P. G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

December, 2022

MCH-004 : ELECTROANALYTICAL AND OTHER METHODS

Time : 3 Hours *Maximum Marks : 75*

Note : *Attempt any* *five* *questions. All questions carry equal marks. Marks of each part of a question are indicated on the RHS.*

1. (A) Fill in the blanks : 10

    (a) Ampere is a unit of........., Coulomb is a unit of.......... .

    (b) Ohm is a unit of resistance, ...is a unit of conductance.

    (c) A galvanic cell is also called a..........cell.

    (d) In an electrolytic cell, passage of current brings about a..........reaction.

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(e) In Daniell cell, the copper has a higher positive potential than zinc. Electrons flow from..........to..........in the outer circuit.

(f) The product of activities of $(H)^+$ and $(OH)^-$ in case of pure water at 298 K is 1.0×10^{-14} $(mol\ m^{-3})^2$; the pH of pure water at this temperature is.......... .

(g) $E_{1/2}$ in a paleographic analysis is related to..........current.

(h) According to first law of radioactivity, the number of decaying atoms never become.......... .

(i) From the DTA curve, it is possible to know the glass transition temperature as well as..........point of the component.

(B) Out of the following, identify 2 pairs of isotopes, 2 pairs of isobars and 1 pair of isotones :   5

$$^{12}_{6}C, \ ^{14}_{6}C, \ ^{14}_{7}N, \ ^{40}_{20}Ca, \ ^{40}_{19}K, \ ^{46}_{20}Ca, \ ^{47}_{21}Sc$$
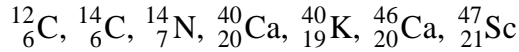
2. (a) Explain the term ohmic potential. Write its units. How is it related to (i) cell potential, and (ii) applied potential ?   5

(b) Sparingly soluble AgCl is dissolved in water; the molar conductivities of Ag^+ and Cl^- are 0.00619 S m^2 mol^{-1} and 0.00763 S m^2 mol^{-1} respectively. Calculate the concentration of Ag^+ and Cl^- in solution, the conductivity of AgCl solution is 2.28×10^{-4} Sm^{-1}.   5

(c) Discuss the working of silver-silver chloride electrode.   5

3. (a) Write a short note on the principle and application of radiometric titration.   5

(b) Draw a neat labelled diagram of integrated assembly of scintillation detector and explain the process by which gamma rays interact with matter.   5

(c) Why does the current fluctuate with the life time of each mercury drop during polarographic analysis. 5

4. (a) Distinguish between limiting current and diffusion current. 5

(b) Briefly describe the advantages of amperometric analysis. 5

(c) What do you understand by the term supporting electrolyte ? Write any *two* examples. 5

5. (a) Explain the term 'Overvoltage' and state its importance. 5

(b) Distinguish between concentration polarisation and kinetic polarisation. 5

(c) Conductivity of 0.1 M HCl is 0.0394 S cm^{-1}. Calculate its molar conductivity. 5

6. (a) Explain the technique of thermo-gravimetric analysis with the help of an illustration. 5

(b) Discuss the thermogram of calcium oxalate dihydrate along with the chemical reactions involved and mechanism of decomposition. 5

(c) At which electrode of a galvanic cell reduction takes place ? Explain why a less active metal is always used at this position. 5

7. (a) Draw a labelled pH titration curve for neutralisation of a weak acid with an equi-normal strong base. Indicate the buffering region. Also draw a labelled first derivative plot to locate the end point. 5

(b) Draw a schematic diagram of 14 MeV neutron generator and write the nuclear reaction of its production. How is this generator used for the determination oxygen in trace amounts ? 5

(c) A current of 9.65 ampere is passed through a solution of $AgNO_3$ for 5 minutes. Calculate the amount of Ag deposited at the cathode. (At wt. of Ag = 108, F = 96490 C). 5

8. (a) Explain the advantages of using a mercury cathode during control potential coulometry. 5

(b) Distinguish between constant current coulometry and controlled potential coulometry. 5

(c) Discuss the advantages of amperometric titrations. 5