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MCH-004

00155

P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

June, 2011

MCH-004 : ELECTROANALYTICAL AND OTHER METHODS

Time : 3 hours *Maximum Marks : 75*

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

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1. (a) Explain electrode potential and its development. How electrode potential is measured ? **5**

(b) What do you understand by cell potential ? Calculate e.m.f. of the cell **2+3=5**

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

$[Mg^{2+}] = 0.1M$ E° $Mg^{2+}/Mg = -2.363V$

$[Ag^+] = 0.1mM$ E° $Ag^+/Ag = +0.799V$

(c) What is reference electrode ? Taking a suitable example describe the specifications and working of a reference electrode. Draw its sketch. **5**

2. (a) Describe various factors that cause errors in pH measurement. **5**

(b) What are solid state membrane electrodes ? Draw a sketch and describe their applications as ion selective electrodes. 5

(c) Define specific conductivity, molar conductivity and cell constant. Calculate cell constant of a conductivity cell if resistance of 0.01 mol dm^{-3} KCl is 150Ω and its conductivity is $1.14 \times 10^{-3} \Omega^{-1}$ cm^{-1}. 3+2=5

3. (a) How will you analyse a binary alloy of copper and silver thermogravimetrically ? 5

(b) What is electrogravimetric analysis ? How does it differ from conventional gravimetric method of analysis ? Compare the two. 5

(c) Explain how will you determine dissociation constant of a weak acid or base by conductometric method ? Draw the nature of plot and describe the method. 5

4. (a) Enlist various voltammetric methods of analysis. Write briefly about Anodic Stripping Voltammetry (ASV) and its usefulness for trace element analysis. 5

(b) Explain the basic principle of AC voltammetry and describe the basic components of the instrument used. 5

(c) Explain the terms limiting current, migration current, diffusion current, residual current and half wave potential ($E_{1/2}$). Draw a labelled typical polarogram. 5

5. (a) Derive equation of polarographic wave and show that potential is a function of current at any point. 5

(b) Explain the terms kinetic current and catalytic current. Discuss their importance. 5

(c) Explain Anodic Stripping Voltammetry (ASV). 50 mL sea water sample was analysed for its Cu^{2+} content by ASV. It gave a peak current of 0.973μA. After adding 5.0μdm^3 spike of 20 ppm Cu^{2+}, the peak was observed 4.76μA. Calculate the concentration of Cu^{2+} in sea water. 5

6. (a) What are amperometric titrations ? Draw common types of curves obtained in amperometirc titrations. 5

(b) Explain briefly thermogravimetric analysis (TGA) and Differential Thermal Analysis (DTA) with the help of suitable example. 5

(c) Draw a labelled diagram of the TG curve obtained by heating a mixture of 50 mg of calcium oxalate monohydrate and 50 mg of barium oxalate monohydrate to 1200°C. Calculate the amount of all mass losses. 5

7. (a) Explain the basic principle of Differential Scanning Calorimetry (DSC). Draw a block diagram of DSC instrument. 5

(b) In what respects nuclear reactions are different from chemical reactions ? Calculate Q value of the reaction $^{63}Cu = (n, \gamma)^{64}Cu$. Give that $^{63}Cu = 62.929590$, $^{64}Cu = 63.929760$, $n = 1.008665$ amu. 3+2=5

(c) Describe various types of neutron sources available for NAA. Which one of these is most suitable for trace element analysis ? 5

8. (a) Define curie (Ci) and Becquerel (Bq). Calculate wt of 5 m Ci of ^{131}I ($t_{1/2} = 8d$). 3

(b) Which one of the following radiotracer should be used (explain why) for the determination of Mn in steel. 3

$^{56}M_n$ ($t_{1/2} = 2.58h$), $^{54}M_n$ ($t_{1/2} = 312d$).

(c) Explain why (n, γ) reaction is most suited for NAA. 3

(d) Explain why it is essential to pass N_2 gas through a sample solution in polorography before recording is started. 3

(e) What are the requirements in coulometric titrations and how do these differ from thermometric titrations ? 3