

**POST GRADUATE DIPLOMA IN
ANALYTICAL CHEMISTRY/M. SC.
ANALYTICAL CHEMISTRY
(PGDAC/MSCANCHEM)
Term-End Examination**

June, 2026

**MCH-004 : ELECTROANALYTICAL AND OTHER
METHODS**

Time : 3 Hours

Maximum Marks : 75

Note : (i) Attempt any **five** questions.

(ii) All questions carry equal marks.

1. (a) State Ohm's law and Faraday's law. 5
(b) Calculate the cell potential for the following cell :



Given $E^\circ (\text{Cu}^{2+}/\text{Cu}) = 0.337 \text{ V}$;

$$E^\circ (\text{Zn}^{2+}/\text{Zn}) = -0.763 \text{ V.} \quad 5$$

- (c) Describe the design of Weston Cadmium cell. Also write half-cell reactions and cell reaction. 5
2. (a) Calculate the equilibrium constant for the following reaction :
- $$\text{Ce}^{4+} + \text{Fe}^{2+} \rightarrow \text{Ce}^{3+} + \text{Fe}^{3+}$$
- Given, $\underline{E}^{\circ}(\text{Ce}^{4+}/\text{Ce}^{3+}) = 1.70 \text{ V}$,
- $$\underline{E}^{\circ}(\text{Fe}^{3+}/\text{Fe}^{2+}) = 0.8 \text{ V}. \quad 5$$
- (b) Describe the Glass membrane electrodes and its uses. 5
- (c) Write the factors which limit the accuracy of pH measurements using glass electrode. 5
3. (a) The resistance of a conductivity cell containing $0.01 \text{ mol dm}^{-3} \text{ KCl}$ is 100Ω . The same conductivity cell containing $0.01 \text{ mol dm}^{-3} \text{ HCl}$ give resistance of 50Ω . The conductivity of KCl solution is $1.5 \times 10^{-3} \Omega^{-1} \text{ cm}^{-1}$. Calculate cell constant and conductivity of HCl solution. 5

- (b) From the following data, calculate the molar conductivity of KCl in aqueous solution :

Conductivity of $5.0 \times 10^{-3} \text{ mol dm}^{-3}$ KCl is $7.55 \times 10^{-3} \text{ S m}^{-1}$.

Conductivity of water = $0.05 \times 10^{-3} \text{ S m}^{-1}$. 5

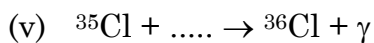
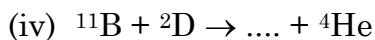
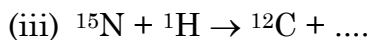
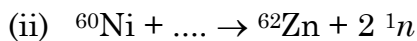
- (c) Write the importance of overvoltage. 5

4. (a) Calculate the time needed for a constant current of 1 A to deposit 0.1 g of Co(II) as elemental cobalt on the surface of a cathode. Relative molar mass of cobalt = 59. 5

- (b) Calculate the dissociation constant of $0.001 \text{ mol dm}^{-3}$ ethanoic acid if its molar conductivity is $48.63 \text{ S cm}^2 \text{ mol}^{-1}$ and limited molar conductivity is $390.75 \text{ S cm}^2 \text{ mol}^{-1}$. 5

- (c) Explain the nature of plots of conductometric titration of a strong acid (HCl) *vs.* a strong base (NaOH). 5
5. (a) Write differences between differential-pulse polarography and square-wave polarography. 5
- (b) What is the advantage of platinum electrode over mercury electrode in cyclic voltammetry ? Why cyclic voltammetry has been recognized as the most versatile electrochemical technique ? 5
- (c) Write Ilkovic equation and define the terms. 5
6. (a) Explain the fundamental principle of polarographic titration. 5

- (b) How can the ferric ion interfere in the polarographic method of steel analysis ?
How is its interference prevented ? 5
- (c) A thermogram of a magnesium compound shows a loss of 104 mg from a total of 200 mg used for analyte. Identify the compound either as MgO , MgCO_3 or MgC_2O_4 . 5
7. (a) What are the advantages of a dropping mercury electrode ? 5
- (b) A 500 mg hydrated sample of Na_2HPO_4 decreases to a mass of 291.4 mg after heating to 115°C . What is the number of water molecules of hydration in Na_2HPO_4 (mol.mass = 216). 5
- (c) Explain principle of DTA. 5
8. (a) Fill in the blank spaces in the following nuclear reactions and represent them in their standard notation form : 5
- (i) $^{27}\text{Al} + {}^4\text{He} \rightarrow {}^{30}\text{P} + \dots$



(b) Explain the principle of isotope dilution analysis. 5

(c) Write the factors related to sample characteristics which affect DTA curves. 5

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