Term-II

ELECTROCHEMISTRY

Syllabus

➢ ***Redox reactions, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis.***

STAND ALONE MCQs [1 Mark each]

AI **Q. 1.** Debye-Huckel Onsager equation for strong electrolytes:

$$\wedge = \wedge_o - A\sqrt{C}$$

Which of the following equality holds?

(A) $\wedge = \wedge_o$ as $C \longrightarrow \sqrt{A}$ **(B)** $\wedge = \wedge_o$ as $C \longrightarrow \infty$

(C) $\wedge = \wedge_o$ as $C \longrightarrow 0$ **(D)** $\wedge = \wedge_o$ as $C \longrightarrow 1$

A **[CBSE Delhi Set-II 2020]**

Ans. Option (B) is correct.

Explanation: When $c \rightarrow \infty$

Then $\wedge = \wedge_o$

Q. 2. Which of the following option will be the limiting molar conductivity of CH_3COOH if the limiting molar conductivity of CH_3COONa is 91 Scm^2mol^{-1}? Limiting molar conductivity for individual ions are given in the following table.

S.No	Ions	limiting molar conductivity / Scm^2mol^{-1}
1	H^+	349.6
2	Na^+	50.1
3	K^+	73.5
4	OH	199.1

(A) 350 Scm^2mol^{-1} **(B)** 375.3 Scm^2mol^{-1}

(C) 390.5 Scm^2mol^{-1} **(D)** 340.4 Scm^2mol^{-1}

U **[CBSE SQP 2020-21]**

Ans. Option (C) is correct.

Explanation: The limiting molar conductivity ($\wedge_m^o$) for strong and weak electrolyte can be determined by using Kohlrausch's law which states that "the limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte."

$$\wedge CH_3COONa = \wedge CH_3COO^- + \wedge Na^+$$
$$91\ Scm^2mol^{-1} = \wedge CH_3COO^- + 50.1\ Scm^2mol^{-1}$$
$$\Rightarrow \wedge CH_3COO^- = 40.9\ Scm^2mol^{-1}$$

For acetic acid,

$$\wedge CH_3COOH = \wedge CH_3COO^- + \wedge H^+$$
$$= 40.9\ Scm^2mol^{-1} + 349.6\ Scm^2mol^{-1}$$
$$= 390.5\ Scm^2mol^{-1}$$

AI **Q. 3.** Which of the statements about solutions of electrolytes is not correct ?

(A) Conductivity of solution depends upon size of ions.

(B) Conductivity depends upon viscosity of solution.

(C) Conductivity does not depend upon solvation of ions present in solution.

(D) Conductivity of solution increases with temperature. R

Ans. Option (C) is correct.

Explanation: Conductivity depends upon solvation of ions present in solution. Greater the solvation of ions of an electrolyte, lesser will be the electrical conductivity of the solution.

Q. 4. When 0.1 mol $CoCl_3(NH_3)_5$ is treated with excess of $AgNO_3$, 0.2 mol of AgCl are obtained. The conductivity of solution will correspond to

(A) 1: 3 electrolyte **(B)** 1: 2 electrolyte

(C) 1: 1 electrolyte **(D)** 3: 1 electrolyte A

Ans. Option (B) is correct.

Explanation: When 0.1 mole of $CoCl_3(NH_3)_5$ was reacted with excess of $AgNO_3$, we get 0.2 moles of AgCl. So, there are two chloride ions that are free and not part of the complex. The formula for complex has to be $[Co(NH_3)_5Cl]Cl_2$.

$$[Co(NH_3)Cl]Cl_2 \rightarrow [Co(NH_3)_5Cl]^{2+} + 2Cl^-$$

Therefore, the conductivity of the solution will be 1: 2 electrolyte.

Q. 5. The cell constant of a conductivity cell _____.

(A) Changes with change of electrolyte.

(B) Changes with change of concentration of electrolyte.

(C) Changes with temperature of electrolyte.

(D) Remains constant for a cell.

Ans. Option (D) is correct.

Explanation: The cell constant of a conductivity cell remains constant for a cell.

Q. 6. $\Lambda^\circ m\,[NH_4OH]$ is equal to _____

(A) $\Lambda^0_{m[NH_4OH]} + \Lambda^0_{m[NH_4Cl]} - \Lambda^0_{[HCl]}$

(B) $\Lambda^0_{m[NH_4Cl]} + \Lambda^0_{m[NaOH]} - \Lambda^0_{[NaCl]}$

(C) $\Lambda^0_{m[NH_4\,Cl]} + \Lambda^0_{m[NaCl]} - \Lambda^0_{[NaOH]}$

(D) $\Lambda^0_{m[NaOH]} + \Lambda^0_{m[NaCl]} - \Lambda^0_{[NH_4Cl]}$

Ans. Option (B) is correct.

Explanation: NH_4Cl $NH_4Cl \rightleftharpoons NH_4^+ + Cl^-$ (i)

$NaCl \rightleftharpoons Na^+ + Cl^-$ (ii)

$NaOH \rightleftharpoons Na^+ + OH^-$ (iii)

$NH_4OH \rightleftharpoons NH_4^+ + OH^-$ (iv)

To get equation (iv)

$\Lambda^\circ_m(NH_4Cl) + (NaOH)^-\Lambda^\circ_m(NaCl) = \Lambda^\circ_m(NH_4OH)$

AI **Q. 7.** In the electrolysis of aqueous sodium chloride solution which of the half cell reaction will occur at anode?

(A) $Na^+(aq) + e^- \rightarrow Na(s)$; $E^\ominus_{Cell} = 2.71$ V

(B) $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$; $E^\ominus_{Cell} = 1.23$ V

(C) $H^+(aq) + e^- \rightarrow \frac{1}{2}H_2(g)$; $E^\ominus_{Cell} = 0.00$ V

(D) $Cl^-(aq) \rightarrow \frac{1}{2}Cl_2(g) + e^-$; $E^\ominus_{Cell} = 1.36$ V

Ans. Option (B) is correct.

Explanation: During electrolysis

$NaCl \rightarrow Na^+ + Cl^-$

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

$Na^+ + e^- \rightarrow Na\left(E^\ominus_{Cell} = -2.71V\right)$

$H^+ + e^- \rightarrow \frac{1}{2}H_2\left(E^\ominus_{Cell} = 0.00V\right)$

At cathode,

$H_2O + e^- \rightarrow \frac{1}{2}H_2 + OH^-$

At anode, two reactions are possible.

$Cl^- \rightarrow \frac{1}{2}Cl_2 + e^-$; $E^\ominus_{Cell} = 1.36$ V

$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$; $E^\ominus_{Cell} = 1.23$ V

AI **Q. 8.** Which of the following statement is correct?

(A) E_{Cell} and Δ_rG of cell reaction both extensive properties.

(B) E_{Cell} and Δ_rG of cell reaction both intensive properties.

(C) E_{Cell} is an intensive property while Δ_rG of cell reaction is an extensive property.

(D) E_{Cell} is an extensive property while Δ_rG of cell reaction is an intensive property.

Ans. Option (C) is correct.

Explanation: E_{cell} is an intensive property and it does not depend upon number of particles but Δ_rG of the cell reaction is an extensive property because this depends upon number of particles.

Q. 9. An electrochemical cell behaves like an electrolytic cell when

(A) $E_{cell} = E_{external}$ **(B)** $E_{cell} = 0$

(C) $E_{external} > E_{cell}$ **(D)** $E_{external} < E_{cell}$

R **[CBSE O.D. Set-II 2020]**

Ans. Option (C) is correct.

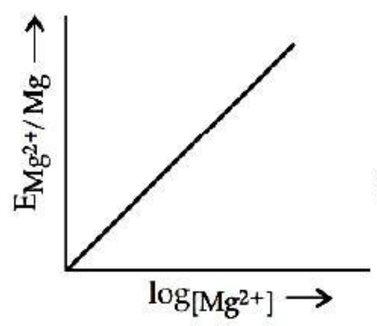
Explanation: If an external opposite potential is applied on the electrochemical cell, the reaction continues to take place till the opposite voltage reaches the value 1.1V. At this stage, no current flow through the cell and if there is any further increase in the external potential($E_{external}$), then reaction starts functioning in opposite direction i.e. an electrochemical cell behaves like an electrolytic cell.

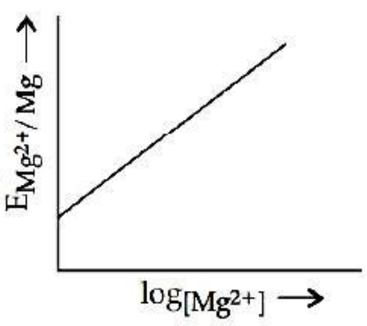
$E_{external} > E_{cell}$

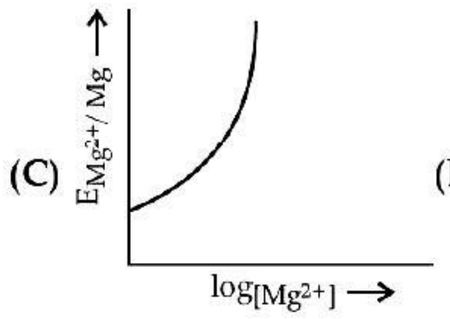
AI **Q. 10.** Electrode potential for Mg electrode varies according to the equation:

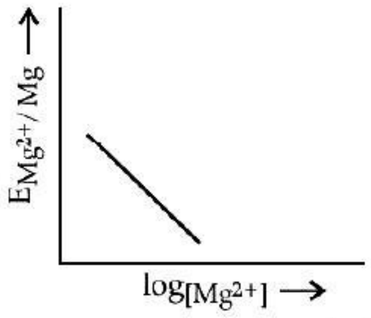
$$E_{Mg^{2+}/Mg} = E^\circ_{Mg^{2+}/Mg} - \frac{0.059}{2}\log\frac{1}{[Mg^{2+}]}.$$

The graph of $E_{Mg^{2+}/Mg}$ vs. $\log[Mg^{2+}]$ is

(A) 

(B) 

(C) 

(D) 

U

Ans. Option (B) is correct.

Explanation:

$$E_{Mg^{2+}/Mg} = E^0_{Mg^{2+}/Mg} + \frac{0.059}{2}\log\left[Mg^{2+}\right]$$

Compare this equation with the equation of straight line $y = mx + c$.

The graph of $E_{Mg^{2+}/Mg}$ vs. $\log [Mg^{2+}]$ is a straight line with a positive slope and intercept $E_{Mg^{2+}/Mg}$.

Q. 11. In an electrochemical process, a salt bridge is used
(A) as a reducing agent
(B) as an oxidizing agent
(C) to complete the circuit so that current can flow
(D) None of these R

Ans. Option (C) is correct.

Explanation: In an electrochemical cell, a salt bridge is used to complete the circuit so that current can flow.

Q. 12. Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution:

$Ag^+(aq) + e^- \rightarrow Ag(s)$ $\quad E^\circ = +0.80$ V

$H^+(aq) + e^- \rightarrow \frac{1}{2}H_2(g)$ $\quad E^\circ = 0.00$ V

On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode ?

(A) $Ag^+(aq) + e^- \rightarrow Ag(s)$ $\quad E^\circ = +0.80$ V

(B) $H^+(aq) + e^- \rightarrow \frac{1}{2}H_2(g)$ $\quad E^\circ = 0.00$ V

(C) Both reactions are feasible
(D) None of the above U

Ans. Option (A) is correct.

Explanation: $Ag^+(aq) + e^- \rightarrow Ag(s)$; $E^\circ = +0.80$ V.

$$H^+(aq) + e^- \rightarrow \frac{1}{2}H_2(g)\ ;\ E^\circ = 0.00\ \text{V}.$$

On the basis of their standard reduction potential (E°) values, cathode reaction is given by the one with higher E° values.
Thus, $Ag^+(aq) + e^- \rightarrow Ag(s)$ reaction will be more feasible at cathode.

Q. 13. Consider the following reaction:

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

Depict the galvanic cell in which the given reaction takes place.

(A) $Cu^{2+}(aq)|Cu(s)||Ag^+(aq)|Ag(s)$

(B) $Cu(s) \mid Cu^{2+}(aq) \mid\mid Ag^+(aq) \mid Ag(s)$

(C) $Ag^+(aq)|Ag(s)||Cu^{2+}(aq)|Cu(s)$

(D) $Ag(s)|Ag^+(aq)||Cu^{2+}(aq)|Cu(s)$ A

Ans. Option (B) is correct.

Explanation: Oxidation half reaction

$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$

Reduction half reaction

$Ag^+(aq) + e^- \rightarrow Ag(s)$

$Cu(s) \mid Cu^{2+}(aq) \mid\mid Ag^+(aq) \mid Ag(s)$

Anode (Oxidation) | salt bridge | Cathode (Reduction)

Q. 14. Which of the following statements is not correct ?
(A) Copper liberates hydrogen from acids.
(B) In its higher oxidation states, manganese forms stable compounds with oxygen and fluorine.
(C) Mn^{3+} and Co^{3+} are oxidising agents in aqueous solution.
(D) Ti^{2+} and Cr^{2+} are reducing agents in aqueous solution. A

Ans. Option (A) is correct.

Explanation: Copper does not liberate hydrogen from acids because copper lies below hydrogen in electrochemical series. So, copper does not have sufficient electrode potential to liberate elemental hydrogen form compounds in which oxidation state of hydrogen is +1.

Q. 15. Calculate the emf of the following cell at 298 K:

$Mg(s)|Mg^{2+}\ (0.1\ M)||Cu^{2+}\ (1.0 \times 10^{-3}\ M)|Cu(s)$

[Given = $E^\circ_{Cell} = 2.71$ V]

(A) 1.426 V **(B)** 2.503 V
(C) 2.651 V **(D)** 1.8 V U

Ans. Option (C) is correct.

Explanation:

$$E_{Cell} = E^0_{Cell} - \frac{0.059}{n}\log\frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= 2.71\text{V} - \frac{0.059}{2}\log\frac{0.1}{0.001}$$

$$= 2.71\text{V} - \frac{0.059}{2}\log 10^2$$

$$E_{Cell} = 2.651\ \text{V}$$

Q. 16. Reduction potentials of some ions are given below. Arrange them in decreasing order of oxidising power.

Ion	ClO_4^-	IO_4^-	BrO_4^-
Reduction potential E^Θ/V	E^Θ=1.19V	E^Θ=1.65V	E^Θ=1.74V

(A) $ClO_4^- > IO_4^- > BrO_4^-$ **(B)** $IO_4^- > BrO_4^- > ClO_4^-$
(C) $BrO_4^- > IO_4^- > ClO_4^-$ **(D)** $BrO_4^- > ClO_4^- > IO_4^-$
A

Ans. Option (A) is correct.

Explanation: Higher the reduction potential, higher is its tendency to get reduced. Hence, the order of oxidising power is:

$ClO_4^- > IO_4^- > BrO_4^-$

Q. 17. Using the data given below find strongest reduction agent.

$E^-_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V, E^-_{Cl_2/Cl^-} = 1.36\ V$

$E^-_{MnO_4^-/Mn^{2+}} = 1.51\,V, E^-_{Cr^{3+}/Cr} = -0.74\ V$

(A) Cl^- **(B)** Cr

(C) Cr^{3+} **(D)** Mn^{2+} A

Ans. Option (B) is correct.

Explanation: The negative value of standard reduction potential for Cr^{3+} to Cr means that the redox couple is a stronger reducing agent.

Q. 18. What will happen during the electrolysis of aqueous solution of $CuSO_4$ by using platinum electrodes?

(A) Copper will deposit at cathode.

(B) Copper will deposit at anode.

(C) Oxygen will be released at anode.

(D) Copper will dissolve at anode.

Ans. Option (C) is correct.

Explanation:

$CuSO_4 \rightleftharpoons Cu^{2+} + SO_4^{2-}$

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

At cathode,

$Cu^{2+} + 2e^- \rightarrow Cu; \qquad E^{\Theta}_{Cell} = 0.34\ V$

$H^+ + e^- \rightarrow \frac{1}{2}H_2; \qquad E^{\Theta}_{Cell} = 0.00\ V$

This reaction will take place due to higher reduction potential.

At anode,

$2SO_4^{2-} + 2e^- \rightarrow S_2O_8^{2-}; \qquad E^{\Theta}_{Cell} = 1.96\ V$

$2H_2O \rightarrow O_2 + 4H^+ + 4e^- \qquad E^{\Theta}_{Cell} = 1.23\ V$

The reaction with lower value of E° will be preferred at anode, hence O_2 is released at anode.

Q. 19. What will happen during the electrolysis of aqueous solution of $CuSO_4$ in the presence of Cu electrodes?

(A) Copper will deposit at cathode.

(B) Copper will dissolve at anode.

(C) Oxygen will be released at anode.

(D) Copper will deposit at anode.

Ans. Option (A) is correct.

Explanation: Electrolysis of $CuSO_4$ can be represented by two half-cell reactions these occurring at cathode and anode, respectively, as given below :

At cathode : $Cu^{2+} + 2e^- \rightarrow Cu(s)$

At anode : $Cu(s) \rightarrow Cu^{2+} + 2e^-$

In above reaction Cu will deposit at cathode while copper will dissolve at anode. Hence, (a) and (b) are the correct options.

Q. 20. Conductivity κ, is equal to _____.

(A) $\wedge_m$ **(B)** $\frac{G^*}{R}$

(C) $\frac{l}{A}$ **(D)** All of the above

Ans. Option (B) is correct.

Explanation: $\kappa = \frac{1}{R}.\frac{l}{A}$ or $\frac{G^*}{R}$

ASSERTION AND REASON BASED MCQs [1 Mark each]

Directions: In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is NOT the correct explanation of A

(C) A is true but R is false

(D) A is false and R is True

Q. 1. Assertion (A): Conductivity of an electrolyte increases with decrease in concentration.

Reason (R): Number of ions per unit volume decreases on dilution.

Ans. Option (D) is correct.

Explanation: Conductivity of an electrolyte decreases with decrease in concentration because of ions per unit volume decreases on dilution.

Q. 2. Assertion (A): Λ_m for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.

Reason (R): For weak electrolytes degree of dissociation increases with dilution of solution.

Ans. Option (A) is correct.

Explanation: Weak electrolytes dissociate partially in concentrated solution. On dilution, their degree of dissociation increases hence, their Λ_m increases sharply.

Q. 3. Assertion (A): Electrolytic conduction increases with increase in temperature.

Reason (R): Increase in temperature cause the electronic movement more rapid

Ans. Option (C) is correct.

Explanation: As the temperature of electrolytic solution is increased, the kinetic energy of the ion increases. This results in the increase of electrical conductance of electrolytic solutions.

Q. 4. Assertion (A): Molar Conductivity of an ionic solution depends on temperature.

Reason (R): Molar Conductivity of an ionic solution depends on the concentration of electrolytes in the solution.

Ans. Option (B) is correct.

> *Explanation:* Molar Conductivity of an ionic solution depends on the temperature as well as on the concentration of the electrolytes in the solution.

Q. 5. Assertion (A): E_{cell} should have a positive value for the cell to function.
Reason (R): $E_{cathode} < E_{anode}$.

Ans. Option (C) is correct.

> *Explanation:* $E_{cell} = E_{cathode} - E_{anode}$.
> To have positive value of E_{cell}, $E_{cathode}$ should be greater than E_{anode}.

Q. 6. Assertion (A): Cu is less reactive than hydrogen.
Reason (R): $E^{\circ}_{Cu^{2+}/Cu}$ is negative.

Ans. Option (C) is correct.

> *Explanation:* Cu is less reactive than hydrogen because $E^{\ominus}_{Cu^{2+}/Cu}$ is positive.

Q. 7. Assertion (A): Copper sulphate can be stored in zinc vessel.
Reason (R): Zinc is more reactive than copper.

Ans. Option (D) is correct.

> *Explanation:* Zinc will get dissolved in $CuSO_4$ solution, since, zinc is more reactive than copper.

Q. 8. Assertion (A): $E_{Ag^+/Ag}$ increases with increase in concentration of Ag^+ ions.
Reason (R): $E_{Ag^+/Ag}$ has a positive value.

Ans. Option (B) is correct.

> *Explanation:*
>
> $$Ag + e^- \rightarrow Ag,$$
>
> $$E_{Ag^+/Ag} = E^{\ominus}_{Ag^+/Ag} - \frac{RT}{nF}\log\frac{1}{[Ag^+]}$$
>
> On increasing $[Ag^+]$, $E_{Ag^+/Ag}$ will increase and it has a positive value.

Q. 9. Assertion (A): Electrolysis of NaCl solution gives chlorine at anode instead of O_2.
Reason (R): Formation of oxygen at anode requires over voltage.

Ans. Option (A) is correct.

> *Explanation:* Formation of oxygen has lower value of E° than formation of chlorine even then it is not formed because it requires over voltage.

CASE-BASED MCQs

I. Read the passage given below and answer the following questions:

The cell constant is usually determined by measuring the resistance of the cell containing a solution whose conductivity is already known. For this purpose, we generally use KCl solutions whose conductivity is known accurately at various concentrations and at different temperatures. Consider the resistance of a conductivity cell filled with 0.1 M KCl solution is 200 Ohm. If the resistance of the same cell when filled with 0.02 M KCl solution is 420 Ohm.
(Conductivity of 0.1 M KCl solution is 1.29 S m^{-1}.)

The following questions are Multiple Choice Questions. Choose the most appropriate answer:

Q. 1. What is the conductivity of 0.02 M KCl solution ?
(A) 0.452 S m^{-1} **(B)** 0.215 S m^{-1}
(C) 0.614 S m^{-1} **(D)** 0.433 S M^{-1}

Ans. Option (C) is correct.

> *Explanation:* Conductivity of 0.02 mol L^{-1} KCl Solution = Cell constant resistance
>
> $$= \frac{258}{420}$$
> $$= 0.614\,S m^{-1}$$

Q. 2. What will happen to the conductivity of the cell with the dilution ?
(A) First decreases then increases
(B) Increases
(C) First increases then decreases
(D) Decreases

Ans. Option (D) is correct.

> *Explanation:* The conductivity decreases with dilution.

Q. 3. The cell constant of a conductivity cell _____.
(A) Changes with change of electrolyte.
(B) Changes with change of concentration of electrolyte.
(C) Changes with temperature of electrolyte.
(D) Remains constant for a cell.

Ans. Option (D) is correct.

> *Explanation:* The cell constant of a conductivity cell remains constant for a cell.

Q. 4. SI unit for conductivity of a solution is
(A) S m^{-1} **(B)** S m^2 mol^{-1}
(C) mol cm^{-3} **(D)** S cm^2 mol^{-1}

Ans. Option (A) is correct.

> *Explanation:* SI unit for conductivity of a solution is S m^{-1}.

OR

Which of the following is not true?
The conductivity of solutions of different electrolytes in the same solvent and at a given temperature differs due to

(A) size of the ions in which they dissociate
(B) concentration of ions
(C) charge of the ions in which they dissociate
(D) is independent of ions movement under a potential gradient

Ans. Option (D) is correct.

Explanation: The conductivity of solutions of different electrolytes in the same solvent and at a given temperature differs due to size and charge of the ions in which they dissociate, concentration of ions, ease with which the ions move under a potential gradient.

II. Read the passage given below and answer the following questions:
A galvanic cell consists of a metallic zinc plate immersed in 0.1 M $Zn(NO_3)_2$ solution and metallic plate of lead in 0.02 M $Pb(NO_3)_2$ solution.

The following questions are multiple choice questions. Choose the most appropriate answer:

Q. 5. How will the cell be represented ?
(A) $Zn(s)|\ Zn^{2+}(aq)||\ Pb^{2+}(aq)|Pb(s)$
(B) $Zn^{2+}(s)|\ Zn(aq)||\ Pb^{2+}(aq)|Pb(s)$
(C) $Pb^{2+}(aq)|Pb(s)||Zn^{2+}(s)|\ Zn(aq)$
(D) $Pb(s)|Pb^{2+}(aq)||Zn^{2+}(s)|\ Zn(aq)$

Ans. Option (A) is correct.

Explanation: Cell representation:
$$Zn(s)|Zn^{2+}(aq)||Pb^{2+}(aq)|Pb(s)$$

Q. 6. Calculate the emf of the cell.
(A) 6.01 V **(B)** 0.412 V
(C) 0.609 V **(D)** 4.12 V

Ans. Option (C) is correct.

Explanation: According to Nernst equation:

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2}\log\frac{[Zn^{2+}]}{[Pb^{2+}]} \quad ½$$

$$E_{cell} = [-0.13 - (-0.76)] - \frac{0.0591}{2}\log\frac{0.1}{0.02}$$
$$= 0.63 - 0.02955 \times \log 5$$
$$= 0.63 - 0.02955 \times 0.6990$$
$$= 0.63 - 0.0206 = 0.6094\ V \quad ½$$

Commonly Made Errors

- The cell representation is given incorrectly by many candidates.
- The calculation of emf of the cell by using Nernst equation is incorrect, in some cases.

Answering Tip

- Do more practice of cell representation and numerical based on Nernst equation.

Q. 7. What product is obtained at cathode ?
(A) Zn **(B)** Pb
(C) Zn^{2+} **(D)** Pb^{2+}

Ans. Option (B) is correct.

Explanation:
Anode reaction: $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$
Cathode reaction: $Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$

Q. 8. Which of the following statement is not correct about an inert electrode in a cell ?
(a) It does not participate in the cell reaction.
(b) It provides surface either for oxidation or for reduction reaction.
(c) It provides surface for conduction of electrons.
(d) It provides surface for redox reaction.

Ans. Option (A) is correct.

Explanation: Inert electrode does not participate in redox reaction and acts only as source or sink for electrons. It provides surface either for oxidation or for reduction reaction.

II. Products of electrolysis depend on the nature of material being electrolysed and the type of electrodes being used. If the electrode is inert (e.g., platinum or gold), it does not participate in the chemical reaction and acts only as source or sink for electrons. On the other hand, if the electrode is reactive, it participates in the electrode reaction. Thus, the products of electrolysis may be different for reactive and inert electrodes.
Aqueous copper sulphate solution and aqueous silver nitrate solution are electrolysed by 1 ampere current for 10 minutes in separate electrolytic cells.

In these questions, a statement of assertion followed by a statement of reason. Choose the correct answer out of the following choices.
(A) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(B) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(C) Assertion is correct statement but reason is wrong statement.
(D) Assertion is wrong statement but reason is correct statement.

Q. 1. Assertion (A): The mass of copper and silver, deposited on the cathode be same.
Reason (R): Copper and silver have different equivalent masses.

Ans. Option (D) is correct.

Explanation: W = itE/96500
= 1 × 10 × 60 × 31.8/96500 for copper.
It will be different for silver since the equivalent weight of silver is different.

Q. 2. Assertion (A): At equilibrium condition $E_{cell} = 0$ or $\Delta_r G = 0$.
Reason (R): E_{cell} is zero when both electrodes of the cell are of the same metal.

Ans. Option (B) is correct.

Explanation:
At equilibrium, condition of $E_{cell} = 0$, $\Delta'G = 0$

Q. 3. Assertion (A): The negative sign in the expression $E_{Zn^{2+}/Zn} = -0.76V$ means Zn^{2+} cannot be oxidised to Zn.

Reason (R): Zn is more reactive than hydrogen & Zn will oxidised, & H^+ will get reduced.

Ans. Option (A) is correct.

Explanation: It shows that the reduced form of (Zn) is not stable. It is difficult to reduce Zn^{2+} to Zn. Rather the reverse reaction i.e Zn can get oxidised to Zn^{2+} and H^+ will get reduced as it is stabler among both the reduced species.

Q. 4 Assertion (A): In a galvanic cell, chemical energy is converted into electrical energy.

Reason (R): Redox reactions provide the chemical energy to the cell.

Ans. Option (A) is correct.

Explanation: The redox reactions provide the chemical energy to the galvanic cell which is converted into electrical energy.

OR

Assertion (A): Copper sulphate cannot be stored in zinc vessel.

Reason (R): Zinc is less reactive than copper.

Ans. Option (C) is correct.

Explanation: Copper sulphate cannot be stored in zinc vessel as zinc is more reactive than copper.