

CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Autumn Examinations 2008/09

Module Title: Bioanalytical Science II CA

Module Code: BIOL 6004

School: Science

Programme Title: Bachelor of Science in Applied Biosciences

Programme Code: SBIOS_7_Y1

External Examiner(s): Prof. Gary Walsh
Internal Examiner(s): Ms. Maryanne Sheehan

Instructions: Answer FOUR questions, answer TWO questions from each Section.
Use separate answer books for each Section

Duration: 2 Hours

Sitting: Autumn 2009

Requirements for this examination:

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.

Section A

Q1.

- (a) Potassium hydrogen phthalate (KHP, $\text{C}_8\text{H}_5\text{O}_4\text{K}$) reacts with sodium hydroxide (NaOH) to produce water and the sodium salt of KHP ($\text{C}_8\text{H}_4\text{O}_4\text{KNa}$).
- (i) Write a balanced equation for this reaction (3 marks)
- (ii) What weight of the sodium salt $\text{C}_8\text{H}_4\text{O}_4\text{KNa}$ is produced when 3.40g of KHP are used in the reaction? (3 marks)
- (iii) What mass of KHP is required to produce 6g of water? (3 marks)
- (iv) What mass of NaOH is required to produce 18.2g of the sodium salt $\text{C}_8\text{H}_4\text{O}_4\text{KNa}$ (3 marks)
- (b) Determine the concentration (in molarity) of a solution of KHP prepared by dissolving 5.1g KHP in water and diluting to a final volume of 250cm^3 . (4 marks)
- (c) A 20cm^3 aliquot of sodium hydroxide (NaOH) was titrated against the KHP solution prepared in (b). The titration carried out by two students. Each student repeated the titration 5 time and their respective titres are shown in the table

Student A	19.6	20.2	20.2	20.1	20.0
Student B	20.3	20.1	20.2	20.2	19.8

Calculate the standard deviation for both sets of results. Hence show which student has the more precise set of results. What steps might be taken to ensure accuracy and precision in results (assume correct titre is 20cm^3)? (5 marks)

- (d) Calculate the concentration (in moles/L) of the sodium hydroxide solution. (4 marks)

Q2.

Errors in scientific measurements can be broadly categorized into systematic and random errors. Distinguish between these two types of errors. Discuss how the analyst, the method and / or the equipment may contribute to these errors and how they may be reduced or eliminated (25 marks)

Q3.

- (a) Using the guidelines provided, give a detailed account on how an impure solid sample may be recrystallized in the laboratory.
- (i) Characteristics of an ideal recrystallization solvent (3 marks)
 - (ii) How a solvent / solvent system is chosen (5 marks)
 - (iii) Use of charcoal – why it is used and precautions (3 marks)
 - (iv) Purpose of hot filtrations – precautions (3 marks)
 - (v) Cooling rate, isolating and drying the pure product (4 marks)
- (b) Briefly outline other purification / separation techniques commonly used in the laboratory (7 marks)

Section B

Q4. Answer ALL of the following

- (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 glycerol (spec. gravity 1.26) (4 marks)
- (c) Give labeled diagrams to illustrate the appearance of a suspension of bacteria **before** and **after** centrifugation at 4 000rpm for 15 minutes (4 marks)
- (d) List 3 buffers commonly used in biological systems (2 marks)
- (e) What solution can be added to an amino acid to give its pK_1 value? (2 marks)
- (f) Give two applications of distillation (2 marks)
- (g) What is the function of agarose in gel electrophoresis? What precautions should be taken at the loading stage of gel electrophoresis to ensure good results? (5 marks)
- (h) (i) Convert 0.05ml to microlitres.
(ii) Comment on the precision of the following set of data (units are in grams): 5.0, 5.01, 4.99, 5.0, 5.01, 6.02, 4.99, 5.0, 5.01, and 5.0

Q5.

- (a) Calculate the weight of KH_2PO_4 (136g) and Na_2HPO_4 (142g) required to make 0.2M phosphate buffer with a pH of 6.2. $\text{pK}_a = 6.8$ (10 marks)
- (b) Calculate the weight of Tris (121.4g/mol) required to prepare 250cm^3 of a 0.25M solution. (5 marks)
- (c) Explain the terms accuracy and precision. (5 marks)
- (d) Comment on human and random errors. (5 marks)

Q6. Write a brief note on EACH of the following:

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