Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF **PURE AND APPLIED SCIENCES**

DIPLOMA IN ANALYTICAL CHEMISTRY
(DAC 11M)

ACH 2308 : PHYSICAL CHEMISTRY II

SEMESTER: EXAMINATIONS

SERIES: DECEMBER 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 **3 PRINTED** pages*

Question ONE

(a) The energy diagram for the reaction

A + B $\rightleftharpoons$ C + D Proceeding from left to right is

(i) State what the energies E1 E2 and E3 represent **(3 marks)**

(ii) What would be the effect on E1,E2 and E3 on adding a catalyst to the reaction **(3 marks)**

(iii) Is the reaction exothermic or endothermic. Give a reason for your answer **(2 marks)**

(iv) Identify the substance at B **(1 mark)**

(b) (i) Distinguish electronic from electrolytic conductors and give two examples for each **(6 marks)**

(ii) State FOUR differences between electronic and electrolytic conductivities **(4 marks)**

(c) (i) Define the term reference electrode **(2 marks)**

(ii) State FOUR conditions on which standard electrode potential is based **(4 marks)**

(d) (i) State the relationship between resistance and conductance **(1 mark)**

(ii) List the FOUR factors that determine the resistance of a solution of an electrolyte **(4 marks)**

Question TWO

(a) Define the term chain reaction **(1 mark)**

(b) Referring to the reaction between methane CH_4 and chlorine gas Cl_2 as an example of a chain reaction

(i) State three conditions that can initiate this reaction **(3 marks)**

(ii) Give

A) The equation for the chain initiation step **(1 mark)**

B) Two equations for the two chain propagating steps **(2 marks)**

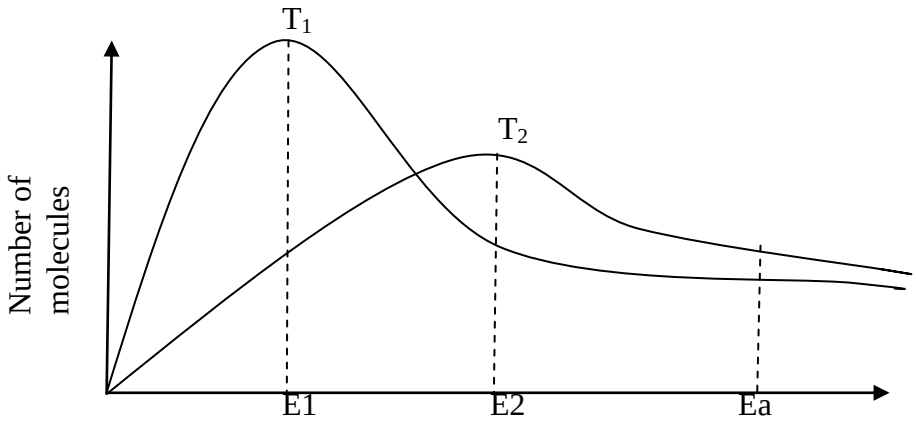
C) Three equations for the three chain terminating steps **(3 marks)**

(iii) State the condition that favours

A) Formation of CH_3Cl as the main product **(1 mark)**

B) Formation of CCl_4 as the main product **(1 mark)**

(c) From the following diagram



(i) State the relationship between temperatures T1 and T2 **(1 mark)**

(ii) What is represented by E1 E2 and Ea **(2 marks)**

(iii) Give the name of the law the diagram represents **(1 mark)**

(iv) The equation

$N = No\ e^{-Ea/RT}$ is applicable to this law. State what the symbols N, No, Ea and R represent **(4 marks)**

Question THREE

(a) State FIVE factors that influence the rate of chemical reactions **(5 marks)**

(b) The reaction represented by the equation $A + 2B + C \rightarrow AB + BC$ gave the following data

Experiment	Concentration mol lit^{-1}			Reaction Rate mol lit^{-1} Sec^{-1}
No	[A]	[B]	[C]	
1	1.00	1.00	2.00	1.00
2	2.00	1.00	2.00	2.00
3	2.00	2.00	2.00	8.00
4	2.0	2.0	4.00	8.00

(i) Write the general (unknown) rate equation for this reaction stating what each symbol in the equation stating what each symbol in the equation represent **(4 marks)**

(ii) Calculate the rate of the reaction if the concentrations of A B and C are 1.00, 2.00 and 3.00 mol lit^{-1} respectively **(11 marks)**

Question FOUR

(a) (i) Define the following

(A) Redox reaction

(B) Oxidation number

(C) Oxidant **(3 marks)**

(iii) Find the oxidation number of

(A) Mn in K_2MnO_4

(B) V in VO_2^{+1}

(C) Cr in $Cr_2O_7^{2-}$

(6 marks)

(b) A solution containing 6.0g ethanoic acid per dm3 has an electrolytic conductivity of $5.21 \times 10^{-2}\Omega^{-1}\ m^{-1}$ at 25˚C. The molar conductivity of ethanoic acid at infinite dilution at t his temperature is $3.91 \times 10^{-2}\ \Omega^{-1}m^2mol^{-1}$. Calculate the degree of dissociation of ethanoic acid (CH_3COOH) (C=12 , O =16, H = 1) **(6marks)**

(c) The behavior of a mixture of nitrogen (ii) oxide, oxygen and sulphur dioxide all gases is represented by the following equations.

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

$NO_2(g) + SO_2(g) \rightarrow SO_3(g) + NO\ (g)$

(i) State the roles played by NO and SO_2 gases in this reaction **(2marks)**

(ii) What property of these gases enables them to play these roles **(1mark)**

(iii) Determine the equation for the overall reaction that occurs **(2marks)**

Question FIVE

(a) Electrolytic conductivity of an electrolyte Can be determined experimentally by use of a Wheatstone bridge circuit

(i) Draw a fully labelled diagram of the Wheatstone bridge circuit **(8marks)**

(ii) State the function of each component in the circuit **(6marks)**

(iii) Give the name used to describe the type of water used in making solutions for conductivity measurements **(1mark)**

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

a. (i) The molar conductivities of KCl, KBr and NaCl are 149.86, 151.92 and 126.45 Scm^2 mol^{-1} respectively. The molar conductivity of sodium ion Na+ is 52.17 Scm^2 mol^{-1}. Find the molar conductivity of the bromide ion **(3marks)**