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

SECOND OPPORTUNITY / SUPPLEMENTARY: EXAMINATION QUESTION PAPER

EXAMINER:	*PROF LAMECH MWAPAGHA*
MODERATOR:	*PROF PETRINA KAPEWANGOLO*

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   [14]

a) Calculate the pH of a mixture of 0.1 M acetic acid and 0.2 M sodium acetate. The pKa of acetic
   acid is 4.75.   (3)

b) A Calculate the pH of a buffer solution that initially consists of 0.0500 M NH_3 and
   0.0350 M NH_4^+. (Ka for NH_4^+ = 5.6 x 10-10).   (5)

$$NH_4^+ \rightleftharpoons H^+ + NH_3$$

c) Given the structures of lysine and the pKa values as shown below: (6)
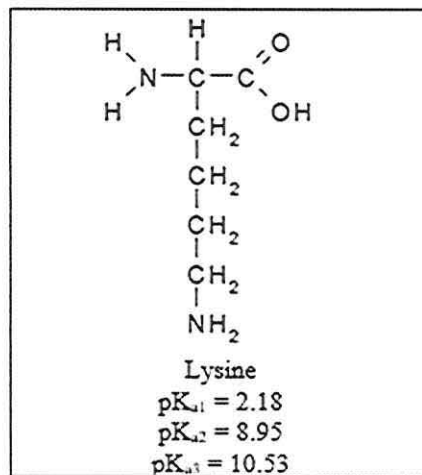
Determine the pI value of lysine. Show clearly how you arrive at the answer.

Question 2   [12]

a) How do cancer cells utilise anaplerosis?   (4)

b) The kinetics of facilitated diffusion can be described by the Michaelis-Menten equation. Plot a
   well labelled graph depicting both the facilitated and simple diffusion curves. (4)

c) A biosynthetic pathway proceeds from compound A to compound G in seven steps and then
   branches. One branch is a three-step pathway to J, and the other is a four-step pathway to N.
   Substrate C is a feed-forward activator of the enzyme that catalyzes the synthesis of G. Products J
   and N are feedback inhibitors. Product N inhibits the first enzyme after the branch point in its own
   pathway and Product J inhibits the second enzyme in the common pathway. Draw a diagram
   showing the regulation of this metabolic pathway   (4)
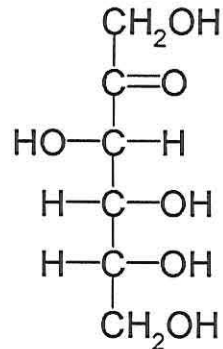
Question 3 [10]

a) Outline the **FOUR (4)** enzyme sites that regulate gluconeogenesis (4)

b) Given the following Fischer projection; (6)

$$
\begin{array}{c}
CH_2OH \\
| \\
C=O \\
| \\
HO-C-H \\
| \\
H-C-OH \\
| \\
H-C-OH \\
| \\
CH_2OH
\end{array}
$$

Draw the two cyclic α and β forms of this structure.

Question 4 [19]

a) Briefly describe the hormonal regulation of gluconeogenesis (6)

b) Give the possible symptoms of deficiency of the following vitamins (5)

    I.   Vitamin B2 (Riboflavin):

    II.   Vitamin B12:

    III.   Vitamin A (Retinol):

    IV.   Vitamin K (Phylloquinone):

    V.   Vitamin D:

c) With the aid of the fatty acyl CoA structure below, discuss the production of energy (ATP) through the process of β-oxidation (breakdown) of fatty acids. (8)

$$CH_3-(CH_2)_x-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-S-CoA$$

Fatty acyl CoA
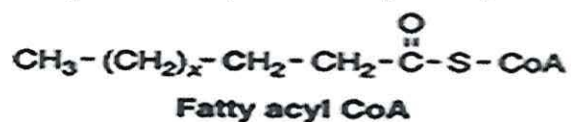
Question 5 [12]

a) Briefly state **SEVEN (7)** functions of the amino acid methionine (7)

b) Briefly describe **FIVE (5)** conditions that will cause the protein to unfold, leaving only the primary structure and rendering it non-functional. (5)

Question 6 [18]

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) Lipids are known to be insoluble in water, briefly elucidate on how dietary lipid are digested, absorbed and transported in the body. (8)

Question 7 [15]

a) The toxicity of a drug candidate can be described in terms of the therapeutic index. Define therapeutic index. (4)

b) Discovery and development is one of the steps involved in drug development. Give **SEVEN (7)** potential data that is gathered by researchers through conducting experiments once they have identified a promising compound for development at this step. (7)

c) Discuss how cholera toxin disrupts the regulation of intestinal secretion following GPCR signalling. (4)

THE END