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 :
   i) Analytical grade reagent
   ii) Argentometric titration
   iii) Titration
   iv) Indicator
   v) Precipitation titrimetry.

(10marks)

b) Show how you can obtain the equivalence point from the following curves.
   i) A sigmoidal titration curve **(4marks)**
   ii) Linear-segmenta titration curve **(4marks)**

c) An acid-base titration requires $25cm^3$ of 1.5M NaOH to neutralize $10cm^3$ of H_2SO_4 solution. Determine the concentration of H_2SO_4 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:

Absorbance	*Volume of $AgNo_3$ added (cm^3)*
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 $AgNo_3$ added. Estimate the end-point of this titration reaction **(7marks)**

Question TWO

a) Discuss how you would prepare each of the following:
   i) 0.5M Na_2CO_3 solution in $2000cm^3$ volumetric flask. (Na_2CO_3 is 99.9% pure, Na = 23, C=12,O = 16) **(5marks)**
   ii) 1.25M benzoic acid (C_6H_5COOH) in $500cm^3$ 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 $KMnO_4$. The iron tablet weighing 0.65g was dissolved in $100cm^3$ of dilute sulphuric acid. $10cm^2$ of the solution required $6.00cm^3$ of 0.005M $KMnO_4$ to produce a faint pink colour. (Fe = 56g/mol). The reaction is describe as:

$$MnO_4^-_{(aq)} + 8H^+_{(aq)} + 5e^- \longrightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$$

$$Fe^{3+}_{(aq)} + e^- \longrightarrow Fe^{2+}_{(aq)}$$

   i) Construct the fully balanced redox ionic equation for the manganate (VII) ion oxidizing the iron II ion. **(2marks)**
   ii) Determine the number of moles of MnO_4^- ion used in the titration. **(2marks)**
   iii) Determine the number of moles of Fe^{2+} in $100cm^3$ of dilute acid. **(4marks)**
   iv) Calculate the percentage of Fe^{2+} in the iron tablet. **(2marks)**

Question THREE

a) Discuss the application of the following indicator methods used in argentometric titrations.
   i) Volhard method **(5marks)**
   ii) Fajan method **(5marks)**
   iii) Mohr method **(5marks)**

b) A $25.0cm^3$ sample of oxalic acid $H_2C_2O_4$ solution is titrated with $300cm^3$ of 0.25M KOH solution. Calculate the molarity of oxalic ($H_2C_2O_4$) acid solution given the reaction as:

$$KOH_{(aq)} + H_2C_2O_4{}_{(aq)} \rightleftharpoons H_2C_2O_4{}_{(aq)} + H_2O_{(l)}$$

(5marks)

Question FOUR

a) 4.90g of pure sulphuric acid was dissolved in water the resulting total volume was $250cm^3$. $20.7cm^3$ of thus solution was found on titration, to completely neutralize $10.0cm^3$ of sodium hydroxide solution. (S = 32, O = 16, H = 1)
   i) Write the equation for the titration reaction. Assume complete reaction **(2marks)**
   ii) Calculate the molarity of the sulphuric acid solution. **(2marks)**
   iii) Calculate the moles of sodium hydroxide neutralized. **(2marks)**
   iv) 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 ($Na_2 CO_3$).

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. (Na = 23, C = 12 , 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)**