

UNIVERSITY OF RUHUNA
BACHELOR OF SCIENCE GENERAL DEGREE LEVEL III
(SEMESTER I) EXAMINATIONS- OCTOBER 2022

Subject: Chemistry

COURSE UNIT: CHE 3132 (Biochemistry)

TIME: One and half (1 1/2) hours

Answer **three (03)** questions only

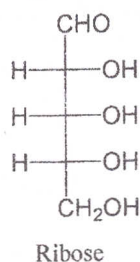
01. Answer **all** parts

- (a) The α -amino acids are classified into polar and non-polar amino acids based on their side chains.
- (i) Group the following amino acids into polar and non-polar groups and give their one letter codes.
Ala, Asn, Cys, Leu, Met, Tyr
(12 marks)
- (ii) Draw the chemical structures of Met and Tyr.
(12 marks)
- (b) Protein structures can be described in four levels as primary, secondary, tertiary and quaternary structures. Briefly describe each of them.
(16 marks)
- (c) Alanine can be synthesized from acetaldehyde by Strecker synthesis. Write necessary steps to illustrate this synthesis.
(20 marks)
- (d) Acid hydrolysis of a polypeptide, **Q** gives Ala₂, Arg, Lys₂, Met, Phe, Ser₂. Deduce the amino acids sequence of the **Q** using the following results of the given treatments:
- (i) carboxypeptidase gives Ala;
- (ii) chymotrypsin gives a tripeptide and hexapeptide with the compositions of: [Ala, Arg, Phe] and [Ala, Lys₂, Met, Ser₂].
- (iii) trypsin gives a dipeptide and two tripeptides with the compositions of: [Ala, Arg] and [Lys, Phe, Ser], [Ala, Met, Ser] and free Lys.
- (iv) CNBr gives a dipeptide and a heptapeptide with the compositions of: [Ala, Ser] and [Ala, Arg, Lys₂, Met, Phe, Ser]

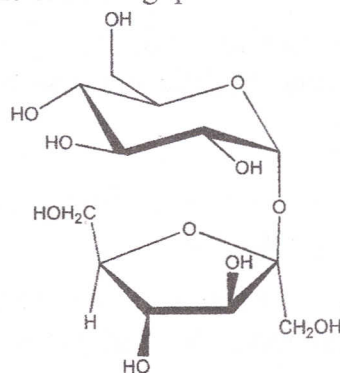
(40 marks)

02. Answer **all** parts

- (a) Ribitol/adonitol which is formed by the reduction of ribose, is essential in the synthesis of the coenzyme flavin mononucleotide (FMN), a cofactor in flavoproteins



- (i) Identify whether ribose is a D/L sugar, an aldose/ketose and according to the number of carbons. (09 marks)
- (ii) Write down the structure of ribitol and reaction conditions required for the conversion of ribose to ribitol. (07 marks)
- (iii) Propose a synthetic method that can be used to synthesize ribose from glucose. (24 marks)
- (b) Structure given below is a disaccharide commonly found in sugar cane. Based on the structure answer the following questions.



- (i) Name the monomeric units that are linked together to form the disaccharide? (08 marks)
- (ii) Label the anomeric carbons, glycone/sugar moiety and glycosidic linkage and type of the above structure. (12 marks)
- (iii) Discuss the reducing capacity of the given disaccharide. (08 marks)

- (iv) Comment on the fate of the disaccharide within the digestive tract of human beings.

(08 marks)

- (c) Compare and contrast the following terms pertaining to carbohydrates

- (i) α and β anomers
- (ii) O- and N- glycosides
- (iii) Glycogen and cellulose

(24 marks)

03. Answer **all** parts

- (a) Deoxyribonucleic acid (DNA) is a polymer of two polynucleotide chains arranged in double helix and carrying genetic instructions for the development, functioning, growth, and reproduction of organisms. A segment of DNA is given below.

5' ATCGGCTACGTTAC 3'

3' TAGCCGATGCAAGTG 5'

- (i) Briefly discuss how DNA is stored within the nucleus of cells. (08 marks)
- (ii) Write down the polynucleotide sequence of the daughter DNA segments resulting from the replication of the given segment of DNA, (06 marks)
- (iii) Draw a schematic diagram of the replication fork for the above DNA segment and label it accordingly. (20 marks)

- (b) Ribonucleic acid (RNA) is responsible for the encoded information carried by the DNA to be used in the synthesis of proteins.

- (i) Name three main types of RNA and explain their functions during protein synthesis. (09 marks)
- (ii) Briefly explain the transcription process of protein synthesis. (17 marks)

- (c) Lipids are a diverse group of organic substances including fats, oils, hormones and structural components of biological membranes.

- (i) Discuss the structural features of storage lipids (12 marks)
- (ii) Give a brief account on the structure of waxes with respect to their functions (12 marks)
- (iii) Draw and label the general structure of steroidal hormones and list three such hormones. (16 marks)

04. Answer **all** parts

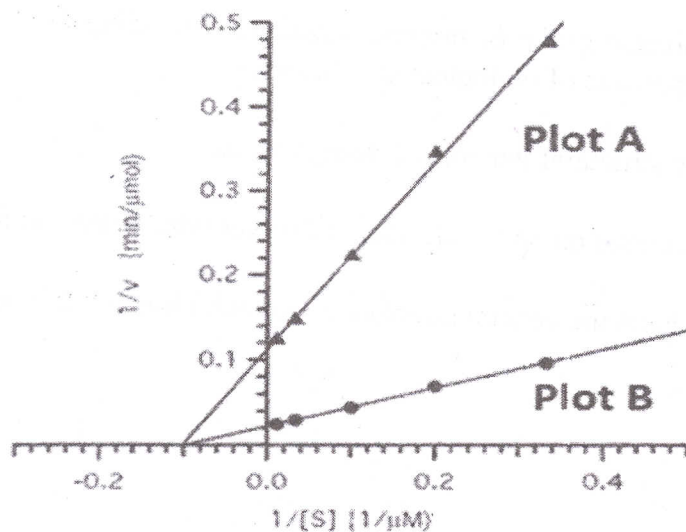
- a) Life is inconceivable without enzymes.
- (i) What is the main role of enzymes? (04 marks)
 - (ii) State four properties of enzymes. (06 marks)

- b) The Michaelis Menten Model is the most popular model to describe enzyme kinetics. According to this model initial velocity (v_0) of enzyme-catalyzed reaction can be expressed as

$$v_0 = \frac{k_{cat}[E_T][S]}{K_M + [S]} \text{ --- (Eq 1)}$$

where $[S]$ is substrate concentration.

- (i) Give the reaction scheme of the above model. (05 marks)
 - (ii) State the two basic assumptions of this model. (10 marks)
 - (iii) Define k_{cat} , K_M , and E_T in (Eq1). (10 marks)
 - (iv) Briefly describe the kinetics (rate) of an enzyme catalyzed reaction when $[S]$ is low and $[S]$ is high based on the Eq 1. (10 marks)
 - (v) Defining V_{max} , simplify the Eq 1. (05 marks)
 - (vi) Rearrange the Eq 1 to obtain the Lineweaver-Burk form. (10 marks)
- c) Lineweaver-Burk plots (plot A and plot B) of the enzyme polyphenol oxidase with substrate catechol with and without an inhibitor is given below.



Answer the following questions using the above plot.

- (i) State the role of an inhibitor in an enzyme catalyzed reaction. (06 marks)
- (ii) Estimate $V_{\max}$ values from the plots A and B. (07 marks)
- (iii) Estimate K_M from the plots A and B. (07 marks)
- (iv) Sketch initial velocity (v_0) vs substrate $[S]$ graph for both A and B situations in the same graph. (10 marks)
- (v) Predict the nature of inhibition for the above reaction and show the reaction scheme of this inhibition. (10 marks)

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