CHEMISTRY

NCERT - NCERT CHEMISTRY(HINGLISH)

ELECTROCHEMISTRY

Solved Examples

1. 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 $E^{\circ}_{cell} = 3.17V$.

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2. Calculate the equilibrium constant of the reaction :

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

$E^{\circ}_{cell} = 0.46V$

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3. The standard electrode potential for Daniell 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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4. 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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5. The electrical resistance of a column of $0.05MNaOH$ solution of diameter $1cm$ and length $50cm$ is $5.55 \times 10^3 ohm$. Calculate its resistivity , conductivity, and molar conductivity.

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

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

$\lambda_{Mg^{2+}}^\circ = 106.0 Scm^2 mol^{-1}$

$\lambda_{SO_4^{2-}}^\circ = 160.0 cm^2 mol^{-1}$

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8. $\wedge_m^\circ$ for $NaCl, HCl,$ and $NaAc$ are$126.4, 425.9,$ and $91.0 Scm^2 mol^{-1}$, respectively. Calculate $\wedge^\circ$ for $HAc.$

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9. The conductivity of $0.001028M$ acetic acid is $4.95 \times 10^{-5} Scm^{-1}$. Calculate dissociation constant if $\wedge_m^\circ$ for acetic acid is $390.5 Scm^2 mol^{-1}$.

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10. A solution of $CuSO_4$ is electrolyzed for 10 min with a current of $1.5A$. What is the mass of Cu deposited at the cathode? [Atomic mass of $Cu = 63g$]

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Exercise

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

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2. Can you store $CuSO_4$ solution in Zn pot ?

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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 $pH = 10$.

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

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

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6. The cell in which the following reaction occurs

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

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

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

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

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

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9. The molar conductivity of $0.25 mol L^{-1}$ methanoic acid is $46.1 S cm^2 mol^{-1}$. Calculate the degree of dissociation constant.

Given : $\lambda^\circ_{(H^\oplus)} = 349.6 S cm^2 mol^{-1}$ and

$\lambda^\circ_{HCOO^-} = 54.6 S cm^2 mol^{-1}$

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

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

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12. Consider the reaction :

$Cr_2O_7^{2-} + 14H^{\oplus} + 6e^- \rightarrow 2Cr^{+3} + 8H_2O$

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

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

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

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

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16. Arrange the following metals in the order in which they displace each other from the solution of their salts. $Al, Cu, Fe, Mg,$ and $Zn.$

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17. Given standard electrode potentials

$K^{\oplus} \mid K = -2.93V, Ag^{\oplus}|Ag = 0.80V,$

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

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

Arrange these metals in their increasing order of reducing power.

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18. Depict the galvanic cell in which the reaction :

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

Further show :

$a.$ Which of the electrode is negatively charged ?

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

$c.$ Individual reaction at each electrode.

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

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

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

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

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

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

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

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

$d.$

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

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

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

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

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

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23. The conductivity of $0.20M$ solution of KCl at $298K$ is $0.0248Scm^{-1}$. Calculate its molar conductivity.

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24. 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 $0.146 \times 10^{-3} Scm^{-1}$.

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25. 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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26. 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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27. How much Charge is required for the following reductions :

$a.$ 1mol of$Al^{3+} \rightarrow Al$

$b.$ 1mol of$Cu^{2+} \rightarrow Cu$

$c.$ 1mol ofMnO_4^- to Mn^{2+} ?

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

$a.$ $20.0g$ of Ca from molten $CaCl_2$

$b.$ $40g$ of Al from molten Al_2O_3

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29. 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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30. 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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31. 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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32. Using the standard electrode potentials given in the electrode potential series, predict if the reaction between the following is feasible:

a. $Fe^{3+}(aq)$ and $I^{-}(aq)$

b. $Ag^{\oplus}(aq)$ and $Cu(s)$

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

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

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

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

a. An aqueous solution of $AgNO_3$ with silver electrodes.

b. An aqeous solution of $AgNO_3$ with platinum electrodes,

c. A dilute solution of H_2SO_4 with platinum electrodes.

d. An aqueous solution of $CuCl_2$ with platinum electrodes.

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