



MACHAKOS UNIVERSITY

University Examinations 2022/2023

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) Ligand (1½ marks)
 - ii) Homologue elements (1½ marks)
 - iii) Ionophores (1½ marks)
 - iv) Coordination compound (1½ marks)
 - v) Bioavailability (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)
- (d) Give the IUPAC names of the following compounds:
- i) $[\text{Cr}(\text{Cl})_2(\text{H}_2\text{O})_4]\text{F}$ (1½ marks)
 - ii) $[\text{CoCl}_2(\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2)_2]^+$ (1½ marks)
 - iii) $\text{Na}_3[\text{Fe}(\text{CN})_6]$ (1½ marks)
 - iv) $[\text{Pt}(\text{CO})_5\text{Cl}]_2(\text{SO}_4)_3$ (1½ marks)
 - v) $[\text{Cu}(\text{CN})_4]^{2-}$ (1½ marks)
- (e) Differentiate between essential macro and trace elements giving two examples under each. (3 marks)

SECTION B (ANSWER ANY TWO QUESTIONS)

QUESTION TWO (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 goat was progressively exposed to pastures with rare to abundant Fluoride levels.

- (i) Draw a well labeled fluoride Response against Dose curve for the goat. (5½ marks)
- (ii) Describe the three main phases of your curve (4½ 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 utilized much biologically. (3 marks)

QUESTION THREE (20 MARKS)

(a) (i) Draw the porphyrin ring structure of a haem group in haemoglobin. (4 marks)

(ii) Porphyrin and chlorin macrocycles occur in haemoglobin and chlorophyll respectively. State any two differences between the two macrocycles. (2 marks)

(b) Describe any two characteristics that make certain elements to be "selected" for use in biological systems. (4 marks)

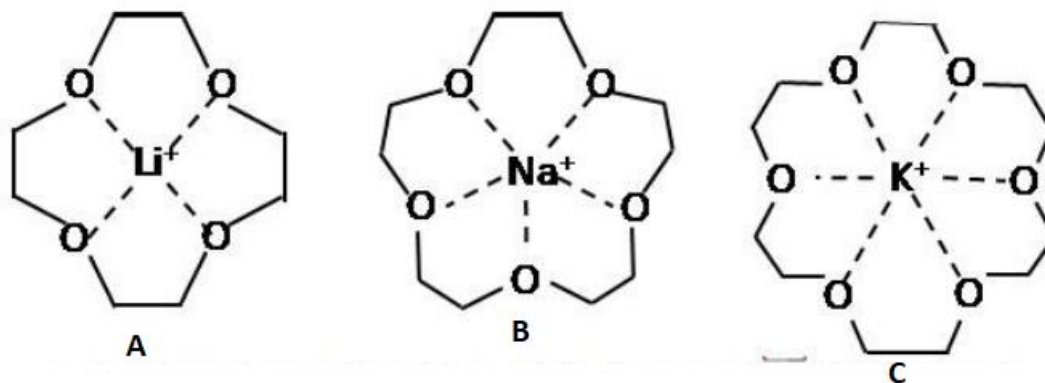
(c) Explain the biological significance of the following elements/ions. (10 marks)

- i) Na¹⁺ and K¹⁺:
- ii) Si^{IV} ("silicate"):
- iii) P^V(phosphate):
- iv) Zn²⁺:
- v) F¹⁻:

QUESTION FOUR (20 MARKS)

(a) Describe briefly how haemoglobin transports oxygen to cell/tissues. (6 marks)

(b) 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.

(i) Define the term macrocycles.

(1 mark)

(ii) Draw the structure of the corrin macrocycle ring.

(4 marks)

QUESTION FIVE (20 MARKS)

a) Describe the three nitrogen fixation processes

(6 marks)

b) Draw the structure of the following cluster molecules and state the function of each in a biological organism:

i) Ferredoxin

(2½ marks)

ii) Zinc finger

(2½ marks)

c) Cadmium is an important global environmental pollutant. State four Cd characteristics that lead to toxicity upon its consumption/exposure to an organism.

(4 marks)

d) Using two examples in each case, discuss the characteristics of a hard acid and a hard base.

(5 marks)