THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Applied & Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY (DSLT 09A)

END OF SEMESTER EXAMINATION

ACH 2309: CHEMICAL ANALYTICAL TECHNIQUES

SERIES: AUGUST/SEPTEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer booklet*

This paper consists of **FIVE** questions.
Answer question **ONE (COMPULSORY)** and choose any other **TWO** questions
This paper consist of **THREE** printed pages

QUESTION ONE (COMPULSORY)

$$mg + Sn^{4+} \rightarrow mg^{2+} + Sn^{2+}$$

a) Give the reaction

i) Identify the type of reaction and explain (4 marks)
ii) Identify the reductant and write its equation (2 marks)

b) Find the oxidation number of:

i) $Mn \text{ in } KmnO_4$
ii) $Cl \text{ in } HclO_3$
iii) $N \text{ in } HNO_3$
iv) $Cr_2O_7^{2-}$
v) $V \text{ in } VO_2^+$
vi) $Cl \text{ in } HclO_4^-$ (12 marks)

c) Using labeled sketches explain the conductometric titration curves obtained in each of the following

i) CH_3cooH against $NaoH$ (6 marks)
ii) Hcl against NH_4OH (4 marks)

d) State **TWO** advantages of conductimetric titration over acid base indicator method (2 marks

QUESTION TWO

Use the following list of standard electrode potentials to answer the questions that follow

Half cell reaction	E^o (Volts)
$Mg^{2+} + 2e \rightarrow Mg_{(s)}$	-2.38
$Al^{3+} + 3e \rightarrow Al_{(s)}$	-1.68
$Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{3+} + 7H_20$	+1.33

$Cl_2 + 2e \rightarrow 2Cl^-$ +1.36

$Fe^{3+} + e \rightarrow Fe^{2+}$ +0.77

$Zn^{2+} + 2e \rightarrow Zn$ -0.76

$Br_2 + 2e \rightarrow 2Br^-$ +1.09

a) Identify

i) The strongest oxidizing agent
ii) The strongest reducing agent (2 marks)

b) From Fe^{3+}, Fe^{2+} and Zn / Zn^{2+} half cells

i) Draw a labeled diagram of the cell composed of the two electrodes and indicate on it the direction of election flow (5 marks)
ii) Write the cell representation stating what each of the symbols represent (4 marks)
iii) Write the equation for the cell reaction taking place (1 mark)
iv) Calculate the equilibrium constant for the cell reaction (3 marks)

$$Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{3+} + H_2 0$$

c) For the half cell reaction Calculate the electrode potential if the hydrogen ion concentration was changed to 0.01m leaving the concentration of the others unchanged (5 marks)

QUESTION THREE

a) Electrolytic conductivity of an electrolyte can be determined experimentally by u se of a Wheatstone bridge circuit

i) Draw a fully labeled diagram of the Wheatstone bridge circuit (8 marks)
ii) State the function of each component in the circuit (6 marks)
iii) Give the name used to describe the type of water used in making solutions for conductivity measurement (1 mark)
iv) Direct current DC is unsuitable for work on conductivity. Give **TWO** reasons. (2 marks)

b) List **THREE** factors that determine the resistance of solution of an electrolyte (3 marks)

QUESTION FOUR

a) State Kohlrausch's Law (2 marks)

b) A solution containing 6g of ethanoic acid per dm^3 has an electrolytic conductivity of 5.21 x 10^{-2} $\Omega^{-1}M^{-1}$ AT 25°C. The molar conductivities at infinite dilution at this temperature for the ions H^+ and CH_3Coo^- are 3.498 x 10^{-2} and 0.412 x 10^{-2} $\Omega^{-1}M^{2}Mol^{-1}$ respectively. Calculate the degree of dissociation of ethanoic acid (8 marks)

C=1.2, H= 1, O= 16

c) Describe how the solubility of slightly soluble silver chloride can be determined by conductivity measurement (10 marks)

QUESTION FIVE

a) Using a labeled diagram of a specific electrochemical cell discuss the role of a salt bridge in the electrochemical cell (15 marks)

b) Electrochemical cells can be classified into two classes on the basis of energy conversion.
   i) Name the **TWO** classes (2 marks)
   ii) Name the class the electrochemical cell in your diagram in 5(a) belong (1 mark)

c) State **TWO** other items that can be used in place of salt bridge (2 marks)