

Cork Institute of Technology

Bachelor of Science (Honours) in BioSciences - Award

(NFQ Level 8)

Spring 2007

Bioanalytical Science

(Time: 3 Hours)

Answer one question from each of Section A, B, C and D. Each question carries equal marks.

Use separate answer books for each section and mark the question attempted

Examiners: Ms. A. Ward
Dr. H. Tarrant
Dr. B. Fogarty
Mr. E. Callery
Ms. E. Howley
Prof. R. Fitzgerald

Section A

- Q1. Discuss the significance of the modulation of enzymatic activity through steric hindrance in homogeneous enzyme assays. In your answer, give examples of both competitive and non-competitive formats of this group of assays. (25 marks)
- Q2. (a) Give an account of the important issues of automation as they apply to immunoassay systems. (15 marks)
- (b) Write a brief overview of the DELFIA (Dissociation-Enhanced Lanthanide Fluoroimmunoassay) system and its importance as a modern automated immunoanalytical technique. (10 marks)

Section B

- Q3. (a) Describe the 5 main steps in a typical solid phase extraction procedure. Illustrate your answer with diagrams. (5 marks)
- (b) What are the considerations and interface options for coupling Gas Chromatography online to Mass Spectrometry. (10 marks)
- (c) What is the main function of a mass analyser? Describe how a quadrupole mass analyser works. (10 marks)
- Q4. (a) Discuss the principles of solid phase extraction. (5 marks)
- (b) What are the advantages of solid phase microextraction (SPME) over other approaches to sample preparation? Explain the term headspace sampling. (10 marks)
- (c) Describe the principle of electrospray ionisation for mass spectrometry. (10 marks)

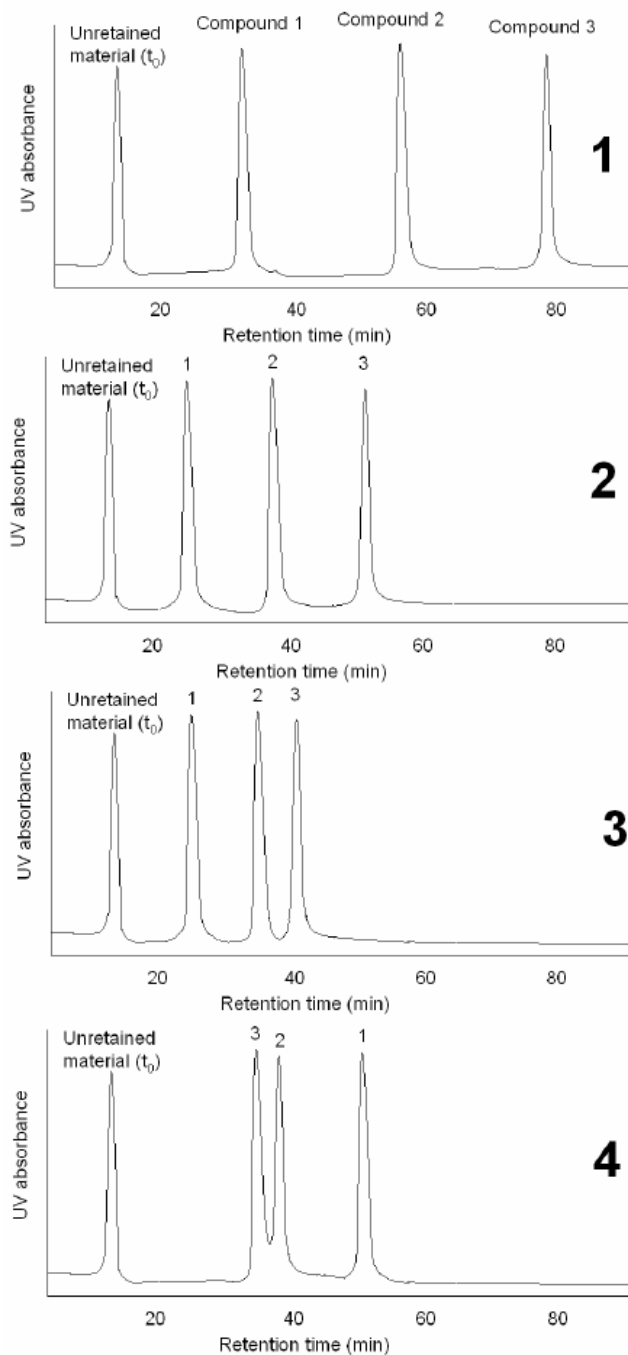
Section C

- Q5. Give an account of current biosensor technology, with special reference to the design and applications of biosensors. (25 marks)
- Q6. Give an account of the various pre-packed and capillary columns available for gas chromatography, illustrating their applications and merits. (25 marks)

Section D

- Q7. In an attempt to develop a suitable and rapid normal (polar) phase HPLC method, your first sample injection of the three compounds of interest (polar drug metabolites) produces the following chromatogram;
- (a) In terms of k' and α parameters, are these conditions reasonable for rapid quantisation of compounds 1-3? (10 marks)
- (b) In an attempt to optimize this HPLC separation you decide to make successive modification and stepwise you obtain the chromatograms shown below.



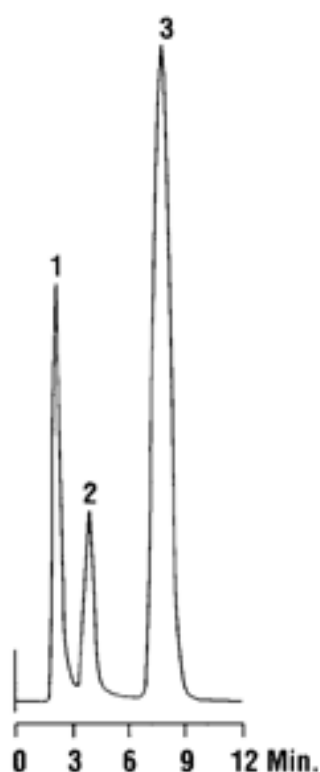


For each chromatogram suggest which of the following modifications could have caused the change from the previous situation and justify your choice. (15 marks)

- (i) Use of a shorter column with the same stationary phase
- (ii) Increased flow rate

- (iii) Increased polarity of the mobile phase
- (iv) Change of the nature of the stationary phase
- (v) Use of brand new but identical column
- (vi) Use of an increasingly polar gradient rather than constant mobile phase composition.

Q8. Catecholamines can be analyzed using High Performance Liquid Chromatography (HPLC) as shown below:



- 1. L-DOPA
- 2. Metanephrine
- 3. DL-Tryptophan

Column: Jordi C-18/DVB, 5 μ m, 4.6 x 150mm

Order No.: 935801

Mobile Phase: 0.2M NaOH: Acetonitrile: Butylamine (75:24:1)

Flow Rate: 2.0mL/min

Temperature: 25°C

Detector: UV at 280nm

- (a) Draw a schematic diagram of a HPLC system that could be used to carry out the analysis. (5 marks)
- (b) Using the information given explain what type of HPLC analysis is involved. Write a brief summary on this type of analysis. (10 marks)
- (c) Explain the difference between a standard variable wavelength detector and a diode-array detector. Outline the advantages and disadvantages of the latter. (10 marks)