(ii) Find the percentage of ionic character of *HCl* molecule using SI unit.

Given :

Internuclear distance $(r) = 127\ pm$

Electronic charge $= 1.6 \times .0^{-19} C$

Actual dipole moment $= 3.44 \times 10^{-30}$ coulomb metre.

(iii) How can you distinguish diamagnetic substances and paramagnetic substances depending on the behaviour in a magnetic field ?

(iv) Explain polar and nonpolar convalent bonds.

(v) Explain the variation of molar polarization with temperature.

$$2+2+2+2+2=10$$

2023

CHEMISTRY

(Honours Core)

Paper : CHE–HC–4036

(Physical Chemistry-IV)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : $1 \times 7 = 7$

(a) What weight of AlF_3 salt be dissolved in 100 *ml* of solution so as to make the solution containing 1 *eq/L* ?

(b) Define equivalent conductance.

(c) What is cell constant ?

(d) What is transport number ?

(e) Ionic product of water at 25°C is approximately equal to

   (i) $1 \times 10^{-7} \left(mol\, L^{-1}\right)^2$
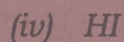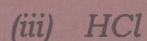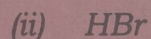
   (ii) $2 \times 10^{-14} (mol/L)^2$

   (iii) $1 \times 10^{-14}\, mol^2\, L^{-2}$

   (iv) $1 \times 10^{-7}\, mol^2\, dm^{-6}$

   (Choose the correct answer)

(f) Write *two* categories of electrochemical cell.

(g) Which of the following hydrogen halides has most polar bond ?

   (i) HF

   (ii) HBr

   (iii) HCl

   (iv) HI

   (Choose the correct answer)

2. Answer following questions : 2×4=8

(a) Find the relationship between molar conductance and specific conductance in SI unit.

(b) A perfectly cubical conductivity cell holds $0.94\ cm^3$ of a solution between its electrodes. Determine its cell constants.

(c) What is relaxation effect ?

(d) Write precisely on potentiometric titration.

3. Answer *any three* questions from the following : 5×3=15

(a) Discuss the Arhenius theory of electrolytic dissociation. Give evidence in support of the dissociation theory. 3+2=5

(b) Write the principle of conductometric titrations. Discuss the characteristics of curves obtained in the titration of *any two* given below : 1+(2+2)=5

   (i) HCl vs NaOH

   (ii) CH_3COOH vs NaOH

   (iii) HCl vs NH_4OH

   (iv) CH_3COOH vs NH_4OH
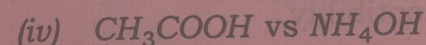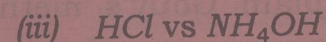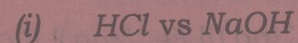
(c) (i) What is ionic mobility ? What is the effect of temperature on ionic mobility ? 2

(ii) A potential of 12·0 volts was applied to two electrodes placed 20 cm apart. A dilute solution of NH_4Cl was placed between the electrodes when NH_4^+ is found to cover a distance of 1.6 cm in one hour. What is the mobility of NH_4^+ ion ? 3

(d) (i) Derive a mathematical relation between the electrical energy of reversible galvanic cell and in free energy of the cell reaction. 3

(ii) What is half cell reaction ? Write the half cell reaction of the following cell : 2

$$Zn\,|\,Zn^{2+}(aq)\,\|\,Fe^{3+}(aq)\,|\,Fe^{2+}\,|\,Pl^-$$
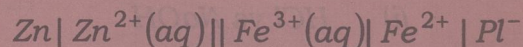
(e) Briefly explain Gouy's method for the measurement of magnetic susceptibility.

4. Answer **any three** questions from the following : 10×3=30

(a) (i) How can you measure electrolytic conductance, specific conductance, equivalent conductance and molar conductance ? Write the unit of cell constant (K) in SI unit.

(ii) The resistance of 0.01 M solution of an electrolyte was found to be 210 ohm at 25 °C. Calculate the molar conductance of the solution at 25 °C.

(Given : cell constant = 0.88 cm^{-1})

(iii) Specific conductance of an electrolyte solution decreases with dilution. Explain.

5+3+2=10

(b) (i) State and explain the Kohlrausch's law of independent migration of ions.

(ii) For the strong electrolytes $NaOH$, $NaCl$ and $BaCl_2$ the molar ionic conductance at infinite dilution are 248.1×10^{-4}, 126.5×10^{-4} and 280.0×10^{-4} $S\ m^2\ mol^{-1}$ respectively. Calculate $\wedge_m^o$ for $Ba(OH)_2$.

(iii) Illustrate the application of Kohlrausch's law.　　5+2+3=10

(c) *(i)* Illustrate how the solubility product of a sparingly soluble salt can be determined with the help of conductance measurement.

(ii) What is Ostwald dilution law ? Write its verification, importance and limitations.　　5+5=10

(d) *(i)* Find the mean ionic activity of a uni-univalent electrolyte.

(ii) How can you calculate the equilibrium constant of a cell reaction of the type

$$aA + bB \rightleftharpoons cC + dD\ ?$$
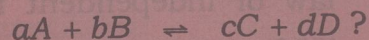
(iii) Calculate the equilibrium constant of the cell reaction

$$2Ag^+ + Zn \rightleftharpoons 2Ag + Z_n^{2+}$$

occurring in the $Zn - Ag$ cell at $25\,^{\circ}C$ when $\left[Z_n^{2+}\right] = 0.10M$ and $\left[Ag^+\right] = 10M$. The EMF of the cell is found to be 1.62 volts.

2+5+3=10

(e) *(i)* State and explain the Nernst equation.

(ii) Find out whether Zn and Ag would react with dilute H_2SO_4 acid or not.

Given :

$E_{el}^o = 0$ for $2H^+, H_2(g); Pt$

$E_{el}^o = -0.76\,V$ for $Zn^{2+}; Zn$

$E_{el}^o = +0.80\,V$ for $Ag^+; Ag$

4+(2×3)=10

(f) *(i)* How can you apply the dipole moment of a molecule to study its molecular structure ?