"CULTIVATING EXCELLENCE IN EVERY STUDENT"

RAKESH KUMAR
M.Sc. (Chemistry) B.Ed.
CTET, PSTET, HPTET qualified

+917973739678
+919814516618
thakurkumar82@gmail.com
http://chemistryexpert.in/

Class:-XII (Sci.) **Name of Student……**
Subject:- Chemistry

10 YEAR QUSTIONS
Chapter-3
Electrochemistry

1. (a) Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution:
$Ag^+(aq) + e^- \rightarrow Ag(s)$ $E^o = +0.80$ V, $H^+(aq) + e^- \rightarrow 1/2H_2(g)$, $E^O = 0.00$ V
On the basis of their standard reduction electrode potential (E^o) values, which reaction is feasible at the cathode and why?
(b) Define limiting molar conductivity. Why conductivity of an electrolyte solution decreases with the decrease in concentration?

2. Calculate emf of the following cell at 25 °C :
$Fe \mid Fe^{2+}(0.001\ M) \parallel H^+(0.01\ M) \mid H_2(g)\ (1\ bar) \mid Pt(s)$ $E^o(Fe^{2+} \mid Fe) = -0.44$ V
$E^O(H^+ \mid H_2) = 0.00$ V.

3. **Calculate e.m.f. and ΔG for the following cell :**

$$\mathbf{Mg\ (s) \mid Mg^{2+}\ (0{\cdot}001\ M) \parallel Cu^{2+}\ (0{\cdot}0001\ M) \mid Cu\ (s)}$$

Given : $\mathbf{E^0_{(Mg^{2+}/Mg)} = -2{\cdot}37\ V,\ E^0_{(Cu^{2+}/Cu)} = +0{\cdot}34\ V.}$

4. (a) Calculate E°_{cell} for the following reaction at 298K :

$$2Al(s) + 3Cu^{2+}(0.01M) \rightarrow 2Al^{3+}(0.01M) + 3Cu(s)$$

Given : $E_{cell} = 1.98$ V

(b) Using the E° values of A and B, predict which is better for coating the surface of iron [$E^\circ(Fe^{2+}/Fe) = -0.44V$] to prevent corrosion and why ?

Given : $E^\circ(A^{2+}/A) = -2.37V$: $E^\circ(B^{2+}/B) = -0.14V$

5. (a) The conductivity of 0.001 mol L^{-1} solution of CH_3COOH is 3.905×10^{-5} S cm^{-1}. Calculate its molar conductivity and degree of dissociation (α).

Given $\lambda^0 (H^+) = 349.6$ S cm^2 mol^{-1} and $\lambda^0 (CH_3COO^-) = 40.9$ S cm^2 mol^{-1}

(b) Define electrochemical cell. What happens if external potential applied becomes greater than E°_{cell} of electrochemical cell ?

6. Calculate e.m.f of the following cell at 298 K :
$2Cr(s) + 3Fe^{2+}(0.1M) \rightarrow 2Cr^{3+}(0.01M) + 3\,Fe(s)$
Given: $E^\circ (Cr^{3+} | Cr) = -0.74$ V $E^\circ (Fe^{2+} | Fe) = -0.44$ V

7. (a) **The conductivity of 0·20 mol L^{-1} solution of KCl is $2{\cdot}48 \times 10^{-2}$ S cm^{-1}. Calculate its molar conductivity and degree of dissociation (α). Given $\lambda^0 (K^+) = 73{\cdot}5$ S cm^2 mol^{-1} and $\lambda^0 (Cl^-) = 76{\cdot}5$ S cm^2 mol^{-1}.**

(b) What type of battery is mercury cell ? Why is it more advantageous than dry cell ?

8. From the given cells: Lead storage cell, Mercury cell, Fuel cell and Dry cell answer the following: (i) Which cell is used in hearing aids?
(ii) Which cell was used in Apollo Space Programme? (iii) Which cell is used in automobiles and inverters? (iv) Which cell does not have long life?

9. Calculate E^0_{cell} for the following reaction at 298K :

$2Cr(s) + 3Fe^{2+}(0.01M) \rightarrow 2Cr^{3+}(0.01M) + 3Fe(s)$

Given : $E_{cell} = 0.261$ V

10. Calculate the degree of dissociation (α) of acetic acid if its molar conductivity (Λm) is 39.05 S $cm^2 mol^{-1}$. Given $\lambda^o(H^+) = 349.6$ S cm^2 mol^{-1} and $\lambda^o(CH_3COO^-) = 40.9$ S cm^2 mol^{-1}

11. (a) Calculate the mass of Ag deposited at cathode when a current of 2 amperes was passed through a solution of $AgNO_3$ for 15 minutes.
(Given: Molar mass of Ag = 108 g mol^{-1} 1F = 96500 C mol^{-1})
(b) Define fuel cell.

12. In a galvanic cell, the following cell reaction occurs:
$Zn\,(s) + 2\,Ag^+\,(aq) \rightarrow Zn^{2+}\,(aq) + 2\,Ag\,(s)$ $E^o cell = +1{\cdot}56$ V
(a) Is the direction of flow of electrons from zinc to silver or silver to zinc?
(b) How will concentration of Zn2+ ions and Ag+ ions be affected when the cell functions?

13. A current of 1.50 A was passed through an electrolytic cell containing $AgNO_3$ solution with inert electrodes. The weight of silver deposited was 1.50 g. How long did the current flow?(Molar mass of Ag =108 g mol^{-1}, 1F = 96500Cmol^{-1}).

14. The conductivity of a 0.01 M solution of acetic acid at 298 K is 1.65×10^{-4} S cm^{-1}. Calculate molar conductivity (λm) of the solution.

15. Consider the following reaction: $Cu(s) + 2Ag^{+}(aq) \rightarrow 2Ag(s) + Cu^{2+}(aq)$

(i) Depict the galvanic cell in which the given reaction takes place.

(ii) Give the direction of flow of current.

(iii) Write the half-cell reactions taking place at cathode and anode.

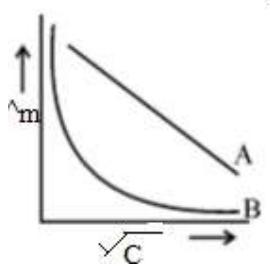
16. E^0cell for the given redox reaction is 2.71 V

$Mg(s) + Cu^{2+}(0.01\ M) \rightarrow Mg^{2+}(0.001\ M) + Cu(s)$

Calculate E_{cell} for the reaction. Write the direction of flow of current when an external opposite potential applied is (i) less than 2.71 V and (ii) greater than 2.71 V.

17. (a) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes $FeSO_4$ and $ZnSO_4$ until 2.8 g of Fe deposited at the cathode of cell X. How long did the current flow? Calculate the mass of Zn deposited at the cathode of cell Y. (Molar mass: Fe = 56 g mol^{-1} Zn = 65.3 g mol^{-1}, 1F = 96500 C mol^{-1})

(b) In the plot of molar conductivity (λm) vs square root of concentration ($c^{1/2}$), following curves are obtained for two electrolytes A and B:



Answer the following: (i) Predict the nature of electrolytes A and B.

(ii) What happens on extrapolation of ^m to concentration approaching zero for electrolytes A and B?

18. (a) The conductivity of 0·001 mol L^{-1} acetic acid is $4{\cdot}95 \times 10^{-5}$ S cm^{-1}. Calculate the dissociation constant if $\lambda^{o}m$ for acetic acid is 390·5 S cm^2 mol^{-1}.

(b) Write Nernst equation for the reaction at 25^0C:

$2\ Al(s) + 3\ Cu^{2+}(aq) \rightarrow 2\ Al^{3+}(aq) + 3\ Cu(s)$

(c) What are secondary batteries? Give an example.

19. (a) Represent the cell in which the following reaction takes place:

$2\ Al(s) + 3\ Ni^{2+}(0{\cdot}1\ M) \rightarrow 2\ Al^{3+}(0{\cdot}01\ M) + 3\ Ni(s)$.

Calculate its emf if E^0cell = 1·41 V.

(b) How does molar conductivity vary with increase in concentration for strong electrolyte and weak electrolyte? How can you obtain limiting molar conductivity ($\lambda^0 m$) for weak electrolyte?

20. (a) Following reaction takes place in the cell :

$Zn(s) + Ag_2O(s) + H_2O(l) \rightarrow Zn^{2+}(aq) + 2Ag(s) + 2OH^{-}(aq)$.

Calculate ΔrG^0 of the reaction. [Given: $E^0_{Zn2+/Zn} = -0{\cdot}76$ V, $E0_{Ag+/Ag} = 0{\cdot}80$ V, 1 F = 96,500 C mol^{-1}]

(b) How can you determine limiting molar conductivity, (λ^0 m) for strong electrolyte and weak electrolyte?

21. Calculate ΔrG^0 and log K_C for the following reaction :

$Cd^{+2}(aq) + Zn(s) \rightarrow Zn^{2+}(aq) + Cd(s)$;Given: $E^0_{Cd^{2+}/Cd} = -0{\cdot}403$ V, $E^0_{Zn2+/Zn} = -0{\cdot}763$ V

22. Chromium metal is electroplated using an acidic solution containing CrO_3 according to the following equation: $CrO_3(aq) + 6H^+ + 6e\text{-} \rightarrow Cr(s) + 3H_2O$

Calculate how many grams of chromium will be electroplated by 24,000 coulombs. How long will it take to electroplate 1·5 g chromium using 12·5 A current? [Atomic mass of Cr = 52 g mol^{-1}, 1 F = 96500 C mol^{-1}]

23. Following reactions may occur at cathode and anode during electrolysis of aqueous sodium chloride. What products will be held at anode and cathode?

Use given E^0 values to justify your answer.

Cathode: $Na+(aq) + e- \rightarrow Na(s)$; $E^0 = -2{\cdot}71$ V,

$H^+(aq) + e- \rightarrow 1/2\ H_2(g)$ $E^0 = 0{\cdot}00$ V

Anode: $Cl^-(aq) \rightarrow 1/2\ Cl_2(g) + e-$; $E^0 = +1{\cdot}36$ V,

$2H_2O(aq) \rightarrow O_2(g) + 4H^+ + 4e-$ $E^0 = +1{\cdot}23$ V

24. Calculate the emf of the following cell at 25^{0}C :

Al (s) $|Al^{3+}$ (0·001 M) || (0·1) Ni^{2+} |Ni (s)

Given: $E^0_{Ni2+/Ni} = -0{\cdot}25$ V, $E^0_{Al^{3+}/Al} = -1{\cdot}66$ V; [log 2 = 0·3010, log 3 = 0·4771]

25. (a) Calculate ΔG° for the reaction

$$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s).$$

Given : E° for $Zn^{2+}/Zn = -0{\cdot}76$ V and

E° for $Cu^{2+}/Cu = +0{\cdot}34$ V

$R = 8{\cdot}314\ JK^{-1}\ mol^{-1}$

$F = 96500\ C\ mol^{-1}$.

(b) Give two advantages of fuel cells.

OR

(a) Out of the following pairs, predict with reason which pair will allow greater conduction of electricity :

(i) Silver wire at 30°C or silver wire at 60°C.

(ii) 0·1 M CH_3COOH solution or 1 M CH_3COOH solution.

(iii) KCl solution at 20°C or KCl solution at 50°C.

Give two points of differences between electrochemical and electrolytic cells.

26. Calculate the maximum work and log K_C for the reaction at 298 K,

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

Given; $E^0_{Ni2+/Ni} = -0{\cdot}25$, $E^0_{Ag+1/Ag} = +0.80$ V, 1F = 96500 C mol^{-1}.

……..