

CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Semester 2 Examinations 2009

Biochemistry – LEGACY EXAM

School: Science

Programme Title: Higher Certificate in Applied Biosciences

Programme Code: SBIOS_7_Y2

External Examiner(s): Prof. Gary Walsh

Internal Examiner(s): Dr. Heloise Tarrant

Instructions: Attempt **five** questions.

Question 1 **section A** is compulsory.

Attempt **two** questions from **section B**, and **two** questions from **section C**.

Duration: 3 hours

Sitting: Summer 2009

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

Q1. **Compulsory**, answer all parts.

(24 marks)

(a) Draw the structure of one amino acid in each of the following groups;

- (i) neutral non-polar amino acid,
- (ii) basic amino acid
- (iii) sulphur-containing amino acid

In each case name the molecule you have drawn.

(b) Define the terms **precision** and **accuracy** with respect to a set of replicate measurements made in the laboratory.

(c) Distinguish between an aldose and a ketose. To which of these classes of carbohydrate does glucose belong?

(d) What is the pH of (i) 0.05 M HCl, and (ii) 0.1 M HCl?

(e) Describe the processes of passive diffusion, facilitated diffusion and active transport, with respect to the transport of a molecule across a cell membrane.

(f) When 3.5 ml of a 0.7 mM sucrose stock solution is added to a reaction mixture with a final volume of 6 ml, calculate the concentration of the final sucrose solution.

(g) Cellulose and starch are both polymers of glucose. What structural feature is responsible for their different properties?

(h) What is the central dogma of molecular biology?

(i) Explain how stereoisomers (enantiomers) arise in carbohydrate chemistry.

(j) List two different fates of pyruvate and explain why the fate of pyruvate differs under aerobic and anaerobic conditions.

(k) Define **anabolism** and **catabolism**.

(l) Using diagrams, summarise how DNA is packaged to fit within the cell.

Section B (Analytical Biochemistry - 38 marks)

Answer any **two** of the following questions (Q2, Q3 or Q4).

- Q2.** (a) Given a stock solution of 100 mM sucrose, describe how you would prepare a series of dilutions containing 0, 4, 8, 12, 16 and 20 mM sucrose in a final volume of 1 ml. [5 marks]
- (b) Describe how you would prepare 50 ml of a 0.2 M acetate buffer, pH 4.5 using stock solutions of 0.5 M acetic acid and 0.5 M sodium acetate. ($pK_a = 4.75$) [5 marks]
- (c) A preparation of the enzyme sucrase was incubated with its substrate, sucrose, at various pH values. After 5 minutes at 30°C the reaction was stopped and the amount of reducing sugar liberated at the different pH values was determined. Using the following data plot a graph of the effect of pH on sucrase activity and determine the pH optimum of the enzyme:

pH	Sucrase Activity ($\mu\text{mol/ml/min}$)
2.5	0.58
3.5	0.60
4.5	0.66
5.5	0.34
6.5	0.23
7.5	0.20

[9 marks]

- Q3.** (a) List the different detection systems used to determine substrate or product levels during an enzyme-catalysed reaction. Write short notes on three of these methods. [9 marks]
- (b) The following data was obtained for an enzyme-catalysed reaction:

[Substrate] (M)	v_o ($\mu\text{mol/ml/20 min}$)
0.20×10^{-5}	0.150
0.40×10^{-5}	0.200
0.85×10^{-5}	0.275
1.25×10^{-5}	0.315
1.70×10^{-5}	0.340
2.00×10^{-5}	0.350
8.00×10^{-5}	0.360

Draw a Lineweaver Burk plot 2nd from this determine K_M and V_{\max} for the enzyme.

[10 marks]

Q4. Write notes on each of the following;

- (i) Tests to identify mutagenic chemicals
- (ii) Edman degradation
- (iii) DNA sequencing

[19 marks]

Section C

(Structural and Metabolic Biochemistry - 38 marks)

Answer any **two** of the following questions (Q5, Q6, Q7 or Q8).

Q5. (a) Define the terms **transcription** and **translation**.

[3 marks]

(b) Write an essay on **translation**, using the following headings as a guide:

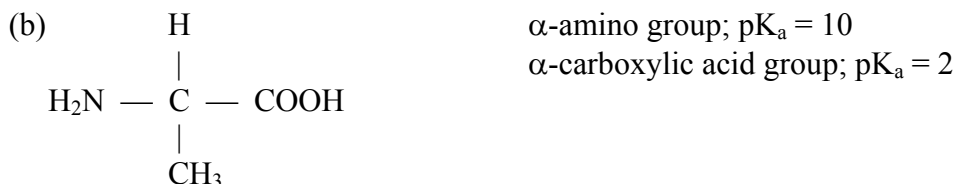
- (i) structure of ribosomes and tRNA
- (ii) initiation
- (iii) chain elongation and formation of the peptide bond, and
- (iv) termination and post-translational modification.

Use diagrams wherever possible to illustrate your answer.

[16 marks]

Q6. (a) List the main roles of proteins in biological systems.

[3 marks]



Given the above information, use the Henderson-Hasselbalch equation to verify the zwitterionic nature of alanine at pH 7.

[6 marks]

(c) Define the four levels of protein structure and write notes explaining how each contributes to the final 3-D structure of the protein.

[10 marks]

- Q7.** (a) List the main biological roles of lipids. [3 marks]
- (b) Draw the full structures of the following fatty acids, *cis*- Δ^6 -decanoic acid and *trans*- Δ^6 -decanoic acid. [6 marks]
- (c) Write brief notes on each of the different classes of lipids, using diagrams to illustrate your points. [10 marks]
- Q8.** Write an essay on glycolysis, including in your answer a discussion of the control of this metabolic process. [19 marks]