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MCH-004

P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

00234

December, 2015

MCH-004 : ELECTROANALYTICAL AND OTHER METHODS

Time : 3 hours *Maximum Marks : 75*

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

1. (a) Calculate the pH of 0·05 M NaCN solution.

Given : Dissociation constant of

$$HCN = 6{\cdot}2 \times 10^{-10}.$$ 5

(b) Calculate the e.m.f. of the cell having the reaction : 5

$$Zn + Cu^{2+} \rightleftharpoons Zn^{2+} + Cu$$

where $[Zn^{2+}] = 5 \times 10^{-3}$ M

$[Cu^{2+}] = 2 \times 10^{-2}$ M

The standard potentials are :

$$E^{\circ}_{Cu^{2+}/Cu} = + 0{\cdot}337 \text{ V}$$

$$E^{\circ}_{Zn^{2+}/Zn} = - 0{\cdot}763 \text{ V}$$

(c) Explain the principle and working of controlled potential coulometry. How can a sample solution of brass containing Cu^{2+}, Zn^{2+} and Pb^{2+} be analysed by this method ? 5

2. (a) Define molar conductivity. The conductivity of 0·1 M HCl is 0·0394 Ω^{-1} cm^{-1}. What is the molar conductivity of this solution ? 5

(b) Explain the following terms : 5

(i) Reference Electrodes

(ii) Indicator Electrodes

(c) Write Ilkovic equation and explain all the terms. How is it used for the determination of trace metal ions ? 5

3. (a) Explain briefly the solid state membrane electrodes. Describe their applications in Analytical Chemistry. 5

(b) Discuss the various factors affecting the conductance of a solution. 5

(c) Define any ***two*** of the following terms with the help of a suitable diagram : 5

(i) Maxima Suppressor

(ii) Catalytic Current

(iii) Kinetic Current

(iv) Migration Current and its Elimination

(v) Voltammetry

4. (a) Explain the different types of titration curves obtained in amperometry giving a suitable example in each case. *5*

(b) Write the advantages of coulometric methods over electrogravimetric methods. *5*

(c) Explain briefly the principle of anodic stripping voltammetry. How is this technique used for the determination of trace metal ions in environmental samples ? *5*

5. (a) Explain the principle of cyclic voltammetry. Why has CV been recognized as the most versatile electroanalytical technique ? *5*

(b) Explain the basic principle of thermogravimetry. How is this technique used for the analysis of copper-silver alloy ? *5*

(c) Compare the neutron activation analysis and isotope dilution techniques for trace element determination. *5*

6. (a) Complete the following nuclear reactions : *5*

(i) $^{10}B + n \rightarrow \ldots\ldots\ldots + \alpha$

(ii) $^{20}Ne + {}^{136}Ba \rightarrow {}^{150}Dy + \ldots\ldots\ldots$

(iii) $\ldots\ldots\ldots + {}^{2}H \rightarrow {}^{22}Na + \alpha$

(iv) $^{130}Te + {}^{2}H \rightarrow {}^{131}I + \ldots\ldots\ldots$

(v) $^{241}Am + \ldots\ldots\ldots \rightarrow {}^{243}Bk + 2n$

(b) Compare the basic principles of DTA and DSC techniques. 5

(c) Explain the use of DTA in the identification of minerals. 5

7. (a) Compare the potentiometric and thermometric titration curves for the titration of HCl and H_3BO_3 with NaOH solution. 5

(b) Explain the procedure for estimating the purity of a compound which melts during DSC melting endotherm. 5

(c) 1·0 mg of labelled naphthalene with an activity of 1,00,000 cpm is added to a 10·00 g sample of coal tar. After an elaborate series of separations, 0·0300 g of pure naphthalene is recovered. It is found to have an activity of 4,320 cpm. What is the percentage of naphthalene in the sample ? 5

8. (a) What are the various sources of neutrons used in activation technique ? 5

(b) Explain briefly the theory of neutron activation analysis (NAA). How is it used for the determination of an element in a sample ? 5

(c) Explain how molar and equivalent conductivities of an electrolyte are related to each other. 5