Total No. of Printed Pages—8

4 SEM TDC CHMH (CBCS) C 10

2024

(May/June)

CHEMISTRY

(Core)

DIBRU COLLEGE CENTRAL LIBRARY
ESTD-1963
DIBRUGARH

Paper : C–10

(Physical Chemistry)

Full Marks : 53
Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer (any *five*) : 1×5=5

(a) The unit of ionic mobility is

(i) ms^{-1}

(ii) $ms^{-1}V^{-1}$

(iii) $m^2s^{-1}V^{-1}$

(iv) $m^1s^{-1}V^{-1}$

(b) During electrolysis, using non-attackable (Pt) electrode, the fall of concentration around the cathode is

(i) equal to the mobility of the cation, v_+

(ii) equal to the mobility of the anion, v_-

(iii) proportional to the mobility of the cation, v_+

(iv) proportional to the mobility of the anion, v_-

(c) If we increase the frequency of alternating current, the conductance of an electrolytic solution increases leading to a limiting value; which is called

(i) Walden's rule

(ii) Debye-Falkenhagen effect

(iii) Wien effect

(iv) Fick's law

(d) For the cell reaction,

$$Al + 3Ag^+(aq) \rightarrow Al^{3+}(aq) + 3Ag(s)$$

the correct cell notation is

(i) $Al(s)\left|Al^{3+}(aq)\right|\left|3Ag^+(aq)\right|3Ag(s)$

(ii) $3Ag^+(aq)\left|3Ag(s)\right|\left|Al(s)\right|Al^{3+}(aq)$

(iii) $Al(s)\left|Al^{3+}(aq)\right|\left|Ag^+(aq)\right|Ag(s)$

(iv) $Ag^+(aq)\left|Ag(s)\right|\left|Al(s)\right|Al^{3+}(aq)$

(e) The ferromagnetic transition occurs at

(i) Neel temperature

(ii) Curie temperature

(iii) Boyle's temperature

(iv) critical temperature

(f) Which is an example of metal-insoluble salt electrode?

(i) $Pt\left|QH_2, Q, H^+(c)\right.$

(ii) $Pt\left|Fe^{2+}(c_1), Fe^{3+}(c_2)\right.$

(iii) $Ag\left|AgCl\right|Cl^-(c)$

(iv) $Ag\left|Ag^+(c)\right.$

2. Answer the following questions : 2×5=10

(a) KNO_3 or KCl is preferred to make salt bridges. Explain why.

(b) During the measurement of conductance alternating current (AC) is used. Explain.

(c) What is meant by electrode potential and standard electrode potential?

(d) Is the transport number constant for an ion? Justify with suitable examples.

(e) Dipole moments of the three isomers of dihalo substituted benzene *P*, *Q* and *R* are 0 D, 1·5 D and 2·13 D respectively. Identify *P*, *Q* and *R*.

3. Answer the following questions {*either* *(a)* or *(b)*} : 3

(a) Define ionic mobility and transport number of an ion. How are ionic mobilities (speeds) of the ions of an electrolyte related with their transport number? 1+1+1=3

Or

(b) In conductometric titration, explain why the concentration of the titre solution should be 10 to 100 times more than the solution to be titrated. If not so, how can you correct the conductance readings? 1+1+1=3

4. Answer any *three* of the following questions : 4×3=12

(a) Define the terms 'specific conductance' and 'equivalent conductance'. Explain why on dilution the specific conductance decreases but equivalent conductance increases. 2+2=4

(b) What is the principle underlining conductometric titration? Discuss the titration curves obtained in the titration of a mixture of HCl and CH_3COOH with sodium hydroxide. 2+2=4

(c) Write short notes on the following : 2×2=4

(i) Debye-Falkenhagen effect

(ii) Wien effect

(d) In electrolysis of copper sulphate between copper electrodes the masses of copper per unit volume of the anode liquid before and after electrolysis were 0·79 g and 0·91 g respectively. The total mass of copper deposited at the cathode in the copper coulometer connected in series was 0·153g. Calculate the transport number of the Cu^{2+} and SO_4^{2-} ions. 2+2=4

5. Answer the following questions {*either (a)* or *(b)*} : 3

(a) E° of Fe^{3+}/Fe^{2+} system is 0·77 V. In the presence of phosphoric acid, Fe^{3+} is removed as phosphate complex as shown in below :

$$Fe^{3+} + H_3PO_4 \rightleftharpoons Fe(H_2PO_4)^{2+}$$

What will be the change on the potential of the system? If the value of equilibrium constant of the above equilibrium is 1×10^3, calculate the approximate value of the potential of the Fe^{3+}/Fe^{2+} system in the presence of H_3PO_4. 1+2=3

Or

(b) Describe how the pH of a solution can be determined by using quinhydrone electrode. 3

6. Answer any *three* of the following questions : 4×3=12

(a) Derive the expression for the e.m.f. of cell where the following reaction takes place :

$$aA + bB \rightleftharpoons cC + dD$$

(b) What are concentration cells? The e.m.f. of a cell formed by dipping two electrodes of a metal (Z) in two solutions of its salt with concentrations 0·1 M and 0·01 M was observed to be 0·0295 volts at 25 °C. If liquid junction potential has been eliminated, what is the valency of the metal? 1+3=4

(c) Establish a relationship between electrical energy and chemical energy (ΔH) of a cell reaction. Under what conditions, the electrical energy produced will be *(i)* equal to, *(ii)* less than and *(iii)* greater than the enthalpy change of the reaction? 2½+1½=4

(d) What is electrochemical series? Discuss two applications of the electrochemical series.

7. Answer any *two* of the following questions : 4×2=8

(a) Define dipole moment and magnetic moment. Calculate the magnetic moment of $[Cr(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ ions. 2+1+1=4

(b) Write the *(i)* Clausius-Mosotti equation and *(ii)* Debye equation. Show graphically the variation of molar polarization with temperature for polar and non-polar molecules. 1+1+2=4

(c) What are diamagnetic, paramagnetic, ferromagnetic and antiferromagnetic substances? 1+1+1+1=4

★★★