Ch -2 Electrochemistry [previous years questions]

CBSE 2025

1. Assertion – Cu cannot liberate H2 on reaction with dilute mineral Acids.

Reason- Cu has positive electrode potential.

2. The charge required for the reduction of 1 mol of MnO_4^- to MnO_2 is

(A) 1 F (B) 3 F

(C) 5 F (D) 6 F

3. Calculate $\Lambda^\circ m$ for acetic acid and its degree of dissociation (α) if its molar conductivity is 48.1 Ω^{-1} cm^2 mol^{-1}.

Given that

$\Lambda^\circ m$ (HCl) = 426 Ω^{-1} cm^2 mol^{-1}

$\Lambda^\circ m$ (NaCl) = 126 Ω^{-1} cm^2 mol^{-1}

$\Lambda^\circ m$ (CH_3COONa) = 91 Ω^{-1} cm^2 mol^{-1}

4. (a) Calculate the standard Gibbs energy ($\Delta_r G^\circ$) of the following reaction at 25 °C : 3 + 2

$Au(s) + Ca^{2+}(1M) \rightarrow Au^{3+}(1M) + Ca(s)$

$E^\circ_{Au^{3+}/Au} = +1.5$ V, $E^\circ_{Ca^{2+}/Ca} = -2.87$ V

Predict whether the reaction will be spontaneous or not at 25 °C.

[1 F = 96500 C mol^{-1}]

(b) Tarnished silver contains Ag_2S. Can this tarnish be removed by placing tarnished silverware in an aluminium pan containing an inert electrolytic solution such as NaCl ? The standard electrode potential for half reaction :

$Ag_2S(s) + 2e^- \longrightarrow 2Ag(s) + S^{2-}$ is –0.71 V and for

$Al^{3+} + 3e^- \longrightarrow 2Al(s)$ is –1.66 V

5. **Standard electrode potential for Sn^{4+}/Sn^{2+} couple is +0.15 V and that for the Cr^{3+}/Cr couple is -0.74 V. The two couples in their standard states are connected to make a cell. The cell potential will be:**

(A) +1.19 V

(B) +0.89 V

(C) +0.18 V

(D) +1.83 V

0

6. **(a) State the following:**

(i) Kohlrausch law of independent migration of ions

(ii) Faraday's first law of electrolysis

(b) Using E° values of X and Y given below, predict which is better for coating the surface of iron to prevent corrosion and why?

7. **(A) (a) Write the cell reaction and calculate the e.m.f. of the following cell at 298 K:**

$$Sn(s) \mid Sn^{2+}(0.004\ M) \parallel H^+(0.02\ M) \mid H_2(1\ Bar) \mid Pt(s)$$

(Given: $E^\circ_{Sn^{2+}/Sn} = -0.14\,V, E^\circ_{H^+/H_2} = 0.00\,V$)

(b) Account for the following:

(i) On the basis of E° values, O_2 gas should be liberated at anode but it is Cl_2 gas which is liberated in the electrolysis of aqueous NaCl.

Solution: The standard electrode potential for the reduction of oxygen to water is $E^\circ_{O_2/H_2O} = +1.23\,V$, while for chloride to chlorine gas, $E^\circ_{Cl^-/Cl_2} = +1.36\,V$. In the electrolysis of aqueous NaCl, chloride ions are more readily oxidized to chlorine gas because the chloride ions are present in much higher concentration compared to oxygen in the solution. Therefore, despite the more positive potential for oxygen reduction, chlorine is liberated at the anode due to the high concentration of chloride ions.

(ii) Conductivity of CH_3COOH decreases on dilution.

Solution: The conductivity of acetic acid (CH_3COOH) decreases on dilution because it is a weak electrolyte that ionizes only partially in solution. As the solution is diluted, the number of ions in the solution decreases, reducing the overall conductivity. In the case of weak electrolytes like acetic acid, dilution reduces the concentration of dissociated ions, leading to a decrease in electrical conductivity.

OR

(B) (a.)Write the anode and cathode reactions and the overall cell reaction occurring in a lead storage battery during its use.

Solution:

In a lead storage battery (also known as a lead-acid battery), during discharge:

- Anode reaction:

$$Pb(s) + H_2SO_4(aq) \rightarrow PbSO_4(s) + 2e^-$$

- Cathode reaction:

$$PbO_2(s) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$$

- Overall reaction:

$$Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$$

(b.)Calculate the potential for half-cell containing 0.01 M $K_2Cr_2O_7$(aq), 0.01 M Cr^{3+}(aq), and 1.0 x 10^{-4} M H^+(aq).

CBSE 2024

1. Which of the following cell was used in Apollo space programme?

(a) Mercury cell (b) H_2—O_2 fuel cell

(c) Dry cell (d) Ni-Cd cell

2. State:

(a) Kohlrausch law of independent migration of lons.

(b) Faraday's first law of electrolysis.

3. Resistance of a conductivity cell filled with 0.2 mol L^{-1} KCl solution is 200 Ω. If the resistance of the same cell when filled with 0.05 mol L^{-1} KCl solution is 620 Ω, calculate the conductivity and molar conductivity of 0.05 mol L^{-1} KCl solution. The conductivity of 0.2 mol L^{-1} KCl solution is 0.0248 S cm^{-1}. 2

4. During the electrolysis of aqueous NaCl, the cathodic reaction is :

(A) Oxidation of Cl^- ion

(B) Reduction of Na^+ ion

(C) Oxidation of H_2O

(D) Reduction of H_2O

5. The conductivity of 0·2 M solution of KCl is $2{\cdot}48 \times 10^{-2}$ S cm^{-1}. Calculate its molar conductivity and degree of dissociation (α). *3*

Given :

$$\lambda^o_{K^+} = 73{\cdot}5 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\lambda^o_{Cl^-} = 76{\cdot}5 \text{ S cm}^2 \text{ mol}^{-1}$$

6. (a) (i) Calculate emf of the following cell at 25°C :

$$Zn\ (s) \mid Zn^{2+}\ (0{\cdot}001M) \mid\mid Cd^{2+}\ (0{\cdot}1\ M) \mid Cd\ (s)$$

Given : $E^o_{Zn^{2+}/Zn} = -\ 0{\cdot}76$ V, $E^o_{Cd^{2+}/Cd} = -\ 0{\cdot}40$ V [log 10 = 1]

(ii) **State Faraday's second law of electrolysis. How will the pH of** aqueous NaCl solution be affected when it is electrolysed ? *3+2=5*

OR

(b) (i) Calculate the $\Delta_r G^o$ and log K_c for the following cell reaction :

$$Fe\ (s) + Ag^+\ (aq) \rightleftharpoons Fe^{2+}(aq) + Ag\ (s)$$

Given : $E^o_{Fe^{2+}/Fe} = -\ 0{\cdot}44$ V, $E^o_{Ag^+/Ag} = +\ 0{\cdot}80$ V,

1 F = 96500 C mol^{-1}

(ii) Write any two advantages of the fuel cells over primary and secondary batteries ?

(iii) How many Faradays are required for the oxidation of 1 mole of H_2O to O_2 ? *3+1+1=5*

Ch-2 Electrochemistry

① Which one of the following cell was used in Apollo space program? [CBSE-2023]

(a) Mercury cell (b) MRI

(c) H_2-O_2 fuel cell (d) Dry cell

② Consider the following standard electrode potential values: CBSE-2023

$Fe^{+3}_{(aq)} + e^- \longrightarrow Fe^{+2}_{(aq)}$ $E^\circ = 0.77V$

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

What is the cell potential of the redox reaction

(a) $-2.28V$ (b) $-0.74V$

(c) $0.74V$ (d) $+2.28V$

③ A voltaic cell is made by connecting two half cells represented by half equation below:- CBSE-2023

$Sn^{+2}_{(aq)} + 2e^- \longrightarrow Sn_{(s)}$ $E^\circ = -0.14V$

$Fe^{+3}_{(aq)} + e^- \longrightarrow Fe^{+2}$ $E^\circ = 0.77V$

Which statement is correct about this voltaic cell

(a) Fe^{+2} is oxidised and the voltage of the cell is $-0.91V$

(b) Sn^{+2} is oxidised and the voltage of cell is $0.91V$

(c) Fe^{+2} is oxidised and the voltage of cell is $0.91V$

(d) Sn is oxidised and the voltage is $0.63V$

④ four half cell reactions I to IV are shown below CBSE 2023

(I) $2Cl^- \longrightarrow Cl_2 + 2e^-$ (II) $4OH^- + O_2 + 2H_2O + 2e^-$

(III) $Na^+ + e^- \longrightarrow Na$ (IV) $2H^+ + 2e^- \longrightarrow H_2$

Which of the reaction are most likely to occur when Conc. brine is electrolysed.

(A) I & III (B) I & IV (C) II and III (D) II and IV.

(5) (a) What should be the sign (positive/negative) for E°_{cell} and ΔG° for a spontaneous redox reaction occuring under standared condition?

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(b) State faraday's first law of electrolysis

or

(6) Calculate the EMF of following cell at 298K

$Fe_{(s)} | Fe^{+2}(0.01M) \,||\, H^+(1M) | H_2(1\,bar), Pt_{(s)}$

Given $E^\circ_{cell} = 0.44V$

CBSE-2023

Ans 0.4991V

2022

(7) Write Nernst equation for the following cell reaction: $Zn_{(s)} + Cu^{+2}_{(aq)} \longrightarrow Zn^{+2}_{(aq)} + Cu_{(s)}$

How will the Ecell be affected when Conc. of

(i) Cu^{+2} ions is increased.

(ii) Zn^{+2} ions is increased.

CBSE-2022

(8) a) The standard Gibb's energy (ΔG°) for the following cell reaction is $-300\ kJ\ mol^{-1}$.

$$Zn_{(s)} + 2\,Ag^+_{(aq)} \longrightarrow Zn^{+2}_{(aq)} + 2\,Ag_{(s)}$$

Calculate E°_{cell} for the following reaction

b) Calculate Λ°_m for $MgCl_2$ if λ° Values for Mg^{+2} ions and Cl^- ions are 106 $S\,cm^2\,mol^{-1}$ and 76.3 $S\,cm^2\,mol^{-1}$ respectively.

CBSE-2022

(9) (i) State Kohlrausch's law of independant migration.

(ii) Calculate the degree of dissociation (α) of CH_3COOH if Λ_m and Λ°_m of CH_3COOH are 48 $S\,cm^2\,mol^{-1}$ & 400 $S\,cm^2\,mol^{-1}$

2021

10 (i) Calculate EMF of the following cell at 298 K

$Al(s) | Al^{+3}(0.1M) || Cu^{+2}(0.01M) | Cu(s)$ CBSE 2021

Given $E^{\circ}_{cell} = 2.00V$ $(\log 10 = 1)$

(ii) Define molar conductivity. On dilution why does the molar conductivity of HCOOH increase drastically, while that of HCOONa increase gradually? CBSE 2021

11 (i) The electrical resistance of a column of 0.02M NaOH solution of diameter 1.40 cm and length 44 cm is 5×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity CBSE 2021

(ii) Depict the galvanic cell in which the reaction take place

$Ni(s) + 2Ag^{+}(aq) \longrightarrow Ni^{+2}(aq) + 2Ag(s)$

further show:

(i) Which of the electrodes is positively charged

(ii) The carries of the current in the outer circuit.