THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. Degree Programme / Stand alone courses in Chemistry
Level 5 –Continuous Assessment Test II– 2011 / 2012

CMU 3123/CME 5123 – Analytical Chemistry

Duration: One and half hours
Date and time: 02nd November, 2011 from 4.00 p.m. to 5.30 p.m.

Reg. No.....

Question number	Max. marks	marks
1	55	
2	24	
3	21	
Total	100	

Instructions to students

Answer all questions in the spaces given. Additional sheets will not be marked.

(1). The distribution coefficient for a weak acid HA between diethyl ether and water is 680 and the dissociation constant of HA is 1.49×10^{-5} moldm^{-3}. 100 cm^3 of 0.01M of HA is extracted with 100 cm^3 of ether at pH 3.00.

(i) What is the difference between distribution coefficient and distribution ratio? (10 marks)

(ii) Calculate the distribution ratio of HA. (05 marks)

(iii) What will be the concentration of acid extracted to the ether layer?
(15 marks)

(iv) Suggest one way of increasing the extracted amount using the same volume of ether. (05 marks)

(v) Distinguish between the following.

(a) Ion exchange and exclusion mechanisms in chromatography.

(b) Capacity factor and selectivity factor in chromatography.

(20 marks)

2. A coloured sample of substance "x" was subjected to measure absorbance using UV/ Visible spectrophotometer.

(i) Draw and label a schematic diagram of a UV/ Visible spectrophotometer. (05 marks)

(ii) The absorbance measured was 0.55 using 1 cm cell with a molar absorptivity of 1000 $dm^3mol^{-1}cm^{-1}$. What would be the concentration of A in the sample? (05 marks)

(iii) What would be the percentage of transmittance? (05 marks)

(iv) Briefly explain the function of the following parts used in Atomic Absorption Spectrophotometer. (03 x 03 marks)

(a) Hollow cathode lamp

(b) Modulator

(c) Monochromator

3. (i) What is the difference in the principles behind Gravimetry and Thermogravimetry? (06 marks)

(ii) Give three major differences of conductometric titrations and classical tititrations. (12 marks)

(iii) Give one advantage of potentiometric titrations compared to classical redox titrations. (03 marks)

Name .....
Address .....
.....
.....

Analytical chemistry –CMU 3123

Assignment test II - Answer Guide

1) (i) Distribution Coefficient – Concentration ratio of one solute species between two immiscible solvents.

Distribution Ratio – Analytical concentration ratio of a solute species (all forms) between two immiscible solvents.

(ii)

$$D = \frac{K_d}{1+\frac{K_d}{[H^+]}} = \frac{680}{1+\frac{1.49X10^{-5}}{10^{-3}}} = 670$$

(iii)

$$C_n = \left[\frac{V_{(aq)}}{DV_{(org)} + V_{(aq)}}\right]^n C_0$$

C_0 = Initial concentration of HA
C_n = Final concentration of HA in aqueous layer
$V_{(org)}$ = Volume of the organic layer
$V_{(aq)}$ = Volume of the aqueous layer

Since $V_{(org)} = V_{(aq)}$

$$C_n = \left[\frac{1}{670+1}\right]0.01 = 1.5X10^{-5}\,moldm^{-3}$$

Concentration of HA extracted to organic layer = $(0.01-1.5 \times 10^{-5}) = 9.98 \times 10^{-3}$ moldm^{-3}

1. Extract several times with smaller volumes.

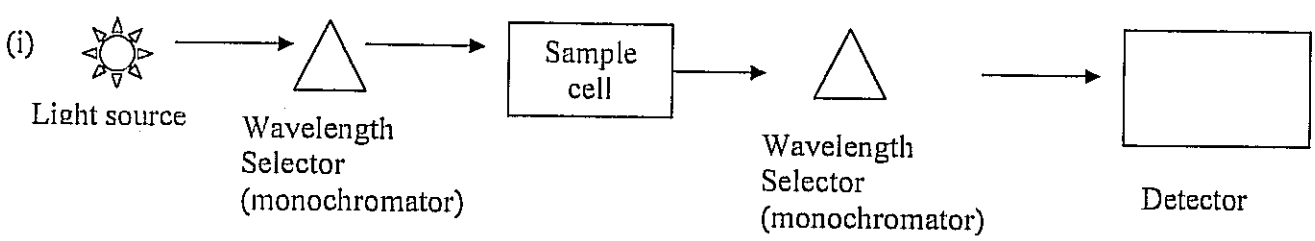
2. (a) In ion exchange chromatography, ions are separated by exchanging with ions of an ion exchanged resin whereas in exclusion, molecules are separated due to the different sizes of molecules.

(b) Capacity factor = $\frac{\text{Time spent in stationary phase}}{\text{Time spent in mobile phase}}$

Selectivity factor = $\frac{\text{Partition coefficient of solute A}}{\text{Partition coefficient of solute B}}$

2).

(i)



(ii) $A = \varepsilon Cl$ $C = \frac{A}{\varepsilon l} = 0.055/10^3 \times 1 = 0.55 \times 10^{-3}$ M

(iii) $A = -\log T$, $0.55 = -\log T$, $T = 10^{-0.55}$, % T = 28.85 %

(iv) (a) HCL - It provides only the radiations having required energy (of which the wave length is λ_{max}) for ground state atoms of a particular element to get exited. By using HCL, sensitivity is increased since almost all the energy supplied can be used.

(b) Modulator – To identify the unabsorbed radiation from the emitted radiation (resulted when the excited atoms come to the ground state) in AAS, so that true absorption can be identified by the detector.

(c) Monochromator - To select the radiation having the required wave length.

3). (i) In Thermogravimetry (TG), the sample mass is continuously monitored as it is heated. In Gravimetry, if necessary only the final weight is measured in addition to the initial weight.

TG uses much smaller quantities than those encountered in Gravimetry.

(ii)

Conductometric titrations	Classical titrations
1.high sensitivity 2. Conductance is varied with the addition of the titrant. 3. High accuracy 4. Indicator is not necessary. 5. Time consuming. 6. Either the titrant, titrand or the product should have a significant conductance.	1. Low sensitivity 2. pH, potential, pM is varied with the addition of the titrant. 3. Low accuracy 4. Need an indicator to detect the end point. 5. Quick. 6. There is no need of either the titrant, titrand or the product to have a significant conductance.

(iii) 1. High accuracy.
2. Can determine the end point of titrations of which the potential difference is even less than 0.4 V but more than 0.2V.