CHEMISTRY

BOOKS - MODERN PUBLISHERS CHEMISTRY (HINGLISH)

ELECTROCHEMISTRY

SOLVED EXAMPLES

1. (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 conductivity cell containing $0.001MKCl$ solution at $298K$ is 1500ω.

What is the cell constant if the conductivity of $0.001MKCl$ solution at $298K$ is $0.146 \times 10^{-3} Scm^{-1}$

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

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3. 0.05 M NaOH solution offered a resistance of 31.6 ohm in a conductivity cell at 298 K . If the area of the plates of the conductivity cell is $3.8 cm^2$ and distance between them is 1.4 cm , calculate the molar conductivity of the sodium hydroxide solution .

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4. Select the equivalent conductivity of $1.0 M H_2SO_4$, if its conductivity is $0.26 ohm^{-1} cm^{-1}$:

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5. The resistance of a conductivity cell filled with $0.1MKCl$ solution is 100Ω. If R of the same cell when filled with $0.02MKCl$ solution is 520Ω, calculate the conductivity and molar conductivity of $0.02MKCl$ solution. The conductivity of $0.1MKCl$solution is $1.29Sm^{-1}$.

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6. A conductivity cell when filled with 0.01 M KCl has a resistance of 745Ω at $25^{\circ}C$. When the same cell was filled with an aqueous solution of 0.005 M $CaCl_2$ solution the resistance was 874Ω . Calculate

(i) Conductivity of solution

(ii) Molar conductivity of solution .

[Conductivity of 0.01 M KCl = 0.141 Sm^{-1}]

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7. A potential difference of 20 V applied to the ends of a column of 0.1 M $AgNO_3$ solution 4 cm in diameter and 12 cm in length gave a current of

0.20 amperes . Calculate

(i) conductivity and

(ii) molar conductance of the solution .

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8. The elctrical resistance of a column of $0.05MNaOH$ solution of diameter $1cm$ and length $50cm$ is $5.55 \times 10^3 ohm$. Calculate its resisteivity , conductivity, and molar conductivity.

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

$Concentration(M):$	0.001	0.010	0.020	0.050	0.100
$10^2 \times k\left(Sm^{-1}\right):$	1.237	11.85	23.15	55.53	$1.06.74$

Calculate $\wedge_m$ for all concentrations and draw a plot between $\wedge_m$ and $c^{1/2}$. Find the value of $\wedge_m^\circ$.

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10. Molar conductivities (Λ_m°) at infinite dilution of $NaCl, HCl$ and CH_3COONa arc $126.4, 425.9$ and $91.0 Scm^2mol^{-1}$ respectively. Λ_m° for CH_3COOH will be

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11. The molar conductivities at infinite dilution for NaI, CH_3COONa and $(CH_3COO)_2$ Mg are $126.9, 91.0$ and $187.8 Scm^2mol^{-1}$ respectively at 25° C . What is the molar conductivity of Mgl_2 at infinite dilution ?

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12. The molar conductance of ammonium hydroxide solution of concentration 0.1 M, 0.01M and 0.001 M are 3.6, 11.3 and $34.0 ohm^{-1}cm^2mol^{-1}$ respectively. Calculate the degree of dissociation of NH_4OH at these concentrations. Molar conductance at infinite dilution for Nh_4OH is 271.1 $ohm^{-1}cm^2mol^{-1}$.

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13. Calculate the molar conductivity of a solution of $MgCl_2$ at infinte dilution given that the molar ionic conductivities of $\lambda^\circ\left(Mg^{2+}\right) = 106.1 Scm^2 mol^{-1}$ and $\lambda^\circ\left(Cl^-\right) = 76.3 Scm^2 mol^{-1}$

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14. What will be the molar conductivity of Al 3+ ions at infinite dilution if molar conductivity of $Al^2(SO_4)_3$ is 858 S cm^2 mol^{-1} and ionic conductance of SO_4^{2-} is 160 S $cm^2\text{mol}^{-1}$ at infinite dilution ?

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15. The molar conductivity at infinite dilution for HCl , KCl and $CH_3ClCOOK$ are $4.26 \times 10^{-2}, 1.50 \times 10^{-2}$ and $1.13 \times 10^{-2} Sm^2 mol^{-1}$ respectively . Calculate the molar conductivity at infinite dilution for monochloro acetic acid $(CH_2ClCOOH)$.

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16. The conducitivity of a 0.01 M solution of acetic acid at 298 K is $1.65 \times 10^{-4} Scm^{-3}$. Calculate

(i) Molar conductivity of the solution

(ii) degree of dissociation of CH_3COOH

(iii) dissociation constant for acetic acid

Given that

$\lambda^{\circ}\left(H^{+}\right) = 349.1$ and $\lambda^{\circ}\left(CH_3COO^{-}\right) = 40.9 Scm^2 mol^{-1}$.

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

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18. The conductivity of a solution of AgCl at 298 K is found to be $1.382 \times 10^{-6} \Omega^{-1} cm^{-1}$ the ionic conductance of Ag^{+} and Cl^{-} at infinite dilution are $61.9 \Omega^{-1} cm^{2} col^{-1}$ ad $76.3 \Omega^{-1} cm^{2} mol^{-1}$ respectively the solubility of AgCl is

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19. The molar conductance of acetic acid at infinite dilution is $390.7 Scm^{2} mol^{-1}$. Calculate the molar conductance of 0.01 M acetic acid solution , given that the dissociation constant of a acetic acid is 1.8×10^{-5} .

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20. Calculate the standard electrode potential of the Ni^{2+} / Ni electrode , if the cell potential potential of the cell,

$Ni / N^{2+} (0.01M) / Cuis 0.59 \text{ V}$. Given $E^{\circ}_{Cu^{2+} / Cu} = +0.34 \text{ V}$

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21. Write the half cell reaction and the overall cell reaction for the electrochemical cell :

$Zn\left|Zn^{2+}(1.0M)\right|\left|Pb^{2+}(1.0M)\right|Pb$

Calculate the standard e.m.f. for the cell if standard electrode potentials (reduction) for $Pb^{2+} \mid Pb$ and $Zn^{2+} \mid Zn$ electrode are -0.126 V and -0.763 V respectively.

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22. Br_2 and I_2 are added to a solution containing $1M$ each of Br^{c-} and I^{c-} . What reaction will occur ?

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23. What will be the spontaneous reaction when the following half reactions are combined ?

(i) $Fe^{3+} + e^- \rightarrow Fe^{2+}$, (ii)

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O, \left(E^\Theta = +1.49V\right)$

What is the value of E_{cell}^Θ ?

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24. The half cell reactions with reduction potentials are

$Pb(s) \rightarrow Pb^{+2}(aq), E_{\text{red}}^\circ = -0.13V$

$Ag(s) \rightarrow Ag^+(aq), E_{\text{rod}}^\circ = +0.80V$

Calculate its emf.

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

$\left(E_{Zn^{2+}/Zn} = -0.76V\right)$.

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26. If E° for copper electrode is +0.34 V , will you calculate e.m.f, value when the solution in contact with it is 0.1 M in copper ions . How does e.m.f. for copper electrode change when concentration of Cu^{2+} ion in the solution is decreased ?

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27. Calculate the reduction potential of the following electrode at 298 K :

Pt $Cl_2(2.5$ atm) HCl $(0.01M)$, $E^{\Theta}Cl_2 \mid 2Cl^- = 1.36$ V .

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28. A silver electrode is immersed in a 0.1 (M) $AgNO_3$ solution at $25^{\circ}C$. If $AgNO_3$ dissociates almost completely in the solution, then determine the potential of the silver electrode.

Given : $E^{\circ}_{Ag^+ \mid Ag} = 0.80V.$

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29. At what concetration of Ag^{2+} ions, will the electrode have a potential of 0.0 V?

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30. 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.

(b) Calucluate 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

$$Cr_2O_7^{2-}(aq) + 4H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$$

and the standard electron potential is given as $E^o = 1.33V$.

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31. Calculate the standard electrode potential of the Ni^{2+}/Ni electrode , if the cell potential potential of the cell,

$Ni/N^{2+}(0.01M)/Cuis0.59\ \text{V}$. Given$E^{\circ}_{Cu^{2+}/Cu} = +0.34\ \text{V}$

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32. Write the Nernst equation and calculate the e.m.f. of the following cell at 298 K :

$Cu(s)\left|Cu^{2+}(0.130M)\right|\left|Ag^{+}\left(1.0\times10^{-4}M\right)\right|Ag(s)$

Given : $E^{\Theta}_{(Cu^{2+}|Cu)} = +0.34V$ and $E^{\Theta}_{(Ag^{+}|Ag)} = +0.80\,\text{V}$

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33. Calculate equilibrium constant for the reaction :

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

Given $E^{\circ}_{(Mg^{2+}/Mg)} = -2.37\ \text{V}$, $E^{\circ}_{(Cu^{2+}/Cu)} = 0.34\ \text{V}$

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34. Mark the correct Nernst equation for the given cell.

$F_{(s)}\left|Fe^{2+}(0.001M)\right|\left|H^{+}(1M)\right|H_{2(g)}(1^{-})\mid Pt_{(s)}$ is

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35. Write Nernst equation and calculate e.m.f of the following cells at 298 K :

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

Given : $E^{\ominus}_{(Sn^{2+}\mid Sn)} = -0.14V$

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36. Represent the cell in which following reaction takes place :

$Mg(s)+2Ag^{\oplus}(0.0001M)\rightarrow Mg^{2+}(0.130M)+2Ag(s)$ calculate its E_{cell} if $E^{c-}{}_{.cell} = 3.17V.$

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37. Calculate the e.m.f of the following cell :

$Cd\left|Cd^{2+}(0.01M)\right|\left|H^{+}(0.02M)\right|Pt,\ H_2(0.8\ \text{atm})$

Given : $E^{\circ}\left(Cd^{2+}\mid Cd\right)\ =\ -0.40V$

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38. Calculate E°_{cell} for the following reaction at 298 K :

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

Given : $E_{cell}\ =\ 0.261V$

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39. The EMF of the cell, $Zn\left|Zn^{2+}(0.1M)\right|\left|Cd^{2+}(M_1)\right|Cd$ has been found to be 0.3305 V at 298 K . Calculate the value of $M_1\left[E^{\circ}_{(Zn^{2+}\mid Zn)}\ =\ -0.76V,E^{\Theta}_{(Cd^{2+}\mid Cd)}\ =\ -0.40V\right]$

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40. Write the anode and cathode reactions and the overall reaction occuring in a lead storage battery.

(b) A copper - silver cell is set up. The copperion concentrations is 0.10 M. The concentration of silver ion is not known. The cell potential when measured was 0.422 V. Determine the concentration of silver ions in the cell.

$Given \quad E^{\circ} Ag^{+} / Ag = +0.80V, E^{\circ} \hat{} \ cu^{2+} / Cu = +0.34V$

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41. A cell contains two hydrogen electrodes. The negative electrode is in contact with a solution of $10^{-6} M$ hydrogen ions. The emf of the cell is 0.118 volt at $25^{\circ} C$. Calculate the concentration of hydrogen ions at the positive electrode.

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42. Calculate the equilibrium constant for the reactant at 298 K

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

Given that $E^{\Theta}_{(Ag^{+}|Ag)} = 0.80V$ and $E^{\Theta}_{(Cu^{2+}|Cu)} = 0.34\,\text{V}$.

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43. Calculate the equilibrium constant for the cell reaction :

$4Br^{-} + O_2 + 4H^{+} \rightarrow 2Br_2 + 2H_2O$. Given $E^{\circ}_{cell} = 0.16V$

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44. Calculate $\Delta_r G^{\circ}$ for the reaction :

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

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

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45. Calculate the maximum work that can be obtained from the daniell call given below,

$Zn(s)\left|Zn^{2+}(aq)\right|\left|Cu^{2+}(aq)\right|Cu(s)$. Given that $E^{\circ}_{Zn^{2+}/Zn} = -0.76V$ and $E^{\circ}_{Cu^{2+}/Cu} = +0.34V$.

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46. The zinc /silver oxide cell is used in hearing aids and electric watches .

$Zn \rightarrow Zn^{2+} + 2e^{-}\, E^{\Theta} = -0.76V$

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

Which is oxidised and which is reduced ?

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

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

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

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

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48. Calculate the cell e.m.f. and ΔG for the cell reaction at 298K for the cell.

$Zn(s)\left|Zn^{2+}(0.0004M)\right|\left|Cd^{2+}(0.2M)\right|Cd(s)$

Given, $E^\circ_{Zn^{2+}/Zn} = -0.763V$, $E^\circ_{Cd^{+2}/Cd} = -0.403V$ at $298K$.

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

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49. The value of ΔG° in the Daniell cell has been found to be -212.3 kJ at $25^\circ C$. Calculate equilibrium constant for the reaction.

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50. For the cell reaction,

$Mg|Mg^{2+}(aq.)||Ag^{+}(aq.)|Ag$

calculate the equilibrium constant at $25^{\circ}C$ and maximum work that can be obtained by operating the cell.

$E^{\circ}_{Mg^{2+}/Mg} = -2.37$ volt and $E^{\circ}_{Ag^{+}/Ag} = +0.80$ volt

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51. (b) Estimate the minimum potential difference needed to reduce AI_2O_3 at $500^{\circ}C$ The gibbs energy change for the decomposition reaction $\frac{2}{3}AI_2O_3 \rightarrow \frac{4}{3}AI + O_2$is 960 kJ (F=96500 C mol^{-1})

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52. (a)For the reaction :

$2AgCl(s) + H_2(g)$ (1 atm)

$\rightarrow 2Ag(s) + 2H^{+}(0.1M) + 2Cl^{-}(0.1M), \Delta G^{\circ} = -43600J$ at 25°C.

Calculate the e.m.f. of the cell . [log $10^{-n} = -n$].

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

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53. Determine the values of equilibrium constant (K_c) and ΔG° for the reaction

$Ni(s) + 2Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s), E^\circ = 1.05V.$ (

Given $1F = 96500\text{C mol}^{-1}$)

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54. A solution of $CuSO_4$ is electroysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode ?

(Molar mass of $Cu = 63.5g/mol$)

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55. How many moles of electrons are required to

(i) reduce 1 mol of MnO_4^- to Mn^{2+}

(ii) produce 10.0 g of Al from molten Al_2O_3 ?

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56. How many moles of electrons are given by

(i) 9860 C (ii) a current of 1.5 A for 30 s ?

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57. How many minutes it would take to reduce 0.20 mol of Cu^{2+} to Cu using a current of 10 A .

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58. Calculate how long it will take to deposit 1.0 g of chromium when a current of 1.25 . A flows through a solution of chromium (III) sulphate . (Molar mass of Cr = 52).

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59. How many coulombs are required to deposit 40.5 g of aluminium when the electrode reaction is :

$Al^{3+} + 3e^{-} \rightarrow Al$

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60. How many coulombs are required for the oxidation of $1mol$ of H_2O to O_2?

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61. How many coulombs are required for the oxidation of 1 mol of FeO to Fe_2O_3 ?

(Hint. $Fe^{2+} \rightarrow Fe^{3+} + e^-$)

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62. How many coulombs of electricity are required for the reduction of 1 mole of MnO_4^- to Mn^{2+} ?

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63. How much charge in faraday is required for the reduction of 1 mole of Cu^{2+} ions to Cu ?

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64. On electrolysis, how many coulombs will be required for the reduction of one mode of Al^{3+} to Al ?

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65. A solution of $Ni(NO_3)_2$ was electrolysed between platinum electrodes using current of 5 amp for 30 min . What is the mass of Ni deposited at the cathode ?

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66. How many hours does it take to reduce 3 mol of Fe^{3+} to Fe^{2+} with 2.0 A current ? (F= 96500 C)

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67. Three electrolytic cells A, B and C containing solutions of zinc sulphate, silver nitrate and copper sulphate, respectively are connected in series. A steady current of 1.5 ampere was passed through them until 1.45 g of silver were deposited at the cathode of cell B. How long did the current flow? What mass of copper and what mass of zinc were deposited in the concerned cells? (Atomic masses of Ag = 108, Zn = 65.4, Cu = 63.5)

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68. In the electrolysis of acidulated water, it is desired to obtain 1.12 cc of hydrogen per second under STP condition. The current to be passed is:

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69. Predict the products of electrolysis of an aqueous solution of $CuBr_2$.

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70. 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 ?

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71. 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 ?

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72. How many moles of mercury will be produced by electrolysing 1.0 M $Hg(NO_3)_2$ solution by a current of 2.0 A when passed for 3 hours ?

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PROBLEMS

1. The conductivity (k) of a saturated solution of $AgBr$(1M) at $298K$ is $8.5 \times 10^{-7} Scm^{-1}$. If $\lambda^{\circ}_{Ag^+}$ and $\lambda^{\circ}_{Br^-}$ are 62 and $78 Scm^2 mol^{-1}$, respectively, then calculate the solubility and K_{sp} of $AgBr$.

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2. The conductance of 0.0015 M aqueous solution of a weak monobasic acid was determined by using a conductivity cell consisting of platinized Pt electrodes. The distance between the electrodes is 120 cm with an area of cross-section of $1cm^2$. The conductance of this solution was found to

be $5 \times 10^{-7} S$. The pH of the solution is 4. Calculate the value of limiting molar conductivity.

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3. The limiting molar conductance of sodium chloride, potassium chloride and potassium bromide are 126.45 , 149.86 and 151.92 $ohm^{-1} cm^2 mol^{-1}$ respectively . Calculate limiting molar ionic conductance of Na^+ given that limiting molar ionic conductance of Br^- ion is 76.34 $ohm^{-1} cm^2 mol^{-1}$

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4. For the cell reaction :

$Sn(s) + Pb^{2+}(aq) \rightarrow Sn^{2+}(aq) + Pb(s)$

$E^{\circ}_{Sn^{2+}|Sn} = -0.140, E^{\circ}_{Pb^{2+}|Pb} = -0.126V$

Calculate the ratio of concentration of Pb^{2+} to Sn^{2+} ion at which the cell reaction be reversed .

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5. The reduction potential for the two half cell reactions are :

$Cu^{2+} + e^- \rightarrow Cu^+, E^\circ = 0.15V$

$Cu^+ + e^- \rightarrow Cu, E^\circ = 0.50V$

Calculate reduction potential for the following reaction :

$Cu^{2+} + 2e^- \rightarrow Cu$

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6. Consider an electrochemical cell :

$A(s)\left|A^{n+}(aq.\ 2M)\right|\left|B^{2n+}(aq.\ 1M)\right|B(s)$. The value of ΔH° for the cell reaction is twice that of ΔG° at 300 K. If the emf of the cell is zero, the $\Delta S^\circ\left(\text{in}\ \ JK^{-1}mol^{-1}\right)$ of the cell reaction per mole of B formed at 300 K is _____ .

(Given : In (2) = 0.7, R (universal gas constant) = 8.3 J $K^{-1}mol^{-1}$. H, S and G are enthalpy, entropy and Gibbs energy, respectively.)

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7. Silver is electro-deposited on a metallic vessel of surface area 900 cm^2 by passing a current of 0.5 ampere for 2 hours. Calculate the thickness of silver deposited, given that its density is 10.5 g cm^{-3}. (At. mass of Ag=108 amu).

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8. Chromium metal can be plated out from an acidic solution containing CrO_3 according to the following equation.

$$CrO_3(aq) + 6H^+(aq) + 6e^- \rightarrow Cr(s) + 3H_2O$$

Calculate (i) How many grams of chromium will be plated out by 24,000 C and (ii) How long will it take to plate out 1.5g of chromium by using 12.5 current?

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9. Chromium metal can be plated out from an acidic solution containing CrO_3 according to the following the reaction:

$$CrO_3 + 6H^+ + 6e^- \rightarrow Cr + 3H_2O$$

How long will it take to plate out 1.5 gm of Cr using 12.5 ampere current ?

(Atomic weight of Cr =52, 1F =96500 C)

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10. An aqueous solution of an unknown salt of palladium is electrolysed to a current of 3.0 A passing for 1 hr . During electrolysis 2.977 g of palladium ions are reduced at the cathode . What is the charge on the palladium ions in solutions ?

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11. A current of 1.5 A is passed through 500 mL of 0.25 M solution of zinc sulphate for 1 hr with a current efficiency of 90% . Calculate the final molarity of Zn^{2+} assuming volume to be constant .

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PRACTICE PROBLEMS

1. The resistance of 0.05 M NaOH solution is 31.6Ω and its cell constant is $0.357cm^{-1}$. Calculate its conductivity and molar conductivity.

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2. The resistance of 0.01 M $AgNO_3$ solution dipped in a conductivity cell at $25^{\circ}C$ was 1412 ohms. If the molar conductivity of this solution $132.6ohm^{-1}cm^2mol^{-1}$, what is the cell constant of the conductivity cell ?

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3. Calculate the resistance of 0.01 N solution of an electrolyte whose equivalent conductivity is 420 $ohm^{-1}cm^2 \equiv^{-1}$. (The cell constant of the cell is 0.88 cm^{-1})

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4. The resistance of 0.5 N solution of an electrolyte in a conductivity cell was found to be 25 ohm. Calculate the equivalent conductivity of the solution if the electrodes in the cell are 1.6 cm apart and have an area of $3.2cm^2$

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5. A conductance cell was filled with a 0.02 M KCl solution which has a specific conductance of $2.768 \times 10^{-3} ohm^{-1}cm^{-1}$. If its resistance is 82.4 ohm at 25° C the cell constant is:

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6. The conductivity of a solution containing 1.0 g of anhydrous BaCl, in 200 cm of the solution has been found to 0.0058 S cm^{-1}. Calculate the molar conductivity and equivalent conductivity of the solution.

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7. The resistance of a 0.5 M solution of an electrolyte was found to be 30 Ω enclosed between two platinum electrodes. Calculate the molar conductivity of the solution if the electrodes in the cell are 1.5 cm apart and having an area of cross section 2.0 cm^2?

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8. A conductivity cell when filled with 0.02 M KCl (conductivity = 0.002768 $\Omega^{-1}cm^{-1}$) has a resistance of 457.3 Ω. What will be the equivalent conductivity of $0.05NCaCl_2$ solution if the same cell filled with this solution has a resistance of 2020?

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9. When a certain conductance cell was filled with 0.1 mol L^{-1}KCl, it has a resistance of 85Ω at 25°C. When the same cell was filled with an aqueous solution of 0.052 mol L^{-1} of an electrolyte solution, the resistance was 96 Ω . Calculate the molar conductivity of the electrolyte at this concentration (Conductivity of 0.1 $molL^{-1}$ KCl solution is $1.29 \times 10^{-2}S$ cm^(-)`)

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10. The resistance of a conductivity cell with 0.1 M KCl solution is found to be 2002 at 298 K. When the same cell was filled with 0.02 M NaCl solution, the resistance at the same temperature is found to be 1100Ω. Calculate:

(i) the cell constant of the cell in m^{-1}

(ii) the molar conductivity of 0.02 M NaCl solution in Sm^2mol^{-1}

Given : Conductivity of 0.1 M KCl solution at 298 K = $1.29Sm^{-1}$

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11. The molar conductance of 0.05 M solution of $MgCl_2$ is 194.5 $\Omega^{-1}cm^2mol^{-1}$ at $25^\circ C$. A cell with electrodes having 1.50 cm^2 surface area and 0.50 cm apart is filled with 0.05 M solution of $MgCl_2$. How much current will flow when the potential difference between the electrodes is 5.0V?

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12. Specific conductivity of N/35 KCl at 298 K is 0.002768 $ohm^{-1}cm^{-1}$ and it has resistance of 520 ohm. A N/25 solution of a salt kept in the same cell was found to have a resistance of 300 ohm at 298 K. Calculate equivalent conductance of the solution.

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13. The molar conductivity of KCl solution at different concentrations at $298K$ is given below :

c or $M\left(molL^{-1}\right)$	$\wedge_m\left(Scm^2mol^{-1}\right)$
0.000198	148.61
0.000309	148.29
0.000521	147.81
0.000989	147.09

Show that a plot between $\wedge_m$ and $\sqrt{c}$ is a straight line. Determine the value of $\wedge_m^\circ$ and A for KCl.

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14. Calculate the degree of dissociation (α) of acetic acid if its molar conductivity ($\wedge_m$) is 39.05 Scm^2mol^{-1}

Given

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

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15. Calculate the molar conductivity at infinite dilution of AgCl from the following data:

$\Lambda^\circ(AgNO_3) = 13.34mSm^2mol^{-1}$, $\Lambda^\circ(KCl) = 14.99mSm^2mol^{-1}$ and $\Lambda^\circ(KNO_3) = 14.40mSm^2mol^{-1}$

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16. The Λ° values of KNO_3 and $LiNO_3$ are 145.0 and 110.1 Scm^2mol^{-1} respectively . The λ° value for K^+ ion is $73.5Scm^2mol^{-1}$. Calculate $\lambda^\circ\left(Li^+\right)$.

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17. 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).

$\left(\text{Given}: \lambda^\circ_{(H^+)} = 349.65Scm^2mol^{-1} \text{ and } \lambda^\circ\left(CH_3COO^-\right) = 40.9Dcm^2r\right.$

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18. Molar conductivities at infinite dilution (at 298 K) of NH_4CI, NaOH and NaCI are 129.8, 217.4 and 108.9 $\Omega^{-1}cm^2mol^{-1}$ respcetively. If the molar conductivity of a centimolar solution of NH_4OH is 9.33

$\Omega^{-1}cm^2mol^{-1}$, what is percentage dissociation of NH_4OH at this concentation ? Also calculte the dissociation constant for NH_4OH.

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19. Molar conductivities at infinite dilution (at 298 K) of NH_4CI, NaOH and NaCI are 129.8, 217.4 and 108.9 $\Omega^{-1}cm^2mol^{-1}$ respcetively. If the molar conductivity of a centimolar solution of NH_4OH is 9.33 $\Omega^{-1}cm^2mol^{-1}$, what is percentage dissociation of NH_4OH at this concentation ? Also calculte the dissociation constant for NH_4OH.

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20. The conductivity of 0.1 M solution of $AgNO_3$ is $9.47 \times 10^{-3} Scm^{-1}$ at 291 K . The ionic conductivities of Ag^+ and NO_3^- at the same temperature are 55.7 and $50.8 Scm^2 \text{equiv}^{-1}$ respectively . Calculate the degree of dissociation of $AgNO_3$ in 0.1 M solution .

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21. The molar conductivity of $0.025 molL^{-1}$ methanoic acid is $46.1 Scm^2 mol^{-1}$. Its degree of dissociation (α) and dissociation constant. Given $\lambda^\circ\left(H^+\right) = 349.6 Scm^{-1}$ and $\lambda^\circ\left(HCOO^-\right) = 54.6 Scm^2 mol^{-1}$.

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22. $\wedge^\circ{}_m$ for $CaCl_2$ and $MgSO_4$ from the given data.

$\lambda^\circ_{Ca^{2+}} = 119.0 Scm^2 mol^{-1}$ ltbr. $\lambda^\circ_{Cl^{c-}} = 76.3 Scm^2 mol^{-1}$

$\lambda^\circ_{Mg^{2+}} = 106.0 Scm^2 mol^{-1}$

$\lambda^\circ_{SO_4^{2-}} = 160.0 cm^2 mol^{-1}$

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23. The conductivity of $0.001028 molL^{-1}$ acetic acid is $4.95 \times 10^{-5} Scm^{-1}$. Calculate its dissociation constant if $\wedge (m)^0$ for acetic acid id $390.5 Scm^2 mol^{-1}$.

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24. At $25^\circ C$, the molar conductances at infinite dilution for the strong electrolytes

$NaOH, NaCl$ and $BaCl_2$ are $248 \times 10^{-4}, 126 \times 10^{-4}$ and $280 \times 10^{-$

respectively. $\Lambda_m^\circ Ba(OH)_2$ in $Sm^2 mol^{-1}$

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25. The conductivity of a saturated solution of $BaSO_4$at 298 K , is found to be $3.758 \times 10^{-6} ohm^{-1} cm^{-1}$ and that of water used is $1.36 \times 10^{-6} ohm^{-1} cm^{-1}$. Molar ionic conduntances at infinite dilution for Ba^{2+} and SO_4^{2-} ions are 110 and $136.6 ohm^{-1} cm^2 mol^{-1}$ respectively . Calculate the solubility of $BaSO_4$ at 295 K (Atomic masses : Ba = 137 , S = 32 , O = 16)

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26. An iron wire is immersed in a solutin containg $ZnSO_4$ and $NiSO_4$. Predict giving reason which of the following reactions is likely to proceed ?

(i) Iron reduces Zn^{2+} ions (ii) Iron reduces Ni^{2+} ions. Given : $E^{\circ}_{Zn^{2+}/Zn} = -0.76$ volt, $E^{\circ}_{Fe^{2+}/Fe} = -0.44$ volt and $E^{\circ}_{Ni^{2+}/Ni} = -0.25$ volt

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27. Can a solution of 1 M copper sulphate be stored in a vessel made of nickel metal ? Given that $E_{Ni^{-2}/Ni} = -0.25$ volt and $E^{\circ}_{Cu^{-2}/Cu} = +0.34$ volt

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28. What is the standard e.m.f of the cell containing $Sn^{2+} \mid Sn$ and $Br_2 \mid Br^-$ electrodes ?

$E^{\Theta}\left(Sn^{2+} \mid Sn\right) = -0.14V, E^{\Theta}\left(Br_2 \mid Br^-\right) = 1.08V\Big)$

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29. Calculate the standard reduction potential of $Ag^{+}|Ag$ electrode when the cell potential for the cell , $Cu(s)|Cu^{2+}(1M)|\ |\ Ag^{+}(1M)Ag$ is 0.46 V . Given that $Cu^{2+}\ |\ Cu = 0.34\,\text{V}$

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

$2Cr_s + 3Cd_{aq}^{+2} \rightarrow 2cr_{aq}^{+3} + 3Cd_s$

Given $E_{Cr^{+3}/Cr} = -0.74(V) E^{\circ}\_\left(Cd^{+2}/Cd\right) = -0.04(V)$

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31. Calculate the standard reduction potentials of galvanic cells in which reaction are

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

Given that $E^{\Theta}\left(Cr^{3+}/Cr\right) = -0.74V, E^{\Theta}\left(Cd^{2+}/Cd\right) = -0.40V$,

$E^{\Theta}\left(Fe^{3+}/Fe^{2+}\right) = 0.77V, E^{\Theta}\left(Ag^{+}/Ag\right) = 0.80V$

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32. Can chlorine gas be stored in a copper cylinder ? Given $E^{\Theta}\left(Cu^{2+}/Cu\right) = 0.34V$ and $E^{\Theta}\left(Cl_2/Cl^{-}\right) = 1.36V.$

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33. Why blue colour of $CuSO_4$ solution gets discharged when zinc rod is dipped in it ? Given, $E^{\circ}_{Cu^{+2}/Cu} = 0.34V$ and $E^{\circ}_{Zn^{+2}/Zn} = -0.76V$

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34. A copper wire is dipped in silver nitrate solution in beaker A and a silver wire is dipped in a solution of copper sulphate kept in a beaker B . If

the standard electrode potential for

$Cu^{2+} + 2e^- \rightarrow Cu$ is +0.34 for $Ag^+ + e^- \rightarrow Ag$ is 0.80 V

Predict in which beaker the ions present will get reduced ?

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35. Calculate the value of equilibrium constant for the reaction :

$2Fe^{3+} + 2I^- \rightarrow 2Fe^{2+} + I_2$

Given that $E^{\circ}_{cell} = 0.235 \text{ V}$

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36. Calculate K_c for the reaction :

$NiO_2 + 2Cl^- + 4H^+ \Leftrightarrow Cl_2 + Ni^2 + 2H_2O$ at 298 K if E^{Θ}_{cell} is 0.320 V .

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37. Calculate at 25° C , the equilibrium constant for the reaction :

$2Fe^{3+} + Sn^{2+} \Leftrightarrow 2Fe^{2+} + Sn^{4+}$

Given that $E^{\Theta}_{(Fe^{3+}|Fe^{2+})} = 0.771V$, $E^{\Theta}_{(Sn^{4+}|Sn^{2+})} = 0.150V$

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38. For a cell reaction :

$A(s) + 2B^{+}(aq) \rightarrow A^{2+}(aq) + 2B(s)$ the equilibrium constant 1×10^{4} . Calculate E^{Θ}_{cell} .

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39. Calculate equilibrium constant for the reaction :

$Zn + Cd^{2+} \Leftrightarrow Zn^{2+} + Cd,$

(Given $E^{\circ}_{cell} = 0.36\text{V}$)

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40. Calculate ΔG^{Θ} and the equilibrium constant for the cell reaction ,

$Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$

Given that $E^{\Theta}_{Cl_2\ Cl^-} = 1.36V, E^{\Theta}_{I_2\ I^-} = 0.536V$

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41. The cell in which the following reaction occurs

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

$E^0_{cell} = 0.236V$ at 298 K.

Calculate the stadard gibbs energy and the equilibrium constant of the cell reaction.

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42. Calculate ΔG^{Θ} and E_{cell} for the cell

$Al|Al^{3+}(0.01M)||Fe^{2+}(0.02M)|Fe$

Given that $E^{\Theta}_{(Al^{3+}|Al)} = -1.66V$ and $E^{\Theta}_{(Fe^{2+}|Fe)} = -0.44V$

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

$2Cr_s + 3Cd_{aq}^{+2} \rightarrow 2cr_{aq}^{+3} + 3Cd_s$

Given $E_{Cr^{+3}/Cr} = -0.74(V) E^{\circ}\_\left(Cd^{+2}/Cd\right) = -0.04(V)$

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44. Write the Nernst equation and calculate the value of ΔG^{Θ} for the galvanic cell

$Cu(s)\left|Cu^2 + (0.130M)\right|\left|Ag^+\left(1.00 \times 10^{-4}M\right)\right|Ag(s)$

Given $E^{\Theta}_{Cu^{2+}|Cu} = 0.34V, E^{\Theta}_{Ag^+|Ag} = 0.80V$

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45. (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 $Ag = 108 gmol^{-1} 1F = 96500 Cmol^{-1}$)

(b) Define fuel cell

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46. When a current of 0.75 A is passed through a $CuSO_4$ solution for 25 min , 0.369 g of copper is deposited . Calculate the atomic mass of copper .

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47. How many grams of chlorine can be produced by the electrolysis of molten NaCl with a current of 1.0A for 15 min ?

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48. How many coulombs are required for the oxidation of 1 mol of FeO to Fe_2O_3 ?

(Hint. $Fe^{2+} \rightarrow Fe^{3+} + e^{-}$)

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49. How many coulombs are required for the oxidation of $1mol$ of H_2O to O_2?

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50. How many coulombs of electricity are required for the process :

(iii) reduction of 1 mol of F_2 to $2F^{-}$?

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51. The same quantity of electrical charge that deposited 0.583 g of silver was passed through a solution of gold salt and 0.355 g of gold was formed . What is the oxidation state of gold in this salt ?

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52. How many hours does it require to reduce 3 mol of Fe^{3+} to Fe^{2+} by passing 2.00 A current ?

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53. What current in amperes is required to produce 50.0 ml of O_2 gas measured at STP by electrolysis of water for a period of 3 hrs ?

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54. How many Faradays of electricity are required to deposit 10 g of calcium from molten calcium chloride using inert electrodes? (Molar mass of calcium = $40 gmol^{-1}$)

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55. How much electricity in terms of Faradays is required to produce ?

81 g of Al from molten Al_2O_3

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56. Silver is electro-deposited on a metallic vessel of surface area 800 cm^2 by passing a current of 0.2 ampere for 3 hours. Calculate the thickness of silver deposited given that its density is 10.47 g cm^{-3}. (At mass of Ag =107.92).

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57. How much electricity in terms of Faraday is required to produce $40.0g$ of Al from molter Al_2O_3?

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CONCEPTUAL QUESTIONS

1. What is the relationship between equivalent conductance and molar conductance ? Illustrate by taking the example of $Al_2(SO_4)_3$.

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2. (a) Define the following terms :

(i) Limiting molar conductivity,

(ii) Fuel cell

(b) Resistance of a conductivity cell filled with $0.1 mol L^{-1} KCl$ solution is 100 W. If the resistance of the same cell when filled with $0.2 mol L^{-1} KCl$ solution is 520 W , calculate the conductivity and molar conductivity of $0.2 mol L^{-1} KCl$ solution. The conductivity of $0.1 mol L^{-1} KCl$ solution is $1.29 \times 10^{-1} W^{-1} cm^{-1}$.

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3. Calculate the osmotic pressure of a solution containing $0.02 mol$ of $NaCl$ and $0.03 mol$ of glucose in $500 mL$ at $27^{\circ} C$.

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4. Why is not possible to determine Λ_m^∞ for weak electrolytes by extrapolation ?

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5. What are the units of cell constant

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

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7. Which out of 0.1 M HCl and 0.1 M NaCl, do you expect to have greater Λ_m^∞ and why ?

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8. Which of the following pairs , will have greater conduction ?

(i) 0.1M acetic acid solution or IM acetic acid solution .

(ii) 0.1M NaCl solution at $25^\circ C$ and 0.1 M NaCl solution at $50^\circ C$.

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9. Which of the following pairs , will have greater conduction ?

(i) 0.1M acetic acid solution or IM acetic acid solution .

(ii) 0.1M NaCl solution at $25^\circ C$ and 0.1 M NaCl solution at $50^\circ C$.

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10. Copper wire test is called

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11. If cell constant is $0.40cm^{-1}$, the conductivity of 0.015 M NaCl solution having R = 1850 ohm is equal to

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12. Define electric power and give its unit.

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13. Write an expression for molar conductivity of acetic acid at infinite dilution according to Kohlrausch's law.

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14. Can conductivity alone be used to compare the conductance of (i) metallic conductor (ii) Electrolytic conductors?

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

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16. Calculate limiting molar conductivity of $CaSO_4$ given that limiting molar conductivity of calcium and sulphate ions are 119.0 and $160.0 \text{ S } cm^2 mol^{-1}$ respectively.

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17. A 0.01 M solution of $MgCl_2$ is diluted by adding water . What will happen to its conductivity and molar conductivity ?

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18. Arrange the following solutions in the decreasing order of specific conductance.

(i) 0.01 M NaCl (ii) 0.05 M NaCl (iii) 0.1 M NaCl (iv) 0.5 M NaCl

Watch Video Solution

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

Watch Video Solution

20. Write the name of the cel which is generally used in hearing aids. Write the reactions taking place at the anode and the cathode of this cell.

Watch Video Solution

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

Watch Video Solution

22. 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.

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23. From the given cells :

Lead storage cell , Mercury cell , Fuel cell and Dry cell

Answer the question

Which cell is used in hearing aids ?

Watch Video Solution

24. From the given cells, Lead storage cell, Mercury cell, Fuel cell and Dry cell

Answer the following :

(ii) Which cell was used in Apollo Space Programme ?

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25. Name the electrolyte used in fuel cell and mercury cell.

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26. Which cell does not have performed cell wall ?

Watch Video Solution

27. 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 ?

$E^\circ_{(A^{2+}/A)} = -2.37V, E^\circ_{(B^{2+}/B)} = 0.14V$

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

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

$Mg^{2+}/Mg = -2.37V, Cr^{3+}/Cr = -0.74V, Fe^{2+}/Fe = -0.44V$

.

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

Or

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

$MnO\bar{4}(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l), E^\circ = +1.51V,$

$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^-, E^\circ = +0.15^V$ constructredox equation and predict if the rech on is rectant or product favoured.

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29. What is the free energy change (ΔG) for galvanic and electrolytic cel

?

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30. The chemical change in an electrolytic cell is non $-$ spontaneous.

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31. Is it safe to stir 1M $AgNO_3$) solution with copper spoon? Given: $E^\circ Ag^+ / ag = 0.80V, E^\circ Cu^{2+} / Cu^{2+} / Cu = 0.34V$

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32. Aerial oxidation gradually changes Fe^{2+} ions to Fe^{3+} ions. Which of the following should be added to Fe^{2+} ions to prevent this from happening?

Use $E^{\circ}_{Fe^{3+}/Fe^{2-}} = +0.771V$, $E^{\circ}_{Cu^{2+}/Cu} = +0.34V$.

$E_{Mg^{2+}/Mg} = -2.37V$

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33. Two metals A and B have reduction potential values $-0.76V$ and $+0.34V$ respectively. Which of these will liberate H_2 from dil.H_2SO_4 ?

Watch Video Solution

34. In corrosion of iron

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35. What is the role of $ZnCl_2$ in dry cell ?

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36. When the silver electrode having reduction potential 0.80 V is attached to NHE , will it act as anode or cathode ?

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

Watch Video Solution

38. How does conc. of sulphuric acid change in lead storage battery when current is drawn from it ?

Watch Video Solution

39. carbon in carbon dioxide is

Watch Video Solution

40. Why is it not possible to measure the single electrode potential ?

Watch Video Solution

41. Why a dry cell becomes dead after a long time even if it is not used ?

Watch Video Solution

42. Why does the cell potential of mercury cell remain constant throughout its life ?

Watch Video Solution

43. Equilibrium constant K is related to E°_{cell} and not E_{cell} because

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44. How can the electrode potentail of an electrode be increased ?

Watch Video Solution

45. E^{θ} values of MnO_4^-, Ce^{4+} and Cl_2 are 1.507, 1.61 and 1.358 V respectively. Arrange these in order of increasing strength as oxidizing agent.

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46. If $E^{\circ}_{Fe^{3+}/Fe}$ and $E^{\circ}_{Fe^{2+}/Fe}$ are $-0.36V$ and $0.439V$ respectively, then value of $E^{\circ}_{Fe^{3+}/Fe^{2+}}$ is

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47. The electrode potentials are :

$O_2 + 4e^{-} + 4H^{+} \rightarrow 2H_2O$

$Ce^{4+} + e^{-} \rightarrow Ce^{3+}$

Will Ce^{4+} oxidize H_2O to O_2 in acidic solution ?

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48. Define corrosion. What is the chemical formula of rust ?

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49. Can we store copper sulphate solution in zinc vessel ?

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50. Which is an extensive property?

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51. What is the use of platinum foil in an SHE ?

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NCERT FILE NCERT (IN -TEXT QUESTIONS)

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

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2. Can we store copper sulphate solution in zinc vessel ?

Watch Video Solution

3. Consult the table of standard electrode potential and suggest three substances that can oxidize Fe^{2+} ions under suitable conditions.

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

Watch Video Solution

5. Calculate the e.m.f. of the cell in which the following reaction takes place :

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

Given E°_{cell}=1.05 v

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6. The cell in which the following reaction occurs

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

$E^0_{cell} = 0.236V$ at 298 K.

Calculate the stadard 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 ?

Watch Video Solution

8. Suggest a way to determine $\wedge_{m^\circ}$ value of water.

Watch Video Solution

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

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10. If a current of $0.5A$ 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 a 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 mole of $Cr_2O_7^{2-}$ ions ?

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13. Write the CHMemistry of reCHMarging of lead storage battery highlighting all the materials that are involved during reCHMarging.

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

Watch Video Solution

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

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NCERT FILE NCERT (TEXTBOOK EXERCISES)

1. Arrange the following metals in the order in whiCHM they displace eaCHM other from the solution of their salts. $Al, Cu, Fe, Mg,$ and $Zn.$

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2. Given the standard electrode potentials, $K^+ \mid K = -2.93V$, $Ag^+ \mid Ag = 0.80V$, $Hg_2^{2+} \mid Hg = 0.79V$, $Mg_2^{2+} \mid Mg = -2.73V$, $Cr_2^{3+} \mid Cr = -0.74V$. Arrange these metals in increasing order of their reducing power.

Watch Video Solution

3. Depict the galvanic in whiCHM the reaction :

$Zn(s) + 2Ag^{\oplus}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$ takes place.

Further show :

$a.$ WhiCHM of the electrode is negatively CHMarged ?

$b.$ The carriers of the current in the cell.

$c.$ Individual reaction at eaCHM electrode.

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

$2Cr_s + 3Cd_{aq}^{+2} \rightarrow 2cr_{aq}^{+3} + 3Cd_s$

Given $E_{Cr^{+3}/Cr} = -0.74(V) E^{\circ}\_\left(Cd^{+2}/Cd\right) = -0.04(V)$

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5. Calculate the standard cell potential (in V) of the cell in which following reaction takes place:

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

Given that $E^{0}_{Ag^{+}/Ag} = xV$, $E^{0}_{Fe^{2+}/Fe} = yV$, $E^{0}_{Fe^{3+}/Fe} = zV$

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6. Write the Nernst equation and EMF of the following cells at $298K$:

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

b. $Fe(s)\left|Fe^{2+}(0.001M)\right|H^{\oplus}(1M)|H_2(g)(1bar)|Pt(s)$

c. $Sn(s)\left|Sn^{2+}(0.050M)\right|\left|H^{\oplus}(0.020M)\right|H_2(g)(1bar)\mid Pt(s)$

d. $Pt(s)|Br_2(1)|Br^{c-}(0.010M)\left|\left|H^{\oplus}(0.030M)\right|H_2(g)(1bar)\right|Pt(s)$

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

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

Determine $\Delta_r G^{c-}$ and E^{c-} for the reaction.

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8. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

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

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

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11. The conductivity of sodium Chloride at $298K$ has been determine at different concentrations and the results are given below :

$Concentration(M):$	0.001	0.010	0.020	0.050	0.100
$10^2 \times k\left(Sm^{-1}\right):$	1.237	11.85	23.15	55.53	$1.06.74$

Calculate $\wedge_m$ for all concentrations and draw a plot between $\wedge_m$ and $c^{1/2}$. Find the value of $\wedge_m^\circ$.

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

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13. How many coulombs are required for the following reductions ?

(i) 1 mole of Ag^+ ions to Ag

(ii) 1 mole of Cu^{2+} ions to Cu

(iii) 1 mole of MnO_4^- ions to MnO_4^{2-}

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14. How much electricity in terms of Faraday is required to produce $20g$ of Ca from molten $CaCl_2$?

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15. How much electricity in terms of Faraday is required to produce $40.0g$ of Al from molter Al_2O_3?

Watch Video Solution

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

(a) 1 mol of H_2O to O_2,

(b) 1 mole of FeO to Fe_2O_3 ?

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17. A solution of $Ni(NO_3)_2$ is electrolyzed between platium electrodes using a current of $5A$ for $20min$. What mass of Ni is deposited at the cathode ?

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18. Three electrolytic cell $A, B,$ and C contaning solutions of $ZnSO_4$, $AgNO_3$, and $CuSO_4$, respectively, are connected in series. A steady current of $1.5A$ was passed through them until $1.45g$ of silver deposited at the cathode of cell B. How long did the current flow ? What mass of copper and zinc were deposited ?

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19. Predict whether reaction will occur between the pairs given below :

Fe^{3+} and I^-

[Given $E_{Fe^{3+}|Fe^{2+}} = +0.77V, E_{\left(\frac{1}{2}\right)I_2|I^-} = +0.54V, E^{\circ}_{Ag^+|Ag} = +0$

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20. The standard cell potential for the cell

$Zn|Zn^{2+}(1M)||Cu^{2+}(1M)|Cu$

given $E^{\circ}_{Cu^{2+}/Cu} = 0.34V$

and $E^{\circ}_{Zn^{2+}/Zn} = -0.76V$ is

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21. Predict if the reaction between is feasible :

$Fe^{3+}(aq)$ and $Br^-(aq)$

Given standard electrode potentials :

$E^{\Theta}_{1/2}I_2/I^- = 0.54V, E^{\Theta}_{1/2}Cu^{2+}/Cu = 0.34V, E^{\Theta}_{1/2}Br_2/Br^- = 1.09V,$

V and $E^{\Theta}_{1/2}Fe^{3+}/Fe^{2+} = 0.77V$

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22. Predict if the reaction between is feasible :

$Ag(s)$ and $Fe^{3+}(aq)$

Given standard electrode potentials :

$E^{\Theta}_{1/2}I_2/I^- = 0.54V, E^{\Theta}_{1/2}Cu^{2+}/Cu = 0.34V, E^{\Theta}_{1/2}Br_2/Br^- = 1.09V,$

V and $E^{\Theta}_{1/2}Fe^{3+}/Fe^{2+} = 0.77V$

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23. Predict if the reaction between is feasible :

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

Given standard electrode potentials :

$E^{\Theta}_{1/2}I_2/I^- = 0.54V, E^{\Theta}_{1/2}Cu^{2+}/Cu = 0.34V, E^{\Theta}_{1/2}Br_2/Br^- = 1.09V,$

V and $E^{\Theta}_{1/2}Fe^{3+}/Fe^{2+} = 0.77V$

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Watch Video Solution

24. Give products of electrolysis of an aqueous solution of $AgNO_3$ with silver electrode.

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25. Give products of electrolysis of an aqueous solution of $AgNO_3$ with silver electrode.

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26. Predict the products of electrolysis of a solution of H_2SO_4 using platinum electrodes.

Watch Video Solution

27. Predict the product of electrolysis of an aqueous solution of $CuCl_2$ with an inert electrode.

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NCERT FILE NCERT NCERT EXEMPLAR PROBLEMS (MULTIPLE CHOICE QUESTIONS (TYPE - I))

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

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

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

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

D. Pt (s) $|H_2(g,$ 1 bar) $|H^+$ (aq., 0. 1 M) $||Cu^{2+}$ (aq., 1 M) |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 $E_{Mg^{2+}|Mg} vs \log\left[Mg^{2+}\right]$ is

A. 

B. 

C. 

D. 

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3. 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 reaction is an intensive property.

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

6. 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.

Watch Video Solution

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

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

Watch Video Solution

8. 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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9. What is electrode potential?

Watch Video Solution

10. 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?

View Text Solution

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

Watch Video Solution

12. 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 ?

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

15. 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.

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

19. Consider a cell given below.

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

Write the reactions that occur at anode and cathode.

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

22. 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?

Watch Video Solution

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

Watch Video Solution

NCERT FILE NCERT NCERT EXEMPLAR PROBLEMS (Matching Type Questions)

1. Match the terms given in Column I with the units given in Column II.

View Text Solution

2. Match the terms given in Column I with the units given in Column II.

View Text Solution

3. Match the items of Column I and Column II.

View Text Solution

4. Match the items of Column I and Column II.

View Text Solution

5. Match the items of Column I and Column II.

View Text Solution

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

$E^{\Theta}_{F_2|F^-} = 2.87V, E^{\Theta}_{Li^+|Li} = -3.5V$

$E^{\Theta}_{Au^{2+}|Au} = 1.4, E^{\Theta}_{Br_2|Br} = 1.09V$

View Text Solution

NCERT FILE NCERT NCERT EXEMPLAR PROBLEMS (Assertion and Reason Type Questions)

1. Assertion (A) : Cu is less reactive than hydrogen.

Reason (R) : $E^{\Theta}_{Cu^{2+}/Cu}$ 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 the 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: C

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2. Assertion (A) E_{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 the 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: C

Watch Video Solution

3. 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 the 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: A

Watch Video Solution

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

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

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

B. Both assertion and reason are true and the 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: A

Watch Video Solution

5. Statement -1 : The volatge of mercury cell remains constant for its life time.

Statement -2 : Overall cell reaction does not involve any ion.

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

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

C. Assertion is true but the reason is false.

D. Assertion is false but reason is true .

Watch Video Solution

6. During the electrolysis of fused NaCl, which reaction occurs at 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 the 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: A

Watch Video Solution

7. 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 the 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: A

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8. A copper-silver cell is set up. The copper ion concentration in it is 0.10 M. The concentration of silver ions is not known.The cell potential measured is 0.422 V. Determine the concentration of silver ions in the cell. [Given $E^{\circ}_{Ag^{+}/Ag} = 0.80, E^{\circ}_{Cu^{2+}/Cu} = +0.34V$]

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

B. Both assertion and reason are true and the 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: A

Watch Video Solution

9. 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 the 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: B

Watch Video Solution

10. Calculate the e.m.f. of the cell,

$Mg(s) / Mg^{+}(0.1M) \mid \mid Ag^{+}\left(1 \times 10^{-4}M\right) / Ag(s)$

$E^{\circ}_{Ag^{+} / Ag} = +0.8 \text{ V}$, $E^{\circ}_{Mg^{2+} / Mg} = -2.37 \text{ V}$

What will be the effect on e.m.f. if concentration of Ag^+ is increased to $1 \times 10^{-3} M$?

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

B. Both assertion and reason are true and the 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: D

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QUICK MEMORY TEST (SAY TRUE OR FALSE)

1. Electrochemical Cell

Watch Video Solution

2. I. Cathode is -ve terminal both in electrochemical and electrolytic cells.

II Reduction occurs at cathode both in galvanic as well as electrolytic cell.

III. Chemical charge in electolytic cell is non-spontaneous

Watch Video Solution

3. The electrical conductivity of a metal decreases with rise in temperature while that of semi-conductor increases. Justify.

Watch Video Solution

4. (A) Identification of cathode and anode is done with the help of thermometer.

(R) Higher is the value of reduction potential. greater would be its reducing power.

Watch Video Solution

5. A copper-silver cell is set up. The copper ion concentration in it is 0.10 M. The concentration of silver ions is not known.The cell potential measured is 0.422 V. Determine the concentration of silver ions in the cell. [Given $E^{\circ}_{Ag^{+}/Ag} = 0.80, E^{\circ}_{Cu^{2+}/Cu} = +0.34V$]

Watch Video Solution

6. Statement-1: Conductivity of a metallic conductor decreases with increases in temperature.

Statement-2: On increasing temperature, collision of electrons becomes more frequent and number of free electrons in the metallic conductor decreases.

Watch Video Solution

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

Watch Video Solution

8. Osmotic potential is numerically equal to

Watch Video Solution

9. Which out of 0.1 M HCl and 0.1 M NaCl, do you expect to have greater Λ_m^∞ and why ?

Watch Video Solution

10. Is it safe to stir 1M $AgNO_3$ solution with copper spoon?

Watch Video Solution

QUICK MEMORY TEST (Complete the missing links)

1. In an electrochemical cell, oxidation occurs at .....and reduction occurs at .....

Watch Video Solution

2. The e.m.f. of a cell depends on

Watch Video Solution

3. The units of cell constant are .....

Watch Video Solution

4. In Leclanche cell, Zinc rod is placed in

Watch Video Solution

5. Prevention of corrosion of iron by Zn coating is called

Watch Video Solution

6. Which set of coditions are correct for spontaneity of a electrochemical cell reaction?

Watch Video Solution

7. Electrolyte used in Ni - Cd cell

Watch Video Solution

8. In dry cell cathode is

Watch Video Solution

9. In electrolytic cell, reduction occurs at .....

View Text Solution

10. During discharge of a lead storage cell the density of sulphuric acid in the cell:

Watch Video Solution

11. Write the chemical formula of rust.

Watch Video Solution

12. Molar conductance of a solution is given by the expression

$$\wedge m = \frac{k \times 1000mLL^{-1}}{c}$$

Here c is the concentration in mol L^{-1} and k is expressed in $ohm^{-1}cm^{-1}$. Units of molar conductance are

Watch Video Solution

13. The magnitude of the equilibrium constant (K_{eq}) for a cell reaction is related to the magnitude of the standard Gibbs energy change for cell reaction by.

Watch Video Solution

QUICK MEMORY TEST (Choose the correct alternative)

1. In electrochemical cells, cathode is always the electrode where:

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2. Which is an extensive property?

Watch Video Solution

3. Assertion: The conductivity of electrolytic soutions increase with increase of temperture.

Reason: Electronic conductance decrease with increase of temperture.

Watch Video Solution

4. Assertion (A): For a Daniell cell : $Zn\left|Zn^{2+}\right|\left|Cu^{2+}\right|Cu$ with $E_{cell}=1.1V$, the application of opposite potential greater than $1.1V$ results into the flow of electron from cathod to anode. Reason (R): Zn is deposited at anode and Cu is dissolved at cathode

Watch Video Solution

5. Variation of directly proportional

Watch Video Solution

6. On passing 0.1 F of electricity through aluminium chloride, the amount of aluminium meta deposited on cathode is (Atomic weight of $Al = 27$)

Watch Video Solution

7. The electrolysis of molten hydrolith produces____gas at anode.

Watch Video Solution

8. In Leclanche cell, Zinc rod is placed in

Watch Video Solution

9. SECONDARY CELL

Watch Video Solution

10. In an electrochemical cell, anode and cathode are:

Watch Video Solution

11. Rusting of iron is

Watch Video Solution

12. In corrosion of iron

Watch Video Solution

REVISION EXERCISES OBJECTIVE QUESTIONS (MULTIPLE CHOICE QUESTIONS)

1. The cell constant of a conductivity cell

A. changes with change in concentration of electrolyte

B. changes with nature of the electrolyte

C. changes with change in time of measurement

D. remains constant for the cell.

Watch Video Solution

2. The efficiency of a fuel cell is given by:

A. $\frac{\Delta G}{\Delta S}$

B. $\frac{\Delta G}{\Delta H}$

C. $\frac{\Delta S}{\Delta G}$

D. $\frac{\Delta H}{\Delta G}$

Watch Video Solution

3. The limiting molar conductivities Λ° for $NaCL, KBr$ and KCI are $126, 152$ and $150 Scm^2, ol^{-1}$ respectively . The Λ° fro $NaBrScm^2\mathrm{mol}^{-1}$ is :

A. $278 Scm^2 mol^{-1}$

B. $976 Scm^2 mol^{-1}$

C. $128 Scm^2 mol^{-1}$

D. $302 Scm^2 mol^{-1}$

Watch Video Solution

4. If the specific conductance and conductance of a solution are same, then its cell constant is equal to:

A. 1

B. 0

C. 10

D. 1000

Watch Video Solution

5. Which of the following statements is incorrect about cycas?

A. Electrons are released at anode.

B. Chemical energy is converted into electrical energy.

C. Salt bridge maintains the electrical neutrality of the electrolytes.

D. Cell can work indefinitely.

Watch Video Solution

6. Write Nernst equation for the electrode reaction :

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

A. $E = E^{\circ} + \frac{RT}{nF}\log\frac{1}{[M^{n+}]}$

B. $E^{\circ} = E^{\circ} + RT\ln[M^{n+}]$

C. $E = E^{\circ} + \frac{RT}{nF}\ln[M^{n+}]$

D. $\frac{E}{E^{\circ}} = \frac{RT}{nF}\ln[M^{n+}]$

Watch Video Solution

7. Saturated solution of KNO_3 is used to make "salt bridge" because .

A. velocity of K^{+} is greater than that of NO_3^{-}

B. velocity of NO_3^{-} is greater than that of K^{+}

C. velocity of both K^{+} and NO_3^{-} are nearly the same

D. KNO_3 is highly solube in water.

Watch Video Solution

8. The charge on 1 gram mole ion of N-is

A. 6.00×10^5 C

B. $2.89 \times 10^5 C$

C. $3.98 \times 10^5 C$

D. $4.89 \times 10^5 C$

Watch Video Solution

9. In Leclanche cell, Zinc rod is placed in

A. Graphite rod

B. FeO and $Fe(OH)_2$

C. Zinc container

D. $MnO_2 + C$

Watch Video Solution

10. Calculate the number of coulombs required to deposit 5.4 g of Al when the electrode reaction is

$Al^{3+} + 3e^- \rightarrow Al$

(Given , atomic mass of Al =27 g mol^{-1}, $F = 96500 C mol^{-1}$)

A. 9.65×10^4

B. 8.685×10^5

C. 9.65×10^5

D. 6.955

Watch Video Solution

11. Consider the following

E° values $E^{o}{}_{Fe^{3+}/Fe^{2+}} = +0.77V$ $E^{o}{}_{Sn^{2+}/Sn} = 0.14V$

Under standard conditions the EMF for the reaction

$Sn(s) + 2Fe^{3+}(aq) \rightarrow 2Fe^{2+}(aq) + Sn^{2+}(aq)$ is :

A. $0.91V$

B. 1.40 V

C. 1.68 V

D. 0.63 V

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12. For the feasibility of a redox reaction in a cell, the emf should be.

A. positive

B. negative

C. fixed

D. zero

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13. The units of conductivity of the solution are

A. $ohm^{-1}cm^{-1}$

B. $ohm^{-1}cm^{2}$

C. ohm^{-1}

D. $ohm^{-2}cm^{2}\text{equiv}^{-1}$

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14. Name the metal which is used for galvanising iron.

A. zinc

B. magnesium

C. copper

D. aluminium

Answer: A

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15. Which of the following statements is false

A. Oxidation and reduction half-reactions occur at electrodes in electrochemical cells.

B. All voltaic (galvanic) cells involve the use of electricity to initiate non-spontaneous chemical reactions.

C. Reduction occurs at the cathode.

D. Oxidation occurs at the anode.

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16. The tendencies of the electrodes made up of Cu, Zn and Ag to release electrons when dipped in their respective salt solutions decrease in the order :

A. $Zn > Ag > Cu$

B. $Cu > Zn > Ag$

C. $Zn > Cu > Ag$

D. $Ag > Cu > Zn$

Watch Video Solution

17. The unit of cell constant is -

A. $ohm^{-1}cm^{-1}$

B. cm

C. $ohm^{-1}cm$

D. cm^{-1}

Watch Video Solution

18. Which one of the following statements is not correct

A. Anode is negatively charged

B. Cathode is positively charged

C. Reduction takes place at the anode

D. Reduction takes place at the cathode

Watch Video Solution

19. Conductivity of an electrolytic solution depends on:

A. nature of electrolyte

B. power of AC source

C. distance between two electrodes

D. none of the above.

Watch Video Solution

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

A. Mg acts as cathode

B. Cu acts as cathode

C. Mg is oxidising agent

D. None of these

Watch Video Solution

21. Molar conductance of a solution is given by the expression

$$\wedge m = \frac{k \times 1000mLL^{-1}}{c}$$

Here c is the concentration in mol L^{-1} and k is expressed in $ohm^{-1}cm^{-1}$. Units of molar conductance are

A. $ohm^{-1}m^2mol^{-1}$

B. $ohmm^2mol^{-1}$

C. $ohm^{-1}m^2mol^{-1}$

D. $ohm^{-2}m^2mol^{-1}$

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22. Standard electrode potential of SHE at 298 K is :

A. $0.34V$

B. -0.44 V

C. 0 V

D. $-0.76V$

Watch Video Solution

23. How many faradays are required to reduce 1 mol of MnO_4^- to Mn^{2+} ?

A. 5 F

B. 2 F

C. 1 F

D. 7 F

Watch Video Solution

24. Given $E^{\circ}_{Cr^{3+}/cr} = -0.72V$, $E^{\circ}_{Fe^{2+}/Fe} = -0.42V$. The potential for the cell

$Cr\left|Cr^{3+}(0.1M)\right|\left|FE^{2+}(0.01M)\right|$ Fe is .

A. $-0.26V$

B. $0.26V$

C. $0.339V$

D. -0.339 V

Watch Video Solution

REVISION EXERCISES OBJECTIVE QUESTIONS (Passage Based Questions)

1. A read storage battery is the most impotant type of secondary cell having a lead anode and a grid of lead packed with PbO_2 as cathode. A 38% solution of sulphuric acid is used as electrolyte. (Density=1.294 g mL^{-1}) battery holds 3.5 L of the acid. During the discharge of the

battery, the density of H_2SO_4 falls to 1.139 g mL^{-1}. (20 % H_2SO_4 by mass)

Write the reaction taking place at the cathode when the battery is in use.

Watch Video Solution

2. A read storage battery is the most impotant type of secondary cell having a lead anode and a grid of lead packed with PbO_2 as cathode. A 38 % solution of sulphuric acid is used as electrolyte. (Density=1.294 g mL^{-1}) battery holds 3.5 L of the acid. During the discharge of the battery, the density of H_2SO_4 falls to 1.139 g mL^{-1}. (20 % H_2SO_4 by mass)

How much electricity in terms of Faraday is required to carry out the reduction of one mole of PbO_2 ?

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3. A read storage battery is the most impotant type of secondary cell having a lead anode and a grid of lead packed with PbO_2 as cathode. A

$38\,\%$ solution of sulphuric acid is used as electrolyte. (Density=1.294 g mL^{-1}) battery holds 3.5 L of the acid. During the discharge of the battery, the density of H_2SO_4 falls to 1.139 g mL^{-1}. ($20\,\%$ H_2SO_4 by mass)

Lead storage battery is considered a secondary cell. Why?

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4. A read storage battery is the most impotant type of secondary cell having a lead anode and a grid of lead packed with PbO_2 as cathode. A $38\,\%$ solution of sulphuric acid is used as electrolyte. (Density=1.294 g mL^{-1}) battery holds 3.5 L of the acid. During the discharge of the battery, the density of H_2SO_4 falls to 1.139 g mL^{-1}. ($20\,\%$ H_2SO_4 by mass)

Lead storage battery is considered a secondary cell. Why?

Watch Video Solution

5. A lead storage battery is the most important type of secondary cell having a lead anode and a grid of lead packed with PbO_2 as cathode. A $38\,\%$ solution of sulphuric acid is used as electrolyte. (Density=1.294 g mL^{-1}) battery holds 3.5 L of the acid. During the discharge of the battery, the density of H_2SO_4 falls to 1.139 g $mL^{-1}(20\,\%\, H_2SO_4$ by mass)

. Lead storage battery is considered a secondary cell. Why?

Watch Video Solution

6. The resistance of a conductivity cell filled with $0.1MKCl$ solution is 100Ω. If R of the same cell when filled with $0.02MKCl$ solution is 520Ω, calculate the conductivity and molar conductivity of $0.02MKCl$ solution. The conductivity of $0.1MKCl$solution is $1.29Sm^{-1}$.

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7. The resistance of a conductivity cell filled with $0.1MKCl$ solution is 100Ω. If R of the same cell when filled with $0.02MKCl$ solution is 520Ω, calculate the conductivity and molar conductivity of $0.02MKCl$ solution. The conductivity of $0.1MKCl$solution is $1.29Sm^{-1}$.

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8. The resistance of a conductivity cell filled with $0.1MKCl$ solution is 100Ω. If R of the same cell when filled with $0.02MKCl$ solution is 520Ω, calculate the conductivity and molar conductivity of $0.02MKCl$ solution. The conductivity of $0.1MKCl$solution is $1.29Sm^{-1}$.

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9. The resistance of a conductivity cell filled with $0.1MKCl$ solution is 100Ω. If R of the same cell when filled with $0.02MKCl$ solution is 520Ω, calculate the conductivity and molar conductivity of $0.02MKCl$ solution. The conductivity of $0.1MKCl$solution is $1.29Sm^{-1}$.

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10. The resistance of a conductivity cell filled with $0.1MKCl$ solution is 100Ω. If R of the same cell when filled with $0.02MKCl$ solution is 520Ω, calculate the conductivity and molar conductivity of $0.02MKCl$ solution. The conductivity of $0.1MKCl$solution is $1.29Sm^{-1}$.

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REVISION EXERCISES OBJECTIVE QUESTIONS (Assertion Reason Questions)

1. Statement-I: Equivalent conductance of all electrolytes decreases with increasing concentration.

Because Statement-II: Lesser number of ions ate available per gram equivalent at higher concentration.

Watch Video Solution

2. Assertion $(A): Fe$ is protected from corrosing by connecting Mg metal with it.

Reason $(R): Fe$ acts as cathode and Mg as anode which gradully disappears.

Watch Video Solution

3. (A) Zinc reacts with H_2SO_4 to give H_2 gas but copper does not.

(R) Zinc has higher reduction potential than copper.

Watch Video Solution

4. Can we store copper sulphate solution in zinc vessel ?

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5. Assertion (A) : pH value of 0.1 M CH_3COOH is more than one.

Reason $(R): CH_3COOH$ is weakly ionised.

Watch Video Solution

6. The pH of a buffer solution of 0.1 M $NH_4OH[pK_a = 4.0]$ and $0.1MNH_4Cl$ is

Watch Video Solution

7. Assertion: $E^{\ominus}$ for $\frac{Mn^{3+}}{Mn^{2+}}$ is more positive than for $\frac{Cr^{3+}}{Cr^{2+}}$.

Reason: The third ionisation energy of Mn is larger than that of Cr.

Watch Video Solution

8. The questions consist of two atatements each, printed as Assertion and Reason. While answering these questions you are required to choose any one of the following four responses :

Assertion : According to Kohlrausch's law the molar conductivity of a strong electrolyte at infinite dilution is sum of molar conductivities of its

ions.

Reason : The current carried by cation and anion is always equal.

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9. Assertion (A) : Galvanized iron does not rust.

Reason (R) : Zn has a more negative electrode potential than Fe.

Watch Video Solution

10. Assertion (A) : In a Daniell cell, if the concentration of Cu^{2+} and Zn^{2+} ions are doubled, the EMF of the cell will be doubled.

Reason (R) : If the concentration of ions in contact with metals is doubled, the electrode potential is doubled.

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REVISION EXERCISES OBJECTIVE QUESTIONS Very Short Answer Questions (One Word/Very Short Sentence Answer)

1. Write Nernst equation for the following cell reaction :

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

Watch Video Solution

2. Write the overall cell reaction for lead storage battery.

Watch Video Solution

3. How is cell potential related to the free energy change? State meaning of each term used.

Watch Video Solution

4. (a) Explain electrochemical series.

(b) Can we store 1M $CuSO_4$ solution in zinc vessel or not, why ?

Watch Video Solution

5. A salt bridge

Watch Video Solution

6. How is ΔG related to e.m.f. of the cell ?

Watch Video Solution

7. How does conc. of sulphuric acid change in lead storage battery when current is drawn from it ?

Watch Video Solution

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

1 mol of Al^{3+} to Al ?

Watch Video Solution

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

Watch Video Solution

10. Why a dry cell becomes dead after a long time even if it is not used ?

Watch Video Solution

11. What is the souce of electrical energy in a galvanic cell ?

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12. An example of a simple fuel cell is

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13. What are the SI unit of molarity ?

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

$H_2SO_4 \xrightarrow{(aq)} 2H^+_{(aq)} + SO_4^{2-}(aq)$

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

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16. 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 ?

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

Watch Video Solution

18. The amount of electricity required to produce one mole of copper from copper sulphate solution will be:

Watch Video Solution

19. Why a mercury cell gives a constant voltage throughout its life ?

Watch Video Solution

20. The amount of electricity required to produce one mole of copper from copper sulphate solution will be:

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21. STANDARD ELECTRODE POTENTIAL

Watch Video Solution

22. What is effect of increasing concentration on the molar conductivity of a weak electrolyte ?

Watch Video Solution

23. The product of electrolysis of an aqueous solution of K_2SO_4 using inert electrodes, at anode and cathode respectively are

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

Watch Video Solution

25. How does electrical cocductivity of semi-conductors vary with temperature ?

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REVISION EXERCISES OBJECTIVE QUESTIONS Short Answer Questions

1. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

Watch Video Solution

2. Electrolytic Conductance

Watch Video Solution

3. How the weak and strong electrolytes are distinguished?

Watch Video Solution

4. Name te factors which affect electrical conductivity of electrolytes.

Watch Video Solution

5. The electric charge for electrode deposition of one gram equivalent of a substance is:

Watch Video Solution

6. Degree of dissociation of weak electrolyte AB is

Watch Video Solution

7. Why a dry cell becomes dead after a long time even if it is not used ?

Watch Video Solution

8. FUEL CELLS

Watch Video Solution

9. Calculate the standard electrode potential of Ni^{2+}/Ni electrode if emf of the cell $Ni_{(s)}\left|Ni^{2+}(0.01M)\right|\left|CU^{2}\right|Cu_{(s)}(0.1M)$ is $0.059V$. $\left[Given: E^{\circ}_{Cu^{2+}/Cu} = +0.34V\right.$

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10. Calculate the maximum work that can be obtained from the daniell call given below,

$Zn(s)\left|Zn^{2+}(aq)\right|\left|Cu^{2+}(aq)\right|Cu(s)$. Given that $E^{\circ}_{Zn^{2+}/Zn} = -0.76V$ and $E^{\circ}_{Cu^{2+}/Cu} = +0.34V$.

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11. How many copper will be deposited at cathode of an electrolytic cell containing Cu^{2+} ions by passing 2 ampere of current for 60 minutes.

Watch Video Solution

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

Watch Video Solution

13. Molar conductivity of a weak acid HA at infinite dilution is 345.8 Scm^2mol^{-1} calculate molar conductivity of 0.05 M HA solution

Watch Video Solution

14. Calculate the emf for the following cell at 298 K.

$Cd|Cd^{2+}(0.1M)||Ag^{+}(0.1M)|Ag$

Given $E^{\circ}_{Cd^{2+}/Cd} = -0.40 \text{ V}$, $E^{\circ}_{Ag^{+}/Ag} = 0.80 \text{ V}$

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15. 0.1 M solution of an electrolyte $A^{+}B^{-}$ placed in a conductivity cell wilth electrodes 4 cm apart and each with area of cross-section equal to 2 sq cm was found to have a resistance of 200Ω. The molar conductivity of the solution will be

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16. Calculate the number of coulombs required to deposit 40.5 g Al when the electrode reaction is :

$Al^{3+} + 3e^- \rightarrow Al$

Watch Video Solution

17. The equilibrium constant (K) for the reaction

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

[Given, $E^\circ_{cell} = 0.46V$]

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18. Where are B-cells and T-cells formed? How do they differ from each other?

Watch Video Solution

19. While charging the lead storage battery:

Watch Video Solution

20. The standard electrode potential for Deniell cell is $1.1V$. Calculate the standard Gibbs energy for the reaction.

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

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21. Calculate equilibrium constant for the reaction :

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

Given $E^{\circ}_{(Mg^{2+}/Mg)} = -2.37 \text{ V}$, $E^{\circ}_{(Cu^{2+}/Cu)} = 0.34 \text{ V}$

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22. How much charge in faraday is required for the reduction of 1 mole of Cu^{2+} ions to Cu ?

Watch Video Solution

23. The conductivity of an electrolytic solution decreases on dilution due to

Watch Video Solution

24. EMF of an $H_2 - O_2$ fuel cell

Watch Video Solution

25. Write Nernst equation for the following cell reaction :

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

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26. During discharging of alead storage battery

Watch Video Solution

27. EMF of an $H_2 - O_2$ fuel cell

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28. The reactions taking place at anode and cathode of a cell respectively are

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29. Explain with a graph the variation of molar conductivity of a strong electrolyte with dilution.

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30. Find E°_{cell} for the cell :

$Zn\left|Zn^{2+}(1M)\right|\left|Ag^{+}(1M)\right|Ag$

[Given that : $E^{\circ}_{Zn\,/\,Zn^{2+}} = 0.76 \ \text{V}, E^{\circ}_{Ag^{+}\,/\,Ag} = 0.80 \ \text{V}.$

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31. Calculate emf of the following cell reaction at 2968 K :

$Ni(s)\,/\,Ni^{2+}(0.01M) \ | \ | \ Cu^{2+}(0.1M)\,/\,Cu(s)$

[Given $E^{\circ}_{Ni^{2+}\,/\,Ni} = -0.25 \ \text{V}$, $E^{\circ}_{Cu^{2+}\,/\,Cu} = +0.34 \ \text{V}$]

Write the overall cell reaction.

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32. The factors that promote electrochemical corrosion are

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33. Write the nearest equation and calculate the e.m.f. of the following cell at 298 K

$Cu(s)\left|Cu^{2+}(0.130M)\right|\left|Ag^{+}\left(1.00\times10^{-4}M\right)\right|Ag(s)$

Given : $E^{\circ}_{Cu^{2+}/Cu}=0.34V$ and $E^{\circ}_{Ag^{+}/Ag}=+0.80V$

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

Watch Video Solution

35. Given

$E^{\circ}_{Ag^{\oplus}|Ag}=+0.80V, E^{\circ}_{Co^{2+}|Co}=-0.28V, E^{\circ}_{Cu^{2+}|Cu}=+0.34V, E^{\circ}_{Zn^{2+}|Z}$

Which metal will corrode fastest?

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36. How many Faradays of electricity are required to deposit 10 g of calcium from molten calcium chloride using inert electrodes? (Molar mass of calcium = $40 gmol^{-1}$)

Watch Video Solution

37. Calculate the e.f.m of the cell $Cr|Cr^{3+}(0.1M)||Fe^{2+}(0.01M)|Fe$ [given that $E^{\circ}_{Cr^{3+}/Cr} = -0.75, E^{\circ}_{Fe^{2+}/Fe} = -0.45V$]

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

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

$Mg^{2+}/Mg = -2.37V, Cr^{3+}/Cr = -0.74V, Fe^{2+}/Fe = -0.44V$

.

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

Or

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

$MnO\bar{4}(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l), E^\circ = +1.51V,$

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

equation and predict if the rech on is rectant or product favoured.

Watch Video Solution

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

$MnO_4^-(aq) + 8H^+(aq) + 5e^-, \rightarrow Mn^{2+}(aq) + 4H_2O(l), E^\circ = +1.51$

$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^-, E^\circ = +0.51V$

Construct the redox equation from the two half cell reactions and predict if these reactions favour formation of reaction or product shown in the equation.

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40. (a) Calculate $\Delta_r G^\circ$ for the reaction

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

Given : $E^\circ cell = +2.71V, 1F = 96500Cmol^{-1}$

(b) Name the type of cell which was used Apollo space progromme for providing electrical, power

Watch Video Solution

41. Define the following terms:

(i) Colligative properties (ii) Molality (m)

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

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

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

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

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43. In the button cell, widely used in watches, the following reaction takes place

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

Determine E° and ΔG° for the reaction.

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

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44. In electrolysis of dilute H_2SO_4 using platinum electrodes .

Watch Video Solution

45. Write anode and cathode reactions that occur in dry cell. How does a dry cell differ from a mercury cell?

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46. Write the name of two fuels other than hydrogen used in fuel cell. Write two advantages of fuel cell over an ordinary cell

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REVISION EXERCISES OBJECTIVE QUESTIONS Long Answer Questions

1. (a) What type of a battery is the lead storage battery ? Write the anode and the cathode reactions and the overall occuring in a lead storage battery when current is drawn from it.

(b) In the buttom cell, widely used in watches the following reaction take place

$Zn_{(s)} + Ag_2O_{(l)} \rightarrow Zn^{2+}(aq) + 2Ag_{(s)} + 2OH^-_{(aq)}$.

Determine E° and ΔG° for the reaction.

(given : $E^\circ_{Ag^+/Ag} = +0.80V, E^\circ_{Zn^{2+}/Zn} = -0.76V$)

Watch Video Solution

2. (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 conductivity cell containing $0.001MKCl$ solution at $298K$ is 1500ω.

What is the cell constant if the conductivity of $0.001MKCl$ solution at $298K$ is $0.146 \times 10^{-3} Scm^{-1}$

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3. Molar conductivity of a 1.5 m solustion of an electrolyte is found to be 138.9 S $cm^2 mol^{-1}$. Calculate the conductivity of this solution.

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4. (a) What is corrosion?

(b) Name any two metals which do not corrode easily.

(c) What is the corrosion of iron known as?

(d) Explain why, aluminium is a highly reactive metal, still it is used to make utensils for cooking.

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5. What is electrochemical series ?

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6. The molar conductance of acetic acid at infinite dilution if Λ° for $CH_3COONa, NACI$ and HCI are $91.0, 126.5$ and $426.2 Scm^2 \text{mol}^{-1}$ respectively is :

Watch Video Solution

7. The equilibrium constant (K) for the reaction

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

[Given, $E^{\circ}_{cell} = 0.46V$]

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8. The equilibrium constant (K) for the reaction

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

[Given, $E^\circ_{cell} = 0.46V$]

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9. A solution of $CuSO_4$ is electroysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode ?

(Molar mass of $Cu = 63.5g/mol$)

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10. The standard electrode potential for Daniell cell is 1.1 V. Calculate the standard Gibbs energy for the reaction.

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

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Watch Video Solution

11. Why does the cell potential of mercury cell remain constant throughout its life ?

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HOTS (HIGHER ORDER THINKING SKILLS)

1. What are the signs of ΔH° and ΔS° for a reaction that is spontaneous at all temperature?

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2. The acid used in lead storage battery is`

Watch Video Solution

3. Blocks of magnesium metal are often strapped to the steel hulls of ocean going ships in order to:

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4. The following curve is obtained when molar conductivity , Λ_m is plotted against the square root of concentration , $C^{1/2}$ along y and x -axis respectively for the two electrolytes X and Y .

What can you say about the nature of these two electrolytes ?

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5. The following curve is obtained when molar conductivity , Λ_m is plotted against the square root of concentration , $C^{1/2}$ along y and x -axis respectively for the two electrolytes X and Y .

How do you account for the increase in Λ_m for the electrolytes X and Y with dilution ?

View Text Solution

6. The following curve is obtained when molar conductivity , Λ_m is plotted against the square root of concentration , $C^{1/2}$ along y and x -axis respectively for the two electrolytes X and Y .

How can you determine Λ_m^∞ for these electrolytes ?

View Text Solution

7. Cl_2 and Br_{c-} are added to a solution containing $1M$ each of Cl^{c-} and Br^{c-}. What reaction will occur ?

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8. Cl_2 and Br_{c-} are added to a solution containing $1M$ each of Cl^{c-} and Br^{c-}. What reaction will occur ?

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9. Consider the following half cell reactions :

$Br_2 + 2e^- \rightarrow 2Br^- \qquad E^\circ = 1.09V$

$I_2 + 2e^- \rightarrow 2I^- \qquad E^\circ = 0.54V$

If I_2 and Br_2 are added to solution containing 1 M concentration of I^- and Br^- respectively .

How will the increase in the concentration of Br^- affect E_{cell} ?

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10. Tarnished silver contains Ag2S. Can this tarnish be removed by placing the tarnished ware in an aluminium pan containing an inert electrolyte solution such as NaCl ? Given that the standard reduction potentials for the half reactions are :

$Ag2S(s) + 2e^- \rightarrow 2Ag(s), + S^2(aq), E^\circ = -0.71$ V.

$Al^{3+}(aq) + 3e^- \rightarrow Al(s), E^\circ = -1.66$ V.

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11. If charge on the electron is $1.60 \times 10^{-19} C$ and 96500 C deposit 107.9 of silver from its solution , calculate the value of Avogadro's number . (At.mass of Ag = 107.9 u)

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12. Given that, $Co^{3+} + e^- \rightarrow Co^{2+} E^\circ = +1.82V$

$2H_2O \rightarrow O_2 + 4H^+ + 4e^-, E^\circ = -1.23V.$

Explain why Co^{3+} is not stable in aqueous solutions.

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13. Prove that for two half reactions having potentials E_1 and E_2 which are combined to yield a third half reaction, having a potential E_3,

$E_3 = \frac{n_1 E_1 + n_2 E_2}{n_3}$

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14. Calculate the reduction potential of a half cell consisting of a platinum electrode immersed in $2.0MFe^{2+}$ and $0.02MFe^{3+}$ solution. Given $E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.771V$.

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15. The standard reduction potential for the half cell :

$NO_3^{c-}(aq) + 2H^{c-} + e^- \rightarrow NO_2(g) + H_2O$ is $0.78V$.

a. Calculate the reduction potential in $8MH^{\oplus}$.

b. What will be the reduction potential of the half cell in a neutral solution ? Assume all the other species to be at unit concentration.

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16. The standard reduction potential for the half-cell, $NO_{3(aq.)}^{-} + 2H_{(aq.)}^{+} + e^{-} \rightarrow NO_{2(g)} + 2H_2O$ is $0.78V$.

(i) Calculate the reduction potential in 8M H^{+}.

(ii) What will be the reduction potential of the half-cell in a neutral solution. Assume all the other species to be at unit concentration

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17. The pressure of H_2 required to make the potential of H_2 – electrode zero in pure water at 298K is :

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18. Calculate the solubility product of $Co_2\left[Fe(CN)_6\right]$ in water at $25^{\circ}C$.

Given, conductivity of saturated solutions of $Co_2\left[Fe(CN)_6\right]$ is $2.06 \times 10^{-6}\Omega^{-1}cm^{-1}$ and that of water used is $4.1 \times 10^{-7}\Omega^{-1}cm^{-1}$.

The ionic molar conductivities of Co^{2+} and $\left[Fe(CN)_6\right]^4$ are $86.0\Omega cm^2 mol^{-1}$ and $444.0\Omega^{-1} cm^2 mol^{-1}$, respectively.

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COMPETITION FILE (OBJECTIVE TYPE QUESTIONS) (MULTIPLE CHOICE QUESTIONS)

1. The units of conductivity of the solution are

A. ohm^{-1}

B. $ohm^{-1} cm^{-1}$

C. $ohm^{-2} cm^2 \text{equiv}^{-1}$

D. $ohm^{-1} cm^2$

Answer: B

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2. The resistance of $1N$ solution of acetic acid is $250ohm$, when measured in a cell of cell constant $1.15cm^{-1}$. The equivalent conductance (in $ohm^{-1}cm^2eq^{-1}$) of $1N$ acetic acid is

A. 18.4

B. 0.023

C. 46

D. 9.2

Answer: C

Watch Video Solution

3. The molar conducatance of Ba^{2+} and Cl^- are 127 and $76ohm^{-1}cm^{-1}mol^{-1}$ respectively at infinite dilution. The equivalent conductance of $BaCl_2$ at infinte dilution will be

A. $280Scm^2mol^{-1}$

B. $330.98Scm^2mol^{-1}$

C. $90.98 Scm^2 mol^{-1}$

D. $203.6 Scm^2 mol^{-1}$

Answer: A

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4. The specific conductance of 0.1 M NaCl solution is $1.06 \times 10^{-2} ohm^{-1} cm^{-1}$. Its molar conductance in $ohm^{-1} cm^2 mol^{-1}$ is

A. 1.06×10^2

B. 1.06×10^3

C. 1.06×10^4

D. 53

Answer: A

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5. $\lambda_{ClCH_2COONa} = 224 \text{ohm}^{-1} cm^2 \text{ gm eq}^{-1}$,

$\lambda_{NaCl} = 38.2 \text{ohm}^{-1} \text{cm}^2 gmeq^{-1}$.

$\lambda_{HCl} = 203 \text{ohm}^{-1} cm^2 \text{gm eq}^{-1}$.

What is the value of λ_{ClCH_2COOH} ?

A. $228.5 ohm^{-1} cm^2 gmeq^{-1}$

B. $289.5 ohm^{-1} cm^2 gmeq^{-1}$

C. $388.8 ohm^{-1} cm^2 gmeq^{-1}$

D. $59.5 ohm^{-1} cm^2 gmeq^{-1}$

Answer: C

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6. The limiting molar conductivities of HCl, CH_3COONa and NaCl are respectiley 425, 90 and 125 mho $cm^2 \text{ mol}^{-1}$ and $25^\circ C$. The molar

conductivity of 0.1M CH_3COCH solution is 7.8 mho $cm^2 \text{mol}^{+1}$ at the same temperature then degree of dissociation is

A. 0.10

B. 0.02

C. 0.15

D. 0.03

Answer: B

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7. The values of limiting ionic conductance of H^+ and $HCOO^-$ ions are respectively 347 and 53 S $cm^2 mol^{-1}$ at 298 K, If the molar conductance of 0.025 M methanoic acid at 298 K is 40 $Scm^2 mol^{-1}$, the dissociation constant of methanoic acid at 298 K is

A. 1×10^{-5}

B. 2×10^{-5}

C. 1.5×10^{-4}

D. 2.5×10^{-4}

Answer: D

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8. The ioisation constant of a weak electroluytes is 25×10^{-6} and the equivalent conductance of its $0.01M$ solution is $19.6 Scm^2 eq^{-1}$. The equivalent conductance at infinited dilution of the electrolyte is $Scm^2 sq^{-1}$. is .

A. 402

B. 392

C. 306

D. 39.2

Answer: B

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9. Point out the correct statement.

A. Zinc acts as cathode and copper as anode.

B. Zinc acts as anode and copper as cathode.

C. The standard reduction potential of zinc is more than that of copper.

D. The flow of electrons is from copper to zinc.

Answer: B

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10. The standard reduction potential of Pb and Zn electrodes are -0.12 6 and -0.763 volts respectively . The e.m.f of the cell

$Zn\left|Zn^{2+}+(0.1M)\right|\ |\ Pb^{2+}(1M)Pb$ is

A. 0.637 V

B. $<$ 0.637 V

C. $>$ 0.637 V

D. 0.889 V

Answer: A

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11. A zinc electrode is placed in $0.1M$ solution of $ZnSO_4$ at $25^\circ C$. Assuming salt is dissociated to the extent of $20\,\%$ at this dilution. The potential of this electrode at this temperature is :

$\left(E^{c-}{}_{.Zn^{2+}|Zn} = -0.76V\right)$

$a.\ 0.79V \quad .\ b.\ -0.79V \quad c.\ -0.81V. \quad d.\ 0.81V$

A. $-0.81V$

B. $-0.79V$

C. $0.81V$

D. $0.79V$

Answer: A

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12. E°_{cell} and ΔG° are related as :

A. $\Delta G^{\circ} = nFE^{\circ}_{cell}$

B. $\Delta G = -nFE^{\circ}_{cell}$

C. $\Delta G^{\circ} = -nFE^{\circ}_{cell}$

D. $\Delta G^{\circ} = nFE^{\circ}_{cell} = 0$

Answer: C

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13. Which one of the following will increase the voltage of the cell ?

$(T = 298K)$

$Sn + 2Ag^+ \rightarrow Sn^{2+} + 2Ag.$

A. increase in the size of silver rod

B. increase in the concentration of Sn^{2+} ions

C. increase in the concentration of Ag^+ ions

D. none of the above.

Answer: B

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14. In the diagram given below, the value of x is

A. $0.35V$

B. $0.65V$

C. $0.325V$

D. $0.65V$

Answer: C

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15. If the solution of the $CuSO_4$ in which copper rod is immersed is diluted to 10 times, the electrode potential :

A. Decreases by 30 mV

B. Increases by 30 mV

C. Increases by 60 mV

D. Decreases by 60 mV

Answer: A

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16. The standard reduction potential of Cu^{2+}/Cu and Cu^{2+}/Cu^{+} are $0.339V$ and $0.153V$ respectively. The standard electrode potential of Cu^{+}/Cu half cell is :

A. -0.34 V

B. $1.26V$

C. $-1.26V$

D. $0.34V$

Answer: D

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17. Aluminium displaces hydrogen from acids, but copper does not. A galvanic cell prepared by combining $Cu \mid Cu^{2+}$ and $Al \mid Al^{3+}$ has an emf of 2.0 V at 298 K. If the potential of copper electrode is + 0.34 V, that of aluminium electrode is

A. $-2.3V$

B. $+2.34V$

C. -1.66 V

D. 1.66 V

Answer: C

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18. Standard electrode potentials are

$Fe^{2+}/Fe, E^{\circ} = -0.44V$

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

If Fe^{3+}, Fe^{2+}, and Fe block are kept together, then

A. Fe^{3+} increases

B. Fe^{3+} decreases

C. $Fe^{2+} \mid Fe^{3+}$ remains unchanged

D. Fe^{2+} decreased

Answer: B

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19. The standard reduction potential for two reactions are given below

$AgCl(s) + e^- \rightarrow Ag(s) + Cl^-(aq), E^\circ = 0.22V$

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

The solubility product of AgCl under standard conditions of temperature is given by

A. 1.6×10^{-5}

B. 1.5×10^{-8}

C. 3.2×10^{-10}

D. 1.5×10^{-10}

Answer: D

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20. The emf of a Daniell cell at $298K$ is E_1

$Zn|ZnSO_4(0.01M)||CuSO_4(1.0M)|Cu$

When the concentration of $ZNSO_4$ is $1.0M$ and that of $CuSO_4$ is $0.01M$, the emf changed to E_2. What is the relationship between E_1 and $E(2)$?

A. $E_1 > E_2$

B. $E_1 < E_2$

C. $E_1 = E_2$

D. $E_2 = 0 \neq E_1$

Answer: A

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21. The emf of a Daniell cell at $298K$ is E_1

$Zn|ZnSO_4(0.01M)||CuSO_4(1.0M)|Cu$

When the concentration of $ZNSO_4$ is $1.0M$ and that of $CuSO_4$ is $0.01M$

, the emf changed to E_2. What is the relationship between E_1 and $E(2)$

?

A. $1.10V$

B. $1.04V$

C. $1.16V$

D. $1.07V$

Answer: D

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22. If $E^{\circ}_{Fe^{2+}}/Fe = -0.441V$

and $E^{\circ}_{Fe^{3+}}/Fe^{2+} = 0.771V$

The standard EMF of the reaction

$Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$

will be:

A. 1.653

B. $1.212V$

C. 0.111

D. $0.330V$

Answer: B

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23. $10800C$ of electricity passed through the electrolyte deposited $2.977g$ of metal with atomic mass $106.4gmol^{-1}$. The charge on the metal cation is

A. 4

B. 3

C. 2

D. 1

Answer: A

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24. A constant current was passed through a solution of $AuCl_4^{c-}$ ion between gold electrodes. After a period of $10.0min$, the increase in the weight of cathode was $1.314g$. The total charge passed through solution is (atomic weight of $AuCl_4^{c-} = 339$)

A. 20 min 8s

B. 30 min 12s

C. 10 min 4s

D. 10 min 40s

Answer: C

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25. An electric current is passed through silver voltameter connected to a water voltmeter. The cathode of the silver voltameter is 0.108g more at

the end of the electrolysis. The volume of oxygen evolved at STP:

A. $5.6cm^3$

B. $550cm^3$

C. $22.4cm^3$

D. $11.2cm^3$

Answer: A

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26. Same amount of electric current is passed through solutions of $AgNO_3$ and HCl. If 1.08 g of silver is obtained in the first case, the amount of hydrogen liberated at S.T .P. in the second case is:

A. $112cm^3$

B. $22400cm^3$

C. $224cm^3$

D. $1.008g$

Answer: A

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27. $4.5g$ of aluminium (at mass $27u$) is deposited at cathode from Al^{3+} solution by a certain quantity of electric charge. The volume of hydrogen gas produced at STP from H^+ ions in solution by the same quantity of electric charge will be:

A. 44.8 L

B. $22.4L$

C. $11.2L$

D. 5.6 L

Answer: D

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28. The quantity of electricity needed to electrolyse completely $1M$ solution of $CuSO_4$, $Bi_2(SO_4)_3$, $AICI_3$ and $AgNO_3$ each will be .

A. $2:3:1$

B. $2:1:1$

C. $2:1:3$

D. $2:2:1$

Answer: A

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29. When a lead storage battery is charged:

A. SO_2 is evolved

B. $PbSO_4$ is consumed

C. Lead is formed

D. H_2SO_4 is consumed

Answer: D

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30. Rust is a mixture of

A. FeO and $Fe(OH)_3$

B. FeO and $Fe(OH)_2$

C. Fe_2O_3 and $Fe(OH)_3$

D. Fe_3O_4 and $Fe(OH)_3$

Answer: C

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31. Which of the following will be formed when lead storage battery is charged ?

A. Sulphuric acid is consumed

B. Lead is consumed

C. Sulphuric acid is formed

D. Lead sulphate is formed .

Answer: C

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32. For a $H_2 - O_2$ fuel cell , the theoretical voltage has been found to be 1.23 V and ΔH to be $-285 kJ mol^{-1}$. The efficiency of the fuel cell is

A. $76\ \%$

B. $83\ \%$

C. $89\ \%$

D. $72\ \%$

Answer: B

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33. Indicate the reactions which take place at cathode and anode in fuel cell.

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

B. $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

C. $2H_2 + O_2 \rightarrow 2H_2O$

D. $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$

Answer: B

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34. Which of the following reactions occurs at the anode during the recharging of lead storage battery ?

A. $PbSO_4 + 2H_2O \rightarrow PbO_2 + SO_4^{2-} + 4H^+ + 2e^-$

B. $Pb + SO_4^{2-} \rightarrow PbSO_4 + 2e^-$

C. $PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$

D. $PbSO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightarrow PbSO_4 + 2H_2O$

Answer: A

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35. In nickel-cadmium storage cell , the electrolyte is

A. moist KOH

B. dil H_2SO_4

C. aqueous NH_4Cl

D. $Ni(OH)_3$ (aq)

Answer: A

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COMPETITION FILE (OBJECTIVE TYPE QUESTIONS) B MULTIPLE CHOICE QUESTIONS

1. Al_2O_3 is reduced by electrolysis at low potentials and high current. If 4.0×10^4 amperes of currernt is passed through molten Al_2O_3 for 6 hours, what mass of aluminium is produced? (Assume 100 % current efficiency, At. Mass of $Al = 27u$)

A. 8.1×10^4 g

B. 2.4×10^5 g

C. 1.3×10^4 g

D. 9.0×10^3 g

Answer: A

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2. The equilibrium constant of the following redox rection at 298 K is 1×10^8

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

If the standard reducing potential of iodine becoming iodide is +0.54 V. what is the standard reduction potential of Fe^{3+}/Fe^{2+} ?

A. $+1.006V$

B. $-1.006V$

C. $+0.77V$

D. -0.652 V

Answer: D

Watch Video Solution

3. The equivalent conductance of $M/32$ solution of a weak monobasic acid is 8.0 mho cm^2 and at infinite dilution is $400mhocm^2$. The dissociation constant of this acid is :

A. 1.25×10^{-6}

B. 6.25×10^{-4}

C. 1.25×10^{-4}

D. 1.25×10^{-5}

Answer: D

Watch Video Solution

4. The solution of nickel sulphate in which nickel rod is dipped is diluted to 10 times. The potential of nickel.

A. Decreases by 60 mV

B. Decreases by 30 mV

C. Decreases by 30 V

D. Increases by 30 mV

Answer: B

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5. For the reduction of silver ions with copper metal, the standard cell potential was foound to be $+0.46V$ at $25^{\circ}C$. The value of standard Gibbs energy, ΔG° will be $\left(F = 96,500 Cmol^{-1}\right)$:

A. -44.5 kJ

B. -98.0 kJ

C. -89.0 kJ

D. $-89.0J$

Answer: C

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6. An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to:

A. increase in both i.e. number of ions and ionic mobility of ions .

B. increase in number of ions

C. increase in ionic mobility of ions

D. 100% ionization of electrolyte at normal dilution .

Answer: C

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7. If the E_{cell}° for a given reaction has a positive value, then which of the following gives the correct relationship for the values of ΔG° and K_{eq} :-

A. $\Delta G^{\circ} > 0, K_{eq} > 1$

B. $\Delta G^{\circ} < 0, K_{eq} > 1$

C. $\Delta G^{\circ} < 0, K_{eq} < 1$

D. $\Delta G^{\circ} > 0, K_{eq} < 1$

Answer: D

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8. The electrode pptenticals for

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

and $Cu^+(aq) + e^- \rightarrow Cu(s)$

are $+0.15V$ and $+0.\ 50V$ repectively. The value of $E^{\circ}_{cu^{2+}/Cu}$ will be.

A. $0.500V$

B. $0.325V$

C. $0.650V$

D. $0.150V$

Answer: B

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9. Standard electrode potential for Sn^{4+}/Sn^{2+} couple is $+0.15$ V and that for the Cr^{3+}/Cr couple is -0.74V . These two couples in their standard state are connected to make a cell . The cell potential will be

A. $+1.19V$

B. $+0.89V$

C. $+0.18V$

D. $+1.83$ V

Answer: B

Watch Video Solution

10. Limiting molar conductivity of NH_4OH [i.e., $\Lambda_m^\circ(NH_4OH)$] is equal to:

A. $\Lambda^\circ_{m(NH_4Cl)} + \Lambda^\circ_{m(NaCl)} - \Lambda^\circ_{m(NaOH)}$

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

C. $\Lambda^\circ_{m(NH_4OH)} + \Lambda^\circ_{m(NH_4Cl)} - \Lambda^\circ_{m(HCl)}$

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

Answer: D

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11. At $25^{\circ}C$ molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is $9.54 ohm^{-1} cm^2 mol^{-1}$ and at infinte dilution its molar conductance is $238 ohm^{-1} cm^2 mol^{-1}$ The degree of ionisation of ammonium hydroxide at the same concentration and termperature is

A. $4.008\ \%$

B. $40.800\ \%$

C. $2.080\ \%$

D. $20.800\ \%$

Answer: A

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12. A button cell used in watches functions as following

$Zn(s) + Ag_2O(s) + H_2O(l)$

$2Ag(s) + Zn^{2+}(aq) = 2OH^{-(aq)}$

If half cell potentials are

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

$Af_2O(s) + H_2O(l) + 2e^{-} \rightarrow$

$2Ag(s) + 2OH^{-(aq)}, E^{\circ} = 0.34V.$

The cell potential will be .

A. $0.84V$

B. $1.34V$

C. $1.10V$

D. $0.42V$

Answer: C

Watch Video Solution

13. A hydrogen gas electrode is made by dipping platinum wire in a solution of HCl or $pH = 10$ and by passing bydrogen gas around the platinum wire at one atm pressure . The oxidation potential of electrode would be ?

A. 0.118 V

B. 1.18 V

C. 0.059 V

D. 0.59 V

Answer: D

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14. When molten magnesium oxide was electrolysed for a certain period , 150 mg of Mg was deposited on the cathode . The volume of oxygen gas in cm^3 at STP conditions liberated at the anode during the same period is (Atomic mass of Mg = 24 $gmol^{-1}$)

A. 140

B. 280

C. 70

D. 120

Answer: C

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15. When $0.1 mol MnO_4^{2-}$ is oxidized the quantity of electricity required to completely oxidize MnO_4^{2-} to MnO_4^- is

A. 96500 C

B. $2 \times 96500 C$

C. 9650 C

D. 96.50 C

Answer: C

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16. The weight of silver (at wt. = 108)displaced by a quantity of electricity which displaces 560 mL of O_2 at STP will be (Volume of 1 mole of gas STP

is 22. 4 L)

A. 5.4 g

B. 10.8 g

C. 54.0 g

D. 108.0 g

Answer: D

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17. A device that convers energy of combustion of fueles like hydrogen and methane, directly into electrical energy is known as .

A. dynamo

B. Ni-Cd cell

C. fuel cell

D. electrolytic cell

Answer: C

Watch Video Solution

18. The pressure of H_2 required to make the potential of H_2 – electrode zero in pure water at 289K is :

A. 10^{-10} atm

B. 10^{-4} atm

C. 10^{-14} atm

D. 10^{-12} atm

Answer: C

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19. The molar conductivity of a $0.5mol/dm^3$ solution of $AgNO_3$ with electrolytic conductivity of $5.76 \times 10^{-3} Scm^{-1}$ at $298K$ is

A. 2.88

B. 11.52

C. 0.086

D. 28.8

Answer: B

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20. During the electrolysis of molten sodium chloride, the time required to produce $0.10 mol$ of chlorine gas using a current of 3 amperes is

A. 55 min.

B. 110 min.

C. 220 min.

D. 330 min.

Answer: B

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21. The number of electrons delivered at the cathode during electrolysis by a current of 1 ampere in 60 seconds is

A. 6×10^{23}

B. 6×10^{20}

C. 3.75×10^{20}

D. 7.48×10^{23}

Answer: C

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22. Zine can be coated on iron to produce galvanize3d iron but the reverse is not possible it is because

A. zinc is lighter than iron

B. zinc has lower melting point than iron

C. zinc has lower negative electrode potential than iron

D. zinc has higher negative electrode potential than iron

Answer: D

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23. The emf of a Daniell cell at $298K$ is E_1

$Zn|ZnSO_4(0.01M)||CuSO_4(1.0M)|Cu$

When the concentration of $ZNSO_4$ is $1.0M$ and that of $CuSO_4$ is $0.01M$, the emf changed to E_2. What is the relationship between E_1 and $E(2)$?

A. $E_1 < E_2$

B. $E_1 > E_2$

C. $E_2 = 0 \neq E_2$

D. $E_1 = E_2$

Answer: B

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24. Consider the change in oxidation state of bromine corresponding to different emf values as shown in the diagram below :

Then the species undergoing disproportionation :

A. BrO_3^-

B. BrO_4^-

C. Br_2

D. $HBrO$

Answer: D

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25. For the cell reaction:

$2Fe^{3+}(aq) + 2l^{-}(aq) \rightarrow 2Fe^{2+}(aq) + l_2(aq)$

$E^{\ominus}_{cell} = 0.24V$ at $298K$. The rstandard gibbs energy $\left(\triangle, G^{\ominus} \right)$ of the cell reaction is

[Given that faraday constnat $F = 96400Cmol^{-1}$]

A. $23.16kJmol^{-1}$

B. $-46.32kJmol^{-1}$

C. $-23.16kJmol^{-1}$

D. $46.32kJmol^{-1}$

Answer: B

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26. For a cell involving one electron $E^{0}_{cell} = 0.59V$ and 298K, the equilibrium constant for the cell reaction is:

[Given that $\frac{2.303RT}{F} = 0.059V$ at $T = 298K$]

A. 1.0×10^{30}

B. 1.0×10^{2}

C. 1.0×10^{5}

D. 1.0×10^{10}

Answer: D

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27. One Faraday of electricity is pa ssed through molten Al_2O_3, aqeusous solution of $CuSO_4$ and molten NaCl taken in three different electrolytic cells connected in seris. The mole ratio of Al, Cu,Na deposted at the respective cathode is

A. $2:3:6$

B. $6:2:3$

C. $6:3:2$

D. $1:2:3$

Answer: A

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28. E_1, E_2 and E_3 are the emfs of the following three galvanic cells respectively

I. $Zn((s))|Zn^{2+}(0.1M)||CU^{2+}(1M)|\,Cu((s))$

II. $Zn((s))ZN^{2+}(1M)\,||Cu^{2+}(1M)|Cu(s)$

III. $Zn(s)\,|\,Zn^{2+}(1M)||CU^{2+}(0.1M)CU(s)$

A. $E_2 > E_1 > E_3$

B. $E_1 > E_2 > E_3$

C. $E_3 > E_1 > E_2$

D. $E_3 > E_2 > E_1$

Answer: B

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29. The reduction potential of a hydrogen electrode at $pH10$ at $298K$ is :

$(p = 1$ atm)

A. 0.59 V

B. 0.00 V

C. $-0.59V$

D. $-0.059V$

Answer: C

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30. The Gibbs energy for the decomposition of Al_2O_3 at $500^\circ C$ is as follows

$$\frac{2}{3}A1_2O_3 \rightarrow \frac{4}{3}Al + O_2, \Delta_r G = +966KJmol^{-1}$$

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

A. 2.5 V

B. $5.0V$

C. 4.5 V

D. 3.0 V

Answer: A

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31. The reduction potential of hydrogen half cell will be negative if :

A. $p(H_2) = 2$ atm and $\left[H^+\right] = 1.0$ M

B. $p(H_2) = 2$ atm and $\left[H^+\right] = 2.0$ M

C. $p(H_2) = 1$ atm and $\left[H^+\right] = 2.0$ M

D. $p(H_2) = 1$ atm and $\left[H^+\right] = 1.0$ M

Answer: A

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32. Resistance of $0.2M$ solution of an electrolyte is 50Ω. The specific conductance of the solution is $1.3Sm^{-1}$. If resistance of the $0.4M$ solution of the same electrolyte is 260Ω, its molar conductivity is .

A. $6.25 \times 10^{-4} Sm^2 mol^{-1}$

B. $625 \times 10^{-4} Sm^2 mol^{-1}$

C. $62.5 Sm^2 mol^{-1}$

D. $6250 Sm^2 mol^{-1}$

Answer: A

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33. The standard redox potentials for the reactions,

$MN^{2+} + 2e^- \rightarrow Mn$ and $Mn^{3+} + e^- are$-1.18V and 1.51V respectively. What is the redox potential for the reaction $Mn^{3+} + 3e^- \rightarrow Mn$?

A. $0.33V$

B. $1.69V$

C. $-0.28V$

D. $-0.85V$

Answer: C

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34. At 298 K, The specific conductivity of a saturated solution of silver chloride in water is $2.30 \times 10^{-5} Scm^{-1}$. Calculate its solubiility in gL^{-1} at 298 K. Given $\lambda_m^\circ(Ag^+) \text{and} \lambda_m^\circ(CI^-)$ are61.9 and 76.3 S $cm^2 mol^{-1}$ respectively.

A. 5.7×10^{-12}

B. 1.32×10^{-12}

C. 7.5×10^{-12}

D. 1.74×10^{-12}

Answer: D

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35. The standard reduction potential of Pb and Zn electrodes are -0.126 and $-0.763V$ respectively. The cell equation will be

A. The overall cell reaction is a spontaneous reaction .

B. The standard EMF of the cell is $-0.27V$

C. The standard EMF of the cell is $-0.77V$

D. The standard EMF of the cell is 0.27 V .

Answer: B

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36. The standard reduction potential for Zn^{2+}/Zn, Ni^{2+}/Ni and Fe^{2+}/Fe are -0.76, -0.23 and $-0.44V$ respectively. The reaction

$X + Y^2 \rightarrow X^{2+} + Y$ will be spontaneous when:

A. X = Ni and Y = Zn

B. X = Fe , Y = Zn

C. X = Zn , Y = Ni

D. X = Ni , Y = Fe

Answer: C

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37. Given

$E^0_{cr^{3+}/Cr} = -0.74V, E^0_{MnO_4/Mn^{2+}} = 1.51cm$

$E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33V, E^0_{Cl/Cl^-} = 1.36V$

Based on the data given above, strongest oxidising agent will be:

A. MnO_4^-

B. Cl^-

C. Cr^{3+}

D. Mn^{2+}

Answer: D

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38. A current strength of 9.65 amperes is passed through excess fused $AlCl_3$ for 5 hours . How many litres of chlorine will be liberated at STP ? (F = 96500 C)

A. 2.016

B. 1.008

C. 11.2

D. 20.16

Answer: D

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39. At $25^\circ C$, the molar conductance of 0.007 M hydrofluoric acid is 150 $mhocm^2mol^{-1}$ and $\wedge_\circ = 500\text{mho}cm^2mol^{-1}$. The value of the dissociation constant of the acid at the given concentration at $25^\circ C$ is _____.

A. $7 \times 10^{-4}M$

B. $7 \times 10^{-5}M$

C. $9 \times 10^{-3}M$

D. $9 \times 10^{-4}M$

Answer: D

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40. Given below are the half -cell reactions

$Mn^{2+} + 2e^- \rightarrow Mn, E^\circ = -1.18V$

$2\left(Mn^{3+} = E^- \rightarrow Mn^{2+}\right). E^\circ = +1.5V$

The E° for $Mn^{2+} \rightarrow Mn + 2Mn^{3+}$ will be.

A. -0.33 V , the reaction will occur

B. $-2.69V$, the reaction will not occur

C. -2.69 V , the reaction will occur

D. -0.33 V , the reaction will not occur

Answer: B

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41. The equivalent conductance of NaCl at concentration C and at infinite dilution are λ_C and λ_∞, respectively. The correct relationship between λ_C and λ_∞ is given as (where, the constant B is positive)

A. $\lambda_c = \lambda_\infty + (B)\sqrt{C}$

B. $\lambda_c = \lambda_\infty + (B)C$

C. $\lambda_c = \lambda_\infty - (B)C$

D. $\lambda_c = \lambda_\infty - (B)\sqrt{C}$

Answer: D

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42. Resistance of $0.2M$ solution of an electrolue is 50Ω. The specific conductance of the solution is $1.4Sm \wedge (-1)$. The resistance of 0.5 M solution of the same electrolyte is $280.\Omega$. The molar conducitivity of $0.5M$ solution of the electrolyte is $Sm^2\text{mol}^{-1}$ is.

A. 5×10^2

B. 5×10^{-4}

C. 5×10^{-3}

D. 5×10^3

Answer: B

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43. For $Cr_2O_7^{2} + 14H^{+} + 6e^{-} \rightarrow 2Cr^{3+} + 7H_2O$

$E^{\circ} = 1.33V. At 298k$, $\left[Cr_2O_7^{2-}\right] = 4.5$ millimole

$\left[Cr^{3+}\right] = 15$ millimole ,E is 1.067 v The pH of the solution is nearly eual to

A. 2

B. 3

C. 5

D. 4

Answer: A

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44. In $H_2 - O_2$ fuel cell the reaction occuring at cathode is:

A. $O_2(g) + 2HO(l) + 4e^{-} \rightarrow 4OH^{-}(aq)$

B. $H^{+}(aq) + OH^{-}(aq) \rightarrow H_2O(l)$

C. $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

D. $H^+ + e^- + \frac{1}{2}H_2$

Answer: A

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45. Which of the following reactions occurs at cathode during charging of storage battery ?

A. formation of PbO_2

B. formation of $PbSO_4$

C. reduction of Pb^{2+} to Pb

D. decomposition of Pb at the anode

Answer: C

Watch Video Solution

46. What pressure of H_2 would be required to make emf of the hydrogen electrode zero in pure water at $25^\circ C$?

A. 10^{-7} atm

B. 10^{-14} atm

C. 1 atm

D. 0.5 atm

Answer: C

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47. Two faraday of electricity is passed through a solution of $CuSO_4$. The mass of copper deposited at the cathode is: (at mass of Cu = 63.5 amu)

A. 2 g

B. 127 g

C. 0 g

D. 63.5 g

Answer: D

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48. Galvanization is applying a coating of :

A. Pb

B. Cr

C. Cu

D. Zn

Answer: D

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49. Number of Faradays required to convert 1 mol of $Cr_2O_7^{2-}$ into Cr^{3+} ions is :

A. 2

B. 3

C. 5

D. 6

Answer: D

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50. Given $E^{\circ}_{Cl_2/Cl^-} = 1.36V$, $E^{\circ}_{Cr^{3+}/Cr} = -0.74V$

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

Among the following, the strongest reducing agent is

A. Cr

B. Mn^{2+}

C. Cr^{3+}

D. Cl^{-}

Answer: A

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51. The standard oxidation potentials, , for the half reactions are as follows :

$Zn \rightarrow Zn^{2+} + 2e^{-}$,$E^{\circ} = +0.76V$

$Fe \rightarrow Fe^{2+} + 2e^{-}$, $E^{\circ} = +0.41V$

The EMF for the cell reaction,

$Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$

A. $-0.35V$

B. $+0.35V$

C. $+1.17V$

D. $-1.17V$

Answer: B

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52. At a particular temperature, the ratio of molar conductance to specific conductance of 0.01 M NaCl is :

A. $10^5 cm^3 mol^{-1}$

B. $10^3 cm^3 mol^{-1}$

C. $10 cm^3 mol^{-1}$

D. $10^5 cm^2 mol^{-1}$

Answer: A

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53. For a cell involving two electron change , $E^\circ_{cell} = 0.3V$ at $25^\circ C$. The equilibrium constant of the reaction is

A. 10^{-10}

B. 3×10^{-2}

C. 10

D. 10^{10}

Answer: D

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54. The charge required for the reduction of 1 mol of MnO_4^- to MnO_2 is

A. 1 F

B. 3 F

C. 5 F

D. 7 F

Answer: B

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55. Consider the electrochemical reaction between Ag (s) and $Cl_2(g)$ electrodes in 1 litre of 0. 1 M KCl aqueous solution . Solubility product of AgCl is 1.8×10^{-10} and F = 96500 C/mol . At 1 μA current , calculate the time required to start observing the AgCl precipitation in the galvanic cell .

A. 173 s

B. 346 s

C. 1.25×10^6 s

D. $1.25 \times 10^5 s$

Answer: A

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56. The conductivity of $0.1 molL^{-1}$ KCl solution is $1.41 \times 10^{-3} Scm^{-1}$. What is its molar conductivity (in $Scm^2 mol^{-1}$) ?

A. 375.6 K

B. 376. 3 K

C. 378.1 K

D. 380.3 K

Answer: A

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57. How long (approximate) should water be electrolysed by passing through 100 amperes current so that the oxygen released can completely burn 27.66 g of diborane?

(Atomic weight of B = 10.8 u)

A. 6.4 hours

B. 0.8 hours

C. 3.2 hours

D. 1.6 hours

Answer: C

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58. The pH of LHE in the following cell is :

$Pt,\ H_2(1atm)\left|H^{\oplus}(xM)\right|\left|H^{\oplus}(0.1M)\right|H_2(0.1atm)Pt$ E_(cell)=0.295V`.

A. $\frac{-2.303RT}{F}$

B. $\frac{2.303RT}{F}$

C. $\frac{-2.303RT}{2F}$

D. $\frac{2.303RT}{2F}$

Answer: A

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59. 1 litre aqueous solution of NaCl was electrolysed bètweern Pt electrodes passing a direct current of 12.87 A for 100s with a current

efficiency of 75%. Calculate pH of the solution after electrolysis assuming no change in volume of solution.

A. 5×10^{-3} M

B. $5 \times 10^{-2} M$

C. 0.5×10^{-3} M

D. $1.0 \times 10^{-2} M$

Answer: D

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60. Two aqueous solutions A and B containing solute $CuSO_4$ and $NaBr$ respectively were electrolysed using platinum electrodes. The pH of the resultins will show a/an:

A. increase

B. remains unchanged

C. decrease

D. increase or decrease depending on the strength of the current

Answer: C

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61. Given $E^{\circ}_{Mn^{7+}/Mn^{2+}}$ and $E^{\circ}_{Mn^{4+}/Mn^{2+}}$ are $1.51V$ and $1.23V$. Calculate $E^{\circ}_{Mn^{7+}/Mn^{4+}}$.

A. 0.3 V

B. 0.1 V

C. 1.7 V

D. 2.1 V

Answer: C

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62. Calculate EMF of following cell at 298 K

$Zn|ZnSO_4(0.1M)||CuSO_4(1.0M)|Cu(s)$ if $E_{cell} = 2.0$ V

A. $2.0296V$

B. $2.0592V$

C. $1.0508V$

D. 2.0 V

Answer: B

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63. The standard electrode potential E^{Θ} and its temperature coefficent $\left(\frac{dE^{\Theta}}{dT}\right)$ for a cell are 2V and $-5 \times 10^{-4} VK^{-1}$ at 300 K respectively. The cell reaction is $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$.

The standard reaction enthalpy $\left(\Delta_t H^{\Theta}\right)$ at 300 K is $4.12 \times 10^x J/\text{mol}$.

Numerical value of x is _____ [Use $R = 8JK^{-1}mol^{-1}$ and $F = 96,000C\text{mol}^{-1}$].

A. 206.4

B. -384.0

C. -412.8

D. 192.0

Answer: C

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64. Calculate the standard cell potential (in V) of the cell in which following reaction takes place:

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

Given that $E^{0}_{Ag^{+}/Ag} = xV, E^{0}_{Fe^{2+}/Fe} = yV, E^{0}_{Fe^{3+}/Fe} = zV$

A. $x + 2y - 3z$

B. $x - z$

C. $x - y$

D. $x + y - z$

Answer: A

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65. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using 0.1 Faraday electricity. How many mole of Ni will be deposited at the cathode?

A. 0.20

B. 0.05

C. 0.10

D. 0.15

Answer: B

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66. If the standed electrode potential for a cell is 2 V at 300 K, the equilibrium constant (K) for the reaction

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

at 300 K is approximately

$\left(R = 8JK^{-1}mol^{-1}, F = 96000Cmol^{-1}\right)$

A. e^{160}

B. e^{320}

C. e^{-160}

D. e^{-80}

Answer: A

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67. Given :

$Co^{3+} + e^{-} \rightarrow Co^{2+}, E^{\circ} = +1.181V$

$Pb^{4+} + 2e^{-} \rightarrow Pb^{2+}, E^{\circ} = +1.67V$

$Ce^{4+} + e^- \rightarrow Ce^{3+}, E^\circ = +1.61V$

$Bi^{3+} + 3e^- \rightarrow Bi^{3+} + 3e^- \rightarrow Bi, E^\circ = +2.20V$

Oxidizing power of the species will increase in the order:

A. $Ce^{4+} < Pb^{4+} < Bi^{3+} < Co^{3+}$

B. $Co^{3} + < Pb^{4+} < Ce^{4+} < Bi^{3+}$

C. $Co^{3+} < Ce^{4+} < Bi^{3+} < Pb^{4+}$

D. $Bi^{3+} < Ce^{4+} < Pb^{4+} < Co^{3+}$

Answer: D

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68. The standard Gibbs energy for the given cell reaction is $KJmol^{-1}$ at 298 K is :

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

$E^\circ = 2Vat298K$

(Friday's constant , $F = 96000Cmol^{-1}$)

A. -384

B. -192

C. 192

D. 384

Answer: A

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69. In the cell $Pt(s)|H_2(g, 1 \text{ bar})|HCl(aq)|AgCl(s)|Ag(s) \mid Pt(s)$ the cell potential is 0.92 V when a 10^{-6} molal HCl solution is used. The standard electrode potential of $(AgCl/Ag, Cl^-)$ electrode is {Given, $\frac{2.303RT}{F} = 0.06V$ at 298 K}

A. 0.20 V

B. $0.76V$

C. 0.40 V

D. 0.94 V

Answer: A

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70. $\wedge_m^\circ$ for $NaCI, HCI$ and NaA are $126.4, 425.9$ and $100.5 Scm^2 mol^{-1}$, respectively. If the conductivity of $0.001 MHA$ is $5 \times 10^{-5} Scm^{-1}$, degree of dissociation of HA is :

A. 0.75

B. 0.125

C. 0.25

D. 0.50

Answer: B

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71. Which one of the following graphs between molar conductivity (A_m) versus $\sqrt{C}$ is correct?

A. 

B. 

C. 

D. 

Answer: B

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72. Consider the following reduction processes :

$Zn^{2+} + 2e^- \rightarrow Zn(s), E^o = -0.76V$

$Ca^{2+} + 2e^- \rightarrow Ca(s), E^o = -2.87V$

$Mg^{2+} + 2e^- \rightarrow Mg(s), E^o = -2.36V$

`Ni^(2+)+2e^(-)toNi(s), E^(o)=-0.25 V

The reducing power of the metals increases in the order :

A. $Ca < Zn < Mg < Ni$

B. $Ni < Zn < Mg < Ca$

C. $Zn < Mg < Ni < Ca$

D. $Ca < Mg < Zn < Ni$

Answer: B

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73. Electrolysis of dilute aqueous $NaCl$ solution was carried out by passing $10mA$ current. The time required to liberate $0.01mol$ of H_2 gas at the cathode is $\left(1F = 96500Cmol^{-1}\right)$

A. 9.65×10^4 sec

B. 19.3×10^4 sec

C. 28.95×10^4 sec

D. 38.6×10^4 sec

Answer: B

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74. Consider the following cell reaction:

$2Fe(s) + O_2(g) + 4H^+(aq) \rightarrow 2Fe^{2+}(aq) + 2H_2O(l), E^\circ = 1.67V$

At $\left[Fe^{2+}\right] = 10^{-3}M$, $P_{O_2} = 0.1$ atm and PH=3 . The cell potential at $25^\circ C$:

A. $1.47V$

B. 1.77 V

C. 1.87 V

D. 1.57 V

Answer: D

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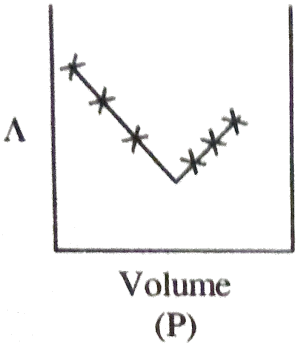
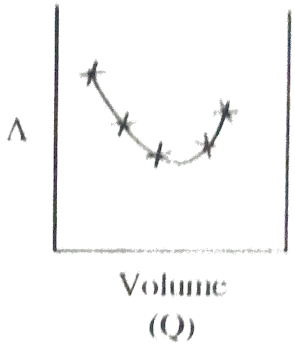
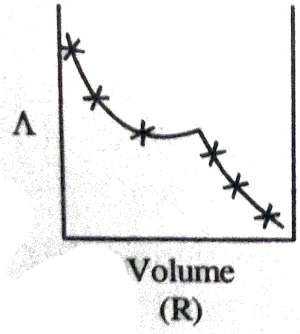
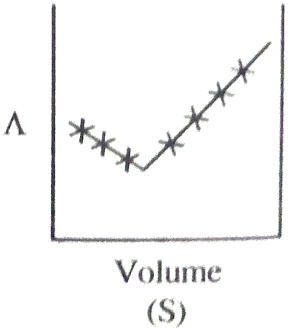
75. $AgNO_3(aq)$ was added to an aqueous KCl soltuion gradually and conductivity of the solution was measured. The plot of conductance (A) versus the value of $AgNO_3$ is









A.

B.

C.

D.

Answer: D

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76. For the following electrochemical cell at 298 k<

$Pt_sH_g(1^-)|H^+\ \_\ (1M)|\ |\ M_{aq}^{4+},\ +(aq)^{2+}\ |\ Pt_sE_{cell}=0.092V$ When $\frac{\left[M_{aq}^{2+}\right]}{\left[M_{aq}^{4+}\right]}=10^X.$

Given : $E^{\circ}_{M^{4+}/M^{2+}}=0.151V, 2.303\frac{RT}{F}=0.059V$]

The value of X is ,

A. -2

B. -1

C. 1

D. 2

Answer: D

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77. For the following cell , $Zn_s|ZnSO_4((aq))CuSO_4((aq))|Cu(s)$ When the concentration of Zn^{2+} is 10 times the concentration of Cu^{2+}, the expression for $\Delta G\left(\text{in } Jmol^{-1}\right.$ is [F is Faraday constant , R is gas constant , T is temperature , $E^{\circ}_{cell} = 1.1V$]

A. 2.303 RT - 2.2 F

B. -2.2 F

C. 2.303 RT + 1.1 F

D. 1.1 F

Answer: A

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COMPETITION FILE (OBJECTIVE TYPE QUESTIONS) C MULTIPLE CHOICE QUESTIONS

1. Which of the following relations are not correct ?

A. $\Lambda_m = \frac{\kappa \times 1000}{M}$

B. $\kappa = C \times \frac{a}{l}$

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

D. $\frac{l}{a}$ (cell constant) = $\kappa \times \frac{1}{R}$

Answer: B::D

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2. Which of the following statements is not true ?

A. Molar conductivity of weak electrolytes is low as compared to that of strong electrolytes .

B. Molar conductance of an electrolyte increases with increase in concentration of electrolyte .

C. Conductivity of an electrolyte increases with decrease in temperature

D. Conductivity of an electrolyte increases with increase in concentration of electrolyte

Answer: B::C

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3. In which of the following pairs , the first can reduce the second ?

A. $Zn^{2+}|Zn, Ni^{2+}|Ni$

B. $Sn^{2+} \mid Sn, Mg^{2+}|Mg$

C. $Cu^{2+} \mid Cu, Ag^{+}|Ag$

D. $Fe^{2+}|Fe, Al^{3+}|Al$

Answer: A::C

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4. For the cell $Tl|Tl^+(0.001M)||Cu^{2+}(0.01M)|Cu$. E_{cell} at $25^\circ C$ is 0.83V, which can be increased:

A. by increasing $[Tl^+]$

B. by decreasing $[Tl^+]$

C. by increasing $[Cu^{2+}]$

D. by decreasing $[Cu^{2+}]$

Answer: B::C

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5. Which of the following increases with dilution?

A. Conductance

B. Specific conductance

C. Molar conductance

D. None of these

Answer: A::C

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6. which of the following statements are correct regarding to galvanic cell?

A. Zinc container acts as anode .

B. Zinc container is in touch with a paste of MnO_2 and carbon.

C. Dry cell can easily be charged

D. Graphite rod acts as cathode .

Answer: A::D

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7. Given that,

$Ni^{2+}/Ni = 0.25V, Cu^{2+}/Cu = 0.34V,$

$Ag^+/Ag = 0.80V$ and $Zn^{2+}/Zn = -0.76V$

Which of the following reaction under standard condition will not take place in the specified direction ?

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

B. $Zn(s) + Ni^{2+}(aq) \rightarrow Zn^{2+}(aq) + Ni(s)$

C. $Cu(s) + Ni^{2+}(aq) \rightarrow Cu^{2+}(aq) + Ni(s)$

D. $Cu(s) + 2H^+(aq) \rightarrow Cu^{2+}(aq) + H_2(g)$

Answer: A::B

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8. Which of the following reactions is not correct ?

A. $E_{cell} = \log \frac{2.303RT}{nF} \log K_c$

B. $\Delta G^\circ = nFE^\circ$

C. $\Delta G^\circ = RT \ln K_c$

D. $\log K_c = \frac{nE^{\circ}_{cell}}{0.059}$ at 298 K

Answer: B::C

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9. In a galvanic cell, the salt bridge.

A. does not participate chemically in the cell reaction

B. stops the diffusion of ions from one electrode to another

C. is necessary for the occurrence of the cell reaction

D. ensures mixing of the two electrolytic solution .

Answer: A::B::C

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10. During the electrolysis of molten NaCl solution, 230 g of sodium metal is deposited on the cathode, then how many moles of chlorine will be obtained at anode?

A. Electrolysis will stop

B. Hydrogen will be evolved

C. Some amount of caustic soda will be formed

D. A fire is likely .

Answer: B::C::D

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COMPETITION FILE (OBJECTIVE TYPE QUESTIONS) D MULTIPLE CHOICE QUESTIONS

1. Fuel cells : Fuel cells are galvanic cells in which the chemical energy of fuel cell is directly converted into electrical energy. A type of fuel cell is a

hydrogen $-$ oxygen fuel cell. It consists of two electrodes made up of two porous graphite impregnated with a catalyst (platinum, silver, or metal oxide). The electrodes are placed in aqueous solution of $NaOH$. Oxygen and hydrogen are continuously fed into the cell. Hydrogen gets oxidized to $H^{\oplus}$ which is neutralized by $\overset{c-}{O}H$, $i.e.$, anodic reaction.

$$H_2 \rightleftharpoons 2H^{\oplus} + 2e^-$$
$$2H^{\oplus} + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O$$
$$H_2 + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O + 2e^-$$

At cathode, O_2 gets reduced to $\overset{\ominus}{O}H$

i.e., $O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$

Hence, the net reaction is $2H_2 + O_2 \rightleftharpoons 2H_2O$

At cathode, O_2 gets reduced to $\overset{c-}{O}H$

Hence, the net reaction is

The overall reaction has

$\Delta H = -285.6kJmol^{-1}$ and $\Delta G = -237.4kJmol^{-1}$ at $25^{\circ}C$

What is the value of ΔS^{c-} for the fuel cell at $25^{\circ}C$?

A. $1944JK^{-1}$

B. $-163JK^{-1}$

C. $-1630JK^{-1}$

D. $1.944 JK^{-1}$

Answer: B

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2. Fuel cells : Fuel cells are galvanic cells in which the chemical energy of fuel cell is directly converted into electrical energy. A type of fuel cell is a hydrogen $-$ oxygen fuel cell. It consists of two electrodes made up of two porous graphite impregnated with a catalyst (platinum, silver, or metal oxide). The electrodes are placed in aqueous solution of $NaOH$. Oxygen and hydrogen are continuously fed into the cell. Hydrogen gets oxidized to $H^{\oplus}$ which is neutralized by $\overset{c-}{O}H, i.e.,$ anodic reaction.

$$H_2 \rightleftharpoons 2H^{\oplus} + 2e^-$$

$$2H^{\oplus} + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O$$

$$H_2 + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O + 2e^-$$

At cathode, O_2 gets reduced to $\overset{\ominus}{O}H$

i.e., $O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$

Hence, the net reaction is $2H_2 + O_2 \rightleftharpoons 2H_2O$

At cathode, O_2 gets reduced to $\overset{c-}{O}H$

$O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$ has $E^{\ominus} = 0.40$ V,
then $E^{\ominus}$ for $2H_2O + 2e^- \rightleftharpoons H_2 + 2\overset{\ominus}{O}H$ will be
a. 0.41 V **b.** 0.83 V **c.** – 0.41 V **d.** – 0.83 V

Hence, the net reaction is

The overall reaction has

$\Delta H = -285.6 kJmol^{-1}$ and $\Delta G = -237.4 kJmol^{-1}$ at $25^{\circ} C$

If the cell voltage is $1.23V$ for the $H_2 - O_2$ fuel cell and for the half cell :

A. 1.64 V

B. 0.82 V

C. -0.82 V

D. -1.64 V

Answer: C

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3. Fuel cells : Fuel cells are galvanic cells in which the chemical energy of fuel cell is directly converted into electrical energy. A type of fuel cell is a hydrogen $-$ oxygen fuel cell. It consists of two electrodes made up of two porous graphite impregnated with a catalyst (platinum, silver, or metal oxide). The electrodes are placed in aqueous solution of $NaOH$. Oxygen and hydrogen are continuously fed into the cell. Hydrogen gets oxidized to $H^{\oplus}$ which is neutralized by $\overset{c-}{O}H$, $i.e.$, anodic reaction.

$$H_2 \rightleftharpoons 2H^{\oplus} + 2e^-$$

$$2H^{\oplus} + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O$$

$$H_2 + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O + 2e^-$$

At cathode, O_2 gets reduced to $\overset{\ominus}{O}H$

i.e., $O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$

Hence, the net reaction is $2H_2 + O_2 \rightleftharpoons 2H_2O$

At cathode, O_2 gets reduced to $\overset{c-}{O}H$

$O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$ has $E^{\ominus} = 0.40$ V,
then $E^{\ominus}$ for $2H_2O + 2e^- \rightleftharpoons H_2 + 2\overset{\ominus}{O}H$ will be
a. 0.41 V **b.** 0.83 V **c.** – 0.41 V **d.** – 0.83 V

Hence, the net reaction is

The overall reaction has

$\Delta H = -285.6 kJ mol^{-1}$ and $\Delta G = -237.4 kJ mol^{-1}$ at $25^{\circ} C$

If the cell voltage is $1.23 V$ for the $H_2 - O_2$ fuel cell and for the half cell :

A. 4.89 L

B. 2.45 L

C. 7.35 L

D. 2.0 L

Answer: A

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4. Fuel cells : Fuel cells are galvanic cells in which the chemical energy of fuel cell is directly converted into electrical energy. A type of fuel cell is a hydrogen $-$ oxygen fuel cell. It consists of two electrodes made up of two porous graphite impregnated with a catalyst (platinum, silver, or metal oxide). The electrodes are placed in aqueous solution of $NaOH$. Oxygen and hydrogen are continuously fed into the cell. Hydrogen gets oxidized to $H^{\oplus}$ which is neutralized by $\overset{c-}{O}H, i.e.,$ anodic reaction.

$$H_2 \rightleftharpoons 2H^{\oplus} + 2e^-$$

$$2H^{\oplus} + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O$$

$$H_2 + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O + 2e^-$$

At cathode, O_2 gets reduced to $\overset{\ominus}{O}H$

i.e., $O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$

Hence, the net reaction is $2H_2 + O_2 \rightleftharpoons 2H_2O$

At cathode, O_2 gets reduced to $\overset{c-}{O}H$

$O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$ has $E^{\ominus} = 0.40$ V,
then $E^{\ominus}$ for $2H_2O + 2e^- \rightleftharpoons H_2 + 2\overset{\ominus}{O}H$ will be
a. 0.41 V **b.** 0.83 V **c.** – 0.41 V **d.** – 0.83 V

Hence, the net reaction is

The overall reaction has

$\Delta H = -285.6 kJmol^{-1}$ and $\Delta G = -237.4 kJmol^{-1}$ at $25^{\circ}C$

If the cell voltage is $1.23V$ for the $H_2 - O_2$ fuel cell and for the half cell :

A. become double

B. be reduced to 1/2

C. become four times

D. remain unchanged.

Answer: D

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5. Fuel cells : Fuel cells are galvanic cells in which the chemical energy of fuel cell is directly converted into electrical energy. A type of fuel cell is a hydrogen $-$ oxygen fuel cell. It consists of two electrodes made up of two porous graphite impregnated with a catalyst (platinum, silver, or metal oxide). The electrodes are placed in aqueous solution of $NaOH$. Oxygen and hydrogen are continuously fed into the cell. Hydrogen gets oxidized to $H^{\oplus}$ which is neutralized by $\overset{c-}{O}H, i.e.,$ anodic reaction.

$$H_2 \rightleftharpoons 2H^{\oplus} + 2e^-$$

$$2H^{\oplus} + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O$$

$$H_2 + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O + 2e^-$$

At cathode, O_2 gets reduced to $\overset{\ominus}{O}H$

i.e., $O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$

Hence, the net reaction is $2H_2 + O_2 \rightleftharpoons 2H_2O$

At cathode, O_2 gets reduced to $\overset{c-}{O}H$

$O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$ has $E^{\ominus} = 0.40$ V,
then $E^{\ominus}$ for $2H_2O + 2e^- \rightleftharpoons H_2 + 2\overset{\ominus}{O}H$ will be
a. 0.41 V **b.** 0.83 V **c.** – 0.41 V **d.** – 0.83 V

Hence, the net reaction is

The overall reaction has

$\Delta H = -285.6 kJmol^{-1}$ and $\Delta G = -237.4 kJmol^{-1}$ at $25^{\circ} C$

If the cell voltage is $1.23V$ for the $H_2 - O_2$ fuel cell and for the half cell :

A. $9.5\ \%$

B. $89\ \%$

C. $83\ \%$

D. $95\ \%$

Answer: C

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6. Tollen reagent is used for the detection of aldehydes. When a solution of $AgNO_3$ is added to glucose with NH_4OH, then gluconic acid is formed.

$Ag^{\oplus} + e^{-} \rightarrow Ag, \qquad E^{c-}{}_{.red} = 0.8V$

$C_6H_{12}O_6 \rightarrow \underset{Gluconicacid}{C_6H_{12}O_7} + 2H^{\oplus} + 2e^{-}, \qquad E^{c-}{}_{.oxid} = -0.05V$

$\left[Ag(NH_3)_2\right]^{\oplus} + e^{-} \rightarrow Ag(s) + 2NH_3, \qquad E^{c-}{}_{.red} = 0.337V$

$\left[Use 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 at 298K\right]$

$2Ag^{\oplus} + C_6H^{12}O_6 + H_2O \rightarrow 2Ag^{s} + C_6H_{12}O_7 + 2H^{\oplus}$ Find $\ln K$ of this reaction.

A. 55.6

B. 29.6

C. 66

D. 58.35

Answer: D

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7. Tollen reagent is used for the detection of aldehydes. When a solution of $AgNO_3$ is added to glucose with NH_4OH, then gluconic acid is formed.

$Ag^{\oplus} + e^- \rightarrow Ag, \qquad E^{c-}{}_{.red} = 0.8V$

$C_6H_{12}O_6 \rightarrow \underset{Gluconicacid}{C_6H_{12}O_7} + 2H^{\oplus} + 2e^-, \qquad E^{c-}{}_{.oxid} = -0.05V$

$\left[Ag(NH_3)_2\right]^{\oplus} + e^- \rightarrow Ag(s) + 2NH_3, \qquad E^{c-}{}_{.red} = 0.337V$

$\left[Use 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 at 298K\right]$

When ammonia is added to the solution, pH is raised to 11. Which half cell reaction is affected by pH and by how much ?

A. E_{ox} increased by E°_{ox} by 0.65 V

B. E_{ox} decreased by E°_{ox} by 0.65 V

C. E_{red} increased by E°_{red} by 0.65 V

D. E_{red} decreased by E°_{red} by 0.65 V

Answer: A

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8. Tollen reagent is used for the detection of aldehydes. When a solution of $AgNO_3$ is added to glucose with NH_4OH, then gluconic acid is formed.

$$Ag^{\oplus} + e^{-} \rightarrow Ag, \qquad E^{c-}{}_{.red} = 0.8V$$

$$C_6H_{12}O_6 \rightarrow \underset{Gluconicacid}{C_6H_{12}O_7} + 2H^{\oplus} + 2e^{-}, \qquad E^{c-}{}_{.oxid} = -0.05V$$

$$\left[Ag(NH_3)_2\right]^{\oplus} + e^{-} \rightarrow Ag(s) + 2NH_3, \qquad E^{c-}{}_{.red} = 0.337V$$

$$\left[Use 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 at 298K\right]$$

Ammonia is always added in this reaction. Which of the followijng must be wrong ?

A. $\left[Ag(NH_3)_2\right]^{+}$ is a weaker oxidising agent than Ag^{+}

B. NH_3 prevents the decomposition of gluconic acid

C. Ag precipitates gluconic acid as its silver salt .

D. NH_3 changes the standard reduction potential of $\left[Ag(NH_3)_2\right]^{+}$

Answer: A

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9. The concentration of potassium ions inside a biological cell is at least twenty times higher than the outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simple mode for such a concentration cell involving a metal M is :

$$M_{(s)}\left|M^{\circ}_{(aq.)}\,0.05\text{molar}\right|\left|M^{\circ}_{(aq.)}\,1\text{molar}\right|M_{(s)}$$

For the above electrolytic cell the magnitude of the cell potential $|E_{cell}| = 70mV$

For the above cell :

A. $E_{cell} < 0, \Delta G > 0$

B. $E_{cell} > 0, \Delta G < 0$

C. $E_{cell} < 0, \Delta G^{\circ} > 0$

D. $E_{cell} > 0, \Delta G^{\circ} < 0$

Answer: B

Watch Video Solution

10. The concentration of potassium ions inside a biological cell is at least 20 times higher than outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simplel model for a concentration cell involving a metal M is

$M(s) \mid M^{\oplus}(aq, 0.05 \text{ molar}) \mid \mid M^{\oplus}(aq, 1 \text{ molar}) \mid M(s)$

For the abov electrolytic cell, the magnitude of the cell potential is $|E_{cell}| = 70mV$.

If the 0.05 moolar solution of $M^{\oplus}$ is replaced by a 0.0025 molar $M^{\oplus}$ solution, then the magnitude of the cell potential would be

A. 35 mV

B. 70 mV

C. 140 mV

D. 700m V

Answer: C

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11. The electrochemical cell shown below is a concentration cell

M/M^{2+} (saturated solution of a sparingly soluble salt, MX_2) $\|\left|M^{2+}\left(0.001 moldm^{-3}\right)\right|M$

The emf of the cell depends on the difference in concentrations of Mn^{2+} ions at the two electrodes. The emf of the cell at $298K$ is $0.059V$.

The value of $\Delta G\left(kJ\text{mol}^{-1}\right)$ for the given cell is : (take $1F = 96500C\text{mol}^{-1}$)

A. -5.7

B. 5.7

C. 11.4

D. -11.4

Answer: D

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12. The electrochemical cell shown below is a concentration cell. $M \mid M^{2+}($ saturated solution of sparingly soluble salt, $MX_2) \mid \left|M^{2+}\left(0.001 mol dm^{-3}\right)\right| M$

The emf of the cell depends on the difference in the concentration of M^{2+} ions at the two electrodes. The emf of the cell at 298 is $0.059V$.

The solubility product $\left(K_{sp}, mol^3 dm^{-9}\right)$ of MX_2 at 298 based on the information available the given concentration cell is (Take $2.303 \times R \times 298 / F = 0.059V$)

A. 1×10^{-15}

B. 4×10^{-15}

C. 1×10^{-12}

D. 4×10^{-12}

Answer: B

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COMPETITION FILE (OBJECTIVE TYPE QUESTIONS) MATRIX MATCH TYPE QUESTIONS

1. Match the electrochemical behaviour of metals in Column I with the examples listed in Column II .

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2. Match the type of cell in Column I with the electrolyte used in the cell listed in column II .

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3. Match the units in Column I with the quantity given in Column II .

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COMPETITION FILE (OBJECTIVE TYPE QUESTIONS)Matching Type Questions

1. The standard reduction potential data at $25^{\circ}C$ is given below .

$E^{\circ}\left(Fe^{3+}, Fe^{2+}\right) = +0.77V, E^{\circ}\left(Fe^{2+}, Fe\right) = -0.44V$

$E^{\circ}\left(Cu^{2+}, Cu\right) = +0.34V, E^{\circ}\left(Cu^{+}, Cu\right) = +0.52\,\text{V}$

$E^{\circ}\left[O_{2(g)} + 4H^{+} + 4e^{-} \rightarrow 2H_2O\right] = +1.23V$,

$E^{\circ}\left[O_{2(g)} + 2H_2O + 4e^{-} \rightarrow 4OH^{-}\right] = +0.40V$

$E^{\circ}\left(Cr^{3+}, Cr\right) = -0.74V, E^{\circ}\left(Cr^{2+}, Cr\right) = -0.91V$

Match E° of the redox pair in List I with the values given in List II and select the correct answer using the code given below the lists :

A.

P	Q	R	S
4	1	2	3

B.

P	Q	R	S
2	3	4	1

C.

P	Q	R	S
1	2	3	4

D.

P	Q	R	S
4	3	1	2

Answer: D

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COMPETITION FILE (OBJECTIVE TYPE QUESTIONS) Integer type or Numerical Value Type Questions

1. The number of metals that show passivity with concentrate HNO_3 among ltbr. $Cr, Fe, Ni, Cu, Zn, Al, Ag, Sn$

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2. For the electrochemical cell,

$Mg(s)\left|Mg^{2+}(aq.\ 1M)\right|\left|Cu^{2+}(aq.\ 1M)\right|Cu(s)$

the standard emf of the cell is 2.70 V at 300 K. When the concentration of Mg^{2+} is chaged to x M, the cell potential changes to 2.67 V at 300 K. The value of x is _____ .

(Given $\frac{F}{R} = 11500kV^{-1}$. where F is the Faraday constant and R is the gas constant, ln (10) = 2.30)

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3. Number of Faraday's required to deposit 4 g of H_2 is _____.

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4. In an electrolysis of acidulated water, 4.48 L of hydrogen at STP was produced by passing a current of 2.14 A. For how many hours was the current passed ?

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5. What volume of 0.1M H_2O_2 solution will be required to completely reduce 1 litre of 0.1 M $KMnO_4$ in acidic medium?

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6. The equilbrium constant for the reaction : $Cu + 2Ag^{+}(aq) \rightarrow Cu(2+)(aq) + 2Ag, E^{\circ} = 0.46V$ at $299K$ is

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7. A cell consists of two hydrogen electrode . The negative electrode is in contact with a solution having pH = 6 . The positive electrode is in contact with a solution of pH = x . Calculate the value of x if the e.m.f. of the cell is found to be 0.118 V at 298 K .

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8. The molar conductivity of a solution of a weak acid $HX(0.01M)$ is 10 times smalller than the molar conductivity of a solution of a weak acid $HY(0.10M)$. If $\lambda^{\circ}_{X^-} = \lambda^{\circ}_{Y^-}$, the difference in their pK_a values, $pK_a(HX) - pK_a(HY)$, is (consider degree of ionisation of both acids to be $< < 1$):

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9. The conductance of 0.0015 M aqueous solution of a weak monobasic acid was determined by using a conductivity cell consisting of platinized Pt electrodes. The distance between the electrodes is 120 cm with an area of cross-section of $1cm^2$. The conductance of this solution was found to be $5 \times 10^{-7}S$. The pH of the solution is 4. Calculate the value of limiting molar conductivity.

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10. Consider an electrochemical cell : $Mg_{(s)}\left|Mg^{2+}(aq), 1M^{2+}\right|\left|Cu^{2+}(aq, 1M)\right|Cu_{(s)}$ the standard emf of the cell is 2.70 V at 300 K. When the concentration of Mg^{2+} is changed to x M, the cell potential changes to 2.67 V at 300 K. The value of x is _____.

(GIven, $\frac{F}{R} = 11500KV^{-1}$, where F is the Faraday constant and R is the gas constant , In (10= 2.30)

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11. Consider an electrochemical cell :

$A(s)\left|A^{n+}(aq.\ 2M)\right|\left|B^{2n+}(aq.\ 1M)\right|B(s)$. The value of ΔH° for the cell reaction is twice that of ΔG° at 300 K. If the amf of the cell is zero, the $DelatS^{\circ}\left(\text{in}\ \ JK^{-1}mol^{-1}\right)$ of the cell reaction per mole of B formed at 300 K is _____ .

(Given : In (2) = 0.7, R (universal gas constant) = 8.3 J $K^{-1}mol^{-1}$. H, S and G are enthalpy, entropy and Gibbs energy, respectively.)

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UNIT PRACTICE TEST

1. What is the souce of electrical energy in a galvanic cell ?

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2. Which reaction occurs at cathode in a galvanic cell ?

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3. The value of ΔG° in the Daniell cell has been found to be -212.3 kJ at $25^{\circ} C$. Calculate equilibrium constant for the reaction.

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

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5. FUEL CELLS

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6. Which of the following reactions occurs at the anode during the recharging of lead storage battery ?

A. $PbSO_4 + 2H_2O \rightarrow PbO_2 + SO_4^{2-} + 4H^+ + 2e^-$

B. $PbO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightarrow PbSO_4 + 2H_2O$

C. $PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$

D. $Pb + SO_4^{2-} \rightarrow PbSO_4 + 2e^-$

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7. The solution of nickel sulphate in which nickel rod is dipped is diluted to 10 times. The potential of nickel.

A. increases by 60 mV

B. decreases by 60 m V

C. decreases by 30 mV

D. increases by 30 m V

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8. Why a dry cell becomes dead after a long time even if it is not used ?

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9. Is e.m.f. an extensive or intensive property ?

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10. From the given cells :

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?

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11. Give products of electrolysis of an aqueous solution of $AgNO_3$ with silver electrode.

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12. Predict the products of electrolysis of a solution of H_2SO_4 using platinum electrodes.

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

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14. Write the Nernst equation and calculate e.m.f. of the following cell at 298 K :

$Sn(s)\left|Sn^{2+}(0.050M)\right|\left|H^{+}(0.20M)\right|H_2$ (1 atm) |Pt.

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15. How can we prevent rusting of Iron?

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16. Can we store copper sulphate solution in zinc vessel ?

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17. Explain Effect of dilution on molar conductivity .

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18. The cell in which the following reaction occurs

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

$E^0_{cell} = 0.236V$ at 298 K.

Calculate the stadard gibbs energy and the equilibrium constant of the cell reaction.

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19. What are fossil fuels ? Give one example.

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20. The unit of cell constant is -

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