MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

P.O. Box 972-60200 – Meru-Kenya
Tel: +254(0) 799 529 958, +254(0) 799 529 959, + 254 (0) 712 524 293,
Website: info@must.ac.ke Email: info@must.ac.ke

University Examinations 2024/2025

FIRST YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE IN BIOLOGICAL SCIENCES, BACHELOR OF SCIENCE IN BIOTECHNOLOGY AND BACHELOR OF SCIENCE IN BIOCHEMISTRY)

SCH 3100: PRINCIPLES OF INORGANIC CHEMISTRY

DATE: DECEMBER 2024 **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE (30 MARKS)

a) Classify the following materials into either element, molecule, compound, or a mixture (2 marks)

- Aqueous iodine solution, barium sulphate, glucose, uranium

b) Matter may be classified by its chemical constitution as an element, a compound, or a mixture. Explain these three terms (3 marks)

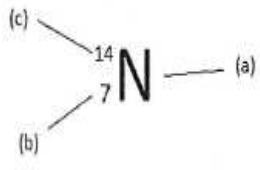
c) You heat 2.53 grams of metallic mercury in air, which produces 2.73 grams of a red-orange residue. Assume that the chemical change is the reaction of the metal with oxygen in air.

Mercury + oxygen →Y red-orange residue

(i) What is the mass of oxygen that reacts? (3 marks)

(ii) When you strongly heat the red-orange residue, it decomposes to give back the mercury and release the oxygen, which you collect. What is the mass of oxygen you collect? (3 marks)

d) A specific isotope of an element is represented by showing its three features (a), (b) and (c) as shown below, name them (3 marks).



e) An element has three naturally occurring isotopes with the following masses and abundances:

Isotopic Mass (amu)	Fractional Abundance
38.964	0.9326
39.964	1.000×10^{-4}
40.962	0.0673

Calculate the atomic mass of this element (4 marks)

f) Hydrogen sulfide (H2S) is a gaseous compound of hydrogen and sulfur in the atomic ratio 2:1. A sample of hydrogen sulfide contains 0.587 g H and 9.330 g S. What is the atomic mass of S relative to H? (4 marks)

g) Group the following compounds as being ionic or molecular (covalent)? (2 marks)

(i) BaF_2 (ii) SF_4 (iii) PH_3 (iv) CH_30H

h) Draw the possible ground state orbital diagram for the electron configuration of the oxygen atom. (3 marks)

i) What is the notation for the subshell in which n=4 and l= 3? How many orbitals are in this subshell? (3 marks)

QUESTION TWO (20 MARKS)

a) With two examples each, distinguish between:

i. Physical and chemical changes (give 2 examples) and (3 marks)

ii. Physical and chemical properties (give 2 examples). (3 marks)

b) Nitric acid is composed of HN03 molecules. A sample weighing 4.50 g contains 4.30×10^{22} HNO_3 molecules. How many nitrogen atoms are in this sample? How many oxygen atoms are in 2.81 g of nitric acid? (5 marks)

c) Boric acid, H_3BO_3, is a mild antiseptic and is often used as an eyewash. A sample contains 0.543 mol H_3BO_3. What is the mass of boric acid in the sample? (Atomic mass of B= 10.81amu) (4 marks)

d) A sample of an alloy of aluminum contains 0.0898 mol Al and 0.0381 mol Mg. What are the mass percentages of Al and Mg in the alloy? (Al =26.98 amu; Mg = 24.31 amu) (5 marks)

QUESTION THREE (20 MARKS)

a) Physical theory at the time Rutherford proposed his nuclear model of the atom was not able to explain how this model could give a stable atom. Explain the nature of this difficulty. (4 marks)

b) Explain the main features of Bohr's theory and state whether these features solve the difficulty alluded to in Question 3a? (5 marks)

c) The green line in the atomic spectrum of thallium has a wavelength of 535 *nm*. Calculate the energy of a photon of this light. (6 marks)

d) If the *n* quantum number of an atomic orbital is 4, what are the possible values of *l*? If the *l* quantum number is 3, what are the possible values of *ml*? (5 marks)

QUESTION FOUR (20 MARKS)

a) Explain why each of the following three sets of quantum numbers would not be permissible for an electron, according to the rules for quantum numbers. (6 marks)

$$n = 1,\ l = 0, m_1 = 0,\ m_s = +1$$

$$n = 1,\ l = 3, m_1 = +3,\ m_s = +\frac{1}{2}$$

$$n = 3,\ l = 2,\ m_1 = +3,\ m_s = -\frac{1}{2}$$

b) What is the wavelength of the electromagnetic radiation emitted from a hydrogen atom when the electron undergoes the transition $n = 5$ to $n = 4$? (7 marks)

c) List the orbitals in order of increasing orbital energy up to and including 4p orbitals. (3 marks)

d) Use the building-up principle to obtain the electron configuration of the ground state of iodine (Z=53). (4 marks)