doubtnut
India's Number 1 Education App

CHEMISTRY

BOOKS - U-LIKE CHEMISTRY (HINGLISH)

ELECTROCHEMISTRY

Ncert Intext Questions

1. How would you determine the standard electrode potential of the system $Mg^{2+}Mg$?

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2. Can you store copper sulphate solutions in a zinc pot ?

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3. Consult the table of standard eletrode potentials and suggest three substances that can oxidise ferrous ions under suitable conditions

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4. Calculate the potential of hydrogen electrode in contact with a solution whose pH is 10.

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5. Calculate the emf of the cell in which the following reaction takes place :

$Ni(s) + 2Ag^{+}(0.002M) \rightarrow Ni^{2+}(0.160M) + 2Ag(s)$

Given that: $E^{\circ}_{\text{cell}} = 1.05\ \text{V}$

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6. Thus emf of the cell = 0.91 V. Q.3.6. The cell in which the following reaction occurs : $2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+0(aq)} + I_2(s)$ has $E^{\circ}_{\text{cell}} = 0.236V$ at 298 K

Calculate the standard Gibbs energy and the equilibrium constant of the cell reaction.

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7. Why does the conductivity of a solution decrease with dilution ?

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8. Suggest a way to determine the Λ^{0}_{m} value of water.

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9. The molar conductivity of 0.025 mol L^{-1} methanoic acid is 46.1 S $cm^2 mol L^{-1}$. Calculate its degree of dissociation and dissociation constant. Given $\lambda^\circ\left(H^+\right) = 349.6 S cm^2 mol^{-1}$ and $\lambda^\circ\left(HCOO^-\right) = 54.6 S cm^2 mol^{-1}$.

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10. If a current of 0.5 ampere flows through a metallic wire for 2 hours, then how many electrons would flow through the wire?

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11. Suggest a list of metals that are extracted electrolytically.

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12. Consider the reaction :$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

What is the quantity of electricity in coulombs needed to reduce 1 mol of $Cr_2O_7^{2-}$?

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13. Write the chemistry of recharging the lead storage battery, highlighting all the materials that are involved during recharging.

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14. Suggest two materials other than hydrogen that can be used as fuels in fuel cells.

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15. Explain how rusting of iron is envisaged as setting up of an electrochemical cell.

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Ncert Textbook Exercises

1. Arrange the following metals in the order in which they displace each other from the solution of their salts.

Al, Cu, Fe, Mg and Zn

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2. Given the standard electrode potentials,

$K^+/K = -2.93V, Ag^+/Ag = 0.80V,$

$Hg^{2+}/Hg = 0.79V$

$Mg^{2+}/Mg = -2.37V, Cr^{3+}/Cr = -0.74V$

Arrange these metals in their increasing order of reducing power.

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3. Depict the galvanic cell in which the reaction :

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

takes place. Further, show

:(i) Which of the electrodes is negatively charged ?

(ii) The carriers of the current in the cell.

(iii) Individual reaction at each electrode.

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4. Calculate the standard cell potentials of galvanic cell in which the following reactions take place:

(i) $2Cr(s) + 3Cd^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Cd$

(ii) $Fe^{2+}(aq) + Ag^{+}(aq) \rightarrow Fe^{3+}(aq) + Ag(s)$

Given:

$E_{Cr^{3+},Cr} = -0.74V, E^{\circ}_{Cd^{2+},Cd} = -0.04V, E_{Ag^{+},Ag} = 0.80V, E^{\circ}_{Fe^{3+},Fe^{2+}}$

.

Calculate the $\Delta_r G^\circ$ and equilibrium constant of the reactions.

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5. Write the Nernst equation and emf of the following cells at 298 K:

(i) $Mg(s)\left|Mg^{2+}(0.001M)\right|\left|Cu^{2+}(0.0001M)\right|Cu(s)$

(ii) Fe(s) | $Fe^{2+}(0.001M)\left|\right|H^{+}(1M)\left|H_2(g)(1^{-})\right|Pt(s)$

(iii) $Sn(s)\left|Sn^{2+}(0.050M)\right|\left|H^{+}(0.020M)\right|H_2(g)(1^{-})$ | $Pt(s)$

(iv) $Pt(s)|Br_2(l)|Br^{-}(0.010M)\left|\right|H^{+}(0.030M)\left|H_2(g)(1^{-})\right|Pt(s)$

Given,

$E^\circ_{Mg^{2+}/Mg} = -2.37V, E^\circ_{Cu^{2+},Cu} = +0.34V, E^\circ_{Fe^{2+},Fe} = -0.44, E^\circ_{Sn^{2+}/}$

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6. In the button cells widely used in watches and other devices, the following reaction takes place:

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

Determine E° and $\Delta_r G^\circ$ for the reaction.

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7. The conductivity of 0.20 M solution of KCI at 298 K is 0.0248 S cm^{-1}. Calculate its molar conductivity.

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8. The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω. What is the cell constant if conductivity of 0.001 M KCl solution at 298 K is $0.146 \times 10^{-3} Scm^{-1}$?

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9. The conductivity of sodium chloride at 298 K has been determined at different concentrations and the results are given below :

Concentration/M	0.001	0.010	0.020	0.050	0.100
$10^2 \times k / Sm^{-1}$	1.237	11.85	23.15	55.53	106.74

Calculate Λ_m for all concentration and draw a plot between Λ_m and $C^{1/2}$. Find the values of Λ_m°.

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10. Conductivity of 0.00241 M acetic acid is $7.896 \times 10^{-5} Scm^{-1}$. Calculate its molar conductivity. If Λ_m° for acetic acid is $390.5 Scm^2 mol^{-1}$. what is its dissociation constant ?

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11. How much charge is required for the following reductions :

(i) 1 mol of Al^{3+} to Al?

(ii) 1 mol of $Cu^{2+} \rightarrow Cu$?

(iii) 1 mol of MnO_4^- to Mn^{2+} ?

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12. How much electricity in terms of Faraday is required to produce

(i) 20.0 g of Ca from molten $CaCl_2$? (ii) 40.0 g of Al from molten Al_2O_3 ?

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13. How much electricity is required in coulomb for the oxidation of

(i) 1 mol of H_2O to O_2 ?

(ii) 1 mol of FeO to Fe_2O_3 ?

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14. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using a current of 0.5 ampere for 20 minutes. What mass of Ni is deposited at the cathode ?

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15. Three electrolytic cells A, B, C containing solutions of $ZnSO_4$, $AgNO_3$ and $CuSO_4$, respectively are connected in series. A steady current of 1.50 amperes was passed through them until 1.45 g of silver deposited at the cathode of cell B. How long did the current flow? What mass of copper and zinc were deposited ? [At. weights of Cu = 63.5, Zn = 65.3, Ag = 108]

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16. Using the standard electrode potentials, predict if the reaction between the following is feasible :

(a) $Fe^{3+}(aq)$ and $I^-(aq)$, (b) $Ag^+(aq)$ and Cu(s)

(iii) $Fe^{3+}(aq)$ and Br^- (aq), (d) Ag (s) and Fe^{3+} (aq)

(c) $Br_2(aq)$ and Fe^{2+} (aq).

Given standard electrode potentials:

$E^\circ_{1/2,I_2} = 0.541V$, $E^\circ_{Cu^{2+},Cu} = 0.34V$

$E^\circ_{1/2,Br_2,Br^-} = 1.09V$, $E^\circ_{Ag^+/Ag} = 0.80V$

$E^\circ_{Fe^{3+},Fe^{2+}} = 0.77V$

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17. Predict the products of electrolysis in each of the following:

(i) An aqueous solution of $AgNO_3$ with silver electrodes.

(ii) An aqueous solution of $AgNO_3$ with platinum electrodes.

(iii) A dilute solution of H_2SO_4 with platinum electrodes.

(iv) An aqueous solution of $CuCl_2$, with platinum electrodes.

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Case Based Source Based Integrated Questions

1. Read the given passage and answer the questions number that follow :

We know that accurate measurement of an unknown resistance can be performed on a Wheatstone bridge: However, for measuring the resistance of an ionic solution we face two problems. Firstly, passing direct current (DC) changes the composition of the solution. Secondly, a solution cannot be connected to the bridge like a metallic wire or other solid conductor. The first difficulty is resolved by using an alternating

current (AC) source of power. The second problem is solved by using a specially designed vessel called conductivity cell. Basically it consists of two platinum electrodes coated with platinum black (finely divided metallic Pt is deposited on the electrodes electrochemically). These have area of cross-section equal to 'A' and are separated by distance 'l'. Therefore, solution confined between these electrodes is a column of length 'l' and area of cross-section 'A'. The resistance of such a column of solution is given by the equation :

$$R = \rho\frac{1}{A} = \frac{1}{kA}$$

Name the instrument for accurate measurement of an unknown resistance.

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2. Read the given passage and answer the questions number that follow :

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Why can't we use direct current for this measurement ?

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3. Read the given passage and answer the questions number that follow :

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direct current (DC) changes the composition of the solution. Secondly, a solution cannot be connected to the bridge like a metallic wire or other solid conductor. The first difficulty is resolved by using an alternating current (AC) source of power. The second problem is solved by using a specially designed vessel called conductivity cell. Basically it consists of two platinum electrodes coated with platinum black (finely divided metallic Pt is deposited on the electrodes electrochemically). These have area of cross-section equal to 'A' and are separated by distance 'l'. Therefore, solution confined between these electrodes is a column of length 'l' and area of cross-section 'A'. The resistance of such a column of solution is given by the equation :

$$R = \rho\frac{1}{A} = \frac{1}{kA}$$

Where do we take the solution for the measurement of conductivity ?

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4. Read the given passage and answer the questions number that follow :

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$$R = \rho\frac{1}{A} = \frac{1}{kA}$$

The electrical resistance of a column of 0.05 mol L NaOH solution of diameter 1 cm and length 50 cm is 5.55 x 108 ohm. Calculate its resistivity.

View Text Solution

5. Read the given passage and answer the questions number that follow :

We know that accurate measurement of an unknown resistance can be performed on a Wheatstone bridge: However, for measuring the resistance of an ionic solution we face two problems. Firstly, passing direct current (DC) changes the composition of the solution. Secondly, a solution cannot be connected to the bridge like a metallic wire or other solid conductor. The first difficulty is resolved by using an alternating current (AC) source of power. The second problem is solved by using a specially designed vessel called conductivity cell. Basically it consists of two platinum electrodes coated with platinum black (finely divided metallic Pt is deposited on the electrodes electrochemically). These have area of cross-section equal to 'A' and are separated by distance 'l'. Therefore, solution confined between these electrodes is a column of length 'l' and area of cross-section 'A'. The resistance of such a column of solution is given by the equation :

$$R = \rho\frac{1}{A} = \frac{1}{kA}$$

If the distance between the electrodes and area of cross-section of a cell are 2.5 cm and 6.75 cm^2 respectively. Calculate the cell constant.

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6. Read the given passage and answer the questions number that follow :

Molar conductivity increases with decrease in concentration. This is because the total volume, V, of solution containing one mole of electrolyte also increases. It has been found that decrease in K on dilution of a solution is more than compensated by increase in its volume. Physically, it means that at a given concentration, Am can be defined as the conductance of the electrolytic solution kept between the electrodes of a conductivity cell at unit distance but having area of cross-section large enough to accommodate sufficient volume of solution that contains one mole of the electrolyte. When concentration approaches zero, the molar conductivity is known as limiting molar conductivity and is represented by the symbol Am The variation in Λ_m with concentration is different for strong and weak electrolytes.

Why does molar conductivity increase with decrease in concentration ?

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7. Read the given passage and answer the questions number that follow :

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Define Λ_m at a given concentration.

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8. Read the given passage and answer the questions number that follow :

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Why is meant by limiting molar conductivity ?

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9. Read the given passage and answer the questions number that follow :

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How is limiting molar conductivity represented ?

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10. Read the given passage and answer the questions number that follow :

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Is the variation in Λ_m with concentration same or different for weak and strong electrolytes ?

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11. Read the given passage and answer the questions number that follow :

Weak electrolytes like acetic acid have lower degree of dissociation at higher concentrations and hence for such electrolytes, the change in Λ_m with dilution is due to increase in the degree of dissociation and consequently the number of ions in total volume of solution that contains one mol of electrolyte. In such cases Λ_m increases steeply on

dilution, especially near lower concentrations. Therefore, Λ_m cannot be obtained by extrapolation of Λ_m to zero concentration. At infinite dilution (i.e., concentration c $\rightarrow$ zero) electrolyte dissociates completely (α = 1), but at such low concentration the conductivity of the solution is so low that it cannot be measured accurately. Therefore, Λ_m° for weak electrolytes is obtained by using Kohlrausch law of independence migration of ions.

Why does the change in Am take place on dilution in case of weak electrolytes ?

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12. Read the given passage and answer the questions number that follow :

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Why does the change in Λ_m take place on dilution in case of weak electrolytes ?

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Why can't we obtain Λ_m° by extrapolation of Λ_m to zero concentration ?

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14. Read the given passage and answer the questions number that follow :

Weak electrolytes like acetic acid have lower degree of dissociation at higher concentrations and hence for such electrolytes, the change in Λ_m with dilution is due to increase in the degree of dissociation and consequently the number of ions in total volume of solution that contains one mol of electrolyte. In such cases Λ_m increases steeply on dilution, especially near lower concentrations. Therefore, Λ_m cannot be

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Which law is used lo calculate Λ_m° for weak electrolyles ?

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dilution (i.e., concentration c $\rightarrow$ zero) electrolyte dissociates completely (α = 1), but at such low concentration the conductivity of the solution is so low that it cannot be measured accurately. Therefore, Λ_m° for weak electrolytes is obtained by using Kohlrausch law of independence migration of ions.

Give the mathematical relation to calculate the degree of dissociation, α for a weak electrolyte.

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Case Based Source Based Integrated Questions Multiple Choice Questions

1. The lead storage battery consists of

A. lead anode and a grid a lead packed with PbO_2 as cathode.

B. grid of lead packed with PbO_2 as anode and lead cathode.

C. Zn anode and a grid of Zn packed with ZnO as cathode

D. grid on Zn packed with ZnO as anode and Zn anode.

Answer: A

View Text Solution

2. The cathode reaction : $MnO_2 + NH_4^+ + e^- \rightarrow MnO(OH) + NH_3$ is applicable in

A. voltaic cell

B. dry cell

C. secondary battery

D. button cell

Answer: B

View Text Solution

3. 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.

Answer: D

View Text Solution

4. 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.

Answer: C

View Text Solution

5. 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.

Answer: A::B

View Text Solution

6. The Gibb's energy for the decomposition of Al_2O_3 at 500° C is as follows:

$$\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2, \Delta G = +966kJmol^{-1}$$

The potential difference needed for electrolytic reduction of Al_2O_3 at 500° C is at least

A. 5.0 V

B. 4.5 V

C. 3.0 V

D. 2.5 V

Answer: D

View Text Solution

7. The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to

A. current only.

B. time only.

C. quantity of electricity.

D. temperature.

Answer: C

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8. Which of the following statement is correct?

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

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

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

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

Answer: C

View Text Solution

9. An electrochemical cell can behave like an electrolytic cell when .....

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

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

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

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

Answer: C

View Text Solution

10. The difference between the electrode potentials of two electrodes when no current is drawn through the cell is called .....

A. cell potential

B. cell emf

C. potential difference

D. cell voltage

Answer: B

View Text Solution

11. Using the data given below find out the strongest reducing agent.

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

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

A. Cl^-

B. Cr

C. Cr^{3+}

D. Mn^{2+}

Answer: B

View Text Solution

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

A. Mg is cathode

B. Cu is cathode

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

D. Cu is the oxidising agent.

Answer: B::C

View Text Solution

13. Which of the following expressions correctly represents the equivalent conductance at infinite dilution of $Al_2(SO_4)_3$? Given that $\Lambda^{\circ}_{Al^{3+}}$ and $\Lambda^{\circ}_{SO_4^{2-}}$ are the equivalent conductances at infinite dilution of the respective ions ?

A. $2\Lambda^{\circ}_{Al^{3+}} + 3\Lambda^{\circ}_{SO_4^{2-}}$

B. $\Lambda^{\circ}_{Al^{3+}} + \Lambda^{\circ}_{SO_4^{3-}}$

C. $\left(\Lambda^{\circ}_{Al^{3+}} + \Lambda^{\circ}_{SO_4^{2-}} + \Lambda^{\circ}_{SO_4^{2-}}\right) \times 6$

D. $\frac{1}{3}\Lambda^{\circ}_{Al^{3+}} + \frac{1}{2}\Lambda^{\circ}_{SO_4^{2-}}$

Answer: B

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14. Which of the following do not determine the electrical conductance ?

A. Structure of metal

B. Number of valence electrons per atom

C. Temperature

D. Pressure

Answer: D

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15. In the Zn-Cu cell, when the concentrations of Zn^{2+} and Cu^{2+} are unity, the e.m.f. is

A. 1.75 V

B. 0.5 V

C. 0.0 V

D. 1.1 V

Answer: D

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16. In a standard hydrogen electrode, the pressure of hydrogen gas and H^+ concentration respectively are

A. 1 atm, 1 M H^+

B. 1 atm, 0.01 M H^+

C. 10 atm, 1 M H^+

D. 10 atm, 0.1 M H^+

Answer: A

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17. Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of anions and cations. This law was given by

A. Faraday

B. Ostwald

C. Davy

D. Kohlrausch

Answer: D

View Text Solution

18. Standard reduction potentials of Zn, Cu and Cr is increasing order can be represented as

A. $Zn < Cu < Cr$

B. $Zn < Cr < Cu$

C. $Cr < Zn < Cu$

D. $Cu < Zn < Cr$

Answer: B

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19. The relation between E°_{cell} and K_c is given by:

A. $E^{\circ}_{\text{cell}} = \dfrac{2.303RT}{nF}\log K_c$

B. $E^{\circ}_{\text{cell}} = \dfrac{2.303nF}{RT}\log K_c$

C. $E^{\circ}_{\text{cell}} = \dfrac{2.303RT}{nF} \times \dfrac{1}{\log K_c}$

D. $E^{\circ}_{\text{cell}} = \dfrac{2.303RT}{nT}\log K_c$

Answer: A

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20. Choose the odd one out of the following:

A. Daniel cell

B. Concentration cell

C. Voltaic cell

D. Galvanic cell

Answer: B

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Case Based Source Based Integrated Questions Assertion Reason Questions

1. Assertion (A) : Electrochemistry is the study of production of electricity from energy released during spontaneous chemical reactions.

Reason (R) : Study of electrochemistry is important for creating new technologies.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: B

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2. Assertion (A) : Batteries and fuel cells convert chemical energy into electrical energy.

Reason (R) : The reactions carried out electrochemically are not energy efficient and more polluting.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: C

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3. Assertion (A) : Daniel cell has a potential of 2.1 V when concentrations of ions is unity,

Reason (R) : The two parts of Zn-Cu cell are connected by salt bridge.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: D

View Text Solution

4. Assertion (A) : At equilibrium, there is a separation of charges and depending upon the tendencies of two opposing reactions, the electrode may be positively or negatively charged with respect to the solution.

Reason (R) : At each electrode-electrolyte interface, there is a tendency of the metal ions from the solution to deposit on the metal and metal atoms of the electrode to go into the solution leaving behind electrons on the electrode.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: A

View Text Solution

5. Assertion (A) : Electrolytical cell is a device for using electrical energy to carry non-spontaneous chemical reactions.

Reason (R) : We can construct innumerable number of galvanic cells on the pattern of Daniel cell by taking combinations of different half-cells.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: B

View Text Solution

6. Assertion (A) : $Cu^{2+} + 2e^- \rightarrow Cu$ (s) is an example of oxidation half reaction.

Reason (R) : When concentrations of all species involved in a half-cell is unity, then the electrode potential is called standard electrode potential.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: D

View Text Solution

7. Assertion (A): A half-cell can also be called redox couple.

Reason (R) : According to IUPAC, standard reduction potentials are now called standard electrode potentials.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: B

View Text Solution

8. Assertion (A): If the standard reduction potential of an electrode is greater than zero, then its reduced form is less stable compared to hydrogen gas.

Reason (R) : Standard hydrogen electrode represented by $Pt(s)|H_2(g)|H^+(aq)$ is assigned a zero potential at all temperatures.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: D

View Text Solution

9. Assertion (A) : Electrical work done in one second is equal to electrical potential multiplied by total charge passed.

Reason (R) : Electrical resistance can be measured with the help of Wheatstone bridge.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: B

View Text Solution

10. Assertion (A) : Conductivity of an electrolyte depends upon the size of the ions produced andtheir solvation.

Reason (R) : Conductivity of an electrolyte does not depend upon temperature.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: C

View Text Solution

Case Based Source Based Integrated Questions Fill In The Blanks

1. When concentration approaches zero, the molar conductivity is known as _____

View Text Solution

2. In an _____ external source of voltage is used to bring above a chemical change.

View Text Solution

3. An electrochemical cell consists of two metallic electrodes dipping in _____ solution(s).

View Text Solution

4. Corrosion of metals is essentially an_____ phenomenon.

View Text Solution

5. The conductivity, K, of an electrolytic solution depends upon the concentration of electrolyte, nature of the solvent and _____

View Text Solution

6. The standard potential of the cell can be obtained by taking the _____ of standard potentials of cathode and anode.

View Text Solution

7. Conductivity decreases but molar conductivity increases with _____ in concentration.

View Text Solution

8. The standard potential of the cell is related to standard Gibb's energy as_____

View Text Solution

Case Based Source Based Integrated Questions True Or False

1. NaCl, $CaCl_2$, $MgSO_4$ are known as 1 - 1, 2 - 1 and 2 - 2 elecrolytes respectively.

View Text Solution

2. At present the main source of energy that is driving our economy is fossil fuel.

View Text Solution

3. Conductance of electrolytic solution can be measured with the help of Wheatstone bridge.

View Text Solution

4. When concentration of the solution approaches zero, the molar conductivity is known as limiting molar conductivity.

View Text Solution

5. Units of Λ_m are is S $m^3 mol^{-1}$, if k is expressed in Sm^- and the concentration in mol m^{-3}.

View Text Solution

6. Carbon dioxide produced by combination of fossil fuel is resulting in Greenhouse effect.

View Text Solution

7. Conductivity cell consists of two nickel electrodes coated with nickel black.

View Text Solution

8. IUPAC has recommended the use of the lerm conductivity over specific conductivity.

View Text Solution

Case Based Source Based Integrated Questions Very Short Answer Questions 1 Mark Each

1. Write the reduction and oxidation half reactions for Daniell cell.

View Text Solution

2. Define resistivity of a substance.

View Text Solution

3. What is the difference between conductivity and specific conductance ?

View Text Solution

4. How much charge in Faradays is required for the reduction of 1 mol of $Al^{3+} \rightarrow Al$? [

View Text Solution

5. How may the conductivity of an intrinsic semiconductor be increased ?

View Text Solution

6. Express the relation between conductivity and molar conductivity of a solution held in a cell.

View Text Solution

7. What is meant by limiting molar conductivity ?

View Text Solution

8. Can absolute electrode potential of an electrode be measured ?

View Text Solution

9. Can E_{cell} or $\Delta_r G^\circ$ for a cell reaction ever be equal to zero ?

View Text Solution

10. Write the product obtained at anode on electrolysis of concentrated sulphuric acid using platinum electrodes.

View Text Solution

11. Why can't aluminium be reduced by carbon ?

View Text Solution

12. Write the overall reaction in nickel-cadmium cell during discharge.

View Text Solution

13. Under what condition is $E_{\text{cell}} = 0$ or $\Delta_r G^\circ = 0$?

View Text Solution

14. What does the negative sign in $F^\circ_{Zn^{2+}/Zn} = -0.76V$ mean?

View Text Solution

15. Depict the galvanic cell in which the cell reaction is

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

View Text Solution

16. Give two examples of corrosion.

View Text Solution

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

View Text Solution

18. 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 the current flowing through the cell ?

View Text Solution

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

View Text Solution

20. What do the notations G and G* represent ?

View Text Solution

21. Unlike dry cell, the mercury cell has a constant cell potential throughout its useful life. Why?

View Text Solution

22. In an aqueous solution, how does specific conductivity of electrolytes change with addition of water?

View Text Solution

23. What is the cell potential of mercury cell ? What are its applications ?

View Text Solution

24. Why is equilibrium constant K related to only E°_{cell} and not E_{cell} ?

View Text Solution

25. Write the relation between cell potential and equilibrium constant.

View Text Solution

26. How does the molar conductivity of KCl solution vary with increasing concentration ?

View Text Solution

27. Write Nernst equation for the electrode reaction :

$M^{n+} + ne^- \rightarrow M(s)$

View Text Solution

28. How does cathodic protection of iron operate ?

View Text Solution

29. Compute the charge on one mole of electrons.

View Text Solution

30. Electrolysis of KBr (aq) gives Br_2 at anode but of KF (aq) does not give F_2 . Give reason for disparity in behaviour.

View Text Solution

31. What are the advantages of using hydrogen as a fuel ?

View Text Solution

32. Name the instrument used to measure conductance.

View Text Solution

33. Name the cells that convert the energy of combustion of fuels into electrical energy.

View Text Solution

34. Name a secondary battery.

View Text Solution

35. Give an example of primary cell.

View Text Solution

36. Name a cell that is suitable for low current devices like hearing aids.

View Text Solution

37. Give the percentage of sulphuric acid solution used in lead storage battery.

View Text Solution

38. What is the amount of electricity required for the reduction of one mole of silver ions ?

View Text Solution

39. Who gave the law of independent migration of ions ?

View Text Solution

40. Name an inert electrode.

View Text Solution

41. Name the term used for rusting of iron, tarnishing of silver and development of green coating on copper.

View Text Solution

42. Name a chemical used to cover the surface to prevent corrosion

View Text Solution

43. What is the efficiency of working of fuel cells ?

View Text Solution

44. What kind of phenomenon is corrosion ?

View Text Solution

45. In the electrolysis of a metal oxide, name a substance that helps to lower the melting point and to increase the conductivity.

View Text Solution

46. Give an example of a weak electrolyte.

View Text Solution

47. In the equation $G^\circ = Rk$, what is G° ?

View Text Solution

Case Based Source Based Integrated Questions Short Answer Questions 2 Marks Each

1. 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 $Ag = 108 gmol^{-1}$?, 1 F = $96500 Cmol^{-1}$]

View Text Solution

2. The conductivity of a 0.01 M solution of acetic acid at 298 K is $1.65 \times 10^{-4} Scm^{-1}$. Calculate molar conductivity (Λ_m) of the solution.

View Text Solution

3. Calculate the degree of dissociation (α) of acetic acid if its molar conductivity (Λ_m) is 39.05 S $cm^2 mol^{-1}$.

Given: $\lambda^\circ\left(H^+\right) = 349.6 Scm^2 mol^{-1}$ and $\lambda^\circ\left(CH_3COO^-\right) = 40.9 Scm^2 mol^{-1}$

View Text Solution

4. Write the name of the cell which is generally used in inverters. Write the reactions taking place at the anode and the cathode of this cell.

View Text Solution

5. Write the name of the cell which is generally used in transistors. Write the reactions taking place at the anode and the cathode of this cell.

View Text Solution

6. In a galvanic cell, the following cell reaction occurs :

$Zn(s) + 2Ag^{+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s) E_{\text{cell}} = +1.56V$

(a) Is the direction of flow of electrons from zinc to silver or silver to zinc ?

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

View Text Solution

7. 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 ?

View Text Solution

8. (a) Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution :

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

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

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 ?

View Text Solution

9. Calculate the time to deposit 1.27 g of copper at cathode when a current of 2 A was passed through the solution of $CuSO_4$. [Molar mass of Cu = 63.5 g mol^{-1}, 1 F = $96500Cmol^{-1}$]

View Text Solution

10. (a) Following reactions occur at cathode during the electrolysis of aqueous copper (II) chloride solution :

$1Cu^{2+}(aq) + 2e^- \rightarrow Cu(s), E^\circ = +0.34V$

$H^+ + (aq) + e^- \rightarrow \frac{1}{2}H_2$ (g)

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

(b) State Kohlrausch law of independent migration of ions. Write its one application.

View Text Solution

11. (a) State the law which helps to determine the limiting molar conductivity of weak electrolytes.

(b) Calculate limiting molar conductivity of $CaSO^4$ (limiting molar conductivity of calcium and sulphate ions are 119.0 and 106.0 S cm^2mol^{-1} respectively).

View Text Solution

12. The conductivity of 0.20 M solution of KCl at 298 K is $0.025 Scm^{-1}$?. Calculate its molar conductivity.

View Text Solution

13. Express the relation among cell constant, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to its conductivity ?

View Text Solution

14. Mention the reactions occurring at (i) anode (ii) cathode, during working of a mercury cell. Why does the voltage of a mercury cell remain constant during operation ?

View Text Solution

15. Give an example of a fuel cell and write the cathode and anode reactions.

View Text Solution

16. The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.

View Text Solution

17. Given that the standard electrode potentials (E°) of metals are:

$K^{+}/K = -2.93V, Ag^{+}/Ag = 0.80V, Cu^{2+}/Cu = 0.34V, Mg^{2+}/Mg$

.

Arrange these metals in an increasing order of their reducing power.

View Text Solution

18. Two half-reactions of an electrochemical cell are given below :

$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H2_O(I), E^\circ = 1.51V$

$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^- E^\circ = +0.15V.$

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.

View Text Solution

19. What type of cell is a lead storage battery ? Write the anode and the cathode reactions and the overall cell reaction occurring in the use of a lead storage battery.

View Text Solution

20. Define the terms given below :

(a) Conductivity (b) Molar conductivity What are their units ?

View Text Solution

21. Describe the construction of a $H_2 - O_2$, fuel cell and the reactions H_2O taking place in it.

View Text Solution

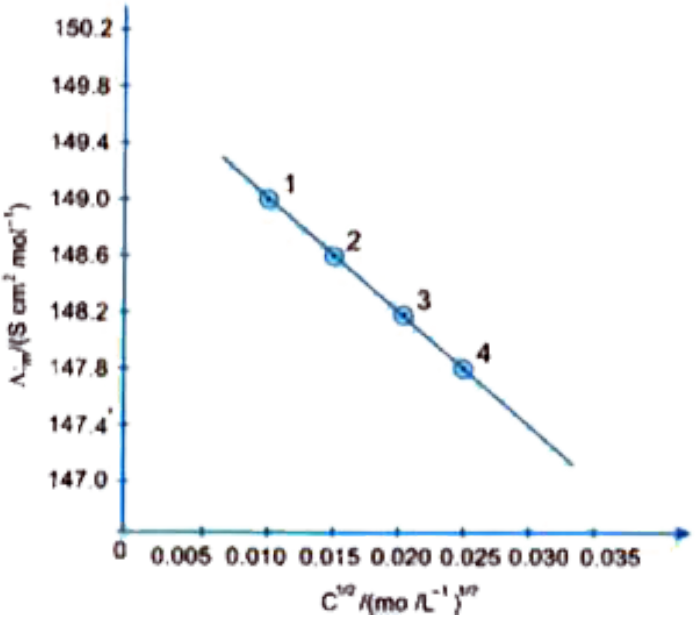
22. The following curve is obtained when molar conductivity Λ_m is plotted against the square root of concentration $C^{1/2}$ (x-axis) for two electrolytes A and B :

(a) What can you say about the nature of the two electrolytes A and B ?

(b) How do you account for the increase in molar conductivity A, for the electrolytes A and B on dilution ?

View Text Solution

23. The molar conductivity (Λ_m) of KCl solutions at different concentrations at 298 K is plotted as shown in the figure below:



Determine the value of Λ_m° and A for KCl.

View Text Solution

24. (i) For a weak electrolyte molar conductance in dilute solution increases sharply as its concentration in solution is decreased. Give reason.

(ii) Write overall cell reaction for lead storage battery when the battery is being charged.

View Text Solution

25. Write the chemical equations for all the steps involved in the rusting of iron. Give any one method to prevent rusting of iron.

View Text Solution

26. 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^- oxidised at anode instead of water ?

View Text Solution

27. 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 or different ? Explain your answer.

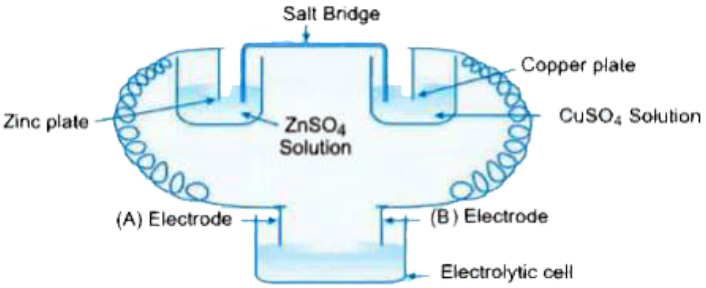
View Text Solution

28. How long a current of 3 amperes has to be passed through a solution of silver nitrate to coat a metal surface of 80 cm^2 with 0.005 mm thick layer ?

[Density of Ag is 10.5 g cm^{-3}, At wt.of silver = 108.0 u]

View Text Solution

29. Consider the following diagram in which an electrochemical cell is coupled to an electrolytic cell. What will be the polarity of electrodes 'A' and 'B' in the electrolytic cell ?



Combination of an electrochemical cell with an electrolytic cell

View Text Solution

30. What advantages do the fuel cells have over primary and secondary batteries ?

View Text Solution

31. Write the Nernst equation for the cell reaction in the Daniel cell. How will the E_{cell} be affected when concentration Zn^{2+} ions is increased ?

View Text Solution

32. Consider a cell given below:

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

Write the reactions that occur at anode and cathode.

View Text Solution

33. 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 ?

View Text Solution

34. Solutions of two electrolytes 'A' and 'B' are diluted. The Λ_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.

View Text Solution

35. Blue colour of copper sulphate is slowly discharged when an iron rod is dipped into it. Explain this by calculating ΔG° with the help of the following data :

$\left[E^\circ_{Cu^{2+}/Cu} = 0.34V, E^\circ_{Fe^{2+}/Fe} = -0.44V \text{ and } 1 \text{ Faraday} = 96500 \text{ C } mol^{-1}\right]$

View Text Solution

View Text Solution

36. Why on dilution the Λ_m of CH_3COOH increases drastically, while that of CH_3COONa increases gradually ?

View Text Solution

37. On the basis of the standard electrode potential values stated for acid solution, predict whether Ti^{4+} species may be used to oxidise Fe^{II} to Fe^{III}.

Reaction

$(E^\circ/V), \left(Ti^{3+} + e^- \rightarrow Ti^{3+}, +0.01\right), \left(Fe^{3+} + e^- \rightarrow Fe^{2+}, +0.77\right)$

View Text Solution

38. Estimate the minimum potential difference required to reduce Al_2O_3 at 500° C. The free energy change for the decomposition reaction :

$\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2$ is $\Delta G = 960kJ$

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

View Text Solution

39. The resistance of conductivity cell containing 0.001 M KCl solution at 298 K is 1500Ω. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is $0.146 \times 10^{-3} Scm^{-1}$?

View Text Solution

40. Explain why electrolysis of aqueous solution of NaCl gives H_2 at cathode and Cl_2 at anode. Write the overall reaction. [Given : $E^{\circ}_{Na^+/Na} = -2.71V, E^{\circ}_{Cl_2/2Cl^-} = 1.36V$]

$\frac{1}{2}O_2(g) + 2H^+(aq) + 2e^- \rightarrow H_2O(l), E^{\circ} = 1.23V$

View Text Solution

41. What are fuel cells ? Write the electrode reactions of a fuel cell which uses the reaction of hydrogen with oxygen.

View Text Solution

42. Zinc rod is dipped in 0.1 M solution of $ZnSO_4$. The salt is 95% dissociated at this dilution at 298 K. Calculate the electrode potential.

[Given, $E^{\circ}_{Zn^{2+}/Zn} = -0.76V$]

View Text Solution

43. Predict the products of electrolysis obtained at the electrodes in each case when the electrodes used are of platinum :

(i) An aqueous solution of $AgNO_3$.

(ii) An aqueous solution of H_2SO_4.

View Text Solution

44. Calculate the equilibrium constant for the following reaction at 298 K:

$Cu(s) + Cl_2(g) \rightarrow CuCl_2(aq)$

Given:

$R = 8.314JK^{-1}mol^{-1}$, $E^{\circ}_{Cu^{2+}/Cu} = 0.34V$, $E^{\circ}_{\frac{1}{2}Cl_2/Cl^-} = 1.36V$, $1F = 965$

View Text Solution

45. What is corrosion ? Describe the role of zinc in cathodic protection of iron. Can we use tin in place of zinc for this purpose ? Give reason.

View Text Solution

46. The conductivity of 10^{-3} mol/L acetic acid at 25 °C is $4.1 \times 10^{-5}cm^{-1}$. Calculate its degree of dissociation, Λ°_m if for acetic acid at 25 °C is $390.5Scm^2mol^{-1}$.

View Text Solution

47. Calculate the emf of the following cell at 298 K:

$Cr(s)\,/\,Cr^{3+}(0.1m)\,/\,Fe^{2+}(0.01M)\,/\,Fe(s)$ [Given: $E^{\circ}_{\text{cell}} = +0.30V$]

View Text Solution

Case Based Source Based Integrated Questions Long Answer Questions I 3 Marks Each

1. 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 palce.

(ii) Give the direction of flow of current

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

View Text Solution

2. Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100 ohms. If the resistance of the same cell filled with 0.02 mol L^{-1} KCl

solution is 520 ohms, calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution. The conductivity of 0.1 mol L^{-1} KCl solution is $1.29 \times 10^{-2} Scm^{-1}$

View Text Solution

3. Write the Nernst equation and calcualte emf of the following cell at 298 K:

$Mg(s)\left|Mg^{2+}(0.1M)\right|\left|Cu^{2+}(0.01M)\right|Cu(s)$

Given: $E^{\circ}_{\text{cell}} = 2.71V$

View Text Solution

4. (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}, 1 F = 96500 C mol^{-1}]

(b) Define fuel cell.

View Text Solution

5. (a) The cell in which the following reaction occurs:

$2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$

has $E^{\circ}_{\text{cell}} 0.236V$ at 298 K. Calculate the standard Gibbs energy of the cell reaction.

[Given: 1F = 96,500 C mol^{-1}]

(b) How many electrons flow through a metallic wire if a current of 0.5 A is passed for 2 hours? [Given: 1F =96,500 mol^{-1}]

View Text Solution

6. The electrical resistance of a column of 0.05 M KOH solution of diameter 1 cm and length 45.5 cm is 4.55×10^3 ohm. Calculate its molar conductivity.

View Text Solution

7. Calcualte the emf of the following cell at 298 K:

$2Cr(s) + 3Fe^{2+}(0.1M) \rightarrow 2Cr^{3+}(0.01M) + 3Fe(s)$

Given: $E^{\circ}_{Cr^{3+}/Cr} = -0.74V, E^{\circ}_{Fe^{2+}/Fe} = -0.44V.$

View Text Solution

8. Calcualte emf of the following at 25° C

$Fe\left|Fe^{2+}(0.001)\right|\left|H^{+}(0.01M)\right|H_2(g)(1^{-}) \mid Pt(s)$

$E^{\circ}\left(Fe^{2+}[Fe]\right)^{\circ} = -0.44V, E\left(H^{+} \mid H_2\right)^{\circ} = 0.00V$

View Text Solution

9. Calculate the emf of the following cell at 25° C

$Zn\left|Zn^{2+}(0.001M)\right|\left|H^{+}(0.01M)\right|H_2(g)(1^{-}) \mid Pt(s)$

$E^{\circ}_{Zn^{2+}/Zn} = -0.76V, E^{\circ}_{H^{+}/H_2} = 0.00V$

View Text Solution

10. Conducitivity of 2.5×10^{-4} M methonic acid is $5.25 \times 10^{-5} Scm^{-1}$. Calculate the molar conductivity and degree of dissociation.

Given: $\lambda^{\circ}\left(H^{+}\right) = 349.5 Scm^{2} mol^{-1}$ and $\lambda^{\circ}\left(HCOO^{-}\right) = 50.5 Scm^{2} mol^{-1}$

View Text Solution

11. (a) Calculate $\Delta_r G^{\circ}$ for the reaction

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

Given: $E^{\circ}_{\text{cell}} = +2.71V, 1F = 96500 C \text{mol}^{-1}$

(b) Name the type of cell which was used in Apollo space programme for providing electrical power.

View Text Solution

12. State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution ?

View Text Solution

13. Calcualte the emf of the following cell at 25° C

$Ag(s)\left|Ag^+\left(10^{-3}M\right)\right|\left|Cu^{2+}\left(10^{-1}M\right)\right|Cu(s)$

Given: $E^\circ_{\text{cell}} = +0.46V$ and $\log 10^n = n$.

View Text Solution

14. The electrical resistance of a column of 0.05 M NaOH solution of diameter 1 cm and length 50 cm is 5.55×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity.

View Text Solution

15. Calculate the equilibrium constant K for the reaction at 298 K

`Zn(s) + Cu^(2+)(aq) [Given:

$E^\circ_{Zn^{2+}/Zn} = -0.76V, E^\circ_{Cu^{2+}/Cu} = +0.34V$]

View Text Solution

16. For the cell

$Zn(s)\left|Zn^{2+}(2M)\right|\left|Cu^{2+}(0.5M)\right|Cu(s)$

(a) Write the equation for each half-reaction.

(b) Calculate the cell potential at 25° C.

[Given, $E^{\circ}_{Zn^{2+}/Zn} = -0.76V$, $E^{\circ}_{Cu^{2+}/Cu} = +0.34C$]

View Text Solution

17. (a) Calculate the charge in coulombs required for oxidation of 2 moles of water to oxygen ?

[Given: $1F = 96,500Cmol^{-1}$]

(b) Zinc/silver oxide cell is used in hearing aids and electric watches. The following reactions occur :

$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^{-}$, $E^{\circ}_{Zn^{2+}/Zn} = -0.76V$

$Ag_2O + H_2O + 2e^{-} \rightarrow 2Ag + 2OH^{-}$, $E^{\circ}_{Ag^{+}/Ag} = 0.344\,V$

Calculate (i) standard potential of the cell, (ii) standard Gibbs energy.

View Text Solution

18. What is nickel-cadmium cell ? State its one merit and one demerit over storage cell. Write the overall reaction that occurs during discharging of this cell.

View Text Solution

19. Give reason

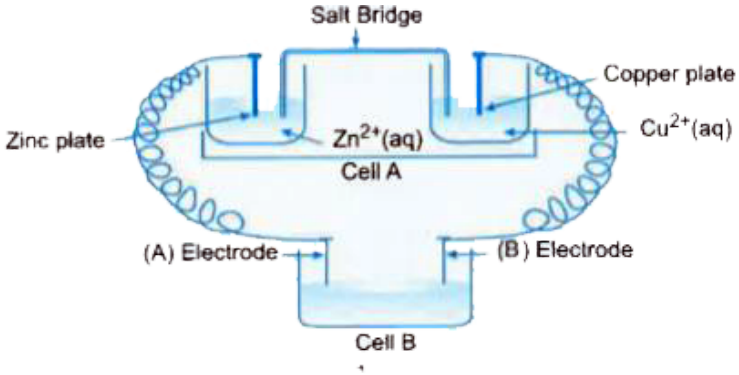
(a) Why does an alkaline medium inhibit the rusting of iron ?

(b) Why does a dry cell become dead after a long time even if it has not been used ?

(c) Why is zinc better than tin in protecting iron from corrosion ?

View Text Solution

20. Consider the figure below and answer the following questions :



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

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

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21. The following chemical reaction is occurring in an electrochemical cell

$$Mg(s) + 2Ag^{+}(0.0001M) \rightarrow Mg^{2+}(0.10M) + 2Ag(s)$$

The E° electrode values are

$$Mg^{2+}/Mg = -2.36V,$$

$Ag^+ / Ag = 0.81V$

For lids cell calculate/write

(a) (i) E° value for the electrode $2Ag^+ / 2Ag$

(ii) Standard cell potential E°_{cell}

(b) Cell potential E_{cell} ,

(c) (i) Symbolic representation of the above cell.

(ii) Will the above cell reaction be spontaneous ?

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22. (a) A current of 1.50 amp was passed through an electrolytic cell containing $AgNO_3$ solution with inert electrodes. The weight of Ag deposited was 1.50 g. How long did the current flow ?

(b) Write the reactions taking place at the anode and cathode in the above cell.

(c) Give reactions taking place at the two electrodes if these are made up of Ag.

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23. Calculate the emf and ΔG of cell reaction for the following cell at 25 °C :

$Mg(s)\left|Mg^{2+}(0.001M)\right| \mid Cu^{2+}(0.0001M) + Cu(s)$

$\left[E_{Mg^{2+}/Mg}\right]^{\circ} = -2.37V, E^{\circ}_{Cu^{2+}/Cu} = +0.34V$ and

$1F = 96500Cmol^{-1}$

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24. Calculate the standard cell potential of the galvanic cell in which the following reaction takes place :

$2Cr(s) + 3Cd^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Cd(s)$

Also calculate the $\Delta_r G^{\circ}$ value of the reaction.

[Given: $E^{\circ}_{Cr^{3+}/Cr} = -0.74V : E^{\circ}_{Cd^{2+}/Cd} = -0.40V$ and

$F = 96500Cmol^{-1}$]

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25. a) Calculate the charge in coulombs required for the oxidation of 2 moles of water to oxygen ? [Given 1 F = 96500 C mol^{-1}]

(b) Zinc/Silver oxide cell is used in hearing aids and watches. The following reactions occur :

$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^{-}, E^{\circ}_{Zn^{2+}/Zn} = -0.76V$

$Ag_2O + H_2O + 2e^{-} \rightarrow 2Ag + OH^{-}, E^{\circ}_{Ag^{+}/Ag} = 0.344V$

Calculate (i) Standard potential of the cell, (ii) Gibb's free energy:

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26. Conductivity of 0.00241 M acetic acid is $7.896 \times 10^{-5} Scm^{-1}$. Calculate its molar conductivity. If Λ°_{m} for acetic acid is 390.5 S $cm^2 mol^{-1}$, what is its dissociation constant?

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27. (i) Solutions of two electrolytes 'A' and 'B' are diluted. The limiting molar conductivity of 'B' increases 1.5 times while that of 'A' increases 25

times. Which of the two is a strong electrolyte ? Justify your answer.

(ii) The products of electrolysis of aqueous NaCl at the respective electrodes are :

Cathode: H_2

Anode : Cl_2 and not O_2 . Explain.

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Case Based Source Based Integrated Questions Long Answer Questions Ii 5 Marks Each

1. For the reaction:

$2AgCl(s) + H_2(g)(1atm) \rightarrow 2Ag(s) + 2H^+(0.1M) + 2Cl^-(0.1M), \Delta G^\circ$

at 25° C

Calculate the emf of the cell.

$\left[\log 10^{-n} = -n\right]$

(b) Define fuel cell and write its two advantages.

View Text Solution

2. (a) Write the cell reaction and calculate the emf of the following cell at 298 K :

$$Sn(s)\left|Sn^{2+}(0.004M)\right|\left|H^{+}(0.020M)\right|H^{2}(g)(1^{-})\ |\ Pt(s)$$

[Given : $E^{\circ}_{Sn^{2+}/Sn} = -0.14V$]

(b) Give reasons :

(i) On the basis of E° values, O_2 gas should be liberated at anode but it is Cl_2 gas which is liberated in the electrolysis of aqueous NaCl.

(ii) Conductivity of CH_3COOH decreases on dilution.

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3. (a) Calcualte E°_{cell} for the following reaction at 298 K

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

Given: $E_{\text{cell}} = 1.98V$

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

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

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4. (a) The conductivity of 0.001 mol L^{-1} solution of CH_3COOH is $3.905 \times 10^{-5} Scm^{-1}$. Calculate its molar conductivity and degree of dissociation (α). Given $\lambda^{\circ}\left(H^{+}\right) = 349.6 Scm^{2} mol^{-1}$ and $\lambda^{\circ}\left(CH_3COO^{-}\right) = 40.9 Scm^{2} mol^{-1}$.

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

View Text Solution

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

Given $:\lambda^{\circ}\left(H^{+}\right) = 349.6 Scm^{2} mol^{-1}$ and $\lambda^{\circ}\left(CH_3COO^{-}\right) = 40.9 Scm^{2} mol^{-1}$

(b) What type of battery is lead storage battery ? Write the overall reaction occurring in lead storage battery.

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6. (a) Calculate ΔG° and log K_c for the following reaction at 298 K :

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

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

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

View Text Solution

7. (a) Define molar conductivity of a solution and explain how molar conductivity changes with change in concentration of solution for a weak and a strong electrolyte.

(b) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500Ω. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is $0.146 \times 10^{-3} Scm^{-1}$?

View Text Solution

8. What type of a battery is the lead storage battery 7 Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery when current is drawn from it.

(b) In the button cell, widely used in watches, the following reaction takes place :

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

Determine E° and ΔG° for the reaction.

[Given: $E^\circ_{Ag^+/Ag} = +0.80V$, $E^\circ_{Zn^{2+}/Zn} = -0.76V$]

View Text Solution

9. (i) What type of a battery is lead storage battery ? Write the anode and cathode reactions and the overall cell reaction occurring in the operation of a lead storage battery. (ii) Calculate the potential for half-cell containing:

0.10 M $K_2Cr_2O_7(aq)$, $0.20MCr^{3+}(aq)$ and $1.0 \times 10^{-4}MH^+$ (aq)

The half-cell reaction is:

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$

and the standard electrode potential is given as $E^\circ = 1.33V$.

View Text Solution

10. (a) State Kohlrausch law of independent migration of ions. Write an expression for the molar conductivity of acetic acid at infinite dilution according to Kohlrausch law.

(b) Calculate Λ_m°, for acetic acid.

Given that $\Lambda_m^\circ(HCl) = 426Scm^2mol^{-1}$

$\Lambda_m^\circ(NaCl) = 126Scm^2mol^{-1}$

$\Lambda_m^\circ(CH_3COONa) = 91Scm^2mol^{-1}$

View Text Solution

11. (a) Two electrolytic cells containing silver nitrate solution and dilute sulphuric acid solution were connected in series. A steady current of 2.5 amp was passed through them till 1.078 g of silver was deposited. [Ag = 107.8 g mol^{-1}, 1 F = 96,500 C]

(i) How much electricity was consumed ?

(ii) What was the weight of oxygen gas liberated ?

(b) Give reason :

(i) Rusting of iron pipe can be prevented by joining it with a piece of magnesium.

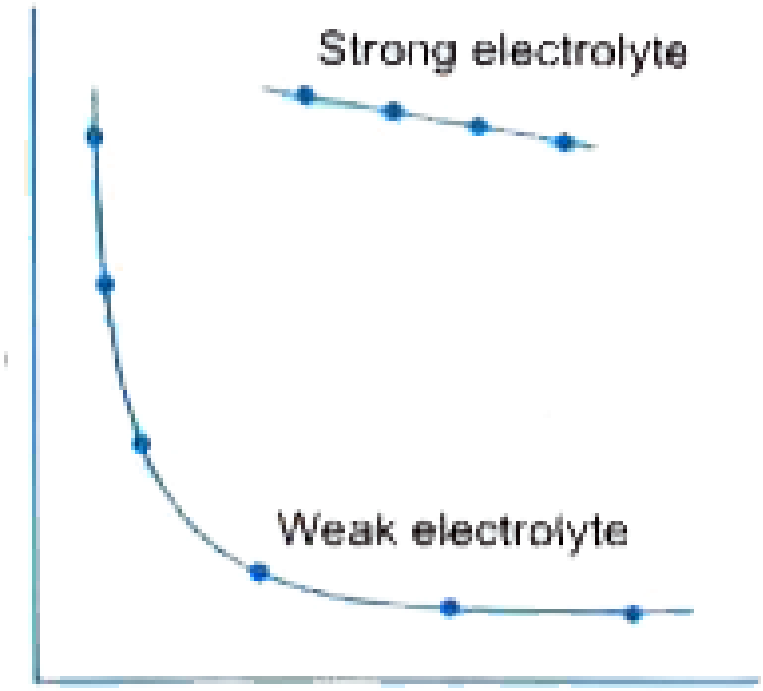
(ii) Conductivity of an electrolyte solution decreases with the decrease in concentration.

View Text Solution

12. Define molar conductivity of a substance and describe how for weak and strong electrolytes, molar conductivity changes with concentration of solute. How is such change explained ? A voltaic cell is set up at 25 °C with the following half-cells :

$Ag^+(0.001M) \mid Ag$ and $Cu^{2+}(0.10M) \mid Cu$

What would be the voltage of this cell ? [E°_{cell} = 0.46 V]



Change of molar conductivity with concentration

View Text Solution

13. (i) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω. What is the cell constant, if the conductivity of 0.001 M KCl solution at 298 K is $0.146 \times 10^{-3} Scm^{-1}$?

(ii) Predict the products of electrolysis in the following

A solution of H_2SO_4 with platinum electrodes.

View Text Solution

14. Consider the figure given alongside and answer the questions (i) to (vi) given below

(i) Give the direction of electron flow.

(ii) Is silver plate the anode or cathode ?

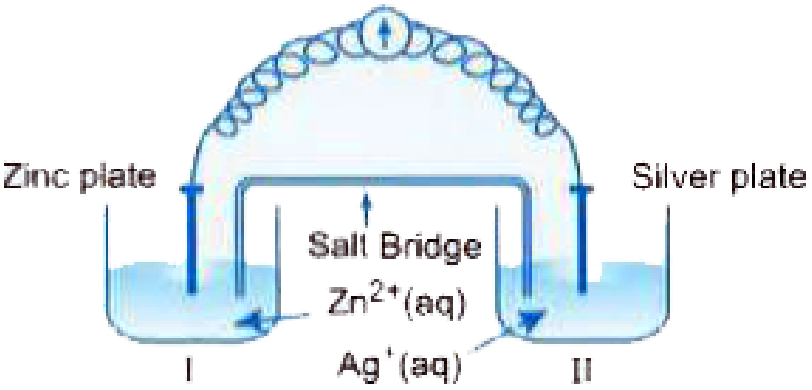
(iii) What will happen if salt bridge is removed ?

(iv) When will the cell stop functioning ? Zinc plate „

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

(vi) How will the concentration of Zn^{2+} ions and Ag^{+} ions be affected

after the cell becomes 'dead' ?



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15. (a) Calculate the equilibrium constant for the reaction :

`Cd^(2+) (aq) + Zn(s) If $E^{\circ}_{Cd^{2+}/Cd} = -0.403V$, $E^{\circ}_{Zn^{2+}/Zn} = -0.763$ V

(b) When a current of 0.75 A is passed through a $CuSO_4$ solution for 25 minutes, 0.369 g of copper is deposited at the cathode. Calculate the atomic mass of copper.

(c) Tarnished silver contains Ag_2S. Can this tarnish be removed by placing tarnished silverware in an aluminium pan containing an inert electrolytic solution such as NaCl. The standard electrode potential for half reaction.

$Ag_2S + 2e^- \rightarrow 2Ag(s) + S^{2-}$ is $-0.71V$ and for $Al^{3+} + 3e^- \rightarrow Al(s)$ is -1.66 V

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16. (i) State the relationship amongst cell constant of a cell, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to conductivity of its solution ?

(ii) A voltaic cell is set up at 25 °C with the following half cell,

$Al\,/\,Al^{3+}(0.001M)$ and $Ni\,/\,Ni^{2+}(0.50M)$

Calcualte the cell voltage: $\left[E^{\circ}_{ni^{2+}\,/\,Ni} = -0.25V, E^{\circ}_{Al^{+}\,/\,Al} = -1.66V\right]$

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Self Assessment Test Section A Multiple Choice Questions Choose The Correct Option

1. MULTIPLE CHOICE QUESTIONS (CHOOSE THE CORRECT OPTION)

A. The half-cell in which oxidation takes place is anode. It has a negative potential with respect to solution.

B. The half-cell in which oxidation takes place is anode. It has a positive potential with respect to solution.

C. The half-cell in which oxidation takes place is cathode. It has a negative potential with respect to solution.

D. The half-cell in which oxidation takes place is cathode. It has a positive potential with respect to solution.

Answer: A

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2. Standard hydrogen electrode has a following composition :

A. Pt electrode $\left[H^+\right] = 1M, p_{H_2} = 1$ bar

B. Ni electrode, $\left[H^+\right] = 0.1M, p_{H_2} = 1$ bar

C. Pt electrode, $\left[H^{+}\right]=1M, p_{H_2}=10$ bar

D. Ni electrode, $\left[H^{+}\right]=1M, p_{H_2}=10$ bar

Answer: A

View Text Solution

3. Nernst equation for cell potential in case of Zn-Cu cell is given by

A. $E_{\text{cell}}=E^{\circ}_{\text{cell}}+\frac{RT}{2F}\frac{\ln\left(\left[Zn^{2+}\right]\right)}{[Cu^{2+}]}$

B. $E_{\text{cell}}=E^{\circ}_{\text{cell}}-\frac{RT}{2F}\frac{\ln\left(\left[Zn^{2+}\right]\right)}{[Cu^{2+}]}$

C. $E_{\text{cell}}=E^{\circ}_{\text{cell}}-\frac{RT}{2F}\frac{\ln\left(\left[Cu^{2+}\right]\right)}{[Zn^{2+}]}$

D. $E_{\text{cell}}=E^{\circ}_{\text{cell}}-\frac{RT}{2T}\frac{\log\left(\left[Zn^{2+}\right]\right)}{[Cu^{2+}]}$

Answer: B

View Text Solution

4. The resistance and resistivity of a conductor is given by

A. $\rho = R\frac{l}{A}$

B. $R = \rho\frac{A}{L}$

C. $R = \rho\frac{l}{A}$

D. $\rho = A\frac{A}{l^2}$

Answer: C

View Text Solution

5. The conductivity of a metal depends upon

A. nature and structure of the metal.

B. number of valence electrons per atom,

C. temperature.

D. all the above.

Answer: D

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6. Assertion (A) : S.I. unit of conductivity is siemen represented by S and is equal to ohm^{-1} or mho or Ω^{-1}.

Reason (R) : Conductivity of an electrolyte depends upon the nature of the electrolyte.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: B

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7. Assertion (A) : Kohlrausch law states that limiting molar conductivity of an electrolyte can be represented as the difference of individual contributions of the anion and the cation.

Reason (R) : A cell in which an external source of voltage is used to bring about a chemical reaction is called electrolytic solution.

A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A)

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

Answer: D

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Self Assessment Test Section B

1. The conductivity of a 0.01 M solution of acetic acid at 298 K is $1.65 \times 10^{-4} Scm^{-1}$. Calculate the molar conductivity (Λ_m) of the solution.

View Text Solution

Self Assessment Test Section C

1. Calculate emf of the following cell at 298 K :

$2Cr(s) + 2Fe^{2+}(0.1M) \rightarrow 2Cr^{3+}(0.01M) + 3Fe(s)$

Given: $E^{\circ}_{Cr^{2+}/Cr} = -0.74V, E^{\circ}_{Fe^{2+}/Fe} = -0.44V$

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Self Assessment Test Section D

1. (a) The conductivity of 0.001 M solution of CH_3COOH is $3.905 \times 10^{-5} Scm^{-1}$. Calculate its molar conductivity and degree of dissociation (α).

Given : $\lambda^{\circ}\left(H^{+}\right) = 349.6 Scm^2 mol^{-1}$ and $\lambda^{\circ}\left(CH_3COO^{-}\right) = 40.9 Scm^2 mol^{-1}$

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

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