



**THE OPEN UNIVERSITY OF SRI LANKA**  
**B.Sc. Degree Programme / Stand alone course – Level 4**

**CHU 2125/CHE 4125 – Analytical Chemistry**  
**Assignment Test II - 2008/2009**

Duration: One and half-hours

Date: 7<sup>th</sup> November 2008 from 3.30 p.m. to 5.00 p.m.

Reg. No. ....

Question No.	Marks
1	
2	
3	
Total	
Percentage	

**Instructions to candidates**

- \* Answer all questions.
- \* Write down answers on this paper itself, attached sheets will not be graded.

1.(a)(i) Define the term 'distillation'.

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(ii) Draw a labeled diagram of a typical set up for fractional distillation.

(iii) Write the advantage(s) of fractional distillation.

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(iv) Briefly explain the process that takes place in fractional distillation. (45 marks)

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(b)(i) Write down the Gibb's phase rule and identify the terms in it.

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(ii) Applying Gibb's phase rule to a mixture of liquid and vapour phases of ethanol, calculate the number of independent variables. What are they? (25 marks)

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(c)(i) What do you mean 'volatility'?

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(ii) What do you understand by 'relative volatility' as applied to distillation?

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(iii) Write down the expression for relative volatility related to the concentration liquid and vapour phases of one species. (30 marks)

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2. (a)(i) Write down expressions for the terms 'distribution coefficient'  $K_D$  and 'distribution ratio'  $D_C$  for a substance A present in solvents 1 and 2. Identify terms in them.

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(ii) Write down expressions for the terms  $K_D$  and  $D_C$  for the system, acetic acid ( $\text{CH}_3\text{COOH}$ ) in a mixture of water and benzene. (30 marks)

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(b) Briefly explain the effect of  $pH$  on solvent extraction of metal by chelating ligand. Draw a typical extraction curve (%E vs.  $pH$ ) for metal ions. (20 marks)

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(c)(i) Draw a schematic diagram of an Atomic Absorption Spectrometer (AAS) and write down the function of each of the units in it.

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(ii) Write **two** advantages and **two** disadvantages of Atomic Absorption Spectrometer.  
(50 marks)

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3. (a) Briefly describe the method of standard addition as used in Atomic Absorption Spectrometry to overcome interferences.  
(30 marks)

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(b)(i) Write the chemical principles involved in the electro-analytical techniques, potentiometry and conductometry.

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(ii) Write down the two advantages and two disadvantages of each of these two techniques. (40 marks)

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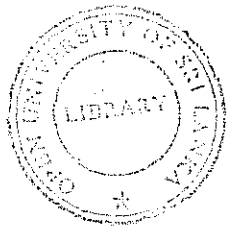
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(c)(i) Draw a simple electrophoretic apparatus.



(ii) Briefly describe the process that takes place in electrophoresis. (30 marks)

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CHU 2125 Answer Guide for CAT 02 (07/11/2008)

Q 01. (a)

- (i) Partial Vaporization of a liquid in a still or retort and the subsequent collection of the vapor in a separate vessel
- (ii) Look the fig 3 in book 4( Separational methods)
- (iii) Efficient  
Can obtain pure samples  
Compounds with low boiling points can be separated
- (iv) When liquid boils the vapor comes in to contact with the inert material in column & condenses. Due to hot vapor this condensed vapor revalorized. This process undergoes a series of micro distillations. During this the vapor gets richer in the more volatile component .After a series of Successive distillations, reasonable pure component obtained at receiving flask.

(b)

(i)  $P + F = C + 2$

P = number of phases.

F = degrees of freedom.

C = Number of components.

(ii) Since  $P = 2$  &  $C = 1$ ,

$F = 1$

Temperature or pressure

(c)

(i)  $V = Y/X$

=  $\frac{\text{Mole fraction of A in vapor phase}}{\text{Mole fraction of A in liquid phase}}$

- (ii) The ratio of the volatility of the more volatile species over the other

$$\alpha = V_1 / V_2 = y_1 x_2 / y_2 x_1$$

- (iii) 10 marks were awarded.

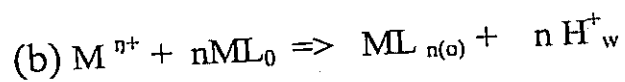
(02)(a)

(i)  $K = c_1 / c_2$       $c_1$  &  $c_2$  = concentrations of substances of A in solvent 1 & 2

$D_c = c_1 / c_2$       $c_1$  &  $c_2$  = concentrations of substances of A "in all forms"  
In solvent 1 & 2

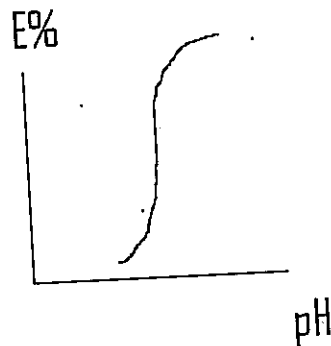
(ii)  $K_D = \frac{[\text{CH}_3\text{COOH}]_{\text{aq}}}{[\text{CH}_3\text{COOH}]_{\text{org}}}$

$$D_c = \frac{[\text{CH}_3\text{COOH}]_{\text{aq}} + [\text{CH}_3\text{COO}^-]_{\text{aq}}}{[(\text{CH}_3\text{COOH})_2]_{\text{org}} + [\text{CH}_3\text{COOH}]_{\text{org}}}$$



$$\log D_c = \log K_{eq} + n \log [\text{HL}]_o + n \text{pH}$$

by this we can show the pH effect



(c) look figure 4.1 in session 4. book v

HCL = Radiation Source

Nebulizer = Provide fine spray of sample

Chopper mirror(modulator) = By this interference from the flame emission is removed.

Monochromater = Purify light

Detector = Study the signals (pmt)

(ii) *Advantages;(any two)*

- 1 High accuracy
- 2 Freedom from interference
- 3 pH & other factors do not effect
- 4 high sensitivity
- 5 Detection limit is low

*Disadvantages;(any two)*

- 1 Relative
- 2 used only for metals
- 3 only 1 metal can be detected using one HCL
- 4 refractory oxide forming metals require hotter flame.
- 5 Expensive

(03)(a)

Look book v 3.5.1 & 3.5.2

There are two methods

1. Standard addition with one added solution(3.5.1)
2. Standard addition with a series of added standards(3.5.2)

For any one method marks were given.

(b)

(i) Potentiometry involves measuring an electrical potential that is related to a component in which someone is interested. (Nernst equation)

In conductometry the electrical conductivity of a sample is used to determine the components and their concentration. (expression for  $\kappa$ )

(ii) Potentiometry-Advantages (any two)

- 1 When no indicators to detect the end point
- 2 When the reagents are colored & difficult to detect the end point
- 3 Use for mixtures of acids, bases, halides & polyprotic acids
- 4 Can use automatic titrator

Disadvantages (any two)

- 1 Slow method
- 2 Polarization of electrodes



Any relevant advantages and disadvantages were considered regarding conductometry

(C)

(i&ii) 30 marks were awarded