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)

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

i) CH_3COOH against NH_4OH (6 marks)

ii) HCl against NH_4OH (4 marks)

b) State two advantages of conductometric titration over acid base indicator method (2 marks)

c) Given the reaction $mg + 5n^{4+} \rightarrow Mg^{2+} 5n^{2+}$, S_n^{H+}

i) Identify the type of reaction and explain (4 marks)

ii) Identify the reductant and write its equation (2 marks)

d) Find the oxidation number of:

i) $Mn \text{ in } KMnO_4$

ii) $Cl \text{ in } HClO_3$

iii) $N \text{ in } HNO_3$

iv) $Cr \text{ in } Cr_2O_7^{2-}$

v) $V \text{ in } VO_2^+$

vi) $Cl \text{ in } HClO_4^-$ (12 marks)

QUESTION TWO

a) 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 (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 a solution of an electrolyte (3 marks)

QUESTION THREE

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
$Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{3+} + 4H_2O$	+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 formed from the two electrodes and indicate on the diagram the direction of electron flow (5 marks)
   ii) Write the cell representation stating what each symbol you use 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)

c) For the half cell reaction
   $Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{3+} + 7H_2O$
   . Calculate the electrode potential if the hydrogen ion concentration was changed to 0.01 leaving the concentration of the other unchanged. (5 marks)

QUESTION FOUR

a) Using a labeled diagram of a specific electrochemical cell discuss the role of the 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 4(a) above belong (1 mark)

c) State **TWO** other items that can be used in place of salt bridge to achieve the same objective (2 marks)

QUESTION FIVE

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 CH_2COO^- and H^+ 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) Describe how the solubility of a slightly soluble silver chloride can be determined by conductivity measurement (10 marks)