark)



QUESTION TWO

(20 MARKS)

- a) State the significance of atomic number (1mark)
- b) Copper consists of two naturally occurring isotopes Copper-63 and copper-65, Its relative atomic mass is 63.62. Find the abundances of each isotope. (3marks)
- c) Draw the shapes of 2p orbitals. (3marks)
- d) State the any **FOUR** postulates of Dalton's atomic theory (4marks)
- e) Consider the following equation for 1st and 2nd electron affinity from a Sulphur gaseous atom.



Explain why the 1st electron affinity of S is negative while the 2nd electron affinity is positive.

(2marks)

f) i) A concentrated solution of Sulphuric acid has a percent purity of 98% and a specific gravity of 1.84g/cm³ (S= 32, O=16,H=1).

a) Calculate the molarity of this solution. (3marks)

b) What volume of concentrated Sulphuric acid is required to make 500ml of 0.2M solution of Sulphuric acid (2marks)

f) ii) 150ml of an aqueous sodium chloride solution contains 0.0045g sodium chloride. Calculate the concentration of sodium chloride in ppm. (2marks)

QUESTION THREE

(20MARKS)

- a) State Hess law (1mark)
- b) Given

Process	ΔH (kJ/mol)
$Li_{(s)} \rightarrow Li_{(g)}$	$\Delta H_1 = 190$
$Li_{(g)} \rightarrow Li_{(g)}^{+}$	$\Delta H_2 = 590$
$\frac{1}{2}Cl_{2(g)} \rightarrow Cl_{(g)}$	$\Delta H_3 = 120$
$Cl_{(g)} \rightarrow Cl_{(g)}^{-}$	$\Delta H_4 = -360$
$Li_{(g)}^{+} + Cl_{(g)}^{-} \rightarrow LiCl_{(s)}$	$\Delta H_5 = -760$

- i) Construct a Born Haber energy diagram for the formation of LiCl_(s).

(4marks)

- ii) Calculate the enthalpy of formation of $\text{LiCl}_{(s)}$ (2marks)
- c) 11.5 g organic compound sample was combusted in a stream of air to yield 22.0 g of CO_2 and 13.5 g of H_2O . If the original compound contained Carbon, Hydrogen and Oxygen only; (C=12, H=1, O=16)
- i) Calculate the mass of each element in the 11.5g of the organic compound. (3marks)
- ii) Determine the empirical formula of the compound (2.5marks)
- d) i) what are intermolecular forces? (1mark)
- ii) Briefly describe the following intermolecular forces and give a diagrammatic illustration of each
- i) Hydrogen Bonding (1mark)
- ii) Dipole-Dipole Forces (1mark)
- e) Calculate the number of neutrons and electrons in one atom of $^{15}_{31}\text{P}$ (1.5marks)
- f) Draw the energy diagram of hydrogen spectra showing clearly all the series (3marks)

