

**CORK INSTITUTE OF TECHNOLOGY**  
**INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

**Autumn Examinations 2011**

<b>Module Title:     Bioanalytical Science II (CA)</b>
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**Module Code:**        **BIOL 6004**

**School:**                Biological 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(s):**     Dr. Anne Nelson, Dr. Alison Gallagher, Dr. Jerry Bird

**Internal Examiner(s):**     Ms. R. Kiernan, Dr. M. Sheahan

**Instructions:**            Answer **TWO** questions from each section  
                              Question 4 is **compulsory**  
                              Use **separate answer book** for each section

**Duration:**        2 Hours

**Sitting:**            Autumn 2011

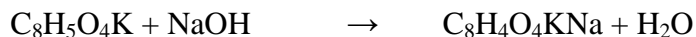
**Requirements for this examination:**        Periodic Table

<p><b>Note to Candidates:</b> 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.

Potassium hydrogen phthalate (KHP,  $\text{C}_8\text{H}_5\text{O}_4\text{K}$ ) is an example of a primary standard. A solution of KHP was prepared by dissolving 5.1g of the solid in water and diluting to a final volume of  $250\text{cm}^3$ . A solution of sodium hydroxide (NaOH) was standardized by titrating a  $20\text{cm}^3$  aliquot of the NaOH solution against the KHP solution prepared above.



The titration was repeated a number of times and the titres ( $\text{cm}^3$ ) were as follows 19.6, 20.2, 20.2, 20.1 and 19.9

- (a) Distinguish between *primary* and *secondary standards*. List the criteria a reagent must meet for it to be considered suitable for use as a primary standard. (10 marks)
  - (b) Determine the molarity of a solution of KHP. (3 marks)
  - (c) Calculate the concentration (in moles/L) of the sodium hydroxide solution. (4 marks)
  - (d) Describe how this procedure might be carried out and highlight the precautions that need to be taken to ensure accuracy and precision in results. (8 marks)
- (25 Marks)

### Q2.

- (a) Give the approximate wavelength range for the IR, UV and visible regions which are utilized in spectrophotometry. Briefly state why electronic transitions do not arise in the IR region (5 marks)
  - (b) Using labelled sketches, show the difference in appearance between IR and UV spectra (4 marks)
  - (c) Name four types of molecular vibrations which arise in IR spectroscopy (2 marks)
  - (d) Describe in detail how an IR spectrum may be obtained in the laboratory. Include in your discussion sample preparation, sample holder and list the precaution which must be observed to obtain a good quality spectrum (8 marks)
  - (e) Give an equation for Beer's Law. Name and assign units to each term in the law. Determine the absorptivity of a sample ( $0.1\text{g/L}$ ) with an absorbance of 0.6376 assuming the measurement was made in a  $1\text{cm}$  cuvette. (6 marks)
- (25 Marks)

**Q3.**

- (a) How many  $\text{cm}^3$  of 0.387M  $\text{CuSO}_4$  contain 12g of solute? (4 marks)
- (b) An aqueous solution of silver nitrate ( $\text{AgNO}_3$ ) was prepared by dissolving 1.567 moles of  $\text{AgNO}_3$  in enough water to make a  $250\text{cm}^3$  of solution. What is the molarity of the silver nitrate solution? (4 marks)
- (c) What volume of conc. hydrochloric acid (36.5% w/w) is required to prepare 2L volume of 3.65% w/w solution? State the type of glassware which must be used for an accurate dilution. (3 marks)
- (d) A mixture contains three components A, B and C respectively. Component A is colourless, component B is blue and component C is yellow. Their polarity increases in the order  $A < B < C$  i.e. C is the most polar. Using a non-polar stationary phase, describe in detail how column chromatography may be used to separate the three components. Use the following as guidelines in your answer: choice of mobile phase, column preparation and sample application, component elution, analysis of eluted samples. (14 marks)
- (25 Marks)

## Section B

**Q4.** Answer ALL parts

- (a) List two safety precautions that should be used when working with a strong acid in the laboratory (2 marks)
  - (b) What is the weight in grams of (i) 1 ml of water and (ii) 1 ml HCl (spec. gravity 1.19) (4 marks)
  - (c) Give two applications of thin layer chromatography (2 marks)
  - (d) Give two adsorbants used in TLC (2 marks)
  - (e) What solution can be added to an amino acid to give its  $pK_2$  value? (2 marks)
  - (f) What is the function of the electrophoresis buffer in gel electrophoresis (2 marks)
  - (g) Express 0.07ml in micro litres. Comment on the precision of the following set of data (units are in grams): 5.0, 4.99, 5.01, 5.0, 4.98, 4.99, 5.0, 5.0, 5.02 and 5.03 (5 marks)
  - (h) Give labelled diagrams to illustrate the appearance of a suspension of bacteria **before** and **after** centrifugation at 10,000rpm for 10 minutes (4 marks)
  - (i) Give two applications of distillation. (2 marks)
- (25 Marks)

**Q5.**

- (a) Write a comprehensive note on buffers stating what they are, giving examples and applications (10 marks)
  - (b) Calculate the weight of Tris (121.14g/mol) required to prepare 200cm<sup>3</sup> of a 0.2M solution (5 marks)
  - (c) Calculate the weight of Na<sub>2</sub>CO<sub>3</sub> (106 g/mol) and NaHCO<sub>3</sub> (84 g/mol) required to prepare a 0.05M bicarbonate buffer pH 10 and  $pK_a$  10.25 (10 marks)
- (25 Marks)

**Q6.** Write a comprehensive note on each of the following:

- (a) The autoclave (5 marks)
- (b) The analytical balance (5 marks)
- (c) The pH meter (5 marks)
- (d) The spectrophotometer (5 marks)
- (e) The centrifuge (5 marks)

(25 Marks)