

THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. Degree Programme / Stand alone courses in Chemistry
Level 5 –Assignment Test 1 – 2016 / 2017



CMU 3128/CME 5128 – INSTRUMENTAL METHODS IN CHEMICAL ANALYSIS

Duration: One hour

Date and time: 07th October, 2017

2.30 p.m. to 3.30 p.m.

Reg. No.....

Question number	marks
1	
2	
3	
Total	

Instructions to students

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

1. (i) Briefly explain what is meant by the following terms.

(a) Phosphorescence

(b) Electrode polarization

(ii) What is the function of the third electrode used in Coulometry?

(iii) Name the instrument in which the “Mass analyser” is an essential part and describe the function of it in brief.

(06x 4 marks)

2. (i) An amperometric titration was carried out to determine the concentration of AgNO_3 solution (25.0 mL) by titrating it with 1 M HCl solution. Sketch and label the expected amperometric titration curve (assume that the volume change in the flask was negligible).

(10 marks)

- (ii) Another 25.0 mL of the same AgNO_3 solution used in above (i) was subjected to Electrogravimetry.

(a) State three factors which would have affected the properties of the deposit.

(b) How do you practically carry out Electrogravimetry, making sure that only the analyte metal ion is deposited?

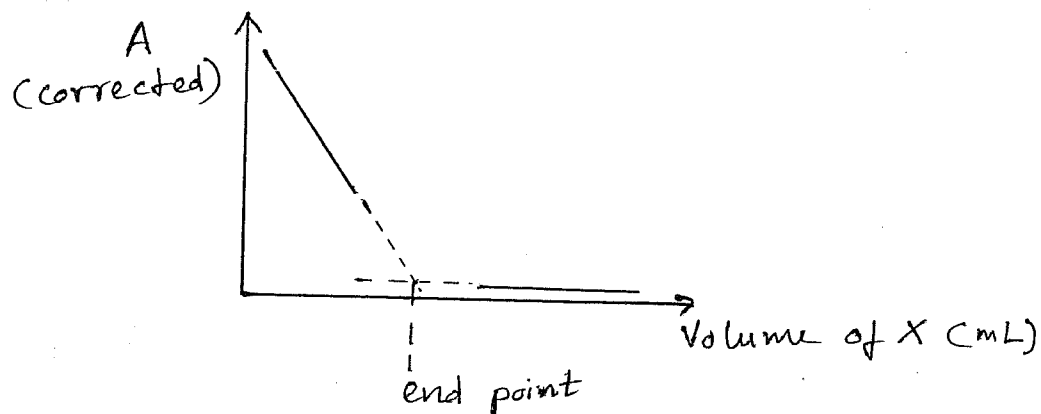
(c) The weight of the deposit was 0.432 g. Calculate the concentration of AgNO_3 solution. ($\text{Ag} = 108.00$, $\text{N} = 14.00$, $\text{O} = 16.00$)

(16 marks)

- (iii) State **one major difference** and **one major similarity** in amperometric titrations and photometric titrations.

(08 marks)

- (iv) A photometric titration was carried out to determine the concentration of the analyte Y (25.0 mL) with the titrant X. The following titration curve was obtained.



- (a) Comment on the light absorbing property of X, Y and the product.
- (b) Sketch and label the expected titration curve if X (25.0 mL) was titrated with Y.

(16 marks)

3. Two complexes Z and Q have molar absorptivity coefficient (ϵ) values of 100 ($\text{Lmol}^{-1}\text{cm}^{-1}$) and 3000 ($\text{Lmol}^{-1}\text{cm}^{-1}$) at 210 nm and, 525 ($\text{Lmol}^{-1}\text{cm}^{-1}$) and 980 ($\text{Lmol}^{-1}\text{cm}^{-1}$) at 295 nm, respectively. When the absorbance of a mixture of Z and Q was measured using a 1 cm cell, the absorbance obtained was 0.575 at 210 nm and, 0.225 at 295 nm.

- (i) What type of cell should be used for the above measurement? Why?
- (ii) Suggest a chemical method to increase the ϵ value of Z.

(iii) Calculate the concentrations of Z and Q.

(26 marks)



Name:.....

Address:.....

.....

.....

Continuous Assessment Test – I Answer guide

1. (i) (a) Phosphorescence:

Phosphorescence is the emission of light resulted when molecules relax from triplet excited state to singlet ground state.

(b) Electrode polarization:

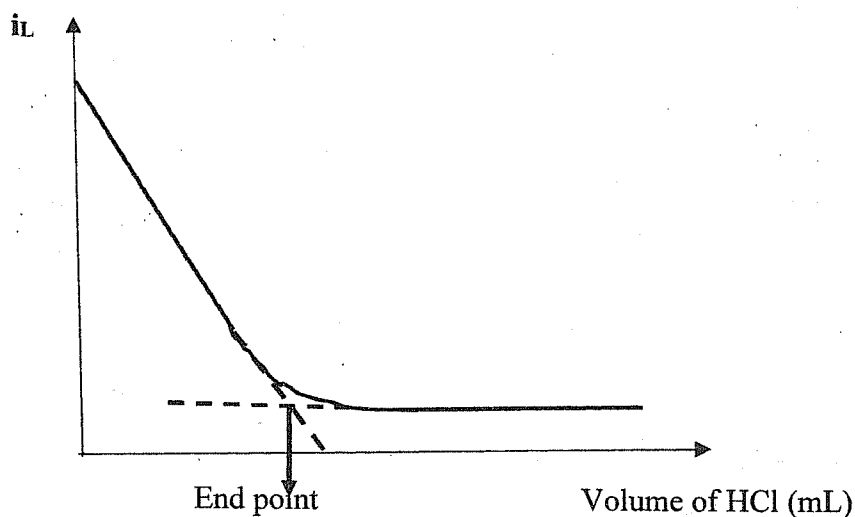
The electrodes are said to be polarized when the current is not increasing with increasing voltage.

(ii) There are three electrodes – working electrode, reference electrode, and auxiliary electrode (third electrode) are used in Constant Potential Coulometry. The function of the third electrode is to keep the potential of the working electrode constant thus the current is passed through the auxiliary electrode not through the reference electrode.

(iii) Mass analyzer:

It is a part of the mass spectrophotometer and it separates the particles based on their mass / charge ratio.

2. (i)



(ii). (a) Factors affecting the properties of the deposit: surface area of the electrode, temperature, stirring, addition of complexing agents.

(b) Analyte can be selectively deposited by controlling the potential.

(c) Ag is deposited.

$$\text{No of moles of Ag} = 0.432 \text{ g} / 108 \text{ gmol}^{-1} = 0.004$$

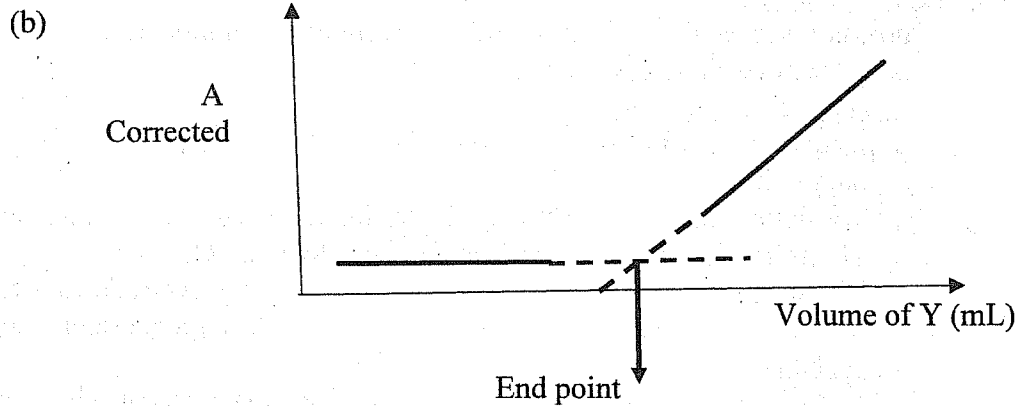
$$\text{No of moles of AgNO}_3 = 0.004$$

$$\text{Concentration of AgNO}_3 = (0.004 \text{ mol} / 25 \text{ mL}) \times 1000 = 0.16 \text{ M}$$

(iii) Difference : In Amperometric titrations, the limiting current is measured whereas in Photometric titrations, the absorbance is measured.

Similarity – In both titrations, no indicators are used and possible only if all the requirements of a titration are met. (There can be many more)

- (iv) (a) X - Non absorbing.
 Y - Absorbing.
 Product - Non absorbing.



3. (i) The cells should be made out of quartz since λ_{max} is in the UV region. Plastic and glass absorb UV light.
 (ii) Increase the conjugation by adding an auxochrome (Examples: -OH, -OR, -NH₂)
 (iii) $A_{Total} = A_z + A_q$

By substituting the equation, $A = \epsilon \times c \times l$

$$\text{At } 210\text{nm} \quad 0.575 = 100 \times C_z \times l + 3000 \times C_q \times l \quad \text{----- (1)}$$

$$\text{At } 295\text{nm} \quad 0.225 = 525 \times C_z \times l + 980 \times C_q \times l \quad \text{----- (2)}$$

From equation (1) $C_q = (0.575 - 100 C_z) / 3000$

By substituting equation (2) with it,

$$C_z = 7.55 \times 10^{-5} \text{ M}$$

By substituting equation (1) or (2),

$$C_q = 1.892 \times 10^{-4} \text{ M}$$