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# CHEMISTRY

## BOOKS - CHEMISTRY

## ELECTROCHEMISTRY

**Electrochemistry**

**1.** Which cell will measure standard electrode potential of copper electrode?

A.

$$Pt(s)|H_2(g, 0.1\text{bar})|H^+(aq.\ , 1M)\ ||\ |Cu^{2+}(aq, 1M)|Cu$$

B.

$$Pt(s)|H_2(g, 1\text{bar})|H^+(aq, 1M) \mid |Cu^{1+}(aq, 2M)|Cu$$

C.

$$Pt(s)|H_2(g, 1\text{bar})|H^+(aq, 1M) \mid |Cu^{2+}(aq, 1M)|Cu$$

D.

$$Pt(s)|H_2(g, 1\text{bar})|H^+(aq, 1M) \mid |Cu^{2+}(aq, 1M)|Cu$$

**Answer:**

$$Pt(s)|H_2(g, 0.1\text{bar})|H^+(aq, 0.1M) \mid |Cu^{2+}(aq, 1M)|Cu$$

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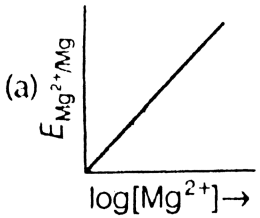
**2.** Electrode potential for $Mg$ electrode varies according to the equation

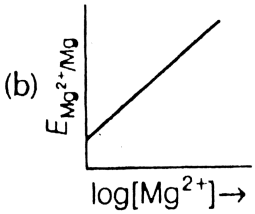
$$E_{Mg^{2+}|Mg} = E^{\theta}_{Mg^{2+}|Mg} - \frac{0.059}{2}\log\frac{1}{[Mg^{2+}]}$$

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

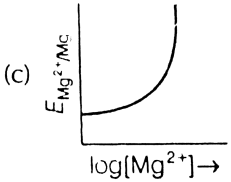
A.



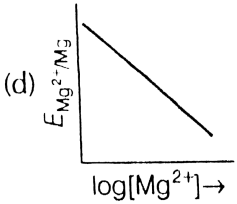

B.




C.




D.




**Answer: B**

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**3.** Which of the following statement is correct?

A. $E_{\text{cell}}$ and $\Delta_r G$ of cell reaction both are extensive properties

B. $E_{\text{cell}}$ and $\Delta_r G$ of cell reaction both are intensive properties

C. $E_{\text{cell}}$ is an intensive property while $\Delta_f G$ of cell reaction is an extensive property

D. $E_{\text{cell}}$ is an extensive property while $\Delta_r G$ of cell reaction is an intensive property

**Answer:**

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**4.** The difference between the electrode potentials of two electrons when no current is drawn through the cell is called:

A. cell potential

B. cell emf

C. potential difference

D. cell voltage

**Answer: B**

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**5.** Which of the following statement is not correct about an inert electrode in a cell?

A. It does n ot 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.

**Answer:**

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**6.** An electrochemical cell an behave like an electrolytic cell when

A. $E_{\text{cell}} = 0$

B. $E_{\text{cell}} > E_{\text{ext}}$

C. $E_{\text{ext}} > E_{\text{cell}}$

D. $E_{\text{cell}} = E_{\text{ext}}$

**Answer:**

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**7.** Which of the statements about solution of electrolytes is not correct?

A. Conductivity so 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

**Answer:**

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**8.** Using the data given below:

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

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

Mark the strongest reducing agent.

A. $Cl^-$

B. $Cr$

C. $Cr^{3+}$

D. $Mn^{2+}$

**Answer:**

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**9.** Given $E^{\circ}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33V$, $E^{\circ}_{MnO_4^-/Mn^{2+}} = 1.51V$

Among the following, the strongest reducing agent is

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

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

Based on the data given above strongest oxidising agent will be

A. $Cl^-$

B. $Mn^{2+}$

C. $MnO_4^-$

D. $Cr^{3+}$

**Answer:**

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**10.** Using the data given below:

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

$E^\circ_{MnO_4^-|Mn^{2+}} = 1.51V\, E_{Cr^{3+}|Cr} = -0.74V$

In which option the order of reducing power is correct?

A. $Cr^{3+} < Cl^- < Mn^{2+} < Cr$

B. $Mn^{2+} < Cl^- < Cr^{3+} < Cr$

C. $Cr^{3+} < Cl^- < Cr_2O_7^{2-} < MnO_4^-$

D. $Mn^{2+} < Cr^{3+} < Cl^{-} < Cr$

**Answer:**

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**11.** Use the data given in Q.8 and find out the most stable ion in its reduced form.

A. $Cl^{-}$

B. $Cr^{3+}$

C. $Cr$

D. $Mn^{2+}$

**Answer:**

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**12.** Using the data given below:

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

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

Find the most stable oxidised species.

A. $Cr^{3+}$

B. $MnO_4^-$

C. $Cr_2O_7^{2-}$

D. $Mn^{2+}$

**Answer:**

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**13.** The quantity of charge required to obtain one mole of aluminium from $Al_2 0_3$ is

A. 1F

B. 6F

C. 3F

D. 2F

**Answer:**

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**14.** The cell constant of a conductivity cell

A. chagnes with chagne of electroyte

B. Changes with chagne of concentration of electrolyte

C. chagnes with temperature of electrolyte

D. remains cosntant for a cell

**Answer:**

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**15.** While charging the lead storage battery:

A. $PbSO_4$ anode is reduced to Pb

B. $PbSO_4$ cathode is reduced to Pb

C. $PbSO_4$ cathode is oxidised to Pb

D. $PbSO_4$ anode is oxidised to $PbO_2$

**Answer:**

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**16.** $\wedge^{o}_{m_{(NH_4OH)}}$ is equal to

A. $\Lambda^{\circ}_{m}(NH_4OH) + \Lambda^{\circ}_{m}(NH_4Cl) - \Lambda^{\circ}_{(HCl)}$

B. $\Lambda^{\circ}_{m}(NH_4Cl) + \Lambda^{\circ}_{m}(NaOH) - \Lambda^{\circ}_{(NaCl)}$

C. $\Lambda^{\circ}_{m(NH_4Cl)} + \Lambda^{\circ}_{m(NaCl)} - \Lambda^{\circ}_{(NaOH)}$

D. $\Lambda^{\circ}_{m(NaOH)} + \Lambda^{\circ}_{m(NaOH)} + \Lambda^{\circ}_{m(NaCl)} - \Lambda^{\circ}_{(NH_4Cl)}$

**Answer:**

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**17.** In the electrolysis of aqueous sodium chloride solution which of the hall cell reaction will occur at anode?

A. $Na^+(aq) + e^- \rightarrow Na(s) : E^\circ_{cell} = -2.71V$

B. $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^- E^\circ_{cell} - 123V$

C. $H^+(aq) + e^- \rightarrow \frac{1}{2}H_2(g) : E^\circ_{cell} = 0.00V$

D. $Cl^-(aq) \rightarrow \frac{1}{2}Cl_2(g) + e^-, E^\circ_{cell} = 1.36V$

**Answer:**

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**18.** The positive value of the standard electrode potential of $Cu^{2+}/Cu$ indicates that.....

A. this redox couple is a stronger reducing agent than the $H^+/H_2$ couple

B. this redox displace $H_2$ from acid

C. Cu cannot displace $H_2$ from acid

D. Cu cannot displace $H_2$ from acid

**Answer:**

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**19.** Potential for some half cell reactions are given below. On the basis of these mark the correct answer.

(i) $H^+(aq) + e^- \rightarrow \left(\frac{1}{2}\right) H^2(g)\ E^\circ_{cell} = 0.00V$

(ii) $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-, E_{cell} = 1.23V$

(iii) $2SO_4^{2-}(aq) \rightarrow S_2O_8^{2-}(aq) + 2e^-, E^\circ_{cell} = 1.96V$

A. In dilute sulphuric acid solution, hydrogen will be reduced at cathode

B. In concentrated sulphuric acid solution, water will be oxidised at anode

C. In dilute sulphuric acid solution water will be oxidised at anode

D. In dilute sulphuric acid solution $SO_4^{2-}$ ion will be oxidised to tetrahionate ion at anode.

**Answer:**

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**20.** $E^{\circ}_{\text{cell}} = 1.1V$ for Daniel cell. Which of the following expressions are correct description of state of equilibrium in this cell?

A. $1.1 = k_c$

B. $\frac{2.303RT}{2F}\log k_c = 1.1$

C. $\log k_c = \frac{2.2}{0.059}$

D. $\log k_c = 1.1$

**Answer:**

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**21.** Conductivity of an electrolytic solution depends on:

A. nature of electrolyte

B. concentration of electrolyte

C. power of AC source

D. distance between the electrodes.

**Answer:**

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**22.** $A_m^\circ H_2O$ is equal to:

A. $\Lambda_{m(HCl)}^\circ + \Lambda_{m(NaOH)}^\circ - \Lambda_{m(NaCl)}^\circ$

B. $\Lambda_{m(HNO_3)}{}^\circ + \Lambda_{m(NaNO_3)}^\circ - \Lambda_{m(NaOH)}^\circ$

C. $\Lambda_{m(HNO_3)}^\circ + \Lambda_{m(NaOH)}^\circ - \Lambda_{m(NaNO_3)}^\circ$

D. $\Lambda_{m(NH_4OH)}^\circ + \Lambda_{m(HCl)}^\circ - \Lambda_{m(NH_4Cl)}^\circ$

**Answer:**

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**23.** 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

**Answer:**

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**24.** What will happen during the electrolysis of aqu eous solution of $CuSO_4$ in the presence of Cu electrodes?

A. Copper will deposit at cathode

B. Copper will disolve at anode

C. Oxygen will be released at anode

D. Copper will deposit at anode

**Answer:**

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**25.** Conductivity k, is equal to .....

A. $\frac{1}{R}\frac{l}{A}$

B. $\frac{G^{\cdot}}{R}$

C. $\Lambda_m$

D. $\frac{l}{A}$

**Answer:**

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**26.** Molar conductivity of inic solution depends on .....

A. temperature

B. distance between electrodes

C. concentration of electrolysis in solution

D. surface area of electrodes

**Answer:**

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**27.** For the given cell, $Mg|Mg^{2+}||Cu^{2+}\ |\ Cu$

A. Mg is cathode

B. Cu is cathode

C. The cell reation is $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$

D. `Cu is the oxidisng agent

**Answer:**

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**28.** Can absolute electrode potential of an electrode be measured?

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**29.** Can $E^{\circ}_{\text{cell}}$ or $\Delta_r G^{\circ}$ for cell reaction ever be equal to zero?

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**30.** Under what condition is $E^{\circ}_{\text{cell}} = 0$ or $\Delta_r G = 0$?

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**31.** What does the negative sign in the expression $E^{\circ}_{Zn^{2+}/Zn} = -0.76V$ mean?

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**32.** Aqueous copper sulphate solution and aqueous silver nitrate solution are electrolysed by 1 ampere current for 10 minutes in separate electrolytic cells. Will the mass of copper and silver deposited on the cathode be same of different? Explain your answer.

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**33.** Depict the galvanic cell in which the cell reaction is

$Cu + 2Ag^{+} \rightarrow 2Ag + Cu^{2+}$

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**34.** Value of standard electrode potential for the oxidation of $Cl^{-}$ ions is more positive than that of water, even then in

the electrolysis of aqueous sodium chloride, why is $Cl^-$ oxidsied at anode instead of water?

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**35.** What is electrode potential?

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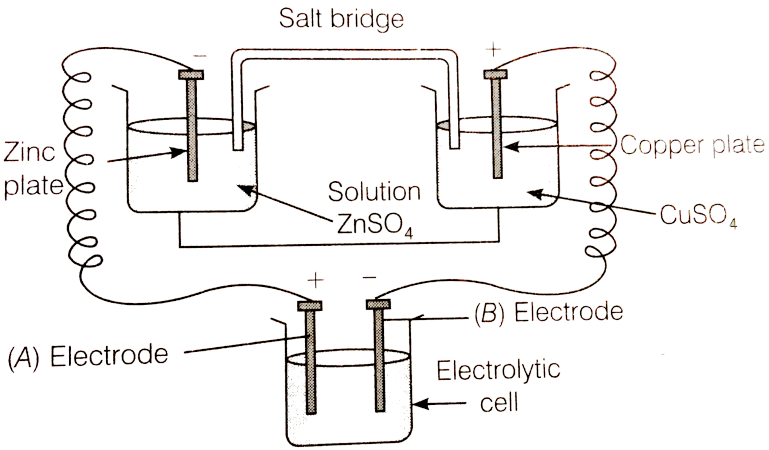
**36.** Consider the following diagram in which an electrochemical cell is coupled to an electrolytic cell. What will be the polarity of electrodes 'A' an d 'B' in the electrolytic

cell?

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**37.** Why is alternating current used for measuring resistance of an electrolytic solution ?

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**38.** A galvanic cell has electrical potential of 1.1 V . If an opposing potential of 1.1 V is applied to this cell, what will happen to the cell reaction and current flowing through the cell ?

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**39.** How will the pH of brine (aq NaCl solution) be affected when it is electrolysed.

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**40.** Unlike dry cell, the mercury cell has a constant cell has a constant cell potential throughout its useful life, why?

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**41.** Solutions of two electrolytes A and B are diluted. The $\Lambda_m$ of 'B' increases 1.5 times while that of A increases 25 times. Which of the two is a strong electrolyte? Justify your answer.

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**42.** When acidulated water (dil. $H_2SO_4$ solution) is electrolysed, with pH of the solution be affected? Justify your answer.

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**43.** In an aqueous solution how does specific conductivity of electrolytes change with additon of water?

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**44.** Which reference electrode is used to measure the electrode potnetial of other electrodes?

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**45.** Consider a cell given below.

$Cu|Cu^{2+}||Cl^{-}\ |\ Cl_2.\ Pt$

Write the reactions that occur at anode and cathode.

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**46.** Write the Nernst equation for the cell reaction in the Daniel cell. How will the $E_{\text{cell}}$ be affected when concentration of $Zn^{+}$ ions is increased?

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**47.** What advantage do the fuel cells have over primary and secondary batteries?

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**48.** Write the cell reaction of a lead storage battery when it is discharged. How does the density of the electrolyte change when the battery is discharged?

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**49.** Why on dilution the $\Lambda_m$ of $CH_3COOH$ increases drastically, while that of $CH_3COONa$ increases gradually?

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**50.** Match the terms given in column I with the units given in column II.

| | Column I | | Column II |
|---|---|---|---|
| A. | $\wedge_m$ | 1. | $S\ cm^{-1}$ |
| B. | $E_{cell}$ | 2. | $m^{-1}$ |
| C. | $\kappa$ | 3. | $S\ cm^2\ mol^{-1}$ |
| D. | $G^*$ | 4. | V |

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**51.** Match the terms given in Column I with the items given in Column II. (One to one match only)

| Column-I | | Column-II | |
|---|---|---|---|
| (a) | $\Lambda_m$ | (p) | Intensive property |
| (b) | $E^{\ominus}_{cell}$ | (q) | Depends on number of ions/volume |
| (c) | $\kappa$ | (r) | Extensive property |
| (d) | $\Delta_r G_{Cell}$ | (s) | Increases with dilution |

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**52.** Match the items of Column I and Column II.

| | Column I | | Column II |
|---|---|---|---|
| A. | Lead storage battery | 1. | Maximum efficiency |
| B. | Mercury cell | 2. | Prevented by galvanisation |
| C. | Fuel cell | 3. | Gives steady potential |
| D. | Rusting | 4. | Pb is anode, $PbO_2$ is cathode |

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**53.** Match the items of Column I and Column II.

| | Column I | | Column II |
|---|---|---|---|
| A. | $\kappa$ | 1. | $I \times t$ |
| B. | $\wedge_m$ | 2. | $\wedge_m / \wedge_m^0$ |
| C. | $\alpha$ | 3. | $\frac{\kappa}{C}$ |
| D. | $Q$ | 4. | $\frac{G^*}{R}$ |

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**54.** Match the items of Column I and Column II.

| | Column I | | Column II |
|---|---|---|---|
| A. | Lechlanche cell | 1. | Cell reaction $2H_2 + O_2 \longrightarrow 2H_2O$ |
| B. | Ni-Cd cell | 2. | Does not involve any ion in solution and is used in hearing aids. |
| C. | Fuel cell | 3. | Rechargeable |
| D. | Mercury cell | 4. | Reaction at anode, $Zn \longrightarrow Zn^{2+} + 2e^-$ |
| | | 5. | Converts energy of combustion into electrical energy |

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**55.** Match the items of Column I and Column II on the basis of data given below:

(One to one match only)

$E^{\circ}_{F_2|F^-}$ = 2.87 V, $E_{Li^+|(Li)}$ = -3.5 V,

$E^{\circ}_{Au^{3+}|Au}$ = 1.4 V, $E^{\circ}_{Br_2|Br^-}$ = 1.09V

| Column-I | | Column-II | |
|---|---|---|---|
| (a) | $F_2$ | (p) | Metal is the strongest reducing agent |
| (b) | Li | (q) | Metal ion which is the weakest oxidising agent |
| (c) | $Au^{3+}$ | (r) | Non-metal which is the best oxidising agent |
| (d) | $Br^-$ | (s) | Unreactive metal |
| (e) | Au | (t) | Anion that can be oxidised by $Au^{3+}$ |
| (f) | $Li^+$ | (u) | Anion which is the weakest reducing agent |
| (g) | $F^-$ | (v) | Metal ion which is an oxidising agent |

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**56.** Assertion(A) Cu is less reactive than hydrogen.

Reason(R) $E^{\oplus}_{Cu^{2+}/Cu}$ is negative.

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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**57.** Assertion (A) $E_{\text{cell}}$ should have a positive value for the cell to function,

Reason(R) $E_{\text{cathode}} < E_{\text{anode}}$

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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**58.** Assertion (A) Conductivity of all electrolytes decreases on dilution.

Reason(R) On dilution number of ions per unit volume decreases.

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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**59.** Assertion(A) $\Lambda_m$ 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.

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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**60.** STATEMENT-1: The voltage of mercury cell remains constant for longer period of time.

STATEMENT-2: It is because net cell reaction does not involve ions.

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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**61.** Assertion (A): Electrolysis of NaCl solution gives chlorine at anode instead of $O_2$.

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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**62.** Assertion : For measuring resistance of an ionic solution an AC source is used.

Reason : Concentration of ionic solution will change if DC source is used.

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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**63.** Assertion : Current stops flowing when $E_{cell} = 0$.

Reason : Equilibrium of the cell reaction is attained.

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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**64.** Assertion (A): $E_{Ag^+/Ag}$ increases with increase in concentration of $Ag^+$ ions.

Reason (R): $E_{Ag^+/Ag}$ has a positive value.

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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**65.** Assertion (A) Copper sulphate can be stored in zinc vessel.

Reason(R) Zinc is less reactve than copper.

A. Both assertion and reason are true and the reason is the correct explanation of assertion.

B. Both assertion and reason are true and reason is not the correct explanation of assertion.

C. Assertion is true but the reason is false.

D. Both assertion and reason are false.

**Answer:**

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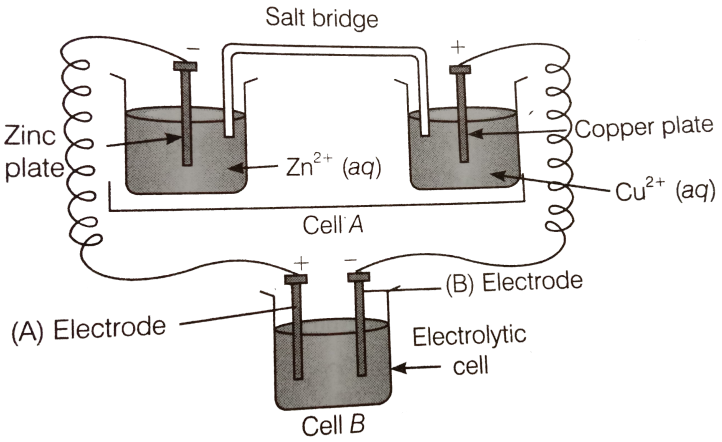
**66.** Consider the figure and answer the following question.




(i) Cell 'A' h as $E_{\text{cell}} = 2V$ and Cell 'B' has $E_{\text{cell}} = 1.1V$ which of the two cell 'A' or 'B' will act as an electrolytic cell. Which electrode reactions will occur in this cell?

(ii) If cell 'A' has $E_{\text{cell}} =$ 0.5V and cell 'B' has $E_{\text{cell}}$=1.1V then what will be the reactions at anode and cathode?

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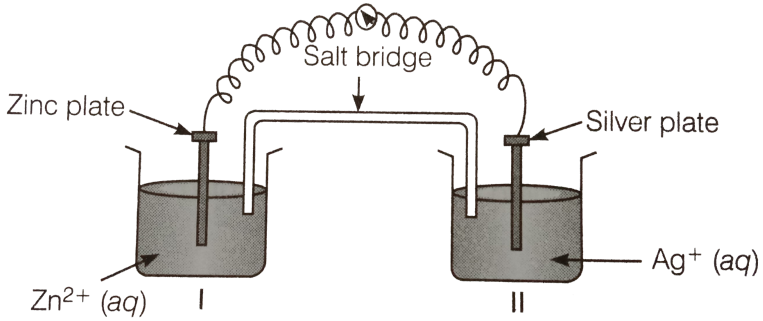
**67.** Consider figure from the above question and answer the questions (i) to (vi) given below.




(i) Redraw the diagram to show the direction of electron flow.

(ii) Is silver plate the anode or cathode?

(iii) what will happen it salt bridge is removed?

(iv) When will the cell stop functining?

( v) How will concentration of $Zn^{2+}$ ions and $Ag^{+}$ ions be affected when the cell function?

(vi) How will the concentration of $Zn^{2+}$ ions and $Ag^{+}$ ions be affected after the cell becomes dead?

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**68.** What is the relationship between Gibbs free energy of the cell reaction in a galvanic cell and the emf of the cell ? When will the maximum work be obtained froma galvanic cell ?

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