Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF **PURE AND APPLIED SCIENCES**

DIPLOMA IN ANALYTICAL CHEMISTRY
(DAC 10J)

ACH 2314 : PHYSICAL CHEMISTRY

SPECIAL/SUPPLEMENTARY: EXAMINATIONS

SERIES: February 2013

TIME: 2 HOURS

INSTRUCTIONS:

You should have the following for this paper
- *Answer booklet*

This paper consists of ***FIVE*** questions.
Answer **ALL** Question in Section **A** and any **THREE** in section **B**.
*This paper consists of **4 PRINTED** pages*

SECTION A
Answer ALL questions in this section

1. State FOUR observable phases in a system containing sulphur only **(4marks)**

2. Distinguish resistivity from conductivity and give their corresponding units **(4marks)**

3. A saturated solution of a slightly soluble salt AB was found to have an electrolytic conductivity of 3.4×10^{-6} S cm^{-1} and 1.6×10^{-6}S $cm^{-1}$for the water used to make the solution. Molar conductivity of AB at infinite dilution is $138.35 cm^2$ mol^{-1}. Calculate the solubility of AB in water in mol/lit. **(4marks)**

4. Define the following terms
   a) Discharge potential
   b) Overvoltage
   c) Polarogram
   d) Half wave potential **(4marks)**

5. State FOUR methods that can be used to separate components of a binary azeotropic mixture.

   (4marks)

6. List FOUR factors that determine the resistance of a solution of an electrolyte **(4marks)**
7. Define the following terms
   a) Standard electrode
   b) Reference electrode
   c) Galvanic cell
   d) Residual current **(4marks)**

8. In a system represented by the equation $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ at 25˚C the equilibrium total pressure is 85.5KPa. If the partial pressure of N_2O_4 is 57.0 KPa find KP and give its units

   (4marks)

9. Two pure liquids A and B have vapour pressures of 1.70×10^4 NM^{-2} at 25˚C. Give that a mixture A and B is an ideal solution, calculate the mole fraction of A in a mixture of A and B which has a total vapour pressure of 2.70×10^4 NM^{-2} at 25˚C **(4marks)**

10. State FOUR advantages of drapping mercury electrode (DME) used in polargraphy **(4marks)**

SECTION B

11. (a) The following data shows the data during the formation of sodium chloride

	Reaction	**ΔH° KJmol^{-1}**
(i)	$Na(s) + \frac{1}{2} Cl_2(g) \longrightarrow NaC(s)$	-410
(ii)	$Na(s) \longrightarrow Na(g)$	+108

(iii) $Na(s) \longrightarrow Na^+(g) + e^-$ +494

(iv) $Cl_2(g) \longrightarrow 2Cl$ +242

(v) $Cl(g) + e \longrightarrow Cl^-$ -364

a) Draw the born-Haber cycle for the calculation of the lattice energy of sodium chloride **(3marks)**

b) Calculate the lattice energy of sodium chloride **(3marks)**

c) Name the heat changes (i) (ii)(iii) and (iv) **(4marks)**

b) The vapour pressure of pure water and pure aniline at stated temperature are shown in the following table

Temperature ˚C	85	90	95	100	105
Vapour pressure	434	526	634	760	906
Vapour pressure of aniline mmHg	22.9	29.2	36.5	45.7	55.0

By drawing a suitable graph find the temperature at which the mixture will pressure of 760mmHg **(10marks)**

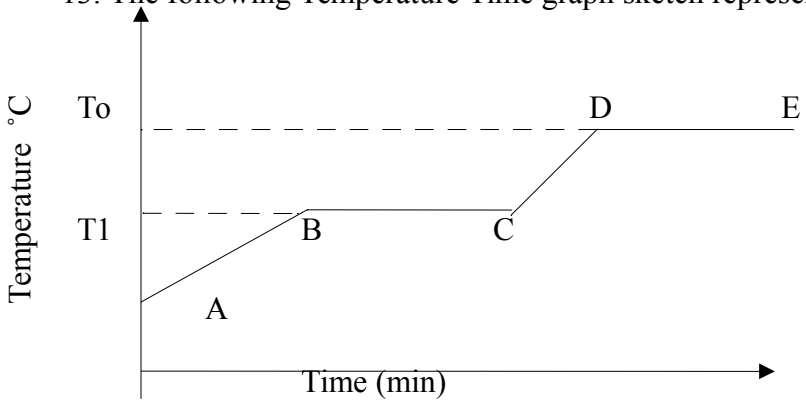
12. You are provided with heats of formation of carbon dioxide and water as Q1 and Q2KJmol^{-1} respectively. Describe an experiment that can be carried out to determine the approximate heat of formation of solid Zinc carbonate. Show clearly how ΔH_f $ZnCO_3$ will be calculated from your experimental results

Zn =65 C=12 O=16 H=1 Cl + 35.5

Assume density of solution formed = 1gcm^{-3}

And its heat capacity = 4.2Jg^{-1}C^{-1} **(20marks)**

13. The following Temperature Time graph sketch represent the warming curve of substance X



a) List the SIX requirements of an experiment to obtain these results **(6marks)**

b) State what each section of the graph represents **(4marks)**

c) Give the names of temperatures To and T_1 **(2marks)**

d) Identify from the sketch the sections that represent latent heat change **(2marks)**

e) Draw the cooling curve of X and state what each section of the graph represents **(6marks)**

14. (a) The slightly soluble ionic compound $Mg(OH)_2$ has $K_{SP} = 7.1 \times 10^{-12}$

(i) Write the equation for the dissolving process of the solid $Mg(OH)_2$ in water **(1mark)**

(ii) Write the KSP expression and determine its units if the species concentration is in mol dm^{-3} **(2marks)**

(iii) Calculate the solubility of $Mg(OH)_2$ (in mol/lit) in

A) Pure water **(4marks)**

B) 0.02M NaOH **(3marks)**

C) 0.02M $Mg(NO_3)_2$ **(4marks)**

(iv) State the name of the principle illustrated by the results obtained in 14(a) (iii) above and state the principle **(2marks)**

(b) Sketch and label the expected polarogram from the polarographic analysis of an aqueous solution containing the ions Zn^{2+}, Ag^{+} and Cu^{2+} given their deposition potentials -0.76, + 0.80 and + 0.34 volts respectively.

(4marks)

15. (a) Draw a well labeled diagram of a vapour pressure osmometer and describe how it functions

(16marks)

(b) State the causes of deviation from osmotic pressure law **(2marks)**

(c) Explain why osmotic pressure is the only colligative property which offers a practical method for the determination of relative molar mass above 10,000g mol^{-1}

(2marks)