



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
SAN 302: BIOINORGANIC CHEMISTRY

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) Describe the following terms as used in bioinorganic chemistry:
- (i) Deficiency (1½ marks)
 - (ii) Essential element
 - (iii) Bioavailability (1½ marks)
 - (iv) Coordination compound (1½ marks)
- b) Explain the medicinal relevance of the following elements/ions. (10 marks)
- i. Li^{1+}
 - ii. Gd^{3+}
 - iii. Pt^{2+}
 - iv. Au^{1+}
 - v. Sb^{3+}
- c) Describe two properties of iron that can account for its extensive use in terrestrial biological reactions. (2 marks)
- (i) State three reasons why certain elements are selected for use in biological systems. (3 marks)
 - (ii) Explain why Molybdenum though a rare element in the earth's crust, is utilized more biologically than Chromium. (3 marks)
 - (iii) Despite the high abundance of silicon, aluminium and titanium on earth, these elements are not much utilized biologically. Explain. (3 marks)
- d) Cadmium is an important global environmental pollutant. State three Cd characteristics that lead to toxicity upon its consumption/exposure by an organism. (3 marks)

SECTION B (ANSWER ANY TWO QUESTIONS)

QUESTION TWO (20 MARKS)

- a) Describe three nitrogen fixation processes (6 marks)
- b) Draw the structure of the following cluster molecules and state their function of each in a biological organism:
- i) Ferredoxin (3 marks)
 - ii) Zinc finger (3 marks)

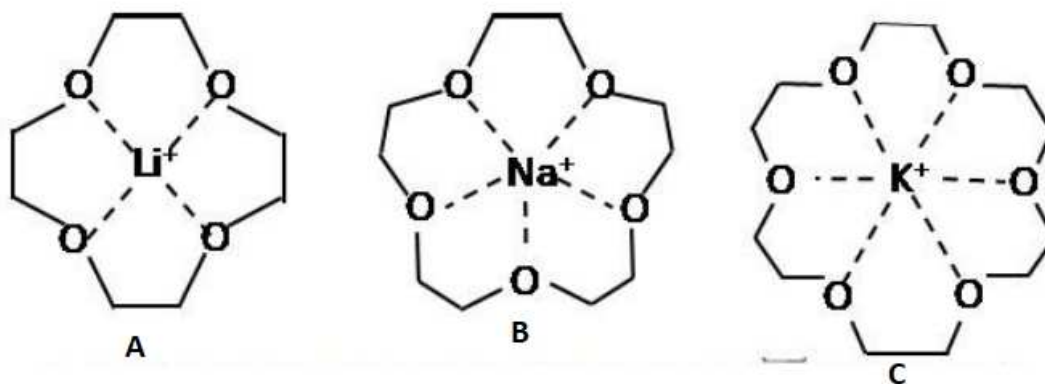
- c) Despite the high abundance of Si, Al and Ti (the 2nd, 3rd, and 10th most abundant elements on earth). Explain why they are not much utilized biologically? (3 marks)
- d) Discuss the characteristics of a soft acid and a soft base. Give two examples of each case. (5 marks)

QUESTION THREE (20 MARKS)

- a) Describe the regulatory role of Na⁺ - K⁺ ATPase/pump. (10 marks)
- b) Explain the biological significance of the following elements/ions. (10 marks)
- Ca²⁺
 - Fe²⁺ /Fe³⁺
 - Si^{IV} (“silicate”)
 - P^V(phosphate)
 - F^{I-}

QUESTION FOUR (20 MARKS)

- a) Describe briefly how haemoglobin transports oxygen to cell/tissues. (6 marks)
- b) (i) Name the following synthetic macrocyclic polyethers. (3 marks)



- (ii) Describe four biological importance of crown ethers (6 marks)
- c) Metals in biological systems are often bound to macrocycles.
- Define the term macrocycles. (1 mark)
 - Draw the structure of the corrin macrocycle ring. (4 marks)

QUESTION FIVE (20 MARKS)

- a) Write the correct chemical formula for the following complexes:
- (i) Amminetetraaquachromium (II) sulphate (1½ marks)
 - (ii) Dihydroxotrinitrocobalt (III) ion (1½ marks)
 - (iii) Dichlorotetrakis(ethylenediammine)platinum (II) (1½ marks)
 - (iv) Pentacarbonyliron (0) (1 mark)
 - (v) Pentaquatetrachlorocobaltate (III) (1½ marks)
- b) A cow was progressively exposed to pastures with rare to abundant Selenium levels. Draw a well labeled selenium Response against Dose curve for the goat. Describe the three main phases of your curve (10 marks)
- c) Differentiate between essential macro and trace elements giving two examples in each case. (3 marks)