

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

SBB 2101/04

FACULTY OF APPLIED SCIENCES
BACHELOR OF SCIENCE HONOURS DEGREE EXAMINATIONS
DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

THEORY: CHEMISTRY OF BIOMOLECULES SBB 2101

DECEMBER 2004

3 HOURS (100 MARKS)

INSTRUCTIONS

Answer **Four** (4) questions only. Each question carries 25 marks. Where a question contains subdivisions, the mark value for each subdivision is given in brackets. Illustrate your answer, where appropriate, with large clearly labeled diagrams.

Question 1

1. a) The table below shows the pK and pI of some amino acids.

Amino Acid	pK _{α-COOH}	pK _{α-NH₂}	pK _{R-group}	pI
Glycine	2.35	9.78		6.1
Alanine	2.34	9.87		6.1
Serine	2.21	9.15		5.7
Valine	2.32	9.62		6.0
Leucine	2.36	9.60		6.0
Aspartic acid	2.09	9.82	3.87	3.0
Glutamic acid	2.19	9.66	4.28	3.2
Cysteine	1.96	10.28	8.18	5.1
Histidine	1.77	9.18	6.10	7.6
Lysine	2.13	8.59	10.58	9.7
Arginine	2.02	9.04	12.48	10.8

- (i) Which of the amino acids would provide a suitable buffer at pH 5 and pH 7 when made up with NaOH and why? (4 marks)
- (ii) How many grams of these amino acids would you require to make a 500 ml of a 0.01 M solution of this buffer? (4 marks)
- (iii) Calculate the pI of valine and arginine from the data provided in the table above. (2 marks)
- b) If 100 ml of a 0.4 M acetic acid solution is mixed with 20ml of a 1.8 M NaOH solution, what is the pH of the resultant buffer? (pK acetic acid = 4.76) (2 marks)
- c) How would you prepare
- (i) NaOH solution pH 9.4 (2 marks)
- (ii) 0.1 M NaOH solution pH 9.7 (MW NaOH = 40) (3 marks)

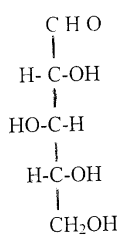
- d) Sketch and label fully the pH titration curve of glycine in the presence of formaldehyde as done in the laboratory class. (10 marks)

Question 2

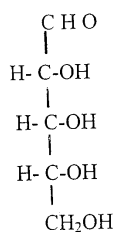
- a) (i) Draw the structure of a tetrapeptide named serylglycyltrosylalanine. (8 marks)
- (ii) Which amino acid residue absorbs light maximally at 280nm? (1 mark)
- (iii) How many peptide linkages are in the peptide? (1 mark)
- b) Give an account of the nature of the peptide bond. (15 marks)

Question 3

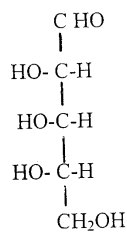
- a) Consider the structure of the aldopentoses shown below.



A



B



C

Name the types of stereoisomerism represented by the following pairs.

- (i) A and B (1 mark)
- (ii) B and C (1 mark)
- (iii) A and C (1 mark)
- b) Name sugar B (1 mark)
- c) Draw the α -anomeric form of the furanose Haworth ring structure for sugar A. (1 mark)
- d) Write short notes on the conformation of sugars in solution. (5 marks)
- e) Compare and contrast the structure and function of glycogen and starch. (15 marks)

Question 4

a) The table below shows the melting point of some selected C₁₈ fatty acids.

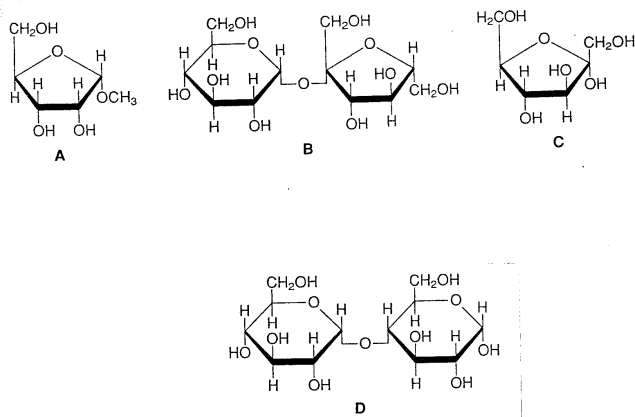
Fatty Acid	Melting Point
C ₁₈ :0	70°C
C ₁₈ :1 (9)	13°C
C ₁₈ :2 (9,12)	-5°C

- (i) Explain the relative difference in melting points. (5 marks)
(ii) Explain the relevance of these differences in understanding of membrane structure and function. (5 marks)
(iii) Name the fatty acids shown in the table above. (3 marks)

b) Describe how you would determine the saponification number of a fat sample in the laboratory. What is the significance of the saponification number? (12 marks)

Question 5

a) Study the structures A – D and answer questions below.



Which of the structures contain:-

- i) Ribose?
ii) Deoxyribose?

(1 mark)

(1 mark)

- iii) A purine? (1 mark)
 - iv) A pyrimidine? (1 mark)
 - v) A guanine? (1 mark)
 - vi) A phosphomonoester? (1 mark)
 - vii) A phosphodiester? (1 mark)
 - viii) Which structure is a nucleotide? (1 mark)
 - ix) Which structure would be found in RNA and DNA? (1 mark)
- b) Compare and contrast the structures of Z DNA and A DNA. (10 marks)
- c) A DNA molecule is composed of 4 800 base pairs. How long is the linear double-helical form of the molecule? (5 marks)

Question 6

- a) Distinguish between the following:
- (i) Diastereomer and enantiomer (2 marks)
 - (ii) Reducing sugar and non-reducing sugar. (2 marks)
 - (iii) Maltose and cellobiose. (2 marks)
 - (iv) Amylose and amylopectin. (2 marks)
 - (v) nucleic acid and amino acid (2 marks)
- b) Write notes on the physiological function of prostaglandins. (5 marks)
- c) Compare and contrast the structure of phospholipids and sphingophospholipids. (10 marks)

END OF EXAMINATION QUESTION PAPER