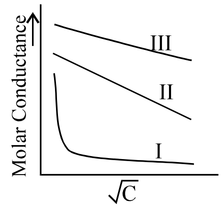
CLASS : CC -AD

Revision Work-sheet Electrochemistry

Single correct:

Q.1 A graph was plotted between the molar conductance of various electrolytes (HCl, KCl and CH_3COOH) and root of their concentrations in mole per litre.



Which of the following is correct match?

(A) I (CH_3COOH) ; II (KCl) ; III (HCl) (B) I (HCl) ; II (KCl) ; III (CH_3COOH)

(C) I (CH_3COOH) ; II (HCl) ; III (KCl) (D) I (KCl) ; II (CH_3COOH) ; III (HCl)

Q.2 Equivalent conductance of 0.1 M HA(weak acid) solution is 10 $Scm^2 equivalent^{-1}$ and that at infinite dilution is 200 $Scm^2 equivalent^{-1}$ Hence pH of HA solution is

(A) 1.3 (B) 1.7 (C) 2.3 (D) 3.7

Q.3 A silver wire dipped in 0.1 M HCl solution saturated with AgCl develops oxidation potential of –0.25 V. If $E^{\circ}_{Ag/Ag^+} = -0.799$ V, the K_{sp} of AgCl in pure water will be

(A) 2.95×10^{-11} (B) 5.1×10^{-11} (C) 3.95×10^{-11} (D) 1.95×10^{-11}

Q.4 For the cell : Pt | H_2(0.4 atm) | H^+(pH=1) || H^+(pH = 2) | H_2 (0.1 atm) | Pt

The measured potential at 25°C is

(A) –0.1 V (B) –0.5 (C) –0.041 (D) none

Q.5 EMF of a cell is given by E = $(-1.05 + 10^{-4} T^2)$ V, where T is temperature in Kelvin. Which of the following options are **correct** w.r.t. the galvanic cell.

(A) ΔH°_{Rxn} of the cell reaction will be temperature independent.

(B) The cell reaction involves increase in randomness.

(C) At all the temperatures, the cell reaction will be spontaneous.

(D) The cell reaction will be non-spontaneous at T = 200K.

Q.6 A saturated solution in AgA ($K_{sp} = 3\times10^{-14}$) and AgB ($K_{sp} = 1\times10^{-14}$) has conductivity of 375×10^{-10} Scm^{-1} and limiting molar conductivity of Ag^+ and A^- are 60 $Scm^2 mol^{-1}$ and 80 $Scm^2 mol^{-1}$ respectively then what will be the limiting molar conductivity of B^- (in $Scm^2 mol^{-1}$)

(A) 150 (B) 180 (C) 190 (D) 270

Q.7 The conductivity of a saturated solution of Ag_3PO_4 is 9×10^{-6} S m^{-1} and its equivalent conductivity is 1.50×10^{-4} S m^2 $equivalent^{-1}$. The K_{sp} of Ag_3PO_4 is

(A) 4.32×10^{-18} (B) 1.8×10^{-9} (C) 8.64×10^{-13} (D) None of these

Q.8 Na-Amalgam is prepared by electrolysis of aq. NaCl solution using 10 gm Hg cathode. How many Faraday's of electricity is required to prepare 18.7 % Na-Amalgam. (current Eff. = 50%)

(A) 0.081 F (B) 0.16 F (C) 0.2 F (D) 0.1 F

Assertion and Reason :

Q.9 **Statement-1**: Electrode potential of any electrode will change on changing any of its intensive properties

Statement-2: Any intensive property of system changes on changing any of its properties whether intensive or extensive.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false. (D) Statement-1 is false, statement-2 is true.

Comprehension : **Paragraph for Question Nos. 10 & 11**

Copper reduces NO_3^- into NO and NO_2 depending upon conc. of HNO_3 in solution. Assuming $[Cu^{2+}] = 0.1$ M, and $P_{NO} = P_{NO_2} = 10^{-3}$ atm and using given data answer the following questions:

$E^o_{Cu^{2+}/Cu} = +0.34$ volt

$E^o_{NO_3^-/NO} = +0.96$ volt

$E^o_{NO_3^-/NO_2} = +0.79$ volt

at 298 K $\frac{RT}{F}(2.303) = 0.06$ volt

Q.10 E_{Cell} for reduction of $NO_3^- \longrightarrow NO$ by Cu(s), when $[HNO_3] = 1M$ is [At T = 298]
(A) ~ 0.61 (B) ~ 0.71 (C) ~ 0.51 (D) ~ 0.81

Q.11 At what HNO_3 concentration thermodynamic tendency for reduction of NO_3^- into NO and NO_2 by copper is same?
(A) $10^{1.23}$ M (B) $10^{0.56}$ M (C) $10^{0.66}$ M (D) $10^{0.12}$ M

Paragraph for question nos. 12 to 14

0.1 mole $AgNO_3$ is added in 250 ml of saturated solution of AgCl at 25°C without changing volume.

Given : K_{sp} of AgCl = 1.0×10^{-10} M^2

Ionic conductance of Ag^+ ion = 60 Ω^{-1} cm^2 mol^{-1}

Ionic conductance of Cl^- ion = 75 Ω^{-1} cm^2 mol^{-1}

Ionic conductance of NO_3^- ion = 75 Ω^{-1} cm^2 mol^{-1}

Q.12 $[Cl^-]$ in the final solution is equal to
(A) 10^{-9} M (B) 2.5×10^{-10} M (C) 10^{-5} M (D) 2.5×10^{-7} M

Q.13 If the solution is electrolysed using inert electrodes, the expected electrode products are :
(A) Ag at cathode and Cl_2 at anode (B) Ag at cathode and O_2 at anode
(C) H_2 at cathode and Cl_2 at anode (D) H_2 at cathode and O_2 at anode

Q.14 The conductivity of solution is :
(A) 5.4×10^{-2} Ω^{-1} cm^{-1} (B) 5.2×10^{-2} Ω^{-1} cm^{-1}
(C) 4.0×10^{-2} Ω^{-1} cm^{-1} (D) 8.4×10^{-2} Ω^{-1} cm^{-1}

Paragraph for question nos. 15 to 16

In quantitative estimation of any element using an oxidizing agent it is essential to predict which substance(s) gets oxidized by the oxidizing agent. In case more than one substance are getting oxidized then the oxidizing agents gets distributed in all the reactions taking place. From this information and the data given below answer the questions that follow.

$Fe^{+2} \rightarrow Fe^{+3} + e^-$ $E^\circ_{O.P.} = -0.77V$
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2-} + 4H_2O$ $E^\circ_{R.P.} = 1.51V$
$2Cl^- \rightarrow Cl_2 + 2e^-$ $E^\circ_{O.P.} = -1.36V$
$2SO_4^{2-} \rightarrow S_2O_8^{2-} + 2e^-$ $E^\circ_{O.P.} = -2.0V$
$C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$ $E^\circ_{O.P.} = -0.77V$

$$Cr_2O_7^{2-} + 14\,H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O \qquad E^\circ_{R.P.} = 1.33V$$

Q.15 Which of the following cannot be used for quantitative estimation of FeC_2O_4?

(A) $K_2Cr_2O_7$ in presence of dil H_2SO_4. (B) $K_2Cr_2O_7$ in presence of dil. HCl.
(C) $KMnO_4$ in presence of dil. HCl. (D) $KMnO_4$ in presence of dil. H_2SO_4

Q.16 Millimoles of FeC_2O_4 in the solution if 50ml of 0.1M $KMnO_4$ is used for its oxidation in presence of dil. HCl if 3.5 millimoles of Cl_2 is obtained along with other products.

(A) 25/3 millimoles (B) 6 millimoles
(C) 12.5 millimoles (D) quantitative estimation can't be made from given data.

Paragraph for Question Nos. 17 to 19

A sample of water from a large swimming pool has a resistance of 10000 Ω at 25°C when placed in a certain conductance cell. When filled with 0.02 M KCl solution, the cell has a resistance of 100 Ω at 25°C. 585 gm of NaCl were dissolved in the pool, which was throughly stirred. A sample of this solution gave a resistance of 8000 Ω.

[**Given** : Molar conductance of NaCl at that concentration is 125 Ω^{-1} cm^2 mol^{-1} and molar conductivity of KCl at 0.02 M is 200 Ω^{-1} cm^2 mol^{-1}.]

Q.17 Cell constant (in cm^{-1}) of conductance cell is:

(A) 4 (B) 0.4 (C) 4×10^{-2} (D) 4×10^{-5}

Q.18 Conductivity (Scm^{-1}) of H_2O is:

(A) 4×10^{-2} (B) 4×10^{-3} (C) 4×10^{-5} (D) None of these

Q.19 Volume (in Litres) of water in the pool is:

(A) 1.25×10^5 (B) 1250 (C) 12500 (D) None of these

More than one correct :

Q.20 Pick out the **correct** statements among the following from inspection of standard reduction potentials (Assume standard state conditions).

$$Cl_2\,(aq.) + 2e \rightleftharpoons 2Cl^-(aq.) \qquad E^o_{Cl_2/Cl^-} = +1.36 \text{ volt}$$

$$Br_2\,(aq.) + 2e \rightleftharpoons 2Br^-(aq.) \qquad E^o_{Br_2/Br^-} = +1.09 \text{ volt}$$

$$I_2(s) + 2e \rightleftharpoons 2I^-\,(aq.) \qquad E^o_{I_2/I^-} = +0.54 \text{ volt}$$

$$S_2O_8^{2-}\,(aq.) + 2e \rightleftharpoons 2SO_4^{2-}\,(aq.) \qquad E^o_{S_2O_8^{2-}/SO_4^{2-}} = +2.00 \text{ volt}$$

(A) Cl_2 can oxidise SO_4^{2-} from solution
(B) Cl_2 can oxidise Br^- and I^- from aqueous solution
(C) $S_2O_8^{2-}$ can oxidise Cl^-, Br^- and I^- from their aqueous solutions
(D) $S_2O_8^{2-}$ is added slowly, Br^- can be reduce in presence of Cl^-

Match the column :

Q.21

	Column I		Column II (Electrolysis product using inert electrode)
(A)	Dilute solution of HCl	(P)	O_2 evolved at anode
(B)	Dilute solution of NaCl	(Q)	H_2 evolved at cathode
(C)	Concentrated solution of NaCl	(R)	Cl_2 evolved at anode
(D)	$AgNO_3$ solution	(S)	Ag deposition at cathode

Subjective:

Q.22 Calculate the potential of an indicator electrode versus the standard hydrogen electrode, which originally contained 0.1M MnO_4^- and 0.8M H^+ and which was treated with 90% of the Fe^{2+} necessary to reduce all the MnO_4^- to Mn^{+2}.

$$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O, E^0 = 1.51V$$

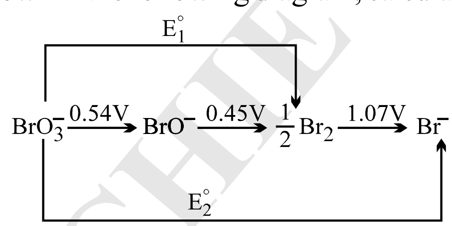
Q.23 One of the methods of preparation of per disulphuric acid, $H_2S_2O_8$, involve electrolytic oxidation of H_2SO_4 at anode ($2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^+ + 2e^-$) with oxygen and hydrogen as by–products. In such an electrolysis, 9.722 L of H_2 and 2.35 L of O_2 were generated at STP. What is the weight of $H_2S_2O_8$ formed?

Q.24 Calculate E° for the following reactions at 298 K,

$$Ag(NH_3)_2^+ + e^- \rightleftharpoons Ag + 2NH_3 \qquad Ag(CN)_2^- + e^- \rightleftharpoons Ag + 2CN^-$$

Given : $E^\circ_{Ag^+|Ag} = 0.7991V, K_{Ins}[Ag(NH_3)_2^+] = 6.02 \times 10^{-8}$ and $K_{Ins}[Ag(CN)_2^-] = 1.995 \times 10^{-19}$

Q.25 From the standard potentials shown in the following diagram, calculate the potentials E_1° and E_2°.



Q.26 If electrolysis of $AgNO_3$ solution is carried out with 100 gm impure Ag as anode of 90% purity and pure Ag of mass 100gm as cathode by passing 2amp current for 9650 sec. Then the mass of cathode and anode will be :

Q.27 Find $\wedge_m^\infty$ (in Ω^{-1} cm^2 mol^{-1}) for $SrCl_2$ in water at 25° from the following data.

Conc. C (mole/L)	0.25	1
$\wedge_m$ (Ω^{-1} cm^2/mol)	260	250

Q.28 $E°_{Cell}$ for the cell :

Pt(s) | Fe^{2+}(aq) | Fe^{3+}(aq) || MnO_4^-(aq), H^+(aq) | Mn^{2+}(aq) | Pt is 0.8 Volt

Given : $\Delta G°_f$, $H_2O(l)$ = – 230 $kJmol^{-1}$

$\Delta G°_f$, Fe^{3+}(aq) = – 10.2 $kJmol^{-1}$

$\Delta G°_f$, Mn^{2+}(aq) = – 229 $kJmol^{-1}$

$\Delta G°_f$, Fe^{2+}(aq) = – 84 $kJmol^{-1}$

Determine magnitude of $\Delta G°_f$, MnO_4^-(aq) in $kJmol^{-1}$.

Q.29 EMF of the following cell is 0.634 volt at 298 K.

Pt | H_2(1 atm) H^+ (aq) | | KCl(1N) | Hg_2Cl_2(s) | Hg

Calculate pH of the anode compartment.

Given : $E^\circ_{Cl^-|Hg_2Cl_2|Hg} = 0.28$ V and $\frac{2.303\ RT}{F} = 0.059$.

REVISION FLOW CHART

Electrochemistry

Galvanic Cell
- Representation (N)
- Function of salt bridge (T)
- Application of ECS (activity of metals), oxidising or reducing power, product of (metal + H^+)Rxns, product of electrolysis (T)
- Different types of half cells (T)
- Nernst equation (determination of E or E° of cell or half cell & factors affecting E & E°) (N)

Commercial cell & fuel cell
- Alkaline Cell (T)
- Fuel Cell (T)
- Lead storage batteries (T)

Electrolysis
- Electrolys's of (T)
  - a. NaCl using Pt or Hg electrode
    NaCl(dilute or concentrated)
  - b. LiCl using inert eluctrode
  - c. Water using Pt electrode
  - d. $CuSO_4$ with & without Cu electrode
- Faradays law (N)

Note **:** oxidation potential of Fe, Pb, Al, Na, Mg, Ca Cs, K, Li is higher than H_2 and of Au, Cu, Hg, Ag is less than H_2

Conductance
- $R = \rho \frac{\lambda}{A}$ or $K = G \frac{\lambda}{A}$ (N)
- Λ_m, Λ_{eq} & cell constant (N)
- Variation of K & λ_m with concentration (N)
- Kohlransch's law & its application (α, Solubility, K_w, K_{eq} etc.) (N)
- Conductometric titration (N)

(G) → represents topic of graphical importance

(T) → represents topic of theoretical importance

(N) → represents topic of numerical importance

LIST OF IMPORTANT FORMULAS

For Galvanic Cell :

$E_{cell} = (E_{oxi})_{anode} + (E_{red})_{cathode} = (E_{red})_{cathode} - (E_{red})_{anode}$

$\Delta G^o = -RT\ell nK = -nFE^o$

Nernst Equation :

$A \rightleftharpoons B$

$$E_{cell} = E^o{}_{cell} - \frac{RT}{nF}\ell n\frac{[B]}{[A]}$$

Constant :

$$\frac{2.303 \times 8.314 \times 298}{96500} = 0.591$$

Thermodynamic Treatment :

$$\Delta H = -nFE + nFT\left(\frac{\partial E}{\partial T}\right)_P$$

$$\Delta S = -nF\left(\frac{\partial E}{\partial T}\right)_P$$

Faraday's Law :

$w = zit$

$Z \rightarrow$ electrochemical equivalent

$$Z = \frac{E}{96500}$$

E = Equivaent Mass

if electrodes are in series then ratio of weight deposited will be

$E_1 : E_2 : E_3$

Electrolytic conductance

$$K = G\frac{\rho}{A}$$

$K \rightarrow$ specific conductance

$G \rightarrow$ conductance

$\frac{\ell}{A} \rightarrow$ Cell constant

$$\Lambda_m = \frac{K(s\,m^{-1})}{1000\times M} = \frac{1000\times K(Scm^{-1})}{M}$$

$$\Lambda_{eq} = \frac{K(Sm^{-1})}{1000\times N} = \frac{1000\times K(Scm^{-1})}{N}$$

Variation of molar conductivity with concentration :

$$\Lambda_m = \lambda^o{}_m - A\sqrt{C}$$

$A \rightarrow$ constant

Application of Kohlrausch law :

$$\alpha = \frac{\lambda_m}{\lambda_m^o}$$

For weak electrolyte

$$HA\,(aq) \rightleftharpoons H^+(aq) + A^-(aq) \quad K = \frac{C\alpha^2}{1-\alpha}$$

$C(1–\alpha)$ $\quad$ $C\alpha$ $\quad$ $C\alpha$

$$K = \frac{C\times\left(\frac{\lambda m}{\lambda_m^o}\right)^2}{1-\frac{\lambda m}{\lambda_m^o}}$$

For sparingly soluble salts :

$$\lambda_m(AB) = \frac{K_{AB}\times 1000}{S} = \frac{(K_{sol}-K_{H_2O})\times 1000}{S}$$

Conductometric Titration :

Conductivity of $H^+(aq)$ & $OH^-(aq)$ ions has exceptionally high.

LAST MOMENT REVIEW

ELECTROCHEMISTRY

Theory : ....

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Exercise - 1 : Question ....

Exercise - 2 : Question ....

Exercise - 3 : Question ....

Exercise - 4 : Question ....

DPPs : ....

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....

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Other Sources : ....

....

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CLASS : CC -AD

Revision Work-sheet Electrochemistry

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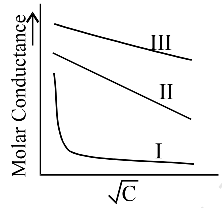

Which of the following is correct match?

(A*) I (CH_3COOH) ; II (KCl) ; III (HCl)   (B) I (HCl) ; II (KCl) ; III (CH_3COOH)
(C) I (CH_3COOH) ; II (HCl) ; III (KCl)   (D) I (KCl) ; II (CH_3COOH) ; III (HCl)

Q.2 Equivalent conductance of 0.1 M HA(weak acid) solution is 10 $Scm^2 equivalent^{-1}$ and that at infinite dilution is 200 $Scm^2 equivalent^{-1}$ Hence pH of HA solution is

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The measured potential at 25°C is

(A) –0.1 V   (B) –0.5   (C*) –0.041   (D) none

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(A) 150   (B) 180   (C) 190   (D*) 270

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(A) 0.081 F   (B) 0.16 F   (C*) 0.2 F   (D) 0.1 F

Assertion and Reason :

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Statement-2: Any intensive property of system changes on changing any of its properties whether intensive or extensive.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

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Comprehension : **Paragraph for Question Nos. 10 & 11**

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$$E^o_{Cu^{2+}/Cu} = +0.34 \text{ volt}$$

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at 298 K $\frac{RT}{F}(2.303) = 0.06$ volt

Q.10 E_{Cell} for reduction of $NO_3^- \longrightarrow NO$ by Cu(s), when $[HNO_3] = 1M$ is [At T = 298]

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Given : K_{sp} of AgCl = 1.0×10^{-10} M^2

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Ionic conductance of Cl^- ion = 75 Ω^{-1} cm^2 mol^{-1}

Ionic conductance of NO_3^- ion = 75 Ω^{-1} cm^2 mol^{-1}

Q.12 $[Cl^-]$ in the final solution is equal to

(A) 10^{-9} M (B*) 2.5×10^{-10} M (C) 10^{-5} M (D) 2.5×10^{-7} M

Q.13 If the solution is electrolysed using inert electrodes, the expected electrode products are :

(A) Ag at cathode and Cl_2 at anode (B*) Ag at cathode and O_2 at anode

(C) H_2 at cathode and Cl_2 at anode (D) H_2 at cathode and O_2 at anode

Q.14 The conductivity of solution is :

(A*) 5.4×10^{-2} Ω^{-1} cm^{-1} (B) 5.2×10^{-2} Ω^{-1} cm^{-1}

(C) 4.0×10^{-2} Ω^{-1} cm^{-1} (D) 8.4×10^{-2} Ω^{-1} cm^{-1}

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$2SO_4^{2-} \rightarrow S_2O_8^{2-} + 2e^-$	$E^\circ_{O.P.} = -2.0V$
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$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O$	$E^\circ_{R.P.} = 1.33V$

Q.15 Which of the following cannot be used for quantitative estimation of FeC_2O_4?

(A) $K_2Cr_2O_7$ in presence of dil H_2SO_4.
(B) $K_2Cr_2O_7$ in presence of dil. HCl.
(C*) $KMnO_4$ in presence of dil. HCl.
(D) $KMnO_4$ in presence of dil. H_2SO_4

Q.16 Millimoles of FeC_2O_4 in the solution if 50ml of 0.1M $KMnO_4$ is used for its oxidation in presence of dil. HCl if 3.5 millimoles of Cl_2 is obtained along with other products.

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[**Given** : Molar conductance of NaCl at that concentration is 125 Ω^{-1} cm^2 mol^{-1} and molar conductivity of KCl at 0.02 M is 200 Ω^{-1} cm^2 mol^{-1}.]

Q.17 Cell constant (in cm^{-1}) of conductance cell is:

(A) 4
(B*) 0.4
(C) 4×10^{-2}
(D) 4×10^{-5}

Q.18 Conductivity (Scm^{-1}) of H_2O is:

(A) 4×10^{-2}
(B) 4×10^{-3}
(C*) 4×10^{-5}
(D) None of these

Q.19 Volume (in Litres) of water in the pool is:

(A*) 1.25×10^5
(B) 1250
(C) 12500
(D) None of these

More than one correct :

Q.20 Pick out the **correct** statements among the following from inspection of standard reduction potentials (Assume standard state conditions).

Cl_2 (aq.) + 2e	⇌	$2Cl^-$(aq.)	$E^o_{Cl_2/Cl^-} = +1.36$ volt
Br_2 (aq.) + 2e	⇌	$2Br^-$(aq.)	$E^o_{Br_2/Br^-} = +1.09$ volt
I_2(s) + 2e	⇌	$2I^-$ (aq.)	$E^o_{I_2/I^-} = +0.54$ volt
$S_2O_8^{2-}$ (aq.) + 2e	⇌	$2SO_4^{2-}$ (aq.)	$E^o_{S_2O_8^{2-}/SO_4^{2-}} = +2.00$ volt

(A) Cl_2 can oxidise SO_4^{2-} from solution
(B*) Cl_2 can oxidise Br^- and I^- from aqueous solution
(C*) $S_2O_8^{2-}$ can oxidise Cl^-, Br^- and I^- from their aqueous solutions
(D) $S_2O_8^{2-}$ is added slowly, Br^- can be reduce in presence of Cl^-

Match the column :

Q.21

	Column I		Column II (Electrolysis product using inert electrode)
(A)	Dilute solution of HCl	(P)	O_2 evolved at anode
(B)	Dilute solution of NaCl	(Q)	H_2 evolved at cathode
(C)	Concentrated solution of NaCl	(R)	Cl_2 evolved at anode
(D)	$AgNO_3$ solution	(S)	Ag deposition at cathode

[Ans. (A) P, Q (B) P, Q (C) Q, R, (D) P,S]

Subjective:

Q.22 Calculate the potential of an indicator electrode versus the standard hydrogen electrode, which originally contained 0.1M MnO_4^- and 0.8M H^+ and which was treated with 90% of the Fe^{2+} necessary to reduce all the MnO_4^- to Mn^{+2}.

$$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O, E^0 = 1.51V$$

Ans. 1.39V

Q.23 One of the methods of preparation of per disulphuric acid, $H_2S_2O_8$, involve electrolytic oxidation of H_2SO_4 at anode ($2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^+ + 2e^-$) with oxygen and hydrogen as by–products. In such an electrolysis, 9.722 L of H_2 and 2.35 L of O_2 were generated at STP. What is the weight of $H_2S_2O_8$ formed?

Ans. 43.456g

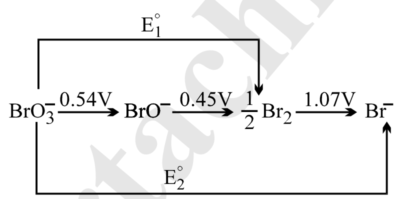
Q.24 Calculate E° for the following reactions at 298 K,

$$Ag(NH_3)_2^+ + e^- \rightleftharpoons Ag + 2NH_3 \qquad Ag(CN)_2^- + e^- \rightleftharpoons Ag + 2CN^-$$

Given : $E^\circ_{Ag^+|Ag} = 0.7991V, K_{Ins}[Ag(NH_3)_2^+] = 6.02 \times 10^{-8}$ and $K_{Ins}[Ag(CN)_2^-] = 1.995 \times 10^{-19}$

Ans. 0.372 V , – 0.307 V

Q.25 From the standard potentials shown in the following diagram, calculate the potentials E_1° and E_2°.



[Ans.0.522V,0.613 V]

Q.26 If electrolysis of $AgNO_3$ solution is carried out with 100 gm impure Ag as anode of 90% purity and pure Ag of mass 100gm as cathode by passing 2amp current for 9650 sec. Then the mass of cathode and anode will be : [Ans.121.6gm,76gm]

Q.27 Find $\wedge_m^\infty$ (in Ω^{-1} cm^2 mol^{-1}) for $SrCl_2$ in water at 25° from the following data.

Conc. C (mole / L)	0.25	1
$\wedge_m$ (Ω^{-1} cm^2 / mol)	260	250

[Ans. 270]

Q.28 E°_{Cell} for the cell :

Pt(s) | Fe^{2+}(aq) | Fe^{3+}(aq) || MnO_4^-(aq), H^+(aq) | Mn^{2+}(aq) | Pt is 0.8 Volt

Given : ΔG°_f, $H_2O(l) = -230$ kJmol^{-1}

ΔG°_f, $Fe^{3+}(aq) = -10.2$ kJmol^{-1}

ΔG°_f, $Mn^{2+}(aq) = -229$ kJmol^{-1}

ΔG°_f, $Fe^{2+}(aq) = -84$ kJmol^{-1}

Determine magnitude of ΔG°_f, MnO_4^-(aq) in kJmol^{-1}. [Ans. 0394]

Q.29 EMF of the following cell is 0.634 volt at 298 K.

Pt | H_2(1 atm) H^+ (aq) | | KCl(1N) | Hg_2Cl_2(s) | Hg

Calculate pH of the anode compartment.

Given : $E^\circ_{Cl^-|Hg_2Cl_2|Hg} = 0.28$ V and $\frac{2.303\ RT}{F} = 0.059$. [Ans.6]

Q.30 For the reaction, $4Al(s) + 3O_2(g) + 6H_2O + 4\ OH^- \rightleftharpoons 4\ [Al(OH)_4^-]$; $E^\circ_{cell} = 2.73$ V. If $\Delta G^\circ_f(OH^-) = -157$ kJ mol^{-1} and $\Delta G^\circ_f(H_2O) = -237.2$ kJ mol^{-1}, determine $\Delta G^\circ_f\,[Al(OH)_4^-]$.

Ans. -1.30×10^3 kJ mol^{-1}

REVISION FLOW CHART

Electrochemistry

- ***Galvanic Cell***
  - Representation (N)
  - Function of salt bridge (T)
  - Application of ECS (activity of metals), oxidising or reducing power, product of (metal + H^+)Rxns, product of electrolysis (T)
  - Different types of half cells (T)
  - Nernst equation (determination of E or E° of cell or half cell & factors affecting E & E°) (N)
- ***Commercial cell & fuel cell***
  - Alkaline Cell (T)
  - Fuel Cell (T)
  - Lead storage batteries (T)
- ***Electrolysis***
  - Electrolys's of (T)
    - a. NaCl using Pt or Hg electrode NaCl(dilute or concentrated)
    - b. LiCl using inert eluctrode
    - c. Water using Pt electrode
    - d. $CuSO_4$ with & without Cu electrode
  - Faradays law (N)

  Note **:** oxidation potential of Fe, Pb, Al, Na, Mg, Ca Cs, K, Li is higher than H_2 and of Au, Cu, Hg, Ag is less than H_2
- ***Conductance***
  - $R = \rho \frac{\lambda}{A}$ or $K = G \frac{\lambda}{A}$ (N)
  - Λ_m, Λ_{eq} & cell constant (N)
  - Variation of K & λ_m with concentration (N)
  - Kohlransch's law & its application (α, Solubility, K_w, K_{eq} etc.) (N)
  - Conductometric titration (N)

(G) → represents topic of graphical importance

(T) → represents topic of theoretical importance

(N) → represents topic of numerical importance

LIST OF IMPORTANT FORMULAS

For Galvanic Cell :

$E_{cell} = (E_{oxi})_{anode} + (E_{red})_{cathode} = (E_{red})_{cathode} - (E_{red})_{anode}$

$\Delta G^o = -RT\ell nK = -nFE^o$

Nernst Equation :

$A \rightleftharpoons B$

$$E_{cell} = E^o_{cell} - \frac{RT}{nF}\ell n\frac{[B]}{[A]}$$

Constant :

$$\frac{2.303\times 8.314\times 298}{96500} = 0.591$$

Thermodynamic Treatment :

$$\Delta H = -nFE + nFT\left(\frac{\partial E}{\partial T}\right)_P$$

$$\Delta S = -nF\left(\frac{\partial E}{\partial T}\right)_P$$

Faraday's Law :

$w = zit$

$Z \rightarrow$ electrochemical equivalent

$$Z = \frac{E}{96500}$$

E = Equivaent Mass

if electrodes are in series then ratio of weight deposited will be

$E_1 : E_2 : E_3$

Electrolytic conductance

$$K = G\frac{\rho}{A}$$

$K \rightarrow$ specific conductance

$G \rightarrow$ conductance

$\frac{\ell}{A} \rightarrow$ Cell constant

$$\Lambda_m = \frac{K(s\,m^{-1})}{1000 \times M} = \frac{1000 \times K(Scm^{-1})}{M}$$

$$\Lambda_{eq} = \frac{K(Sm^{-1})}{1000 \times N} = \frac{1000 \times K(Scm^{-1})}{N}$$

Variation of molar conductivity with concentration :

$$\Lambda_m = \lambda^o{}_m - A\sqrt{C}$$

$A \rightarrow$ constant

Application of Kohlrausch law :

$$\alpha = \frac{\lambda_m}{\lambda_m^o}$$

For weak electrolyte

$$HA\,(aq) \rightleftharpoons H^+(aq) + A^-(aq) \quad K = \frac{C\alpha^2}{1-\alpha}$$

$C(1-\alpha) \qquad C\alpha \qquad C\alpha$

$$K = \frac{C \times \left(\frac{\lambda m}{\lambda_m^o}\right)^2}{1 - \frac{\lambda m}{\lambda_m^o}}$$

For sparingly soluble salts :

$$\lambda_m(AB) = \frac{K_{AB} \times 1000}{S} = \frac{(K_{sol} - K_{H_2O}) \times 1000}{S}$$

Conductometric Titration :

Conductivity of $H^+(aq)$ & $OH^-(aq)$ ions has exceptionally high.

LAST MOMENT REVIEW

ELECTROCHEMISTRY

Theory : ....

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Exercise - 1 : Question ....

Exercise - 2 : Question ....

Exercise - 3 : Question ....

Exercise - 4 : Question ....

DPPs : ....

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Other Sources : ....

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