NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS – AUGUST 2010
PHYSICAL CHEMISTRY II – SCH 2204
TIME: THREE HOURS (3 HRS)

INSTRUCTIONS TO CANDIDATES

MATERIAL
Reduction potential tables

INSTRUCTIONS TO STUDENTS
Answer All questions.

$R = 8.314\ JK^{-1}mol^{-1} = 0.08205\ dm^3\ atm^{-1}\ K^{-1}mol^{-1}$.
$F = eN_A = 96\ 485\ C\ mol^{-1}$
1 atm = 760 torr = 760mmHg = 101 325 Pa
lnx = 3.303logx

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

1. (a) The cell constant was given to be 0.400 cm^{-1}. A 0.100$moldm^{-3}$ NH_4Cl (aq) solution had a resistance of 28.49Ω. Calculate the molar conductivity of NH_4Cl(aq) at this concentration. [4 marks]

(b) The limiting molar conductivities of KCl, KNO_3, and $AgNO_3$ at standard conditions are 149.9 Scm^2mol^{-1}, 145.0 Scm^2mol^{-1}, and 133.4Scm^2mol^{-1}, respectively. What is the limiting molar conductivity of AgCl at this temperature? [6 marks]

2. Calculate the ionic strength of an aqueous solution of Calcium chloride at 298K having a molality equal to 0.002 $molkg^{-1}$ and, using the Debye-Huckel limiting law, estimate
(a) The activity coefficients of the Ca^{2+} and Cl^- ions in this solution, and
(b) The mean activity coefficients of these ions
[10 marks]

[$I = \frac{1}{2}\sum m_i z_i^2$; $\log\gamma = -Az^2\sqrt{I}$; $A = 0.51 kg^{\frac{1}{2}} mol^{\frac{1}{2}}$ for aqueous solutions at 298K]

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

(b) Derive the Langmuir's isotherm. Include the steps for its conversion to the linear form. [6 marks]

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

4. (a) State the size range of colloidal particles. What kind of particles are above and below this range. [2 marks]

(b) What is Rayleigh scattering? [2 marks]

(b) 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 how this role is performed. [6 marks]

SECTION B

Answer ALL questions from this section.

5. (a) The cell Mg | Mg SO_4(aq, a =1) || $CuSO_4$(aq, a = 1)| Cu was set up in a laboratory experiment.

Calculate (i) the e.m.f of the cell at standard conditions
(ii) the value of ΔG_r^{Θ} for the cell reaction
(iii) the equilibrium constant for the cell reaction.

Which electrode is more positive, and which way do electrons flow? [8 marks]

(b) Write the cell reactions and half-reactions for the following cells:
(i) Pt | $SnCl_2$(aq), $SnCl_2$(aq) || $MnCl_2$(aq), HCl(aq) | MnO_2(s) | Pt
(ii) Pt| Fe^{3+}(aq), Fe^{2+}(aq)|| Sn^{4+}(aq) | Sn^{2+}(aq) | Pt [6 marks]

(c) Using electrode potentials, calculate the equilibrium constant for the following reactions at 25°C.
(i) $Sn(s) + SnCl_4(aq) \longrightarrow 2SnCl_2(aq)$
(ii) $Sn(s) + 2AgCl(s) \longrightarrow SnCl_2(aq) + 2Ag(s)$
[6 marks]

6. (a) State the four common kinds of electrodes used in electrochemical cells [4 marks]

(b) State the two types of concentration cells and highlight the major difference between them [2 marks]

(c) Draw a rough graph that describes the variation in the conductance of:
(i) A strong acid titrated with a strong base
(ii) A weak acid titrated with a strong base
(iii) A strong acid titrated with a weak base
[6 marks]

State two titrimetric analyses in which conductometric methods may be more preferable. [2 marks]

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

7. The data below relates to the adsorption of carbon monoxide on charcoal at 273K. Confirm that they fit the Langmuir isotherm, and find:
(a) The constant k
(b) The volume corresponding to complete coverage

In each case V has been corrected to 1 atm

P/Torr	100	200	300	400	500	600	700
V/cm^3	10.3	19.3	27.3	34.1	40.0	45.5	48.0

The Langmuir's isotherm: $\theta = \dfrac{kP}{(1+kP)}$ [20 marks]

END OF QUESTION PAPER!!!