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QUALIFICATION : **BACHELOR OF MEDICAL LABORATORY SCIENCES AND BACHELOR OF HUMAN NUTRITION**	
QUALIFICATION CODE: **08BMLS OR 08BOHN**	LEVEL: **6**
COURSE: **BIOCHEMISTRY OR INTRODUCTION TO BIOCHEMISTRY**	COURSE CODE: **BIO521S AND IBC521S**
DATE: **NOVEMBER 2024**	SESSION: **1**
DURATION: **3 HOURS**	MARKS: **100**

FIRST OPPORTUNITY EXAMINATION: QUESTION PAPER

EXAMINER: **Mr Junias Natangwe Jackson**

MODERATOR: **Ms Vanessa Tjijenda**

Mr George Waliomuzibu Mukisa

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

ATTACHMENTS:

NONE

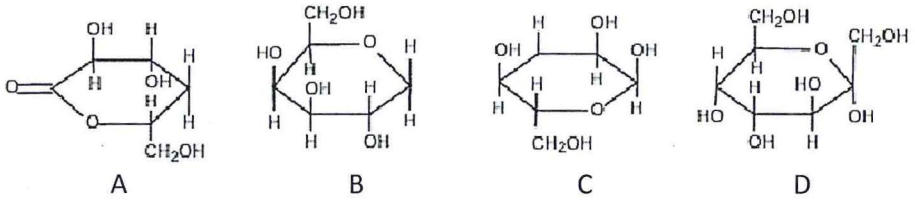
This paper consists of 6 pages including this front page

SECTION A: MULTIPLE CHOICE AND TRUE / FALSE [20 MARKS]

QUESTION 1: MULTIPLE CHOICE QUESTIONS [10 MARKS]

Evaluate the statements in each numbered section and select the most appropriate answer or phrase from the given possibilities. Fill in the appropriate letter next to the number of the correct statement/phrase on your ANSWER SHEET. [10]

1.1. Which one of the following is a ketose:



A B C D

1.2. Which of the following statements is correct about column chromatography:
- a) Resolution improves as column length increases
- b) Mobile phase is a porous solid material kept in the column with appropriate chemical characteristics
- c) Stationary phase is a buffered solution that percolates through the mobile phase
- d) Large proteins exit the column faster than tiny proteins:

1.3. Which of the following catalyses the reversible degradation of 2-phosphoglycerate to phosphoenolpyruvate:
- a) Trypsin
- b) Enolase
- c) Chymotrypsin
- d) Hexokinase

1.4. If the free energy change (ΔG) for a reaction is -50.45 kJ/mol, the reaction is:
- a) Exothermic.
- b) Exergonic.
- c) Endergonic.
- d) At equilibrium.

1.5. Which of the following is a choline-containing lipid:
- a) Phosphatidylethanolamine
- b) Phosphatidylserine
- c) Sphingomyelin
- d) Phosphatidylglycerol

1.6. Which of the following enzyme is responsible for the conversion of glucose 1-phosphate to glucose 6-phosphate:
- a) Epimerase
- b) Phosphoglucomutase
- c) Glycogen phosphorylase
- d) Isomerase

1.7. Which of the following condenses acyl and malonyl groups:
- a) Acetyl co-A ACP transacetylase
- b) Malonyl co-A ACP transferase

c) β-ketoacyl ACP synthase
d) Acyl carrier protein

1.8. Which of the following is called "bad" Cholesterol:

a) Cholesterol
b) Triglyceride
c) HDL
d) LDL

1.9. Which of the following is a building block of proteins:

a) Fatty acid
b) Amino acid
c) Nucleotide
d) Monosaccharide

1.10. What are enzymes:

a) Proteins
b) Lipids
c) Carbohydrates
d) Nucleic acids

QUESTION 2: TRUE/FALSE QUESTIONS **[10 MARKS]**

Evaluate the statements and select whether the statement is true or false. Write the word 'True' or 'False' next to the corresponding number on your ANSWER SHEET. [10]

2.1 Glycogen, starch, and cellulose are all chains of amino acids.
2.2 A simple sugar that is a building block of carbohydrates is called a polysaccharide
2.3 In uncompetitive inhibition, k_m increases as an inhibitor is added.
2.4 Two monosaccharide are joined through a peptide bond to form a disaccharide
2.5 Amino acid is one of the major macromolecules
2.6 The chemical structure of a competitive inhibitor resembles that of the enzymes substrate
2.7 Active transport requires energy and involves the movement of solute from the lower concentration side of a membrane to the higher concentration side
2.8 NADPH is a oxidising agent for fatty acid biosynthesis
2.9 The formation of "ketone bodies" occurs when acetyl-CoA from fatty acid metabolism is unable to enter the citric acid cycle due to a low concentration of oxaloacetate
2.10 The enzymes for the glycolysis pathway and for fatty acid biosynthesis occur in the cytosol

SECTION B: SHORT/LONG ANSWER QUESTIONS [80 MARKS]

Please answer ALL of the questions in this section.

QUESTION 3 **[35]**

3.1. Write a mechanism for the conversion of pyruvate to acetyl CoA. Assume all of the required coenzymes are present. [6]

3.2. What is protein denaturation? Is there any change in the primary structure when a protein is denatured? What are some factors that can lead to protein denaturation? [4]

3.3. Describe allosteric regulation of enzyme activity? [4]

3.4. What is the prosthetic group that hemoglobin and myoglobin's oxygen binding ability depends on? [1]

3.5. Briefly explain the Cori cycle which is linked metabolic pathways [5]

3.6. Define cooperativity to binding oxygen [3]

3.7. What is oxidative phosphorylation? [2]

3.8. List four (4) non covalent interaction in the biomolecules [4]

3.9. How are proteins separated by electrophoresis? [3]

3.10. What are Glycolipids and what are their important functions? [3]

QUESTION 4: CALCULATIONS **[9]**

4.1. What is the [H+] of a solution with a pH of 4.5? [3]

4.2. What do you understand by pK_a [2]

4.3. Calculate the pH of a buffer that contains 0.7 M ammonia and 0.9 M ammonium chloride. (pK_a = 9.248). [4]

QUESTION 5: ENZYMES **[10]**

5.1 At what substrate concentration would an enzyme with a k_{cat} of 30.0 s^{-1} and a K_m of 0.0050 M operate at one-quarter of its maximum rate? [4]

5.2 Determine the fraction of V_{max} that would be obtained at the following substrate concentrations: [S] = $\frac{1}{2}$ k_m, 2 k_m, and 10 k_m [3]

5.3 An enzyme that catalyzes the reaction X ⇌ Y is isolated from two bacterial species. The enzymes have the same V_{max} but different K_m values for the substrate X. Enzyme A has a K_m of 2.0 µM, and enzyme B has a Km of 0.5 µM. The plot below shows the kinetics of reactions carried out with the same concentration of each enzyme and with [X] = 1 µM. Which curve corresponds to which enzyme? [3]

QUESTION 6: CARBOHYDRATES **[14]**

Figure 6. 1 shows a Fischer projection of D-glucose and three other structure

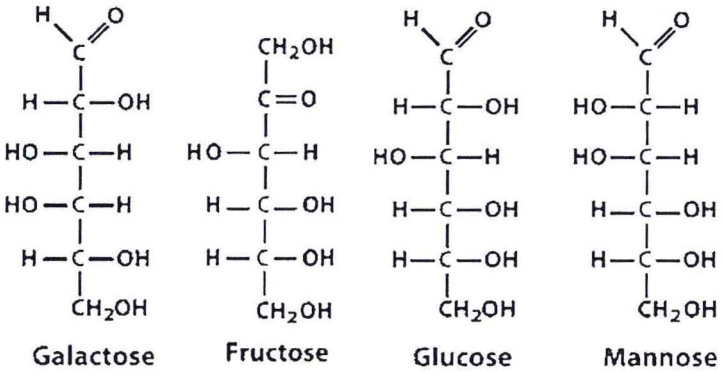


Figure 6.1

6.1 Draw Haworth projections of any of its cyclic forms numbering the carbon atoms [5]

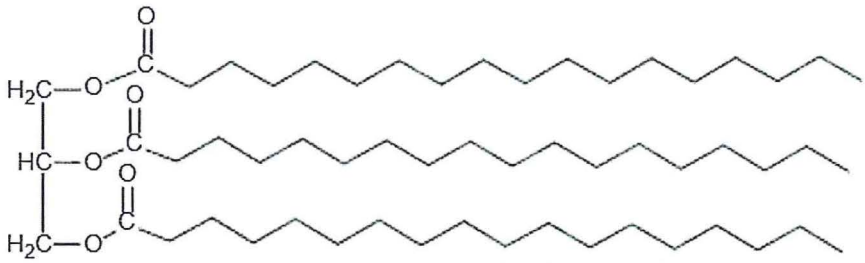
6.2 Indicate the anomeric carbon and draw its alpha and beta alternatives [4]

6.3 Determine two structure that are epimers and describe the epimerization [2]

6.4 Describe how glucose molecules are joined together to make amylose, starches and glycogen. [3]

QUESTION 7: LIPID **[8]**

Use the following chemical structure of a lipid to answer the following questions



7.1 To which type (class) of lipids does this compound belong? [1]

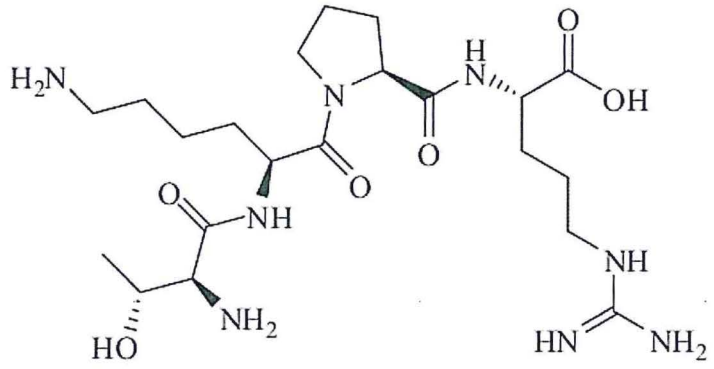
7.2 Give the names of the products that will be produced by the saponification of this lipid. [2]

7.3 What is the function of this type of lipid in living organisms? [2]

7.4 How is saponification done? [3]

QUESTION 8: PROTEINS AND AMINO ACIDS **[4]**

Tuftsin is a tetrapeptide (Thr-Lys-Pro-Arg) produced by enzymatic cleavage of the Fc-domain of the heavy chain of immunoglobulin G. It is mainly produced in the spleen and its activity is related primarily to immune system function.



Draw the Fischer projections of the four L-amino acids that result from the acid hydrolysis of tuftsin.

END OF QUESTION PAPER