NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SECOND SEMESTER EXAMINATIONS – JUNE 2010
PHYSICAL CHEMISTRY II – SCH 2204
TIME: (3) THREE HOURS

INSTRUCTIONS TO CANDIDATES

MATERIAL
Reduction potential tables, graph papers.

INSTRUCTIONS TO STUDENTS
Answer All questions in section A and All questions in Section B.
Answer each question on a FRESH page.

$R = 8.314\ JK^{-1}mol^{-1} = 0.08205\ dm^3\ atm^{-1}\ K^{-1}mol^{-1}$.
$F = eN_A = 96\ 485\ C\ mol^{-1}$
1 atm = 760 torr = 760mmHg = 101 325 Pa
lnx = 2.3026logx

SECTION A *Answer ALL questions. Each question carries 10 marks*

1. (a) The conductivity of 0.01 $moldm^{-3}$ aqueous solution of barium chloride at 25^0C is 0.2382 Sm^{-1} ant the transport number of the barium ions in this electrolyte is 0.4375. Calculate the mobilities of barium and chloride ions [8 marks]

   (b) State two applications of conductometric methods. [2 marks]

2. .(a) Consider an electrode that responds to the equilibrium between Oxygen, water and Hydroxide ions, according to the following reaction:
   $O_2(g) + 2H_2O(aq) + 4e^- \longleftrightarrow 4OH^-(aq)$
   Derive an expression for the potential difference across the electrode interface. [4 marks]

   (b) Using the electrode potentials, calculate the solubility of AgCl in $moldm^{-3}$ at 25^0C [4 marks]

   (c) Write the cell reaction and half-reaction for the following cells reaction:
   $AgNO_3 + Fe(NO_3)_2 \longleftrightarrow Ag + Fe(NO_3)_3$ [2 marks]

3. (a) State the conditions of temperature and pressure in which the BET isotherm is strongly obeyed. [2 marks]

   (c) Compare and contrast *physisorption* and *chemisorption.* [6 marks]

(c) When is the term *sorption* used? [2 marks]

4.

(a) Name three major techniques that are used in characterization of colloidal systems. Highlight the principle for each technique and briefly explain its application. [9 marks]

(b) What is a sol? [1mark]

SECTION B

Answer ALL questions from this section.

5. (a) With the aid of a diagram outline the moving boundary method for determining transport numbers for ions [6 marks]

(b) With the aid of diagrams, describe the three models of the electric double layer at the electrode/electrolyte interface [10 marks]

(c) Write the cell reactions and half-reactions for the following cells:
(i) $Sn \mid SnCl_2(aq) \parallel MnCl_2(aq), HCl(aq) \mid MnO_2(s) \mid Pt$
(ii) $Pt \mid Fe^{3+}(aq), Fe^{2+}(aq) \parallel Sn^{4+}(aq) \mid Sn^{2+}(aq) \mid Pt$ [4 marks]

6.

(a) Outline the formation of an electric double layer on the surface of a colloidal particle. State the prime role of the electric double layer and explain how this role is performed [4 marks]

(b) From the principle of light scattering, explain why the sky is blue during the day [2 marks]

(c) Copy and complete the following table:

Disperse system	Disperse phase	Dispersion medium	Examples
(a)……..	(b)……	(c)…….	toothpaste
	(d)……	Solid	
(e)……...	(f)……	(g)…….	
	(h)……	(i)…….	Fog
(j)……	Gas	Solid	
	(k)……..	(l)…….	
(m)……..	liquid	Solid	
(n)……	(o)……..		milk

[8 marks]

(c) Calculate the ionic strength and the mean activity coefficient of 0.001molkg^{-1} $CaCl_2(aq)$ at 25^0C.

$\log \gamma_{\pm} = -\left|z_- z_+\right| AI^{1/2}$, $I = \frac{1}{2}\sum z_i^2 m_i$, $A = 0.509/(molkg^{-1})^{1/2}$

[6 marks]

7. The data below show the pressure of CO needed for the value of adsorption on charcoal (corrected to 1 atm and 273K) to be 10cm^3. Calculate the adsorption enthalpy at this surface coverage.

T/K	200	210	220	230	240	250
p/Torr	30.0	37.1	45.2	54.0	63.5	73.9

Hint: $\left(\frac{\partial \ln p}{\partial\left[\frac{1}{T}\right]}\right) = \frac{\Delta H_{ads}^{\theta}}{R}$. [20 marks]

END OF QUESTION PAPER!!!