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MCH-004

P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

00992

Term-End Examination

December, 2014

MCH-004 : ELECTROANALYTICAL AND OTHER METHODS

Time : 3 hours *Maximum Marks : 75*

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

1. (a) Calculate the emf of the cell in which the following reaction occurs :

$$Mg + 2\,Ag^{+} \rightleftharpoons Mg^{2+} + 2\,Ag$$

Given :

$[Mg^{2+}] = 0{\cdot}10$ M; $[Ag^{+}] = 1{\cdot}0 \times 10^{-4}$ M

$E^{\circ}_{Mg^{2+}/Mg} = -2{\cdot}363$ V

$E^{\circ}_{Ag^{+}/Ag} = +0{\cdot}799$ *4*

(b) What are the advantages of a pH metric titration over a direct pH metry ? *3*

(c) Explain the source of potential of an ion selective electrode used to determine the concentration of fluoride ion. 4

(d) Explain various factors which cause error in pH measurement. 4

2. (a) Define equivalent conductivity and molar conductivity. Cite their units also. How are the two terms related with each other ? 5

(b) Discuss the factors which affect the conductance of a solution. 5

(c) At 298 K, the resistance of $2{\cdot}00 \times 10^{-2}$ M KCl is 200·0 Ω and that of $2{\cdot}50 \times 10^{-3}$ M K_2SO_4 is 775·0 Ω. The conductivity (κ) of $2{\cdot}00 \times 10^{-2}$ M KCl at 298 K is 0·277 Sm^{-1}. Calculate the molar conductivity of K_2SO_4 solution. 5

3. (a) What is the basic principle of controlled potential coulometry ? Point out the inherent advantages of the technique. Discuss any two applications of this technique. 7

(b) Why is there a need of external generation of titrant in coulometric titrations ? Discuss the advantages of coulometric titrations. 5

(c) Distinguish between concentration polarization and kinetic polarization. 3

4. (a) Describe a broad classification of commonly used voltammetric methods. Explain the principle of Linear Sweep Voltammetry. 5

(b) Discuss the advantages of dropping mercury electrode. 4

(c) Explain the origins of migration current. How can it be eliminated ? 4

(d) Why is there a need of maxima suppressor in polarography ? Name two of the maxima suppressors. 2

5. (a) Draw a diagram showing the basic components of a manual polarograph. Label each component and explain the working of the instrument. 5

(b) Explain the principle of amperometric titrations. Discuss the different types of curves obtained between volume of the reagent and current during the titration. 5

(c) Discuss the advantages of amperometry. 5

6. (a) Discuss the factors which affect the shape of a TGA curve. 5

(b) What are the basic components of a DTA instrument ? Discuss the essential characteristics of each component and its working. 5

(c) How is DTA used in the characterization of polymers ? Explain with examples. 5

7. (a) What is the basic principle of enthalpy titrations ? Discuss the shape of a typical enthalpogram for an exothermic and an endothermic reaction. Explain the different portions of the curves. *6*

(b) Draw the diagram of an integrated assembly of a well type NaI (Tl) scintillation detector. Label each component and explain its working. Explain how does gamma ray interact with the detector material. *6*

(c) What are the different sources of natural radioactive background in the human environment ? *3*

8. (a) What are the advantages of neutron activation analysis over other commonly used instrumental methods of analysis ? Point out the limitations of the technique. *4*

(b) 1·00 g of an ore containing 5·0% sodium was irradiated in a nuclear reactor at a thermal neutron flux of $5{\cdot}0 \times 10^{12}$ n cm^{-2} sec^{-1} for 15 hr. Calculate the amount of radioactivity due to Na^{24} in mCi immediately after the end of the irradiation.

Given :

(i) Percentage abundance of Na^{23} in natural sodium = 100.

(ii) Cross section of

Na^{23} (n, r) Na^{24} = 0·13 barn

(iii) Half life of Na^{24} = 15 hr *6*