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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES
B.Sc. Third year Semester II Examination – September/October 2014
CHE 3211 – Analytical Chemistry II

Answer any four questions.   Time: 2 hours.

Use of non programmable calculator is permitted.

1). (a). Define the partition coefficient of a solute between two immiscible solvents.
Outline the method you would use to determine the distribution coefficient of iodine between water and tetrachloromethane at room temperature.

(25 marks)

(b). At 25° C the partition coefficient of butanoic acid, $CH_3CH_2CH_2COOH$ between ether and water is 3.5. Calculate the mass of butanoic acid extracted by shaking 100 cm^3 of water containing 10 g of butanoic acid with 100 cm^3 of ether. What would be the mass of butanoic acid removed in each of two further extractions using 100 cm^3 of ether each time? Compare the total mass of butanoic acid extracted in these three successive extractions with that in a single extraction using 300 cm^3 of ether.

(55 marks)

(c) Discuss the limitations of solvent extraction.

(20 marks)

2). (a) Describe two principal solvent extraction systems for metal ions. Give an example of each extraction system.

25 marks)

(b) Consider the partition of acetic acid, HOAc between benzene and an aqueous solution.
(i) Write down all the significant equilibria including dimer formation in the organic phase.

(ii) Show that the distribution, D is given by;

$$D = \frac{K_D(1 + 2K_{dim}[HOAc]_{org}}{1 + (K_a /[H_3O^+]aq)}$$

(35 marks)

(c) Give a typical sequence to do the extraction with solid phase extraction (SPE).

(20 marks)

(d) How does solid phase extraction differ from solvent extraction?
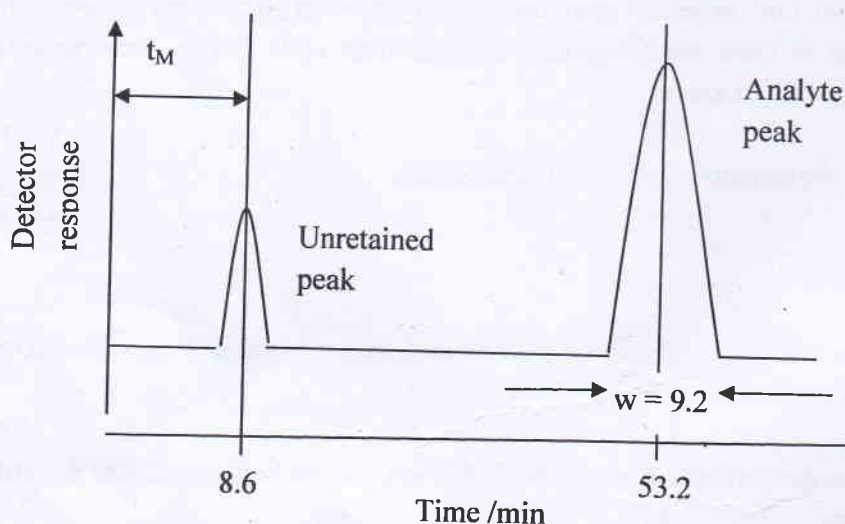
(20 marks)

3. (a) Define the following terms:
   (i) Separation factor.
   (ii) Retention factor.
   (iii) resolution.

(15 marks)

(b) Write down the van Deemter equation and define the terms. Draw HETP versus average linear velocity to illustrate van Deemter equation.

(20 marks)

(c) Answer the following using the chromatogram below:

(i) Calculate the number of plates in the column.
(ii) What is the HETP if the coloumn is 150 cm long?
(iii) Calculate the retention factor for the analyte peak.

(45 marks)

(d)   Give the equation to show the effect of retention factor and selectivity factor on resolution. If the retention factor and selectivity factor of the two peaks in a chromatogram are 2.28 and 1.60 respectively, calculate the resolution.

(20 marks)

4).   (a)   List the variables that lead to band broadening in gas chromatography.

20 marks)

(b)   What is meant by temperature programming in gas chromatography.

(20 marks)

(c)   Name three types of detectors used in gas chromatography, and give one advantage and one limitation of each detector.

(30 marks)

(d)   Briefly describe the applications of gas chromatography.

30 marks)

5.   (a)   Explain the terms normal phase chromatography and reversed phase chromatography.

(20 marks)

(b)   Briefly describe the principles of ion exchange chromatography technique.

(20 marks)

(c)   List the advantages and disadvantages of the dropping mercury electrode compared with carbon electrode.

(20 marks)

(d)   Write down the Randles-Sevcik equation is used to obtain the quantitative information in cyclic voltammetry. Define the terms in terms with respective units in this equation.

(20 marks)

(e)   Discuss the use of cyclic voltammetry in chemical analysis.

(20 marks)