CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Autumn Examinations 2012

Module Title: Enzymes and Metabolism

Module Code: BIOL6017

School: Science

Programme Title: Bachelor of Science in Applied Biosciences
Bachelor of Science (Honours) in Herbal Science
Bachelor of Science (Honours) in Pharmaceutical Biotechnology
Bachelor of Science (Honours) Analytical & Pharmaceutical Chemistry
Bachelor of Science (Honours) in Analytical & Pharmaceutical Chemistry
Quality Assurance

Programme Code: SBIOS_7_Y2
SHERB_8_Y2
SPHBI_8_Y2
SCHEM_7_Y3
SCHQA_8_Y3

External Examiner(s): Dr. Don Faller
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, Graph Paper

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 <u>all</u> parts

(a) Explain the term energy of activation (E_a).

(b) Define the term **inhibition constant** (K_i).

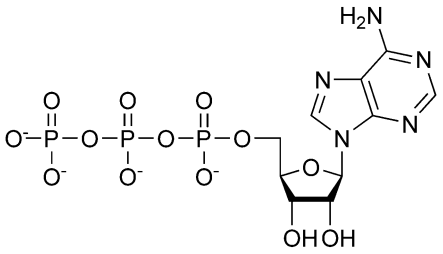
(c) Draw graphs illustrating the relationship between the rate of an enzyme catalysed reaction (υ_o) and
   a. enzyme concentration
   b. substrate concentration
   c. pH
   d. temperature

   In each case, give a biochemical explanation for the shape of the curve.

(d) Enzymes are highly **efficient**, highly **specific** catalysts that are almost always **protein** in nature. Write brief notes elaborating on each of these characteristics.

(e) Draw a table summarising three main types of reversible enzyme inhibition under the following headings;
   a. type of inhibition,
   b. effect on V_{max} and K_M of an enzyme-catalysed reaction,
   c. Lineweaver-Burke plot obtained in the presence of increasing concentrations of inhibitor.

(f) Name the following molecule. Use an arrow to show the location(s) of the high energy phosphoanhydride bond(s) in the structure.



(g) Draw a simple summary of the citric acid cycle, naming the different intermediates and the number of carbon atoms in each compound. Also show where in the cycle CO_2 and reducing power are produced.

(h) The citric acid cycle is often described as amphibolic. What does this mean?

(i) What are the three possible fates of pyruvate in living cells? Indicate under which conditions each one will occur.

(j) Draw a diagram summarising the stages in the extraction of energy from foodstuffs.

Section B (50 marks)

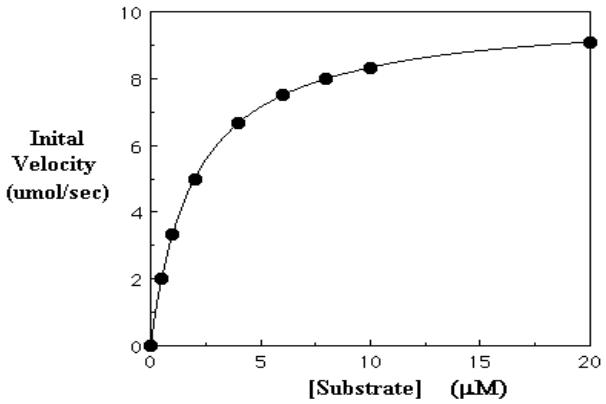
Answer any two questions.

Q.2 (a) Use this graph of enzyme reaction rate (υ_o) versus substrate concentration [S], to indicate

(i) the V_{max} and K_m values of this enzyme,

(ii) the region of the graph where υ_o is independent of substrate concentration, and

(iii) the region of the graph where υ_o is first order (directly proportional) to substrate concentration.



(10 marks)

(b) The conversion of fumarate to L-malate is one of the reactions of the Citric Acid Cycle. It is catalysed by the enzyme fumarase. Use the following experimental data to construct a Lineweaver-Burk plot and determine the K_m and V_{max} for this reaction.

[Fumarate] (mM)	v_o **(mmol/l/min)**
2.0	2.5
3.3	3.1
5.0	3.6
10.0	4.2

(15 marks)

Q.3 Write an essay on glycolysis, indicating clearly the energy-consuming reactions and the energy-yielding reactions. Include a discussion of the mechanisms used to control the rate of this pathway. (25 marks)

Q.4 Oxidative phosphorylation is the final stage in the energy-yielding metabolism of aerobic organisms. Write an essay on this process making use of diagrams to illustrate your answer. (25 marks)