EASTERN UNIVERSITY, SRI LANKA
FIRST EXAMINATION IN SCIENCE
CH 101 PEREODICITY & BONDING, THERMODYNAMICS AND INTRODUCTION TO ELECTROCHEMISTRY
(RE-REPEAT –2002/2003)

Time : 02 Hours

ANSWER FOUR QUESTIONS ONLY.

1.(a) State Pauli's exclusion principle and Hund's rule

(b) Using x , y, z axis system , draw

(i) $d_{x^2-y^2}$ orbital
(ii) d_{z^2} orbital

(c) Predict the shape of the following molecules using Valence Shell Electron Pair Repulsion (VSEPR) theory.

BCl_3 , NH_3 , CH_4

2. (a) (i)Write down the Nernst equation for the redox reaction

$$[ox] + n\,e \rightleftharpoons [red]$$

and define each term in it.

(ii) Given that , at 298 K

$$MnO_4^- + 8\,H^+ + 5\,e \longrightarrow Mn^{2+} + 4\,H_2O : E^\varphi = 1.51v$$

$$MnO_2 + 4\,H^+ + 2\,e \longrightarrow Mn^{2+} + 2\,H_2O : E^\varphi = 1.239v$$

Deduce the value of E^φ for the following system

$$MnO_4^- + 4\,H^+ + 3\,e \longrightarrow MnO_2 + 2\,H_2O$$

(b) Represent the cell with the cell reaction

$$Cd + 2\,Ag^+ \longrightarrow Cd^{2+} + 2\,Ag$$

Calculate the value of E^φ of the cell.

Given:

$E^\varphi_{Cd^{2+}/Cd} = -0.40V$
$E^\varphi_{Ag^+/Ag} = 0.080V$ at 298 K

contd.....

3 (a) (i) Write down the Einstein's equation and Planck's equation.

(ii) Derive the de-Broglie's relationship between the momentum and wavelength using the equation in (i).

(b) Write short notes on three of the following

(i) Photoelectric effect
(ii) Compton effect
(iii) Hydrogen bonding

(c) Give the differences between the ionic and covalent compounds.

(d) Explain the term 'resonance' using an example.

4. (a) Define the following terms
i. Closed system
ii. Extensive property

(b) Write down the mathematical expressions for the following
(i) First law of thermodynamics
(ii) Second law of thermodynamics

(c) i. Derive an expression for the work done during an isothermal reversible expansion of an ideal gas from a volume V_1 to V_2.

ii. Calculate the maximum work done when liquid Nitrogen gas (10 l) is allowed to expand from 10^6 Pa to 10^5 Pa isothermally.

5 (a) Derive the Maxwell relation $(\partial V/\partial T)_P = -(\partial S/\partial P)_P$.

(b) i. Define the term molar heat capacity
ii. From the first law of thermodynamics derive the relationship
$C_P = (\partial H/\partial T)_P$

(c) Derive the Clapeyron equation, $dP/dT = (\Delta H_m)/(T\Delta V_m)$ for a phase transition ΔV_m is the change in molar volume.

6. (a) What is meant by electrode potential?
Calculate the $E^{\varnothing}$ of Ni^{2+}/Ni electrode from the cell $Ni_{(s)}/Ni^{2+}_{(aq)}//Cu^{2+}_{(aq)}/Cu_{(s)}$.
The $E^{\varnothing}$ of the cell is 0.59 V.
($E^{\varnothing}$ $Cu^{2+}/Cu = 0.34$ V)

(b) Calculate the electrode potential of a Zn^{2+}/Zn electrode in which the concentration of Zn^{2+} ions is 0.01 M ($E^{\Phi}_{Zn^{2+}/Zn} = -0.76$ V)

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