**CORK INSTITUTE OF TECHNOLOGY**
**INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

**Autumn Examinations 2012**

# Module Title: Applied Enzymology

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| **Module Code:** | **BIOL7001** |
| **School:** | Science |
| **Programme Title:** | Bachelor of Science in Applied Biosciences and Biotechnology<br>Bachelor of Science (Honours) in Pharmaceutical Biotechnology<br>Bachelor of Science (Honours) in Herbal Science |
| **Programme Code:** | **SBIBI_7_Y3**<br>**SHERB_8_Y3**<br>**SPHBI_8_Y3** |
| **External Examiner(s):** | Dr. Don Faller, Dr. Jerry Bird |
| **Internal Examiner(s):** | Dr. Heloise Tarrant, Dr. Brendan O'Connell, Dr. Fiona O'Halloran. |
| **Instructions:** | Answer Section A (compulsory) and TWO questions from Section B. |
| **Duration:** | 2 hours |
| **Sitting:** | Autumn 2012 |
| **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)

**Q1.** *(compulsory)* Answer all parts.

(All parts carry equal marks)

a) Draw a graph showing how the energy distribution of a population of molecules changes with increasing temperature.

b) For an enzyme that follows Michaelis Menten kinetics, draw graphs showing the relationship between initial velocity (a) enzyme concentration and (b) substrate concentration.

c) Explain, with the aid of a graph, each of the following:

   a. Energy of activation

   b. Transition-state structure

   c. Exothermic and endothermic reactions.

d) What is the equilibrium constant ($K_{eq}$) of a reaction? A large $K_{eq}$ (>100) indicates a reaction that tends to completion – true or false?

e) Define each of the following terms: holoenzyme, apoenzyme, cofactor, prosthetic group.

f) Distinguish between reversible and irreversible inhibitors of enzyme reactions.

g) Briefly describe the different mechanisms by which multisubstrate enzyme reactions can occur. Give an example in each case.

h) For a multisubunit enzyme showing **cooperative** binding of substrate, draw a graph of $\upsilon_o$ versus substrate concentration.

i) What advantage, if any, does the cooperative binding of substrate present to the cell?

j) For an enzyme reaction that follows Michaelis-Menten kinetics, define the following terms: $V_{max}$, $K_m$, $\upsilon_o$, $k_{cat}$ and $k_{cat}/K_m$.

# Section B (50 marks)

Answer any <u>two</u> questions.

**Q.2** The kinetics of an enzyme was measured as a function of substrate concentration, in the presence and absence of each of two inhibitors ($I_1$ and $I_2$). The following results were obtained:

| | $\upsilon_o$ (μmol/l/min) | | |
|---|---|---|---|
| **[S] (μM)** | No inhibitor | Inhibitor ($I_1$) | Inhibitor ($I_2$) |
| 3 | 10.4 | 4.1 | 2.1 |
| 5 | 14.5 | 6.4 | 2.9 |
| 10 | 22.5 | 11.3 | 4.5 |
| 30 | 33.8 | 22.6 | 6.8 |
| 90 | 40.5 | 33.8 | 8.1 |

(a) Draw a Lineweaver-Burk plot of these results. (10 marks)

(b) What are the values of Vmax and Km in the absence and presence of each inhibitor? (10 marks)

(c) In each case state what type of inhibition is seen. (5 marks)

**Q.3** You are asked to determine the specific activity of an enzyme solution; outline the steps of the assay you would design for this purpose. (25 marks)

**Q.4** Write an essay describing the methods used, and the benefits arising, from enzyme immobilisation. (25 marks)