



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 (DSL09J)

ACH 2309: CHEMICAL ANALYTICAL TECHNIQUES

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: OCTOBER 2011

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

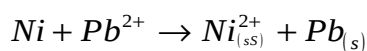
- *Answer booklet*

This paper consists of **FIVE** questions

Answer question **ONE (COMPULSORY)** and choose any other **TWO** questions

This paper consist of **FOUR** printed pages

QUESTION ONE – (COMPULSORY)



- a) Given the reaction
- Identify the type of reaction. Explain (3 marks)
 - Write the half cell equation for the reluctant (1 mark)
- b) Find the oxidation number of
- Mn in Mn_2O_3
 - Cl in $HClO_3$
 - N in HNO_2
 - $Cr_2O_7^{2-}$
 - V in VO_2^+
- (10 marks)
- c) Electrolytic conductivity of an electrolyte can be determined experimentally by use of a Wheatstone bridge circuit.
- Draw a fully labeled diagram of the Wheatstone Bridge Circuit (8 marks)
 - State the function of each component in the circuit (6 marks)
 - Give the name used to describe the type of water used in making solution for conductivity measurement (1 mark)
 - Explain why direct current is unsuitable for this work (1 mark)

QUESTION TWO

- a) State Kohlraushch's law (2 marks)
- b) A solution containing 6g of ethanoic acid per dm^3 has an electrolytic conductivity of $5.21 \times 10^{-2} \Omega^{-1} M^{-1}$ at $25^\circ C$. The molar conductivities at infinite dilution at this temperature for the ions H^+ and CH_3COO^- are 3.498×10^{-2} and $0.412 \times 10^{-2} \Omega^{-1} M^2 mol^{-1}$ respectively. Calculate the degree of dissociation of ethanoic acid
- C = 12, H = 1, O = 16 (8 marks)
- c) Given a sample of organic to demonstrate presence of elements carbon and hydrogen.

- i) Name three chemical substances you will require and the function of each giving chemical equations where applicable (8 marks)
- ii) State the observations made to confirm presence of carbon and hydrogen (2 marks)

QUESTION THREE

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

Half cell reaction	E°Volts
$Mg^{2+} + 2e \rightarrow Mg_{(s)}$	-2.38
$Al^{3+} + 3e \rightarrow Al_{(s)}$	-1.68
$Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{3+} + 7H_2O$	+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) 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 electron 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 (3 marks)



- c) For the half cell reaction

Calculate the electrode potential if hydrogen ion concentration was changed to 0.01 leaving the concentration of the others unchanged. (5 marks)

QUESTION FOUR

- a) (i) Define the term Polarogram (1 mark)
- (ii) Draw a clearly labeled diagram of the apparatus used to obtain polarogram in chemical analysis (8 marks)
- (iii) sketch and label the expected polarogram from the polarographic analysis of an aqueous solution containing $Zn^{2+}, Pb^{2+}, Sn^{2+}, Ag^+, Cu^{2+}$ given their decomposition potentials as -0.76, -0.13, -0.14, +0.80 and +0.34 volts respectively. (7 marks)
- b) Silver nitrate is used as a testing reagent in the last stage in detection of elements in organic samples.
- i) Identify the target element (1 mark)
- ii) State how the test is carried out (1 mark)
- iii) State one observation made during such a test and the inference. (2 marks)

QUESTION FIVE

- a) A crude organic sample (containing C H and O)sample is known to contain 4% by mass of uncombustible impurities. On being subjected to combustion analysis 9.375g of the crude sample on complete combustion gave 8.8g of carbon dioxide and 1.8g of water. Calculate the percentage of each of the three elements in the sample (8 marks)

$$C = 12, O = 16, H = 1$$

- b) The Kjeldahl method is one of the methods commonly used in determination of elements in organic synthesis. List three basic steps of this method and for each state the reagents used and the role of each (12 marks)