IMPORTANT QUESTIONS CLASS – 12 CHEMISTRY CHAPTER – 2 ELECTROCHEMISTRY

Question 1.
What is meant by 'limiting molar conductivity'?
Answer:
The molar conductivity of a solution at infinite dilution is called limiting molar conductivity and is represented by the symbol Λ_m.

Question 2.
Express the relation between conductivity and molar conductivity of a solution held in a cell. (Delhi 2011)
Answer:
Λ_m = KC= Conductivity Concentration

Question 3.
What is the effect of catalyst on:
(i) Gibbs energy (ΔG) and
(ii) activation energy of a reaction? (Delhi 2017)
Answer:
(i) There will be no effect of catalyst on Gibbs .energy.
(ii) The catalyst provides an alternative pathway by decreasing the activation energy of a reaction.

Question 4.
What is the effect of adding a catalyst on
(a) Activation energy (Ea), and
(b) Gibbs energy (AG) of a reaction? (All India 2017)
Answer:
(a) On adding catalyst in a reaction, the activation energy reduces and rate of reaction is fastened.
(b) A catalyst does not alter Gibbs energy (AG) of a reaction.

Question 5.
Two half cell reactions of an electrochemical cell are given below :
$MnO^-_4(aq) + 8H^+ (aq) + 5e^- \rightarrow Mn^{2+} (aq) + 4H_2O$ (I), $E° = + 1.51$ V
$Sn^{2+} (aq) \rightarrow 4\ Sn^{4+} (aq) + 2e^-$, $E° = + 0.15$ V
Construct the redox equation from the two half cell reactions and predict if this

reaction favours formation of reactants or product shown in the equation.
Answer:
The reactions can be represented at anode and at cathode in the following ways :
At anode (oxidation) :
$Sn^{2+} \rightarrow = Sn^{4+}$ (aq) + $2e^-$] × 5 E° = + 0.15 V
At cathode (reduction) :
MnO^-_4(aq) + $8H^+$ (aq) + $5e^- \rightarrow Mn^{2+}$ (aq) + $4H_2O$ (I)] × 2 E° = + 1.51 V
The Net R × M = $2MnO^-_4$(aq) + $16H^+$ + $5Sn^{2+} \rightarrow 2Mn^{2+} + 5Sn^{4+} + 8H_2O$
Now $E°_{cell} = E°_{cathode} - E°_{anode}$
= 1.51 – 0.15 = + 1.36 V
∴ Positive value of $E°_{cell}$ favours formation of product.

Question 6.
Express the relation among the cell constant, the resistance of the solution in the cell and the conductivity of the solution. How is the conductivity of a solution related to its molar conductivity? (All India 2010)
Answer:
1R×1a = Conductance (C) × Cell constant
Molar conductance : (Λ_m) = K×1000c.

Question 7.
Given that the standard electrode potentials (E°) of metals are :
K^+/K = -2.93 V, Ag^+/Ag = 0.80 V, Cu^{2+}/Cu = 0.34 V,
Mg^{2+}/Mg = -2.37 V, Cr^{3+}/Cr = -0.74 V, Fe^{2+}/Fe = -0.44 V.
Arrange these metals in increasing order of their reducing power. (All India 2010)
Answer:
$Ag^+/Ag < Cu^{2+}/Cu < Fe^{2+}/Fe < Cr^{3+}/Cr < Mg^{2+}/Mg < K^+/K$
More negative the value of standard electrode potentials of metals is, more will be the reducing power.

Question 8.
Two half-reactions of an electrochemical cell are given below :
MnO^-_4 (aq) + $8H^+$ (aq) + $5e^- \rightarrow Mn^{2+}$ (aq) + $4H_2O$ (I), E° = 1.51 V
Sn^{2+} (aq) → Sn^{4+} (aq) + $2e^-$, E° = + 0.15 V.
Construct the redox reaction equation from the two half-reactions and calculate the cell potential from the standard potentials and predict if the reaction is reactant or product favoured. (All India 2010)
Answer:
The reactions can be represented at anode and at cathode in the following ways :
At anode (oxidation) :
$Sn^{2+} \rightarrow Sn^{4+}$ (aq) + $2e^-$] × 5 E° = + 0.15 V

Af cathode (reduction) :

$MnO^-_4(aq) + 8H^+ (aq) + 5e^- \rightarrow Mn^{2+} (aq) + 4H_2O (I)] \times 2$ $E^\circ = + 1.51$ V

The Net R × M = $2MnO^-_4(aq) + 16H^+ + 5Sn^{2+} \rightarrow 2Mn^{2+} + 5Sn^{4+} + 8H_2O$

Now $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= 1.51 - 0.15 = + 1.36$ V

∴ Positive value of E°_{cell} favours formation of product.

Question 9.
The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.
Answer:
The mechanism of corrosion is explained on the basis of electrochemical theory. By taking example of rusting of iron, we Refer tothe formation of small electrochemical cells on the surface of iron.

The redox reaction involves

At anode : $Fe(S) \rightarrow Fe^{2+} (aq) + 2e^-$

At cathode : $H_2O + CO_2 \rightleftharpoons H_2CO_3$ (Carbonic acid)

$H_2CO_3 \rightleftharpoons 2H^+ + CO_2^{2-}$

$H_2O \rightleftharpoons H^+ + OH^-$

$H^+ + e^- \rightarrow H$

$4H + O_2 \rightarrow 2H_2O$

Then net resultant Redox reaction is

$2Fe(s) + O_2 (g) + 4H^+ \rightarrow 2Fe^{2+} + 2H_2O$

Question 10.
Determine the values of equilibrium constant (K_c) and ΔG° for the following reaction :
$Ni(s) + 2Ag^+ (aq) \rightarrow Ni^{2+} (aq) + 2Ag(s)$,
$E^\circ = 1.05$ V
(1F = 96500 C mol^{-1}) (Delhi 2011)
Answer:
According to the formula

$\Delta G^\circ = -nFE^\circ = -2 \times 96500 \times 1.05$

or $\Delta G^\circ = -202650$ J mol^{-1} = -202.65 KJ mol^{-1}

Now $\Delta G^\circ \Rightarrow -202650$ J Mol^{-1}

R = 8.314 J/Mol/K, T = 298 K

$$\log K = \frac{\Delta G^\circ}{2.303\,RT}$$

$$\text{or } \log K = \frac{-202650}{2.303 \times 8.314 \times 298}$$

$$\log K = \frac{-202650}{5705.84831} = 35.52$$

K = Antilog of 35.52 ∴ $K = 0.35 \times 10^7$