

**P.G. DIPLOMA IN ANALYTICAL CHEMISTRY
(PGDAC)**

Term-End Examination

00408

June, 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 HCl and 0.05 M CH₃COOH solutions.

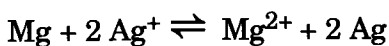
Given : For CH₃COOH, $K_a = 1.75 \times 10^{-5}$. 5

- (b) Explain the principle of conductometric titrations. Draw the shapes of any **two** of the titration curves in the following cases : 5

- (i) HCl with NaOH
(ii) CH₃COOH with NaOH
(iii) H₂SO₄ with NH₄OH

- (c) Derive the equation of polarographic wave. What does it represent ? 5

2. (a) Explain the principle of amperometric titrations and write its applications. 5
- (b) What is coulometry ? How is the solution of nickel and cobalt analysed by this technique ? 5
- (c) Calculate the e.m.f. of the cell in which the following reaction takes place : 5



where $[\text{Mg}^{2+}] = 0.1 \text{ M}$

$$[\text{Ag}^+] = 1 \times 10^{-4} \text{ M}$$

The standard potentials are :

$$E^0_{\text{Mg}^{2+}/\text{Mg}} = -2.363 \text{ V}$$

$$E^0_{\text{Ag}^+/\text{Ag}} = +0.799 \text{ V}$$

3. (a) Explain glass membrane electrode. How is it used for the measurement of pH of a solution ? 5
- (b) Explain molar conductivity and equivalent conductivity of an electrolyte. The conductivity of $5.0 \times 10^{-4} \text{ mol dm}^{-3}$ of KCl solution is $7.44 \times 10^{-3} \text{ S m}^{-1}$. Calculate the molar conductivity of KCl in aqueous solution. 5

Given : Conductivity of water is $0.06 \times 10^{-3} \text{ S m}^{-1}$.

- (c) Define any *two* of the following terms briefly using a polarogram : 5
- (i) $E_{1/2}$
 - (ii) Diffusion current
 - (iii) Polarographic maxima
 - (iv) Limiting current
 - (v) Residual current
4. (a) Explain the principle of a DC polarograph. How is it used for the identification and determination of trace metal ions ? 5
- (b) Explain the principle and working of electrogravimetric method for the analysis of Cu(II) ions. 5
- (c) What is thermogravimetric technique of analysis ? How is this used for the analysis of binary mixture of calcium and magnesium oxalates ? 5
5. (a) Explain the basic principle of thermometric titrimetry. 5
- (b) Calculate the activity for 10.0 mg sample of an aluminium alloy containing 0.041% of manganese after a 0.50 hr irradiation at a flux of 5×10^{13} neutron $\text{cm}^{-1} \text{sec}^{-1}$.
 Given : $t_{1/2} = 2.58$ hr for ^{55}Mn .
 Mass number of Mn = 55,
 Avogadro number = 6.023×10^{23} . 5
- (c) Explain briefly the principle of cyclic voltammetry and discuss its applications. 5

6. (a) Explain the effect of atmosphere and furnace heating rate on the shape of TG curves using suitable examples. 5

(b) Explain the term 'Threshold Energy'. Calculate the Q value of the reaction $^{14}\text{N}(\alpha, p)^{17}\text{O}$.

Given :

$$^{14}\text{N} = 14.003074 \text{ amu}$$

$$^4\text{He} = 4.002603 \text{ amu}$$

$$^{17}\text{O} = 16.999133 \text{ amu}$$

$$^1\text{H} = 1.007825 \text{ amu} \quad 5$$

(c) Explain briefly the Isotope Dilution Analysis technique. How is it used in the determination of total blood volume in an animal body? 5

7. (a) Explain the technique of radioimmunoassay (RIA) for assessing the hormone concentration. 5

(b) Explain the principle and working of differential scanning calorimeter with the help of its block diagram. 5

(c) Explain the following terms : 5

(i) Electrode Potential

(ii) Standard Cell

8. (a) Define the terms pH and pK_a . How is the pK_a value of a weak acid calculated by pH-metric titration? 5
- (b) How will you measure electrolytic conductance of a solution? 5
- (c) Explain the use of DTA for the characterization of a mixture of polymeric materials, giving a suitable example. 5
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