OPEN UNIVERSITY OF SRI LANKA
B.Sc. Degree Programme / Stand alone courses in Chemistry
Level 5 –Continuous Assessment Test 2– 2016 / 2017

CMU 3123/CME 5123 – Analytical Chemistry

Duration: One hour
Date and time: 28th May, 2017. From 2.30 p.m. to 3.30 p.m.

Reg. No.....

Question number	Max. marks	marks
1	32	
2	35	
3	33	
Total	100	

Instructions to students

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

1. (i) What is the principle behind separation in the method Electrophoresis? (07 marks)

(ii) An aqueous solution (20.0 mL) having 0.01 M of the weak acid HQ, was extracted with 50 mL of diethyl ether at pH 4 and was able to extract 75% of the weak acid to the organic layer. Calculate the distribution coefficient. (05 marks)

(iii) Do you think that the distribution ratio and the distribution coefficient is the same in the above system in (ii)? Give reasons for your answer. (08 marks)

(iv) Do you agree with the following statement? Justify your answer.

"Amines dissolved in aqueous phase can be extracted efficiently into the organic phase when the pH is low." (12 marks)

2. A hard water sample was analysed for Ca using Atomic Absorption Spectroscopy. The absorbance of a 0.5 ppm standard solution of Ca was 0.402 at λ_{max} of Ca. The absorbance of the sample was 0.354 under the same conditions.

(i) What is meant by λ_{max}? (05 marks)

(ii) Calculate the transmittance of the standard solution. (05 marks)

(iii) Calculate the concentration of Ca in the sample solution. (08 marks)

(iv) Suppose the absorbance value of the sample was found to be incorrect but that of the standard was correct, state one possible reason for getting a wrong absorbance value and also a way of correcting it. (10 marks)

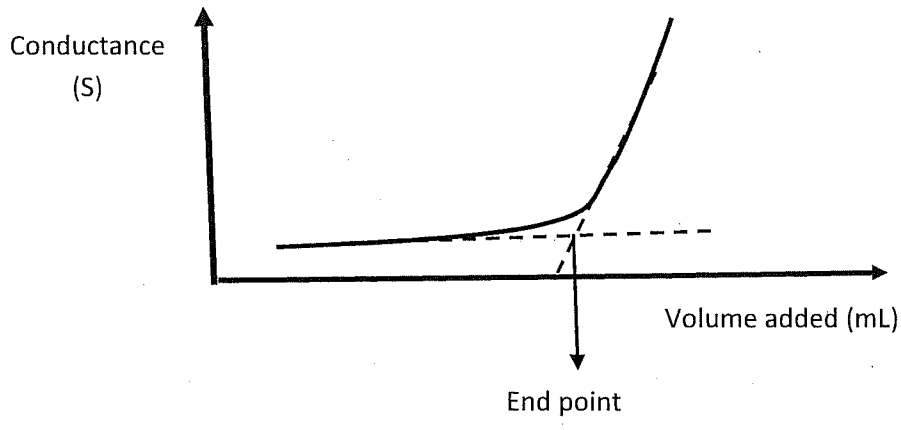
(v) State one difference in the instrumentation of Atomic absorption spectrophotometer compared to UV-Visible spectrophotometer. (06 marks)

3. (i) What is meant by the term "noise" of an instrument? (05 marks)

(ii) What is the principle behind thermometric titrations? (10 marks)

(iii) State one difference between thermometric titrations and potentiometric titrations. (08 marks)

(vi) The following conductometric titration curve was obtained for a titration between an acid and a base (25.0 mL). Giving reasons, state whether the acid and the base are strong or weak.



(10 marks)

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CMU3123 - Analytical Chemistry
Continuous Assessment Test II (2016/2017)
Answer Guide

1. (i) In Electrophoresis, ions will be separated due to different speeds in the applied electric field which is resulted by difference in type and magnitude of charge and frictional forces.

   (ii) Percentage of moles in the organic phase = 75 %
   Percentage of moles in the aqueous phase = 25 %

$$K_D = \frac{[HQ]_{org}}{[HQ]_{aq}} = \frac{\left(^{75}/_{50}\right)}{\left(^{25}/_{20}\right)} = \frac{3 \times 2}{5} = \mathbf{1.2}$$

   (iii) No.
   Distribution ratio considers concentration of all possible species whereas for the Distribution coefficient concentration of only one single species is considered.
   Since HQ undergoes dissociation resulting several ionic species (conjugate base) in the aqueous phase, Distribution ratio and Distribution coefficient will not be the same.

   (iv) $RNH_2(aq) + H^+(aq) \rightleftarrows RNH_3^+(aq)$
   When the pH is low, $[H^+]$ is high resulting more RNH_3^+. This results low concentration of RNH_2 which is non polar making the extraction into organic phase low.

   I do not agree with the statement .

2. (i) It is the wave length of the radiation that is absorbed by most of the atoms/ molecules

   (ii) $T = -\log A = -\log 0.402 = \mathbf{0.396}$

   (iii) $A = \varepsilon cl$

$$0.402 = \varepsilon \times 0.5 \text{ ppm} \times l \text{ ---------(1)}$$
$$0.354 = \varepsilon \times c \times l \text{ ---------- (2)}$$

$$\frac{(1)}{(2)} = \frac{0.402}{0.354} = \frac{0.5}{c}$$
$$c = \frac{0.5 \times 0.354}{0.402} = \mathbf{0.440 \text{ ppm}}$$

   (iv) Reason- matrix effect (interference by the other ions present in the medium of the sample).
   Matrix effect can be corrected by using standard addition method (or by matching the background of the standard with that of sample).

   (v)

Atomic absorption spectrometer	UV-Visible spectrometer
1. Source- Hollow cathode lamp	Tungsten lamp
2. A chopper is used	No chopper is used
3. One monochromator is used	Two monochromators are used

3. (i) The signal given by the instrument when there is no sample to detect (or the disturbance in the base line).

(ii) Change of enthalpy of a reaction is proportional to the change in Temperature (ΔT) which is proportional to the amount of substance reacting.

$$\Delta T \alpha \; No: of \; moles \; reacting$$

(iii)

Thermometric titration	Potentiometric titration
1. Change in temperature is measured. 2. Titration is carried out in thermostatic vessels. 3. A Thermometer is used to measure the temperature.	Change in potential (E) is measured. No such conditions are required. A potentiometer is used.

(iv) The base is in the flask (indicated by the constant volume-25.00 mL). Initial conductance is low showing that only few ions are resulted. This indicates that the solution in the flask, the base is weakly dissociated. Only a slight increase in conductance is observed up to the end point.
During the titration, Acid + Base → water + salt
The salt resulted is also not fully dissociating thus does not increase the conductance much.
After the end point, the increase is sharp resulted by addition of acid. It shows that a high amount of H^+ is resulted in the flask which indicates that the acid is strong thus fully dissociated.