

P.G. DIPLOMA IN ANALYTICAL CHEMISTRY
(PGDAC)

Term-End Examination

June, 2010

MCH-004 : ELECTROANALYTICAL AND OTHER
METHODS

Time : 3 hours

Maximum Marks : 75

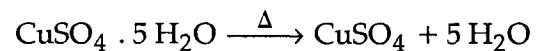
Note : Answer any five questions. All questions carry equal marks.

1. (a) (i) Write the cell reaction for the cell given below : 1
$$\text{Cd(Hg)} | \text{CdSO}_4 \cdot 8/3\text{H}_2\text{O(s)} | | \text{Hg}_2\text{SO}_4(\text{S}) | \text{Hg.}$$
- (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 $0.005 \text{ mol dm}^{-3}$ ethanoic acid if its degree of dissociation is 0.058 and molar conductivity at infinite dilution is $390.7 \text{ S cm}^3 \text{ mol}^{-1}$. 2

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

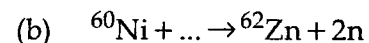
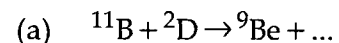
(iii) Give any two advantages of amperometry. 2

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

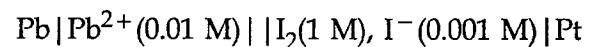


$$[A_r(\text{Cu}) = 63.54, A_r(\text{S}) = 32.00, \\ A_r(\text{O}) = 16.00, A_r(\text{H}) = 1.00]$$

(v) Complete the following nuclear reactions : 2



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



$$\left[E^\circ_{\text{Pb}^{2+}/\text{Pb}} = -0.126 \text{ V}; E^\circ_{\text{I}_2/2\text{I}^-} = 0.615 \text{ V} \right]$$

(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 : $8.24 \times 10^{-3} \text{ S m}^2 \text{ mol}^{-1}$
- Hydrochloric acid : $4.26 \times 10^{-2} \text{ S m}^2 \text{ mol}^{-1}$
- Sodium chloride : $1.26 \times 10^{-2} \text{ S m}^2 \text{ mol}^{-1}$
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 [$\text{Ar}(\text{Cu}) = 63.54$]. 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 $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ 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
- [$A_r(\text{Ca}) = 40.1$, $A_r(\text{O}) = 16.00$, $A_r(\text{C}) = 12.00$, $A_r(\text{H}) = 1.00$]
8. Write short notes on the following : 5x3=15
- (a) Differential Thermal Analysis.
- (b) Isotope dilution technique.
- (c) Applications of DSC technique.
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