

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Autumn Examinations 2014 (Legacy Paper)

Module Title: Bioanalytical Science II

Module Code: **BIOL 6004**

School : Science

Programme Title: Bachelor of Science in Applied Sciences – Year 1
 Bachelor of Science in Nutrition and Health – Year 1
 Bachelor of Science in Pharmaceutical Biotechnology – Year 1

Programme Code: **SBIOS_7_Y1**
 SNHSC_8_Y1
 SPHBI_8_Y1

External Examiner: Dr Tom O'Connor

Internal Examiner(s): Dr M. Begley, Dr M. Sheahan

Instructions: Answer **FOUR** questions as follows:

Section A: Answer *any two questions*

Section B: Answer Question 4 **and** either question 5 **or** 6

Use **separate answer book** for each section

Duration: 2 Hours

Sitting: Autumn 2014

Requirements for this examination: Periodic Table

<p>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.</p>
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Section A

Q1. Answer ALL parts

- (a) Using thin layer chromatography, explain in detail how one would analyze a mixture containing two different components A and B (assume A is more polar than B). Support your answer with the appropriate sketches **(8 marks)**
- (b) An aliquot of 0.40M Na_2CO_3 solution was transferred to a 250cm^3 volumetric flask and diluted to the mark; the concentration of the resultant Na_2CO_3 solution was 0.04M. What do you understand by an *aliquot*? What piece of laboratory glassware should be used to measure this aliquot? Calculate the volume of the aliquot (show your calculations) **(6 marks)**
- (c) What is a *solution*? List three different units which may be used to express the concentration of a solution **(4 marks)**
- (d) Distinguish between a primary standard and a secondary standard. Give one example of each **(4 marks)**
- (e) An aqueous solution of potassium chloride (KCl) was prepared by dissolving 40g of KCl in enough water to make 300cm^3 of solution. What is the molar concentration of the solution? Show the relevant calculations **(3 marks)**

Q2.

- (a) A mixture contains three components A, B and C. A is the most polar and C is the least polar. A is colourless, B is blue and C is yellow. Describe in detail how pure samples of each component may be obtained using column chromatography. Support answer with relevant sketches. **(12 marks)**
- (b) What are the main precautions to be observed when performing column chromatography? **(5 marks)**
- (c) Highlight the main differences between HPLC and column chromatography **(4 marks)**
- (d) Distinguish between reverse phase and normal phase chromatography **(4 marks)**

Q3.

- (a) Give the approximate wavelength range for the IR, UV and visible regions which are utilized in spectrophotometry. Hence briefly state why electronic transitions do not arise in the IR region. **(4 marks)**
- (b) What is a *chromophore*? **(3 marks)**
- (c) A series of standard solutions were prepared from a 100ppm stock solution of a yellow food dye. The absorbance of each standard was measured at the λ_{max} ; results are given in the table. A 5cm³ aliquot of a yellow dye solution of unknown concentration was transferred to a 20cm³ volumetric flask and diluted to the mark; the absorbance of this solution was found to be 0.052.

Conc. of standards (ppm)	1	5	10	15	20
Absorbance	0.008	0.039	0.073	0.117	0.160

- (i) Name the sample holder used in this experiment and describe it in brief **(4 marks)**
- (ii) Use the data in the table to construct a standard calibration plot and determine the concentration of the unknown solution of the dye **(6 marks)**
- (iii) Write a brief note on the precautions that should be taken to minimize errors in the procedure **(6 marks)**
- (iv) Why was it necessary to dilute the unknown solution? **(2 marks)**

Section B

Q4. COMPULSORY QUESTION. Answer all parts.

- (a) What are the benefits/uses of SOPs? (2.5 marks)
- (b) List the main elements/components of an SOP. (2.5 marks)
- (c) What is the purpose of adding dye to DNA samples before loading into the wells of an agarose gel? (2.5 marks)
- (d) Why is the fact that DNA has a negative charge important in the gel electrophoresis process? (2.5 marks)
- (e) List 3 practices which should be followed when centrifuging hazardous waste. (2.5 marks)
- (f) Give an example of a chemical indicator, a biological indicator and a physical indicator that can be used for autoclave quality assurance. (2.5 marks)
- (g) Explain what distillation is. (2.5 marks)
- (h) State what type of cuvettes should be used for UV spectrophotometry and explain why. (2.5 marks)
- (i) Explain what the isoelectric point of an amino acid is. (2.5 marks)
- (j) List two possible sources of error associated with using an analytic balance. (2.5 marks)

Q5. Write short comprehensive notes on five of the following:

- (a) Amino acid titration curves
- (b) Autoclave
- (c) Biological Safety Cabinet
- (d) Centrifuge
- (e) Microbiology culture media
- (f) Spectrophotometer

(5 x 5 marks)

Q6.

(a) List 3 applications of buffers. **(3 marks)**

(b) Calculate the weight of Na_2HPO_4 ($\text{Mr} = 142\text{g}$) and KH_2PO_4 ($\text{Mr} = 136\text{g}$) required to make 100ml of a 0.01M phosphate buffer $\text{pH} = 6.4$ and $\text{pK}_a = 6.8$

(11 marks)

(c) Calculate the weight of Na_2CO_3 ($\text{Mr} = 106\text{g}$) and NaHCO_3 ($\text{Mr} = 84\text{g}$) required to make 100ml of a 0.025M bicarbonate buffer $\text{pH} = 9.6$ and $\text{pK}_a = 10.25$

(11 marks)