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QUALIFICATION : **BACHELOR OF SCIENCE**	
QUALIFICATION CODE: **07BOSC**	LEVEL: **7**
COURSE: **BIOCHEMISTRY: BIOCHEMICAL PRINCIPLES AND PRACTICE**	COURSE CODE: **BPP702S**
DATE: **NOVEMBER 2024**	SESSION: **1**
DURATION: **3 HOURS**	MARKS: **100**

FIRST OPPORTUNITY: QUESTION PAPER

EXAMINER: ***PROF LAMECH MWAPAGHA***

MODERATOR: ***DR HARRIS ONYWERA***

INSTRUCTIONS:

1. Answer all questions on the separate answer sheet.
2. Please write neatly and legibly.
3. Do not use the left side margin of the exam paper. This must be allowed for the examiner.
4. No books, notes and other additional aids are allowed.
5. Mark all answers clearly with their respective question numbers.

PERMISSIBLE MATERIALS:

1. Non-Programmable Calculator

This question paper consists of four (4) pages including this front page.

Question 1 **[12]**

(a) Using the Henderson-Hasselbalch equation calculate the pH of a solution composed of 0.20 M NH_3 and 0.15 M NH_4Cl? (K_b for $NH_3 = 1.8 \times 10^{-5}$) (4)

(b) In 2024 the SpaceX's Dragon spacecraft returned to earth with a sample of a Martian single-celled organism. Not surprisingly, extracts of the organism catalyzed the hydrolysis of ATP, showing Michaelis-Menten kinetics with a K_m of 3.5×10^{-5} M and a V_{max} of 90 µmoles-min^{-1}-mg $protein^{-1}$.

I. Give the Michaelis-Menten equation. (2)

II. Calculate the velocity of the ATPase reaction at the following ATP concentrations: (6)

a . $S = 0.75 \times 10^{-6}$ M

b . $S = 2.5 \times 10^{-4}$ M

c. $S = 0.035$ M

Question 2 **[16]**

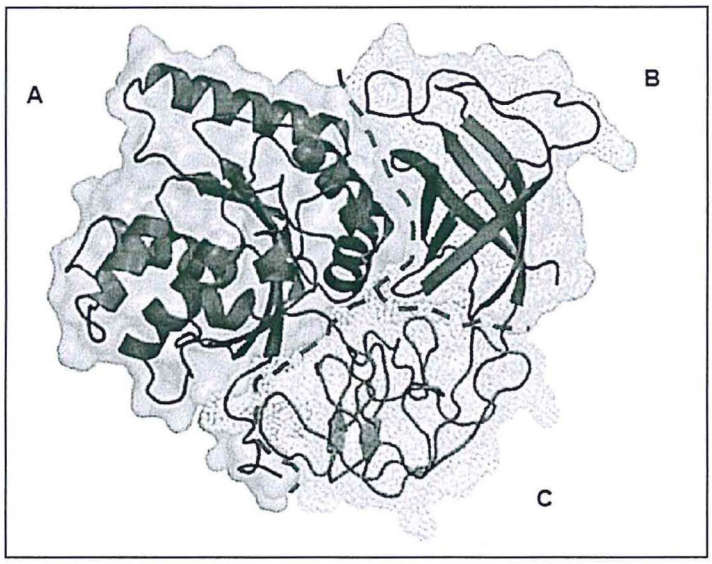
(a) Oxidative phosphorylation is a process involving a flow of electrons through the electron transport chain, a series of proteins and electron carriers within the mitochondrial membrane. Briefly describe this process. (10)

(b) Discuss the role of inhibitors of the electron transport chain and their impact on ATP production. (6)

Question 3 **[14]**

(a) Delineate how mutations can affect the genetic code and protein synthesis. (8)

(b) The figure below shows a stable structure of a protein. The dashed line divides the structure into three regions labelled A, B, and C.



I. Does this protein have a quaternary structure and how do you reach that conclusion? (2)

II. Explain why it is likely that each of these three regions folds independently. (2)

III. Which one of the three parts of this protein is comprised mostly of α-helical secondary structure? (1)

IV. Which one of the three parts of this protein is comprised mostly of β-sheet secondary structure? (1)

Question 4 **[14]**

(a) Briefly discuss how the irreversible steps in glycolysis are bypassed by alternate enzymes specific to gluconeogenesis. (8)

(b) Anaplerosis is the act of replenishing TCA cycle intermediates that have been extracted for biosynthesis. Describe the anapleurotic reaction that aids in the formation of malate from pyruvate. (6)

Question 5 **[12]**

(a) Using structural formulas, write the balanced chemical equation in the Kreb cycle for the reaction where Malate is oxidized to form oxaloacetate leading to the production of the electron carrier NADH. (6)

(b) Briefly discuss the biosynthesis of the Fatty acids describing the role of the **THREE (3)** important enzymes involved. (6)

Question 6 **[14]**

(a) Briefly discuss how fatty acids are activated and transported into the mitochondria (8)

(b) Match the phrase on the left with the letter of the answer on the right that bests matches the description of fatty acid (FA) metabolism (only one answer best matches each description) (6)

I. An oxidant in FA degradation pathway: .....
II. A reductant in FA synthesis pathway: .....
III. Catalyzes the commitment step in FA degradation: .....
IV. Building block of FA synthesis: .....
V. Subcellular location of FA degradation: .....
VI. Catalyzes the commitment step in FA synthesis: .....

A. Palmitoyl CoA
B. Acetyl CoA carboxylase
C. Cytosol
D. FAD/FADH2
E. Carnitine acyltransferase I
F. Phosphoenolpyruvate carboxykinase
G. Mitochondrial matrix
H. Coenzyme Q (QH2)
I. Malonyl CoA
J. NADPH/NADP+

Question 7 **[18]**

(a) Explain the major stages of drug development from discovery to market approval (10)

(b) Evaluate the impact of emerging technologies, such as artificial intelligence (AI) and biotechnology, on drug development. (8)

THE END