MCH-004

P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

June, 2021

MCH-004 : ELECTROANALYTICAL AND OTHER METHODS

Time : 3 hours *Maximum Marks : 75*

Note : *Answer any* ***five*** *questions. All questions carry equal marks. Marks of each part are shown on the right. Log tables may be used.*

Faraday, F = 96500 C

1. (a) Define the following units : *5×1=5*

(i) Ampere

(ii) Coulomb

(iii) Faraday

(iv) Ohm

(v) Siemens

(b) Explain the term 'electrode potential'. Why can its absolute value not be determined ? Comment. *5*

(c) Explain why it is not necessary to remove dissolved oxygen from the solution before recording voltammogram in case of anodic current. *5*

2. (a) Describe 'Dropping Mercury Electrode' (DME) with illustration. Mention its potential range. *5*

(b) 0·180 g of a purified organic acid sample was titrated coulometrically with OH^- ions, equivalent amount of which was produced in 5 minutes by a constant current of 0·514 amp. Calculate the molar mass of the acid if n is 1. *5*

(c) Which analytical technique would you choose to analyse a sample containing reducible metal ions, in the presence of anions like IO_3^-, NO_2^- ? Justify your answer. *5*

3. (a) Thermogram of a magnesium compound, possibly an oxide, carbonate or oxalate, weighing 175·0 mg shows a loss of 91·0 mg. Identify the compound and write balanced equations for the thermal decomposition reactions. *10*

(b) Name the radiotracer technique used for the following :

(i) Determination of TSH

(ii) Blood volume in a normal patient

Briefly describe the techniques used in any one of the above cases. *5*

4. (a) Write the principle of Differential Thermal Analysis (DTA). How does a DTA curve differ from a TG curve ? *5*

(b) Identify (i) 2 pairs of isotopes, (ii) 2 pairs of isobars, and (iii) one pair of isotones using the following nuclides : *5*

$^{11}_{6}C$, $^{14}_{6}C$, $^{14}_{7}N$, $^{40}_{19}K$, $^{40}_{20}Ca$, $^{46}_{20}Ca$, $^{50}_{24}Cr$

(c) Explain any ***two*** of the following : *5*

(i) Use of Ag – AgCl electrode

(ii) Indicator electrode

(iii) Standard cell

5. (a) Describe an electrochemical cell. Write the reactions taking place at each electrode. *5*

(b) A 9·65 ampere current is passed through a solution of $AgNO_3$ for 50 minutes. Calculate the amount of silver deposited at the cathode. (Atomic weight of Ag is 108). *5*

(c) What are Electrolytes ? How are these classified ? Write one example of each type. *5*

6. (a) Describe the use of controlled potential coulometry for the determination of organic compounds. *5*

(b) Draw a labelled conductometric titration curve of a strong dibasic acid and a weak base. *5*

(c) Write Ilkovic equation and define the terms used. *5*

7. (a) Calculate E_{cell} when silver and copper electrodes are dipped in solutions of unit activity. Reduction potential of Cu^{2+}/Cu is + 0·337 V and of Ag^{+}/Ag is + 0·799 V. State polarity of each electrode and the type of reaction taking place at it. *5*

(b) Discuss the principle of conductometric titration and its advantages over other conventional methods. *5*

(c) Explain the principle of activation analysis. Which projectile is commonly used ? What is the reason ? *5*

8. (a) Name any two commonly used reference electrodes. Discuss any one of these with illustration. *5*

(b) Calculate the emf of the cell in which the reaction taking place is

$Mg + 2Ag^{+} = Mg^{2+} + 2Ag.$

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

$E^{0}_{Mg^{2+}/Mg} = -2{\cdot}363$ V,

$E^{0}_{Ag^{+}/Ag} = +0{\cdot}799$ V. *5*

(c) Explain why N : Z ratio increases from 1·0 (for ^{40}Ca) to 1·5 (for ^{150}Nd) for stable nuclides.

What will be the modes of decay if N/Z is less or more than required ? *5*