TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ANALYTICAL CHEMISTRY

DAC 14S

ACH 2301: Chemical Analytical Methods II

END OF SEMESTER EXAMINATION

SERIES:DECEMBER2016

TIME:2HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attemptquestion ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE

a) 13.2 g of iron (III) alum were dissolved in water and reduced to an iron(II) ion solution by zinc and dilute sulphuric acid. The mixture was filtered and the filtrate and washings made up to 500 cm^3 in a standard volumetric flask. If 20.0 cm^3 of this solution required 26.5 cm^3 of 0.0100 mol dm^{-3} $KMnO_4$ for oxidation.

(i) write the ionic equation for the reduction of iron(III) ions by zinc metal (2marks)

(ii) Calculate the percentage by mass of iron in iron alum (3marks)

b) 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). (5marks)

c) State any FIVE Advantage of potassium dichromate over potassium permanganate (5 marks)

d) Find the oxidation number of

(i) Mn in $KMnO_4$ (2marks)

(ii) Cl in $HClO_3$ (2marks)

(iii) N in HNO_3 (2marks)

e) Explain the following terms as used in volumetric analysis (4marks)
   i) Stoichiometric equivalence
   ii) Titrand

f) State Any FIVE advantages of conductometric titration over acid base indicator method (5marks)

Question TWO

a) A piece of rusted iron was analysed to find out how much of the iron had been oxidised to rust (hydrated iron (III) oxide). A small sample of the iron was dissolved in excess dilute sulphuric acid to give 250 cm^3 of solution. The solution contains Fe^{2+} ions from the unrusted iron dissolved in the acid, and, Fe^{3+} ions from the rusted iron.

(i) 25.0 cm^3 of this solution required 16.9 cm^3 of 0.0200 mol dm^{-3} $KMnO_4$ for complete oxidation of the Fe^{2+} ions. Calculate the moles of Fe^{2+} ions in the sample titrated. (2marks)

(ii) To a second 25.00 cm^3 of the rusted iron solution, an oxidizing agent was added to convert all the Fe^{2+} ions present to Fe^{3+} ions. The Fe^{3+} ions were titrated with a solution of $EDTA^{4-}{}_{(aq)}$ ions and 17.6 cm^3 of 0.100 mol dm^{-3} EDTA were required. Assuming 1 mole of EDTA reacts with 1 mole of Fe^{3+} ions, calculate the moles of Fe^{3+} ions in the sample. 2marks

(iii) From your calculations in (i) and (ii) calculate the ratio of rusted iron to unrusted iron and hence the percentage of iron that had rusted. (4marks)

b) Write the balanced half reactions of the following reactions:

(i) $2\ H^+ + H_2O_2 + 2\ Fe^{2+} \rightarrow 2\ Fe^{3+} + 2\ H_2O$ in acidic solution (2marks)

(ii) $H^+ + 2\ H^2O + 2\ MnO^{4-} + 5\ SO_2 \rightarrow 2\ Mn^{2+} + 5\ HSO_4^-$ in acidic solution (2marks)

(iii) Differentiate between oxidation reaction and oxidation reaction (3marks)

Question THREE

Electrolytic conductivity of an electrolyte can be determined experimentally by use of a Wheatstone bridge circuit

(i) Draw a fully labeled diagram of the circuit (6 marks)

(ii) State the function of each component in the circuit (4 marks)

(iii) Direct current DC is unsuitable for work on conductivity. Give TWO reasons (2 marks)

(iv) List THREE factors that determine the resistance of a solution of an electrolyte (3 marks)

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. (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. (2marks)

(ii) State the main features of a good primary standard. (5marks)

Question FIVE

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)

iii) How many moles of sodium carbonate were titrated? (2marks)

iv) How many moles of hydrochloric acid were used in the titration? (2marks)

v) What is the molarity of the hydrochloric acid. (2marks)

vi) Outline the main qualities of a good standard solution for use in titration. (5marks)