

Cork Institute of Technology

Higher Certificate in Science in Applied Biology - Award

Autumn 2006

BIOCHEMISTRY

(Time: 3 Hours)

Answer Section A (compulsory) and TWO questions from each of Sections B and C.

Examiners: Dr. H. Tarrant
Prof. R. Fitzgerald

Use separate answer books for each section and mark the questions attempted.

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 acidIn each case name the molecule you have drawn.
- (b) List three non-covalent interactions important in determining the 3-D structure of a protein.
- (c) Distinguish between an aldose and a ketose. To which of these classes of carbohydrate does glucose belong?
- (d) Define **energy of activation** (E_a) and use a diagram to show how an enzyme affects the E_a of a reaction pathway.
- (e) What is the pH of (i) 0.05 M HCl, and (ii) 0.1 M HCl?
- (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) Write a short note on tRNA structure.
- (i) What is meant by the **isoelectric point (pI)** of a protein?
- (j) List four mechanisms used to regulate the level of gene transcription.

- (k) If there are 14 mg of KOH in a 500 ml volume, calculate (a) the number of moles of KOH present and (b) the molarity (concentration) of the solution. (Atomic weight K = 39, O = 16, H = 1).
- (l) Explain the term **oxidative phosphorylation**.

Section B

(Analytical Biochemistry - 38 marks)

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

- Q2.** (a) Define the Beer-Lambert Law. The A_{340} of a solution of NADH was found to be 0.28. What was the concentration of this solution? ($\epsilon_{NADH} = 6220 \text{ M}^{-1} \text{ cm}^{-1}$) [7 marks]
- (b) Given the following experimental data, calculate the value of ϵ (Molar Extinction Coefficient) for Bromophenol Blue (BPB) at 625 nm;

Absorbance (@ 625 nm)	[BPB] (μM)
0.14	5
0.30	10
0.46	15
0.60	20
0.80	25

Express ϵ in units of $\text{M}^{-1} \text{cm}^{-1}$, showing clearly how you arrived at such units.

Note: path length of light through cuvette = 1 cm [12 marks]

- Q3.** (a) Define the term pH. Calculate the pH value of a (i) 0.002 M and (ii) 0.007 M solution of the strong acid HCl. [7 marks]
- (b) Describe fully the preparation of 500 ml of a 0.05 M phosphate buffer, pH 7.1, from KH_2PO_4 and K_2HPO_4 salts. List additional factors you may need to take into consideration to ensure the buffer is of the correct pH.
($pK_a = 7.2$; $MW \text{ KH}_2\text{PO}_4 = 136$; $MW \text{ K}_2\text{HPO}_4 = 174$) [12 marks]

- Q4.** Write notes on each of the following;

- (i) Ames test to identify mutagenic chemicals
- (ii) Protein denaturation
- (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).

Q6. (a) Describe the classical experiment performed by Meselson and Stahl in 1958 which illustrates the semi-conservative nature of DNA replication. [9 marks]

(c) Give a brief account of DNA replication. Include in your answer the chain elongation reaction, replication fork and the synthesis of leading and lagging strands. [10 marks]

Q7. (a) The Enzyme Commission of the International Union of Biochemistry has classified enzymes according to the reaction they catalyse. List the six main categories of enzymes and describe briefly the general reaction catalysed. [9 mark]

(b) Given the following data for an enzyme-catalysed reaction;

[S] (μM)	v_o (nmol/l/min)
2.5	24
4.0	34
10.0	60
40.0	96
100.0	109

Use a Lineweaver-Burke plot to establish the values of K_m and V_{max} . [10 marks]

Q6. (a) List the main biological roles of lipids. [3 marks]

(c) Write a note on each of the following: (i) fatty acids and (ii) triglycerides. [8 marks]

(d) Write a note on the currently accepted structure of biological membranes. [8 marks]

Q8. Write an essay on glycolysis, including in your answer a discussion of the control of this metabolic process. [19 marks]