

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

FACULTY OF APPLIED SCIENCES

BACHELOR OF SCIENCE HONOURS DEGREE EXAMINATIONS

DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

**THEORY: INTRODUCTION TO ENZYMOLOGY AND IMMUNOLOGY SBB 2104**

DECEMBER 2005

3 HOURS (100 marks)

**INSTRUCTIONS**

Answer **Four (4)** Questions, Two (2) from Section A and Two (2) from Section B. Each question carries 25 marks. Where a question contains subdivisions, the mark value for each subdivision is given in brackets. Illustrate your answer where appropriate with large, clearly labelled diagrams.

**SECTION A**

- 1.(a) What is the literal meaning of the word enzyme? (1 mark)
- (b) Consider an enzyme catalyzed reaction given by  
$$A + B \rightarrow C + D$$
- (i) Write rate equations for both the forward and reverse reactions. (2 marks)
- (ii) What is the reaction order for each of the reactants? (1 mark)
- (iii) What are the units of the rate constant and the rate of reaction? (2 marks)
- (iv) What would be the effect of adding more enzyme to the reaction mixture? (1 mark)
- (c) What do you understand by the following:
- (i) oxidoreductase? (1 mark)
- (ii) Transferase? (1 mark)
- (iii) Hydrolase? (1 mark)
- (iv) Lyase? (1 mark)
- (v) Isomerase? (1 mark)
- (vi) Ligase? (1 mark)
- (d) Consider the following sequence of reactions involved in glycolysis at 37°C.
- 3 phosphoglycerate  $\rightarrow$  2 phosphoglycerate  $\Delta G^0 = 4.441$  kJ/mol
- 2 phosphoglycerate  $\rightarrow$  phosphoenolpyruvate + H<sub>2</sub>O  $\Delta G^0 = 2.581$  kJ/mol
- 2 phosphoenolpyruvate + ADP  $\xrightarrow{H^+}$  pyruvate + ATP  $\Delta G^0 = -25.521$  kJ/mol
- (i) Write down the overall reaction. (4 marks)
- (ii) Calculate  $\Delta G^0$  for the overall reaction. (2 marks)
- (iii) Calculate the apparent equilibrium constant for the reaction ( $R=8.3146$ JK<sup>-1</sup>mol<sup>-1</sup>) (3 marks)
- (iv) Comment on whether each of the reaction shown by the three (3) equations generated are likely to proceed spontaneously or not (2 marks)
- (v) What name is given to this type of reaction? (1 mark)

2.(a) Sketch and label fully what the Eadie Hofstee plot would look like for a series of experiments which are carried out under the following conditions.

(i) Substrate + enzyme (3 marks)

(ii) Substrate + enzyme + competitive inhibitor (3 marks)

(iii) Substrate + enzyme + non-competitive inhibitor (4 marks)

(b) Distinguish between

(i) product inhibition and end product inhibition (2 marks)

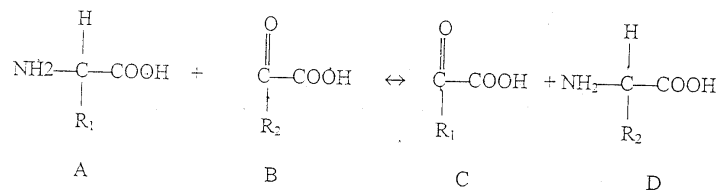
(ii) apoenzyme and holoenzyme (2 marks)

(iii) cofactor and coenzyme (2 marks)

(iv) uncompetitive inhibition and non-competitive inhibition (2 marks)

(v) trypsinogen and trypsin (2 marks)

(c) The equation below represents a reaction which occurs in the liver and other body cells.



Give the name of:

(i) The type of compound labeled A (1 mark)

(ii) The functional group common to all the four molecules. (1 mark)

(iii) The functional group that molecule A is donating to molecule B. (1 mark)

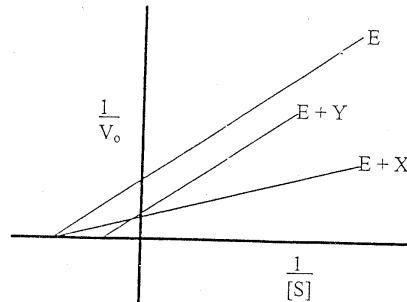
(iv) The type of reaction of which this is an example. (1 mark)

(v) Give one reason why this reaction is important in the body? (1 mark)

(a) Outline the role of cofactors in enzymes. Illustrate your answer.

(10 marks)

(b) The figure below shows reactions of enzyme in the presence and absence of inhibitors X and Y.



(i) Does X combine with E, with ES or both? Explain.

(2 marks)

(ii) If  $\frac{1}{V_o} = 0.015$  for E + Y, calculate  $V_{max}$

(1 mark)

(iii) If  $\frac{1}{K_m}$  without an inhibitor E is 0.015, calculate  $K_m$ .

(1 mark)

(iv) Deduce the kind of inhibitions exerted by X and Y

(1 mark)

(d) Describe the Monod, Wyman and Changeux model for explaining the heterotropic interactions in oligomeric enzymes.

(10 marks)

### SECTION B

4.(a) Describe primary and secondary antibody responses.

(10 marks)

(b) What do you understand of the following terms.

(i) Epitope

(1 mark)

(ii) Immunogen

(1 mark)

(iii) Agglutination

(1 mark)

(iv) Tolerogen

(1 mark)

(v) Paratope

(1 mark)

(c) An antibody A raised against antigen B is seen to react with another antigen C. Explain how this can come about.

(10 marks)

5. Discuss the biological role of different immunoglobulin types.

6.(a) Write short notes on the major functions of the following cells stating whether they are antigen specific or not.

(i)  $T_H$  cells (2 marks)

(ii)  $T_c$  cells (2 marks)

(iii)  $T_s$  cells (2 marks)

(iv) B cells (2 marks)

(v) Macrophage (2 marks)

(b) " $CD^{4+}$  cells are central to the immune response". Discuss. (15 marks)

**END OF EXAMINATION**

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