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MCH-004

P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination 00816

December, 2011

MCH-004 : ELECTROANALYTICAL AND OTHER METHODS

Time : 3 hours *Maximum Marks : 75*

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

1. (a) Derive Nernst equation for the chemical reaction $M^+ + e^- \rightleftharpoons M$ **5**

(b) Explain the basis of classification of electroanalytical methods. Describe each method in 2-3 lines. **5**

(c) How electrode potential measurement can be used for the determination of equilibrium constant (k) ? Calculate the value of k for the reaction. **2+3**

$$Ce^{4+} + Fe^{2+} \rightleftharpoons Ce^{3+} + Fe^{3+}$$

Given that $E^\circ\ Ce^{4+}/Ce^{3+} = 1.70V$,

$E^\circ\ Fe^{2+}/Fe^{3+} = 0.771\ V$

2. (a) Explain the working of a glass membrane electrode. How can it be used for the determination of pH ? 5

(b) Explain why it is advisable to use first and second derivative curves for the identification of end point in a pH titration. How do you perform the titration of acetic acid and NaOH ? 5

(c) What do you understand by ionic mobility and transport number. List various factors affecting conductivity of solution. 5

3. (a) Discuss advantages and limitations of conductivity measurements. Explain how conductance measurement of soil helps in classifying the soil as saline and non saline. 5

(b) What is polarization ? Explain concentration polarization and kinetic polarization. Discuss the importance of over voltage. 5

(c) What is coulometry ? Write its advantages over electrogravimetry. Describe a method of separation of nickel and cobalt by controlled potential coulometer. 5

4. (a) What is polarography ? Explain the principle of DC polarography and draw the nature of sampled DC polarogram depicting $E_{1/2}$. 5

(b) Explain the basic principle of cyclic voltammetry (CV). Draw a schematic diagram showing instrumentation explaining its components. Why CV has been recognised as the most versatile electrochemical technique ? 5

(c) Write Ilkovic equation and explain all the terms. Show that diffusion current (i_d) is proportional to the concentration and a plot between i_d and c can be used for the determination of concentration. 5

5. (a) Describe various factors affecting the diffusion current. 5

(b) Describe the following briefly 5

(i) Polarographic maxima and its suppression

(ii) Biamperometry and its applications

(c) In coulometric titration of iodine with 20 cm^3 of thiosulphate, 25 minutes were required to oxidise thiosulphate and 200 mA of current were used. Calculate the molarity of thiosulphate solution. 5

6. (a) Write essential differences between DTA and DSC techniques. 5

(b) What is thermogravimetry ? Draw a labelled schematic diagram of a thermobalance and describe all its components briefly. 5

(c) Draw the nature of thermogravimetric curve for a compound undergoing decomposition in two stages. Calculate percent mass loss in following cases - **2+3**

(i) $CaC_2O_4 \rightarrow CaCO_3 \rightarrow CaO$

(ii) $Ca(OH)_2 \rightarrow CaO$

(iii) $CuSO_4\ 5H_2O \rightarrow CuSO_4 \rightarrow CuO$

7. (a) Explain characteristics of thermometric titrations (TT). What type of information is derived from an enthalpogram. In what respects these differ from convential titrations. **5**

(b) Name three processes by which gamma rays interact with matter. Explain these briefly. **5**

(c) Explain the principle of neutron activation analysis (NAA) and how is it used for the quantitative analysis of a sample. **5**

8. (a) Describe various sources of background activity of a counter. How these are eliminated or minimized. **3**

(b) How many α and β particles will be emitted during decay of ^{234}U to ^{214}Bi. **3**

(c) Explain why GM counter cannot be used for recording gamma ray spectrum. **3**

(d) Capillary height should not be disturbed during recording of polarogram or else capillary characteristics will change. **3**

(e) Thermogravimetric analysis is considerably affected by the furnace atmosphere i.e inert or oxygen and useful information about decomposition reaction may be obtained. 3