CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Autumn Examination, 2013

Module Title: Applied Enzymology

Module Code: **BIOL7001**

School: Science

Programme Title: Bachelor of Science in Applied Biosciences and Biotechnology
Bachelor of Science (Honours) in Pharmaceutical Biotechnology
Bachelor of Science (Honours) in Herbal Science

Programme Code: **SBIBI_7_Y3**
SHERB_8_Y3
SPHBI_8_Y3

External Examiner(s): Dr. Gillian Gardiner
Internal Examiner(s): Dr. Fiona O Halloran

Instructions: Answer Section A (compulsory) and TWO questions from Section B.

Duration: 2 Hours

Sitting: Autumn, 2013

Requirements for this examination: Scientific calculator

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination paper.
If in doubt please contact an Invigilator.

Section A (50 Marks)

Answer <u>all</u> parts.

Q1. Part A

The kinetics of an enzyme was measured as a function of substrate concentration, in the presence and absence of an inhibitor (I_1). The following results were obtained:

[S] (M)	v_o (µmol/l/min)	
	No inhibitor	Inhibitor (I_1)
0.3×10^{-5}	10.4	4.1
0.5×10^{-5}	14.5	6.4
1.0×10^{-5}	22.5	11.3
3.0×10^{-5}	33.8	22.6
9.0×10^{-5}	40.5	33.8

(a) Draw a Lineweaver-Burke plot of these results.

(15 Marks)

(b) What are the values of V_{max} and K_m in (i) the absence and (ii) in the presence of the inhibitor?

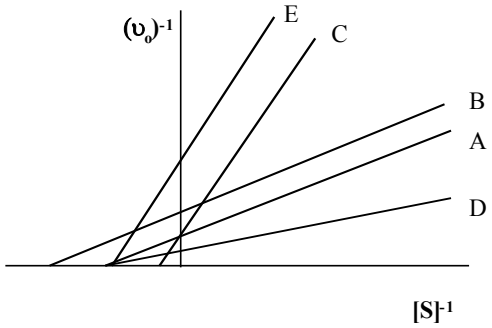
(10 Marks)

(c) What type of inhibition is this?

(5 Marks)

Part B

In the following graph of an enzyme-catalysed reaction, Line A represents the Lineweaver-Burke plot for the reaction of a normal substrate in the absence of any inhibitor.



(a) Which line would be expected in the presence of (i) an uncompetitive inhibitor, (ii) a noncompetitive inhibitor and (iii) a competitive inhibitor? In each case explain your chosen answer.

(15 Marks)

(b) Which line would be expected if the concentration of enzyme is doubled? Explain your chosen answer. (5 Marks)

Section B (50 Marks)

Answer <u>two</u> questions.

Q2.

(a) Explain, using a diagram, how enzymes affect the rate of a chemical reaction

(10 Marks)

(b) List five common features of enzyme active sites

(5 marks)

(c) Using a diagram, explain the difference between Fischers 'lock and key' model and Koshlands 'induced fit' model for enzyme-substrate (ES) binding. Which model, best describes the formation of the ES complex? Explain your choice.

(10 Marks)

Q3.

(a) For an enzyme reaction that follows Michaelis-Menten kinetics, define the following:
a. Michaelis-Menten equation
b. Vmax
c. Km
d. v_o

(10 Marks)

(b) To investigate enzyme reaction rates and identify enzyme kinetic data the Michaelis-Menten equation can be transformed into two other equations. Define these two other equations and graphically represent them.

(10 Marks)

(c) Using the information in Table 1 indicate which enzyme is the most efficient catalyst. Explain your answer.

(5 Marks)

Table 1: Turnover number, Kcat for some enzymes

Enzyme	**Substrate**	**Kcat (s^{-1})**
Catalase	Hydrogen peroxide	40,000,000
Carbonic anhydrase	Bicarbonate	400,000
Acetylcholine esterase	Acetylcholine	14,000
Beta-lactamase	Benzylpenicillin	2,000
Fumarase	Fumarate	800

Q4.
For a multi-subunit enzyme showing cooperative binding of substrate:

(a) Draw a graph of vo versus substrate concentration

(5 Marks)

(b) Explain the shape of the curve in terms of the enzyme's transition between T and R states

(10 Marks)

(c) Define positive and negative allosterism.

(10 marks)