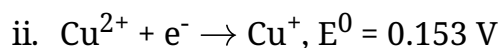
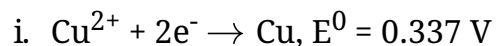


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**CBSE Test Paper-01**  
**Class 12 Chemistry (Electrochemistry)**

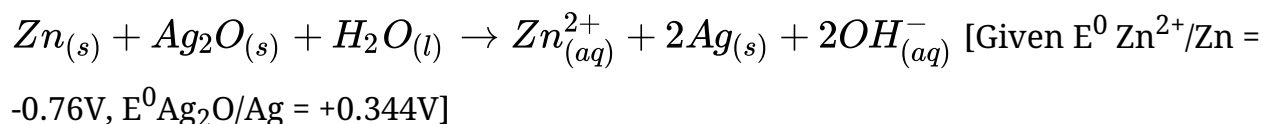
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1. Given



Electrode potential  $E^\circ$  for the reaction  $\text{Cu}^{2+} + \text{e}^- \rightarrow \text{Cu}$  will be

- a. 0.52 V
  - b. 0.38 V
  - c. 0.30 V
  - d. 0.90 V
2. How much electricity is required in coulomb for the oxidation of 1 mol of FeO to  $\text{Fe}_2\text{O}_3$ ?
- a. 95000C
  - b. 96000C
  - c. 96487C
  - d. 95550C
3. Correct arrangement of Al, Cu, Fe, Mg and Zn in the order in which they displace each other from the solution of their salts is
- a.  $\text{Mg} > \text{Al} > \text{Cu} > \text{Fe} > \text{Zn}$
  - b.  $\text{Mg} > \text{Al} > \text{Zn} > \text{Cu} > \text{F}$
  - c.  $\text{Mg} > \text{Al} > \text{Zn} > \text{Fe} > \text{Cu}$
  - d.  $\text{Cu} > \text{Al} > \text{Zn} > \text{Fe} > \text{Mg}$
4. In the button cells widely used in watches and other devices the following reaction takes place:



Determine  $E^\circ$  cell for the reaction.

- a. 1.104 V
- b. 1.005 V
- c. 0.913 V

- d. 1.159 V
5. Conductivity of 0.00241 M acetic acid is  $7.896 \times 10^{-5} \text{ S cm}^{-1}$ . If  $\Lambda^0_m$  for acetic acid is  $390.5 \text{ S cm}^2 \text{ mol}^{-1}$ , what is its dissociation constant?
- $1.75 \times 10^{-5}$
  - $2.05 \times 10^{-5}$
  - $1.95 \times 10^{-5}$
  - $1.85 \times 10^{-5}$
6. Write the cell formulation and calculate the standard cell potential of the galvanic cell in which the following reaction takes place:
- $$\text{Fe}^{2+}(\text{aq}) + \text{Ag}^+(\text{aq}) \rightarrow \text{Fe}^{3+}(\text{aq}) + \text{Ag}(\text{s})$$
- Calculate  $\Delta_r G^0$  for the above reaction
- [Given:  $E^0_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}$   
 $E^0_{\text{Fe}^{3+}/\text{Fe}^{2+}} = +0.77\text{V}$   
 $[1 \text{ F} = 96500 \text{ C mol}^{-1}]$ ]
7. What is the representation of a Daniell cell?
8. Why is the voltage of a mercury cell constant during its working?
9. Suggest a way to determine the  $\Lambda^0_m$  value of water?
10. Molar conductance of 1.5 M solution of an electrolyte is found to be  $138.9 \text{ S cm}^2 \text{ mol}^{-1}$ . What would be the specific conductance of this solution?
11. At 298 K, the molar conductivities at infinite dilution of  $\text{NH}_4\text{Cl}$ ,  $\text{NaOH}$  and  $\text{NaCl}$  are 129.8, 217.4 and  $108.9 \text{ S cm}^2 \text{ mol}^{-1}$  respectively. The molar conductivity of 0.01 M  $\text{NH}_4\text{OH}$  solution is  $9.33 \text{ S cm}^2 \text{ mol}^{-1}$ , calculate the degree of dissociation of  $\text{NH}_4\text{OH}$  at this dilution?
12. Consider the reaction:
- $$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$$
- What is the quantity of electricity in coulombs needed to reduce 1 mol of  $\text{Cr}_2\text{O}_7^{2-}$ ?

- 
13. a. The resistance of a conductivity cell containing 0.0001 M KCl solution at 298 K is  $1500\Omega$ . What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is  $0.146 \times 10^{-3} S cm^{-1}$
- b. Predict the products of electrolysis in the following:  
A solution of  $H_2SO_4$  with platinum electrode.
14. Zinc rod is dipped in 0.1 M solution of  $ZnSO_4$   
The salt is 95% dissociated at its dilution at 298 K . Calculate the electrode potential.  
Given:  
 $E^0(Zn^{2+}/Zn) = -0.76$
15. Explain construction and working of standard Hydrogen electrode?

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**CBSE Test Paper-01**  
**Class 12 Chemistry (Electrochemistry)**  
**Solutions**

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1. a. 0.52 V

**Explanation:**  $E^{\circ}_{\text{cell}} = 2(0.337) - 0.153$

2. c. 96487C

**Explanation:** For converting FeO to Fe<sub>2</sub>O<sub>3</sub> 1mol of electrons are required.

3. c. Mg > Al > Zn > Fe > Cu

**Explanation:** In application of electrochemical series, the metal which has lower reduction potential has higher tendency to get oxidised and would displace metals with lesser reduction potential from their salt solution.

4. a. 1.104 V

**Explanation:**  $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}}$

$$E^{\circ}_{\text{cell}} = E^{\circ}_{\text{Ag}_2\text{O}/\text{Ag}} - E^{\circ}_{\text{Zn}^{2+}/\text{Zn}}$$

$$= +0.344 - (-0.76) = 1.104\text{V}$$

5. d.  $1.85 \times 10^{-5}$

**Explanation:**  $\Lambda m = \frac{k}{c} \times 1000 = 7.896 \times 10^{-5} \times 1000 / 0.00241 = 32.76 \text{Scm}^2/\text{mol}$

$$\text{and } \alpha = \Lambda m / \Lambda^{\circ} m = 32.76 / 390.5 = 0.084$$

$$\text{and } K = C\alpha^2 / (1-\alpha) = 0.00241 \times (0.084)^2 / (1-0.084) = 1.85 \times 10^{-5}$$

$$6. E^{\circ}_{\text{cell}} = E^{\circ}_{\text{Ag}^+/\text{Ag}} - E^{\circ}_{\text{Fe}^{3+}/\text{Fe}}$$

$$= +0.80 \text{ V} - (+0.77) \text{ V}$$

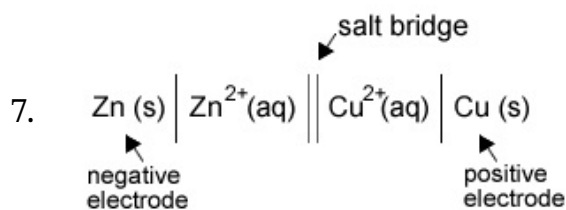
$$= 0.03 \text{ V}$$

$$\Delta_r G^{\circ} = -nFE^{\circ}$$

$$= -2 \times 0.03 \text{ V} \times 96500$$

$$= -5790 \text{ J mol}^{-1}$$

$$= 57.90 \text{ KJ mol}^{-1}$$



8. As all the products and reactants are either in solid or liquid state, their concentration does not change with the use of the cell.

9. Applying Kohlrausch's law of independent migration of ions, the  $\Lambda_m^0$  value of water can be determined as follows:

$$\begin{aligned}\Lambda_{m(H_2O)}^0 &= \lambda_{H^+}^0 + \lambda_{OH^-}^0 \\ &= \left( \lambda_{H^+}^0 + \lambda_{Cl^-}^0 \right) + \left( \lambda_{Na^+}^0 + \lambda_{OH^-}^0 \right) - \left( \lambda_{Na^+}^0 + \lambda_{Cl^-}^0 \right) \\ &= \lambda_{m(HCl)}^0 + \lambda_{m(NaOH)}^0 - \lambda_{m(NaCl)}^0\end{aligned}$$

Hence, by knowing the  $\lambda_m^0$  values of HCl, NaOH, and NaCl, the  $\lambda_m^0$  value of water can be determined.

10. Given that

molarity = 1.5 m

molar conductivity =  $138.9 \text{ S cm}^2 \text{ mol}^{-1}$

$$\begin{aligned}\lambda_m &= \frac{1000K}{M} = K = \frac{\lambda_m \times M}{1000} \\ &= \frac{138.9 \text{ S cm}^2 \text{ mol}^{-1} \times 1.5 \text{ mol}}{1000 \text{ cm}^3}\end{aligned}$$

$$K = 0.20835 \text{ S cm}^{-1}$$

$$= 2.0835 \times 10^{-1} \text{ S cm}^{-1}$$

$$11. \lambda_m^0(\text{NH}_4\text{OH}) = \lambda_m^0(\text{Na}_4\text{Cl}) + \lambda_m^0(\text{NaOH}) - \lambda_m^0(\text{NaCl})$$

$$= 129.8 + 217.4 - 108.9 = 237.3 \text{ S cm}^2/\text{mol}$$

$$\text{Degree of dissociation, } \alpha = \frac{\lambda_m}{\lambda_m^0} = \frac{9.335 \text{ S cm}^2/\text{mol}}{237.35 \text{ S cm}^2/\text{mol}}$$

$$= 0.039 \text{ or } 3.9\%.$$

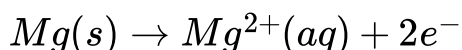
12. From the given reaction

1 mol of  $\text{Cr}_2\text{O}_7^{2-}$  ions requires

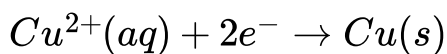
$$6F = 6 \times 96500 \text{ C}$$

$$= 579000 \text{ C of electricity for reduction of } \text{Cr}^{3+}.$$

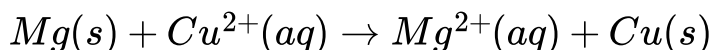
13. a. At Anode:



At Cathode:



Overall reaction is:



Using nernst equation for n=2,

$$\begin{aligned} E_{cell} &= [E^0_{Cu^{2+}/Cu} - E^0_{Mg^{2+}/Mg}] - \frac{0.0591}{2} \log \frac{[Mg^{2+}]}{[Cu^{2+}]} \\ &= +0.34V - (-2.37V) - \frac{0.0591}{2} \log \frac{0.001}{0.0001} \\ &= 2.71V - \frac{0.0591}{2} \log 10 \\ &= 2.71V - 0.0295V \\ &= 2.6805 V \end{aligned}$$

For free gibbs energy

$$\begin{aligned} \Delta G &= -nEF \\ &= -2 \times 2.6805 \times 96500 \\ &= -517336.5 \text{ J mol}^{-1} \\ &= -517.34 \text{ KJ mol}^{-1} \end{aligned}$$

b. At cathode:  $2H^{+}(aq) + 2e^{-} \rightarrow H_2(g)$

At anode:  $2OH^{-}(aq) \rightarrow O_2(g) + 2H^{+}(aq) + 4e^{-}$

H<sub>2</sub>(g) is evolved at cathode and O<sub>2</sub>(g) is evolved at anode.

14.  $[Zn^{2+}] = 0.1 \times \frac{95}{100} = 0.095M$



$$\begin{aligned} E_{(Zn^{+}/Zn)} &= E^0_{(Zn^{+}/Zn)} - \frac{0.0591}{2} \log \frac{1}{[Zn^{2+}]} \\ &= -0.76V - \frac{0.0591}{2} \log \frac{1}{0.095} \\ &= -0.76V - \frac{0.0591}{2} [\log 1000 - \log 95] \\ &= -0.76 - \frac{0.0591}{2} [3.000 - 1.9777] \\ &= -0.76V - \frac{0.0591}{2} \times 1.0223 \\ &= -0.76V - \frac{0.0604}{2} = -0.76 - 0.0302 \\ &= -0.7902 V \end{aligned}$$

15. **Construction:** SHE consists of a platinum electrode coated with platinum black. The electrode is dipped in an acidic solution and pure Hydrogen gas is bubbled through it.

The concentration of both the reduced and oxidized. Forms of Hydrogen is maintained at unity i.e) pressure of  $H_2$  gas is 1 bar and concentration of Hydrogen ions in the solution is 1 molar.

Working – The reaction taking place in SHE is  $H^+ (aq) + e^- \rightarrow 1/2 H_2 (g)$  At 298 K, the emf of the cell constructed by taking SHE as anode and other half-cell as cathode, gives the reduction potential of the other f cell whereas for a cell constructed by taking SHE as anode gives the oxidation potential of other half cell as conventionally the electrode potential of SHE is zero.

