

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER EXAMINATIONS - MAY 2001
PHYSICAL CHEMISTRY II - SCH 2204
TIME: 3 HOURS

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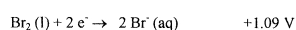
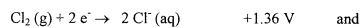
INSTRUCTIONS TO CANDIDATES

Answer **ALL** questions from Section A and **ANY THREE** from Section B.

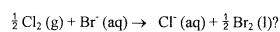
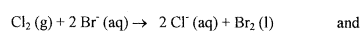
Gas Constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $0^\circ \text{C} = 273.15 \text{ K}$
Faraday's Constant $F = 9.6485 \times 10^4 \text{ C mol}^{-1}$ Avogadro's Number $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

SECTION A

1. Given the standard reduction potentials at 298K for the reactions:

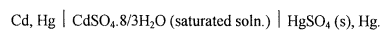


what are the values of ΔG° and the equilibrium constant K for the following reactions:



(8 marks)

2. The Weston standard cell is



- (a) What is the principle use of the Weston cell? (2 marks)
- (b) Sketch the cell, and state the reactions occurring at each electrode, and the overall cell reaction. (8 marks)
- (c) At 298 K its emf is 1.01832 V and $\partial E^\circ / \partial T = -5.00 \times 10^{-5} \text{ V K}^{-1}$. Calculate ΔG° , ΔH° and ΔS° . (6 marks)

< 1 >

3. (a) Given the relation

$$D = \lambda kT / z^2 e^2$$

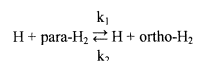
between the ionic conductance and the diffusion constant, and

$$j_L = (zFD/\delta) c$$

derive an expression for the thickness of the diffusion layer in terms of the electrolyte concentration, limiting current density and the ionic conductance. (4 marks)

- (b) The ionic conductance of Fe^{2+} is $40 \text{ S cm}^2 \text{ mol}^{-1}$. The limiting current at a Pt electrode of area 40 cm^2 in a 0.250 M solution of iron(II) chloride at 298 K was 215 mA . Calculate the thickness of the diffusion layer. (6 marks)

4. The gas phase reaction $2 \text{ A} \rightarrow \text{ B}$ is second order in A, and takes place in a reaction vessel of constant volume and temperature with a half-life of 1 h. If the initial pressure of A is 1 atmosphere, what is the total pressure in the vessel after 2 h? (6 marks)
5. Show that the interconversion of ortho- and para-hydrogen will be $\frac{3}{2}$ order, as obtained experimentally in the range $600 - 750^\circ\text{C}$, if the rate-determining step is that between atoms and molecules of hydrogen



(6 marks)

6. The data for the adsorption isotherm for ammonia on barium fluoride at 18.6°C are reported below. Confirm that they fit a BET isotherm and find values of the constants. ($p^* = 3222 \text{ Torr}$)

p/Torr	62.7	108	219	466	555	601	765
V/cm ³	9.8	10.3	11.3	12.9	13.1	13.4	14.1

(9 marks)

SECTION B

7. (a) What is the ionic strength and mean activity coefficient of a 0.01 M solution of LaCl_3 ? (Debye-Hückel $A = 0.509$) (10 marks)
- (b) If the standard reduction potential for $\text{Ag} | \text{AgCl} | \text{Cl}^-$ at 298 K is 0.2221 V , what would be its electrode potential if immersed in the solution described in (a)? (5 marks)

< 2 >