



Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF **PURE AND APPLIED SCIENCES**

DIPLOMA IN ANALYTICAL CHEMISTRY

(DAC 11M)

ACH 2301: CHEMICAL ANALYTICAL METHODS II

SPECIAL/SUPPLEMENTARY: EXAMINATIONS

SERIES: OCTOBER 2013

TIME: 2 HOURS

INSTRUCTIONS:

You should have the following for this paper

- *Answer booklet*

This paper consists of **FIVE** questions.

Answer Question **ONE (compulsory)** and any other **TWO** questions

This paper consists of 4 PRINTED pages

Question ONE

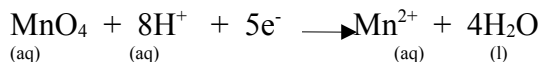
- a) Using suitable examples where possible briefly state the meaning of each of the following :
- Analytical grade reagent
 - Argentometric titration
 - Titration
 - Indicator
 - Precipitation titrimetry.
- (10marks)**
- b) Show how you can obtain the equivalence point from the following curves.
- A sigmoidal titration curve **(4marks)**
 - Linear-segmenta titration curve **(4marks)**
- c) An acid-base titration requires 25cm³ of 1.5M NaOH to neutralize 10cm³ of H₂SO₄ solution. Determine the concentration of H₂SO₄ in molarity. (Na = 23, O = 16, H =1 and S =32). Assume complete reaction. **(5marks)**
- d) Silver nitrate based reactions used to determine chloride concentrations may be followed photometrically since silver ion will react with chromate to form red silver chromate. The silver ions will however only react with chromate once all the chloride has been consumed. The formation of silver chromate may therefore be used as an indicator. The data for a photometric silver nitrate is shown below:

<i>Absorbance</i>	<i>Volume of AgNO₃ added (cm³)</i>
0.12	0
0.13	1
0.13	2
0.13	3
1.16	4
0.19	5
0.24	6
0.52	7
1.35	8
1.46	9
1.57	10
1.68	11
1.79	12
1.89	13
1.91	14

Plot a titration curves of absorbance against volume of AgNO₃ added. Estimate the end-point of this titration reaction **(7marks)**

Question TWO

- a) Discuss how you would prepare each of the following:
- 0.5M Na₂CO₃ solution in 2000cm³ volumetric flask. (Na₂ CO₃ is 99.9% pure, Na = 23, C=12,O = 16) **(5marks)**
 - 1.25M benzoic acid (C₆H₅COOH) in 500cm³ volumetric flask. Benzoic acid is 98.7% pure, C = 12, H = 1 and O = 16) **(5marks)**
- b) An iron tablet containing iron II sulphate was analysed using 0.005M KMnO₄. The iron tablet weighing 0.65g was dissolved in 100cm³ of dilute sulphuric acid. 10cm² of the solution required 6.00cm³ of 0.005M KMnO₄ to produce a faint pink colour. (Fe = 56g/mol). The reaction is describe as:



- Construct the fully balanced redox ionic equation for the manganate (VII) ion oxidizing the iron II ion. **(2marks)**
- Determine the number of moles of MnO₄⁻ ion used in the titration. **(2marks)**
- Determine the number of moles of Fe²⁺ in 100cm³ of dilute acid. **(4marks)**
- Calculate the percentage of Fe²⁺ in the iron tablet. **(2marks)**

Question THREE

- a) Discuss the application of the following indicator methods used in argentometric titrations.
- Volhard method **(5marks)**
 - Fajan method **(5marks)**
 - Mohr method **(5marks)**
- b) A 25.0cm³ sample of oxalic acid H₂C₂O₄ solution is titrated with 300cm³ of 0.25M KOH solution. Calculate the molarity of oxalic (H₂C₂O₄) acid solution given the reaction as:
- $$\text{KOH (aq)} + \text{H}_2\text{C}_2\text{O}_4 \text{ (aq)} \rightleftharpoons \text{H}_2\text{C}_2\text{O}_4 \text{ (aq)} + \text{H}_2\text{O (l)}$$
- (5marks)**

Question FOUR

- a) 4.90g of pure sulphuric acid was dissolved in water the resulting total volume was 250cm³. 20.7cm³ of thus solution was found on titration, to completely neutralize 10.0cm³ of sodium hydroxide solution. (S = 32, O = 16, H = 1)
- Write the equation for the titration reaction. Assume complete reaction **(2marks)**
 - Calculate the molarity of the sulphuric acid solution. **(2marks)**
 - Calculate the moles of sodium hydroxide neutralized. **(2marks)**
 - Calculate the molarity of sodium hydroxide. **(2marks)**
- b) (i) Differentiate between primary standard and secondary standard. **(4marks)**
(ii) State the main features of a good primary standard. **(6marks)**

Question FIVE

- a) A bulk solution of hydrochloric acid was standardized using pure anhydrous sodium carbonate (Na_2CO_3).

13.25g of Na_2CO_3 was dissolved in about 150.0cm^3 of deionized water in a beaker. The solution was then transferred with appropriate washings, into a graduated flask and the volume of water made up to 250cm^3 , and thoroughly shaken to ensure complete mixing.

25.0cm^3 of the Na_2CO_3 solution was pipette into a conical flask and screened methyl orange indicator added. The aliquot required 24.65cm^3 of a hydrochloric acid solution, of unknown molarity, to completely neutralize it. ($\text{Na} = 23$, $\text{C} = 12$, $\text{O} = 16$).

- i) Calculate the molarity of the prepared sodium carbonate. **(2marks)**
 - ii) Write out the equation n between sodium carbonate and hydrochloric acid. **(2marks)**
 - iv) How many moles of sodium carbonate were titrated? **(2marks)**
 - v) How many moles of hydrochloric acid were used in the titration? **(2marks)**
 - vi) What is the molarity of the hydrochloric acid. **(2marks)**
- b) i) define a standard solution **(2marks)**
- ii) Outline the main qualities of a good standard solution for use in titration. **(4marks)**
 - iii) Briefly discuss the preparation of standard solutions by the direct method and by the standardization method. **(4marks)**