



**PAMIBIA UNIVERSITY**  
OF SCIENCE AND TECHNOLOGY

**FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES**

**DEPARTMENT OF HEALTH SCIENCES**

<b>QUALIFICATION:</b> BACHELOR OF MEDICAL LABORATORY SCIENCES/BACHELOR OF HUMAN NUTRITION	
<b>QUALIFICATION CODE:</b> 08BMLS/08BOHN	<b>LEVEL:</b> 5
<b>COURSE:</b> BIOCHEMISTRY/INTRODUCTION TO BIOCHEMISTRY	<b>COURSE CODE:</b> BIO521S/IBC521S
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<b>DURATION:</b> 3 HOURS	<b>MARKS:</b> 120

<b>FIRST OPPORTUNITY EXAMINATION QUESTION PAPER</b>	
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<b>INSTRUCTIONS</b>
<ol style="list-style-type: none"><li>1. Answer all questions.</li><li>2. Please write neatly and legibly.</li><li>3. Do not use the left side margin of the exam answer book.</li><li>4. No books, notes or other additional aids are allowed.</li><li>5. Mark all answers clearly with their respective question numbers.</li></ol>

Non-programmable calculator is allowed.

**THIS QUESTION PAPER CONSISTS OF 8 PAGES** (Including this front page)

**SECTION A**

**[20]**

**Question 1: Multiple Choice**

- 1.1 Which of the following domains contains the most primitive bacteria that live in extreme environments? (1)
- a. Archaea
  - b. Bacteria
  - c. Plantae
  - d. Eukarya
- 1.2 The kidneys contribute to acid–base balance by (1)
- a. Secretion of ammonia
  - b. Decreased carbon dioxide uptake
  - c. Regulating the  $p\text{CO}_2$
  - d. Increased ketogenesis
- 1.3 pKa (1)
- a. Indicates the strength of an acid
  - b. Reflects the pH of the solution
  - c. Is a measure of the buffer capacity
  - d. Is high when the acid is weak
- 1.4 The normal pH of human blood is (1)
- a. 7.0–7.1
  - b. 7.25–7.3
  - c. 7.35–7.4
  - d. 7.5–7.55
- 1.5 Which of these amino acids does not have optical isomer(s) (1)
- a. Alanine
  - b. Histidine
  - c. Threonine
  - d. Glycine
- 1.6 The following forces may play a role in the formation of quaternary structure EXCEPT (1)
- a. Hydrogen bonds
  - b. Disulphide bridges
  - c. Electrostatic interactions
  - d. Peptide bonds

- 1.7 In phenylketonuria (PKU), the compound accumulated in the urine is (1)
- Homocysteine
  - Tryptophan
  - $\alpha$ -keto acid
  - Phenylpyruvate
- 1.8 Thyroxine is derived from (1)
- Thiamine
  - Threonine
  - Tyrosine
  - Tryptophan
- 1.9 The reactions of the urea cycle occur in (1)
- Cytosol
  - Mitochondrial matrix
  - Lysosome
  - Mitochondrial matrix and the cytosol
- 1.10 The major source of ammonia in the kidneys is (1)
- Glutamine
  - Alanine
  - Creatinine
  - Leucine
- 1.11 Which of these serum enzyme activities rises 4–8 hours after acute (1)  
myocardial infarction (AMI)?
- AST
  - ALT
  - CKMB
  - LDH
- 1.12 Enzymes increase reaction rates by (1)
- Altering the change in free energy of the reaction
  - Inhibiting the backward reaction
  - Enhancing the forward reaction
  - Decreasing the energy of activation
- 1.13 Pancreatic  $\alpha$ -amylase (1)
- Hydrolyses starch completely to glucose
  - Hydrolyses  $\alpha$ -dextrins
  - Hydrolyses  $\alpha$  (1  $\rightarrow$ 4) glycosidic bonds
  - Is secreted as a zymogen

- 1.14 All the following are composed of glucose EXCEPT (1)
- Amylose
  - Glycogen
  - Maltose
  - Inulin
- 1.15 Fructose is (1)
- A ketose sugar
  - A pentose
  - A sugar that requires insulin for its absorption
  - Phosphorylated by a phosphatase
- 1.16 D-Galactose and D-mannose are a pair of (1)
- Enantiomers
  - Isomers
  - Epimers
  - Anomers
- 1.17 In  $\beta$ -oxidation of fatty acids, which of the following are utilised as co-enzymes? (1)
- FAD and NAD<sup>+</sup>
  - FAD H<sub>2</sub> and NADH + H<sup>+</sup>
  - NAD<sup>+</sup> and NADP<sup>+</sup>
  - FAD and FMN
- 1.18 A deficiency of carnitine might interfere with (1)
- $\beta$ -oxidation
  - Palmitate synthesis
  - Mobilisation of stored triacylglycerol from adipose tissue
  - Ketone body formation
- 1.19 Which of the following is an essential fatty acid? (1)
- Linolenic acid
  - Linoleic acid
  - Arachidonic acid
  - All above
- 1.20 Pancreatic lipase converts triacylglycerols into (1)
- 2-Monoacylglycerol
  - 3-Monoacylglycerol
  - 1-Monoacylglycerol
  - 2, 3-Diacylglycerol

**SECTION B****[100]****Question 2: Fill the blank spaces only by writing down the number and the correct missing expression (1 mark per correct answer). (20)**

- 2.1 Deamination of an amino acid is coupled with amination of \_\_\_\_\_ acid.
- 2.2 To form polypeptides and proteins, amino acids are joined together by \_\_\_\_\_ bonds.
- 2.3 \_\_\_\_\_ are long, rod-shaped molecules that are insoluble in water and physically tough.
- 2.4 The \_\_\_\_\_ concentration that produces half the maximal velocity ( $V_{max}/2$ ) is known as Michaelis constant.
- 2.5 Substances that decrease the catalytic activity of enzymes are called \_\_\_\_\_.
- 2.6 One difference between 'chemical catalysts and enzymes is that enzymes are \_\_\_\_\_ in the type of reaction to be catalysed and they function within a moderate range of hydrogen ion concentration and temperature along with certain other specified conditions.
- 2.7 Catalytic efficiency of enzymes can be regulated by \_\_\_\_\_ or inhibition.
- 2.8 Enzymes may be termed as 'molecular switches', which regulate the catalytic activity and transfer of \_\_\_\_\_ in the biological system.
- 2.9 \_\_\_\_\_ is present in the exoskeleton of invertebrates such as crabs, lobsters and insects.
- 2.10 \_\_\_\_\_ is the most abundant carbohydrate in nature.
- 2.11 In diabetic patients, the accumulation of \_\_\_\_\_ in lens of the eye leads to development of cataract.
- 2.12 Carbohydrates not only serve as major sources of energy but also function as \_\_\_\_\_ for the synthesis of lipids, amino acids, glycoproteins and proteoglycans in the body.
- 2.13 \_\_\_\_\_ are formed by interaction between a monosaccharide or a monosaccharide residue and the hydroxyl group of a second compound that may or may not be a monosaccharide.
- 2.14 \_\_\_\_\_ is the disease in which lactate, the final product of anaerobic glycolysis, accumulates.
- 2.15 \_\_\_\_\_ is a condition where ketone bodies in blood rise above normal levels.
- 2.16 Phospholipids are major components of cell membranes. They are also part of lipoproteins and bile and act as lung \_\_\_\_\_.
- 2.17 Biosynthesis of cellular nucleic acids is largely dependent on the \_\_\_\_\_ synthesis of nitrogenous bases, namely purines and pyrimidines.
- 3.10 Sphingolipids are involved in intracellular communication and as \_\_\_\_\_ determinants of the ABO blood groups.
- 2.19 \_\_\_\_\_ is characterized by an elevated serum urate, which could be due to a renal disorder.
- 2.20 Cholesterol molecule has \_\_\_\_\_ carbon atoms.

(20)

**Question 3: Match the correct expressions or definitions by writing down the number and the letter only (1 mark per correct answer).**

- a. Fehling's
- b. Epimers
- c. Cholesterol
- d. Glycogen
- e. Enantiomers
- f. Cellulose
- g. Lectins
- h. Catalytic
- i. Axial
- j. Glycoproteins
- k. Golgi bodies
- l. Amphoteric properties
- m. A buffer
- n. Albinism
- o. Amphipathic
- p. Amphipathic
- q. Phenylalanine hydroxylase
- r. Michaelis–Menten constant
- s. Dissociation constant
- t. Organic solvent
- u. Phospholipid
- v. Prokaryotes
- w. Glycolipid
- x. pH
- y. Isoenzymes
- z. Glycolipid
- aa. apoenzyme

- 3.1 \_\_\_\_\_ These are stereoisomers that are mirror images of each other which are bound by a membrane.
- 3.2 \_\_\_\_\_ These monosaccharides differ at a single asymmetric carbon.
- 3.3 Proteins produced by the ribosomes are stored in the form of secretory granules in the \_\_\_\_\_.
- 3.4 \_\_\_\_\_ This is the most abundant organic molecule in the biosphere.
- 3.5 \_\_\_\_\_ This is a test solution used to identify reducing and nonreducing sugars.
- 3.6 \_\_\_\_\_ The storage form of glucose in animals.
- 3.7 \_\_\_\_\_ proteins act as biocatalysts in various metabolic reactions, known as enzymes, e.g. hexokinase and lactate dehydrogenase.
- 3.8 Proteins exhibit \_\_\_\_\_. Each protein has an isoelectric pH at which there is no net charge on the protein.
- 3.9 phenylketonuria is an inborn error of amino acid metabolism. \_\_\_\_\_ is the deficient enzyme.

- 3.10 \_\_\_\_\_ occurs due to the deficiency of the enzyme tyrosinase.
- 3.11 Blood \_\_\_\_\_ plays a very important role in the maintenance of body homeostasis.
- 3.12 \_\_\_\_\_ is defined as a solution which resists a change in pH when an acid or a base is added.
- 3.13 pKa is the negative logarithm of the \_\_\_\_\_ of a weak acid.
- 3.14 \_\_\_\_\_ is the characteristic of an enzyme at any given pH and temperature. It helps to evaluate the affinity of the enzyme towards its substrate.
- 3.15 \_\_\_\_\_ are enzymes that catalyse the same chemical reaction, but differ from each other structurally, electrophoretically and immunologically (e.g LDH).
- 3.16 In addition to phospholipids and glycolipids, \_\_\_\_\_ is a major type of membrane lipid.
- 3.17 \_\_\_\_\_: A term applied to molecules that have both hydrophilic and hydrophobic moieties.
- 3.18 A lipid is defined as a compound soluble in \_\_\_\_\_.
- 3.19 Lipids which contain carbohydrates are \_\_\_\_\_.
- 3.20 \_\_\_\_\_: A type of lipid with two acyl chains, a glycerol backbone, and a polar head group.

**Question 4: Short Answers**

**(40)**

- 4.1 Name the four buffer systems in the body. (4)
- 4.2 What is the difference between holoenzyme, apoenzyme and abzyme? (3)
- 4.3 Name the amino acids which are glycogenic and ketogenic. (4)
- 4.4 Name the tests which detect the following amino acids: aromatic, tryptophan, arginine,  $\alpha$ -amino acids, and tyrosine. (5)
- 4.5 Answer the following questions on metabolic alkalosis
- a. What is metabolic alkalosis? (2)
- b. When does it occur? (2)
- c. How will metabolic alkalosis be compensated by the human body? (2)

- 4.6 Answer the following questions on carbohydrate metabolism
- a. Define gluconeogenesis (2)
  - b. What is Cori cycle and explain the events that place in that cycle? (4)
  - c. What are the irreversible steps of glycolysis and name the enzymes involved in these steps? (6)

- 4.7 Answer the following questions on lipids and fatty acids metabolism
- a. What is the importance of ketone bodies as fuels? (2)
  - b. Which enzyme is absent in adipose tissue? (2)
  - c. What is the role of bile salts? (2)

**Question 5: Calculation (20)**

- 5.1 What is the pH of the following solutions?
- a. 0.35 M hydrochloric acid (2)
  - b. 0.35 M acetic acid ( $pK_a = 4.76$ ) (3)
- 5.2 A weak acid, HA, has a total concentration of 0.20M and is ionized (dissociated) to 2% (5)
- 5.3 A solution is labeled "0.450 M  $\text{NaN}_3$ . Calculate the following  $[\text{N}_3^{1-}]$ ,  $[\text{OH}^{1-}]$ ,  $[\text{HN}_3]$ , and the pH of the solution? Express your concentrations to three significant figures. Note that  $K_a$  for  $\text{HN}_3 = 1.9 \times 10^{-5}$ . (5)
- 5.4 What is the pH of a buffer that is 0.12 M in lactic acid  $[\text{CH}_3\text{CH}(\text{OH})\text{COOH}$ , or  $\text{HC}_3\text{H}_5\text{O}_3$ ] and 0.10 M in sodium lactate  $[\text{CH}_3\text{CH}(\text{OH})\text{COONa}$  or  $\text{NaC}_3\text{H}_5\text{O}_3$ ]? lactic acid,  $K_a = 1.4 \times 10^{-4}$  (5)

**THE END**