P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

00068

Term-End Examination

June, 2010

MCH-004 : ELECTROANALYTICAL AND OTHER METHODS

Time : 3 hours *Maximum Marks : 75*

Note : *Answer **any five** questions. All questions **carry equal** marks.*

1. (a) (i) Write the cell reaction for the cell given below : 1

$$Cd(Hg)\,|\,CdSO_4\ 8/3H_2O(s)\,||\,Hg_2SO_4(S)\,|\,Hg.$$

(ii) Why is calomel electrode preferred over hydrogen electrode ? 1

(iii) Name the membrane which is used to prepare F^- ion electrode. 1

(iv) Write the expression for molar conductivity. 1

(v) What is potential drop ? How is it expressed ? 1

(b) (i) Calculate the molar conductivity of 0.005 mol dm^{-3} ethanoic acid if its degree of dissociation is 0.058 and molar conductivity at infinite dilution is 390.7 S cm^3 mol^{-1}. 2

(ii) Why has cyclic voltammetry been considered as the most versatile electrochemical technique ? 2

(iii) Give any two advantages of amperometry. 2

(iv) Calculate the percentage mass change (m%) for the following reaction : 2

$$CuSO_4 \cdot 5H_2O \xrightarrow{\Delta} CuSO_4 + 5H_2O$$

[$A_r(Cu) = 63.54$, $A_r(S) = 32.00$, $A_r(O) = 16.00$, $A_r(H) = 1.00$]

(v) Complete the following nuclear reactions : 2

(a) $^{11}B + {}^{2}D \rightarrow {}^{9}Be + ...$

(b) $^{60}Ni + ... \rightarrow {}^{62}Zn + 2n$

2. (a) Write the reaction, calculate the cell potential and predict whether the reaction is spontaneous or not for the cell given below : 7

$Pb\,|\,Pb^{2+}(0.01\ M)\,||\,I_2(1\ M), I^-(0.001\ M)\,|\,Pt$

$$\left[E^\circ_{Pb^{2+}/Pb} = -0.126\ V; E^\circ_{I_2/2I^-} = 0.615\ V \right]$$

(b) Taking a suitable example explain how are thermometric titrations different from the classical acid-base titrations. Discuss the advantages of the thermometric titrations. 8

3. (a) Write at least five differences between nuclear reactions and chemical reactions. 7

(b) What is limiting molar conductivity ? From the following data of limiting molar conductivities, calculate the limiting molar conductivity of benzoic acid. 8

Sodium benzoate : 8.24×10^{-3} S m^2 mol^{-1}

Hydrochloric acid : 4.26×10^{-2} S m^2 mol^{-1}

Sodium chloride : 1.26×10^{-2} S m^2 mol^{-1}

4. (a) Explain briefly the technique of Neutron Activation Analysis (NAA). 7

(b) A solution containing 0.50 g of copper as Cu^{2+} requires 20 minutes for complete deposition of copper at 1.50 A. Calculate the coulombs required and efficiency of the process [Ar (Cu) = 63.54]. 8

5. (a) Distinguish between : 8

(i) Linear-scan polarography and pulse polarography.

(ii) Differential pulse polarography and square-wave polarography.

(b) Give the experimental details of the polarographic method for the determination of lead and copper in the steel. 7

6. (a) Derive an expression used for determination of percentage amount of the components in the sample for IDA method. 7

(b) Write the principle and working of a calomel electrode. Draw a labelled diagram of a typical calomel electrode. 8

7. (a) Explain the factors which limit the accuracy of pH measurements. 7

(b) An impure sample of $CaC_2O_4.H_2O$ is analysed using TGA technique. TG curve of the sample indicates total mass change from 85 mg to 30.7 mg, when this sample was heated upto 900°C. Calculate the percent purity of the sample. Draw a thermogram for this decomposition. 8

$[A_r(Ca) = 40.1, A_r(O) = 16.00, A_r(C) = 12.00, A_r(H) = 1.00]$

8. Write short notes on the following : **5x3=15**

(a) Differential Thermal Analysis.

(b) Isotope dilution technique.

(c) Applications of DSC technique.