# DPP No. 34

**Total Marks : 40**

**Max. Time : 47 min.**

**Topic : Electro Chemistry**

| Type of Questions | | M.M., Min. |
|---|---|---|
| Single choice Objective ('–1' negative marking) Q.1 to Q.4 | (3 marks, 3 min.) | [12, 12] |
| Match the Following (no negative marking) Q. 5 | (8 marks, 10 min.) | [8, 10] |
| Subjective Questions ('–1' negative marking) Q.6 to Q.10 | (4 marks, 5 min.) | [20, 25] |

**1.** Two aqueous solutions A and B containing solute $CuSO_4$ and NaBr respectively were electrolysed using platinum electrodes. The pH of the resulting solutions will show a/an :

(A) Increase in both the solutions
(B) Decrease in both the solutions
(C) Increase in A and decrease in B
(D) Decrease in A and increase in B

**2.** 'Spin only' magnetic moment of Ni in $[Ni(dmg)_2]$ is same as that found in :

(A) Ni in $[NiCl_2(PPh_3)_2]$
(B) Mn in $[MnO_4]^{2-}$
(C) Co in $[CoBr_4]^{2-}$
(D) Pt in $[Pt(H_2O)_2Br_2]$

**3.** **$S_1$ :** pH of the solution increases when 1M aqueous solution $CuSO_4$ is electrolysed using platinum electrodes.

**$S_2$ :** At equilibrium, $E^o_{cell}$ of a Daniel cell will be equal to zero.

**$S_3$ :** Equivalent conductance of a weak electrolyte solution increases with decreases in concentration of solution.

(A) FTT (B) FFT (C) TFT (D) TTF

**4.** **Statement-1 :** On increasing dilution, the conductivity of solution gets increased.

**Statement-2 :** On increasing dilution, degree of ionization of weak electrolyte increases and mobility of ions also increases.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

**5.**

| **Column – I** **(Quantities)** | **Column – II** **(Factors on which dependency exist)** |
|---|---|
| (A) Molar conductance | (p) Temperature |
| (B) emf of a cell in operation | (q) Concentration of species involved |
| (C) Gibbs energy change ($\Delta G$) for a cell | (r) Nature of substance involved |
| (D) Conductivity | (s) Stoichiometric coefficient of the cell reaction. |
| | (t) Presence of complex forming ligand in sufficient concentration. |

### *Integer Answer Type*

This section contains 3 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

**6.** Equivalent conductance of 0.2 M aqueous solution of a weak monobasic acid (HA) is 10 S $cm^2$ $equiv^{-1}$ and that at infinite dilution is 200 S $cm^2$ $equiv^{-1}$. Hence pH of this solution is.

**7.** Conductivity of a saturated solution of $Cu_2[Fe(CN)_6]$ after subtracting the conductivity of water is $1.28 \times 10^{-5}\ \Omega^{-1}\ cm^{-1}$. Calculate value of solubility of $Cu_2[Fe(CN)_6]$.
$[\Lambda_m^{\infty}(CuSO_4) = 260\ S\ cm^2\ mol^{-1}$, $\Lambda_m^{\infty}(K_2SO_4) = 300\ S\ cm^2\ mol^{-1}$, $\Lambda_m^{\infty}(K_4Fe(CN)_6) = 720\ S\ cm^2\ mol^{-1}]$
Report your answer as (solubility ) × ($10^5$)

**8.** A dilute solution of KCl was placed between two Pt electrodes 10 cm apart across which a potential difference of 6.0 volts was applied. Calcualte how far (in cm) would $K^+$ ion move in 2 hours 46 minutes and 60 seconds at 25ºC. Given that ionic conductivity of $K^+$ at infinite dilution is 96.50 S $cm^2$ $eq^{-1}$ at 25ºC. (Assume 1F = 96500 C).

**9.** Calculate $K_{sp}$ for $BaSO_4$ with the help of following data at 298 K. Specific conductance of saturated solution of $BaSO_4 = 4.44\times10^{-6}\ ohm^{-1}\times cm^{-1}$ and that of water used for making the solution $= 1.34\times10^{-6}\ ohm^{-1} \times cm^{-1}$, molar ionic conductance at infinite dilution for $Ba^{++}$ and $SO_4^{--}$ are 127.28 and 159.60 respectively.

**10.** A conductivity cell has a resistance of 250 Ω when filled with 0.02 M KCl at $25^0$C and one of $10^5\ \Omega$ when filled with $6 \times 10^{-5}$ M $NH_4OH$ solution, the specific conductivity of 0.02 M KCl is 0.00277 S $cm^{-1}$ and the $\lambda_\varepsilon NH_4^+$ and $\lambda_\varepsilon OH^-$ are 73.4 and 198 respectively. Calculate the cell constant and the degree of dissociation of $NH_4OH$ in the $6 \times 10^{-5}$ M solution.

# Answer Key

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1.** | (D) | **2.** | (D) | **3.** | (B) | **4.** | (D) |
| **5.** | (A) → p, q, r, t ; (B) → p, q, r, t ; (C) → p, q, r, s, t ; (D) → p, q, r, t | | | | | **6.** | 2 |
| **7.** | 2 | **8.** | 6 | **9.** | $K_{SP}$ $BaSO_4 = 1.167 \times 10^{-10}$ | **10.** | 0.69 $cm^{-1}$, 0.425. |

# Hints & Solutions

## PHYSICAL / INORGANIC CHEMISTRY

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1. In solution A : $Cu^{2+} + 2e^- \longrightarrow Cu$ ; $2H_2O \longrightarrow O_2 + 4H^+ + 4e^-$ (pH decreases)

   In solution B : $2Br^- \longrightarrow Br_2 + 2e^-$ ; $2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$ (pH increases)

2. (D) Ni $(dmg)_2$ complex is square planar and dimagnetic.
   Pt (II) – $5d^8$ configuration. Complex is square planar and therefore, dimagnetic.
   So, $\mu = 0$

4. On increasing dilution, conductivity (k) of solution decreases but molar conductivity ($\lambda_m$) increases.

5. emf of cell is intensive function so do not depend stoichometic coefficient. In complex formation concentration of cation of decreases, emf and connectivity get change.

7. $\Lambda_m^\infty (Cu_2[Fe(CN)_6]) = 2\lambda_m^\infty(Cu^{2+}) + \lambda_m^\infty(Fe(CN)_6{}^{4-})$
   $= 2\Lambda_m^\infty(CuSO_4) + \Lambda_m^\infty(K_4Fe(CN)_6) - 2\Lambda_m^\infty(K_2SO_4)$
   $= 640\ S\ cm^2\ mol^{-1}$

   $\Lambda_m^\infty = \frac{\kappa \times 100}{s}$

   $s = \frac{\kappa \times 1000}{\Lambda_m^\infty} = \frac{1.28 \times 10^{-5} \times 1000}{640} = 2 \times 10^{-5}$

8. $\lambda^\infty_{K^+} = 96.50$

   $\therefore$ Ionic mobility $\mu^\infty_{K^+} = \frac{\lambda^\infty_{K^+}}{F} = \frac{96.50}{96500} = 10^{-3}\ cm^2\ sec^{-1}\ volt^{-1}$

   Potential gradient applied $= \frac{6.0}{10} = 0.6$ volt $cm^{-1}$

   Ionic mobility $(\mu) = \left(\frac{\text{speed of ion}}{\text{potential gradient}}\right)$

   So speed of $(K^+) = (10^{-3} \times 0.6) = 6 \times 10^{-4}$ cm/sec.

   $\therefore$ Distance travelled in 2 hours 46 minutes and 60 seconds
   d = 6 cm.