

CHUKA



UNIVERSITY

### UNIVERSITY EXAMINATIONS

## EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE CHEM 314: BIOINORGANIC CHEMISTRY

STREAMS: BSC Y3S1

TIME: 2 HOURS

DAY/DATE: MONDAY 23/12/2024

11.30 A.M -

1.30 P.M

### INSTRUCTIONS:

Answer Question **ONE** and Any other **TWO** Questions

### QUESTION ONE [30 marks]

(a)(i) Distinguish between an essential element and a beneficial element [2marks]

(ii) What biochemical criteria must an element demonstrate to be regarded

An essential element?

[ 4marks]

(b).(i). Define hard acids and hard bases. Provide two examples each and explain the characteristics that make them "hard." [4 marks]

(ii) Define soft acids and soft bases. Provide two examples each and explain

the characteristics that make them "soft"

[ 4marks].

c. (i). Illustrating with examples where necessary demonstrate how toxicity can arise in an organism [5marks].

(ii) With reference to copper as an example, discuss its toxicity and show

how it can be treated.

[4marks].

d) (i) Distinguish between bioavailability and homeostasis. [ 2. marks]

(ii) Discuss factors that affect the strength of the binding of a metal ion in a complex [5marks].

**QUESTION TWO [20 marks]**

(a) Chelation therapy is a commonly used treatment method for heavy metal poisoning

(i). Explain briefly what is meant by the term chelate effect. [1.5 marks]

(ii). Enumerate the necessary criteria a potential chelating agent must exhibit before it can be used as a drug. [4marks]

b).(i). What are siderophores? Explain their sources and functions.[2.5marks]

(ii). Draw the basic functional groups of siderophores that enable them to bind iron with high affinity and give an example of each category of siderophores. [1.5 marks]

c). (i). Briefly describe how microbes get and releases enough iron from their environment despite the fact that they are too tiny. [3marks].

(ii). Explain developing embryos of certain birds are protected against microbial attacks. [2marks]

d). (i). Where and in which form is iron stored in human body? [ 1.5marks]

(ii). What are transferrins ? Name three well known transferrins and where they are found. **[ 2marks]**

(iii). Describe briefly the structure of transferrin and explain the mechanism for release of iron from transferrin. **[2marks]**

**QUESTION THREE [20marks]**

a).(i). Distinguish between active and passive transport of ions across a cell membrane. **[ 1.5. marks]**

(ii). Discuss briefly the origin and propagation of a nerve impulse. **[2 marks]**

(b).(i).What are respiratory pigments? Give examples of respiratory pigments. **[2marks]**

(ii). Discuss the changes that occur in the heme of hemoglobin on going from deoxy to oxy form? **[2.5marks]**

(c).(i). Hemoglobin acts as an oxygen carrier from lungs to muscles but as carbon

dioxide carrier from the tissues to the lungs. Explain this cycle **[ 2.5marks]**

(ii). Compare and contrast the oxygen-binding curves of myoglobin and hemoglobin. What do these curves indicate about their respective roles in oxygen transport?

**[2.5marks]**

d) (i) Explain the Bohr effect and its importance in oxygen transport and release by hemoglobin. **[ 2.marks]**

(ii) Describe briefly what cytochromes are and why cytochrome C has no potential

oxygen binding capacity. **[2marks]**

(iii). Outline the similarities and differences between haem units in

deoxyoglobin and cytochrome c. [2.5marks]

### QUESTION FOUR [ 20marks]

a) (i). Describe briefly the structure of chlorophyll  $a_1$  and rationalize why magnesium is the metal of choice found in a chlorophyll molecule.

[5marks]

(ii) Why is chlorophyll such a stable molecule towards photodecomposition?

[1.5marks]

b). (i). Briefly describe what iron – sulphur proteins are? [2marks]

(ii). With the help of a sketch of rubredoxin and the simplest ferredoxin,

differentiate between these two iron –sulphur proteins. [3.5marks]

c). Draw the structure of  $[2Fe-2S^*]$  iron –sulphur protein and give the main difference and similarity between  $[2Fe-2S^*]$  ferredoxin and rieske protein.

[4marks]

d). What are picket fence porphyrins? What features of picket fence porphyrins make them good models for  $O_2$  binding to myoglobin or hemoglobin. [4marks]

### QUESTION FIVE [20 marks]

(a). (i). By giving one example each, distinguish between diagnostic and therapeutic drugs. [2 marks]

(ii). List the requirements that must be exhibited by any radionuclide

imaging agent. [3 marks].

(b)(i) Give reasons why is  $^{99m}Tc$  the most desirable imaging agent? [3 marks]

(ii). Why should  $^{99m}Tc$  be prepared at the point of use? [1 marks]

(iii). List body organs that are imaged by  $^{99m}Tc$  and explain how it reaches the cells of the target tissues. [1.5

marks]

(c).(i). Name and draw the structure of one platinum based drug that is effective in the treatment of genitourinary, testicular and ovarian cancer. What are its major drawbacks. **[ 2.5marks]**

(ii). Enumerate the features that a prospective platinum based anticancer drugs should possess to exhibit significant antitumor activity **[ 3marks]**

d) (i). What are gold based drugs used for? Name one example of a more recent gold drugs and why it is more stable than its predecessors. **[ 1.5 marks].**

(ii). Boron neutron capture therapy (BNCT) is a therapeutic technique that finds use in cancer treatment. Briefly discuss how this technique works. **[2.5 marks]**

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