



MAASAI MARA UNIVERSITY

**REGULAR UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR
FOURTH YEAR FIRST SEMESTER**

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

BACHELOR OF SCIENCE IN CHEMISTRY

COURSE CODE: CHE 4137

COURSE TITLE: BIO-INORGANIC CHEMISTRY

DATE: XX MARCH, 2022

TIME: XX - YY HRS

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

QUESTION ONE

[30 MARKS]

- a) Define the following terms;
- i. Bio-inorganic compounds [1 mark]
 - ii. Porphyrin rings [1 mark]
 - iii. None-heme metalloproteins [1 mark]
 - iv. Hydroxamic acids [1 mark]
- b) Name at least two bio-inorganic compounds with the following functions;
- i. Electron transfer [1 mark]
 - ii. Oxygen transportation [1 mark]
 - iii. Enzymatic functions [1 mark]
- c) Write the electronic configurations of the following f-block elements;
- i. Erbium ($Z = 68$) [1 mark]
 - ii. Am^{3+} ($Z = 95$) [1 mark]
- d) Describe three similarities between lanthanoids and actinoids [3 marks]
- e) Draw the following bio-inorganic compounds crucial in the field of medicine;
- i. Cis-platin [2 marks]
 - ii. Ruthenium anti-cancer drugs [2 marks]
 - iii. Ferric hydroxamate [2 marks]
- f) Write a general reaction for laboratory synthesis of porphyrins [3 marks]
- g) Identify any two industrial applications of porphyrin compounds [2 marks]
- h) Draw the structures of the following oxygen-transportation porphyrin derivatives;
- i. Hemoglobin [3 marks]
 - ii. Myoglobin [3 marks]
- i) How is metal poisoning treated? [1 mark]

QUESTION TWO

[30 MARKS]

- a) Give any four differences between lanthanoids and actinoids [4 marks]
- b) Name and draw the parent/precursor porphyrin compound [3 marks]
- c) Draw and give the significances of the following porphyrin and corrin derivatives;
 - i. Chlorophyll a [4 marks]
 - ii. Vitamin B₁₂ [4 marks]
- d) What are the basic properties of d and f-block metals that enable them form bio-inorganic compounds [3 marks]
- e) What do you understand by lanthanoid contraction? [2 marks]

QUESTION THREE

[30 MARKS]

- a) Draw the following states of hemoglobin dependent on the carrier molecule;
 - i. Oxyhemoglobin [2 marks]
 - ii. Carbamino-hemoglobin [2 marks]
 - iii. Carboxy-hemoglobin [2 marks]
- b) Describe cooperativity function of hemoglobin [4 marks]
- c) Draw and state organisms with the following non-heme metalloproteins;
 - i. Ferritin [3 marks]
 - ii. Rubredoxin [3 marks]
 - iii. Hemerythrin [3 marks]
- d) The early lanthanoids participate in bio-inorganic compounds formation while there exist rarely any bio-inorganic compounds with actinoids. Why is this so? [1 mark]

QUESTION FOUR

[30 MARKS]

- a) What do you understand by metal-ion poisoning? [2 marks]
- b) What are heavy metals [1 mark]
- c) Describe the route of exposure, bio-uptake and bio-accumulation of metals into the human body [4 marks]
- d) Use relevant equations to illustrate the mechanism of metal poisoning by;
 - i. Metal-induced oxidative stress and oxidation of bio-compounds [3 marks]
 - ii. Biochemical mechanisms [3 marks]
- e) Describe the nitrogen cycle [3 marks]
- f) State the role and draw the structure of molybdenum nitrogenase [3 marks]
- g) What is the role of manganese in photosynthesis? [1 mark]