CHEMISTRY

BOOKS - PRADEEP CHEMISTRY (HINGLISH)

ELECTROCHEMISTRY

Problem

1. How much charge is required for the following reaction?

(i) 1mol of Al^{3+} to Al. (ii) 1 mol of Cu^{2+} to Cu. (iii) 10 mole of MnO_4^- to Mn^{2+}

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2. Calculate the charge in coulombs required for the oxidation of:

(i) 2 moles of H_2O to O_2

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3. How many coulombs of electricity are required for complete oxidation of 90 g of H_2O?

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4. 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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5. Two electrolytic cells containing silver nitrate solution and copper sulphate solution are connected in series. A steady currrent of 2.5 ampere was passed through them till 1.078 g of Ag were deposited. How long did the current flow? What weight of copper will be deposited? (At mass of Ag=107.8, Cu=63.5)

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6. 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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7. In the electrolysis of acidulated water, it is desired to obtain hydrogen at the rate of 1 cc per second at NTP condition. What should be the current passed?

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8. The charge in coulombs on 1 g ion of N^{3-} is

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9. 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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10. Calculate the quantity of electricity that would be required to reduce $12.3g$ of nitrobenzene to aniline, if the current efficiency for the process is $50\ \%$. If the potential drop across the cell is 3.0V, how much energy will be consumed?

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11. A current of 4 ampere was passed for 1.5 hours through a solution of copper sulphate when 3.2 g of copper was deposited. Calculate the current efficiency.

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

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13. On passing electric current of one ampere for 16 min and 5 sec through one litre solution of $CuCl_2$, all copper of solution was deposited at cathode. The normality of $CuCl_2$ solution was:

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14. A current is passed through two cells connected in series. The first cell contains $X(NO_3)_{3(aq)}$ and the second cell contains $Y(NO_3)_{2(aq)}$. The relative atomic masses of X and Y are in the ratio $1:2$. What is the ratio of liberated mass of X to that of Y ?

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15. If specific conductivity of N/50 KCl solution at 298 K is 0.002765 $ohm^{-1}cm^{-1}$ and resistance of a cell containing this solution is 100 ohms, calculate the cell constant.

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16. 0.5 N solution of a salt placed between two platinum electrode 2.0cm apart and of area of cross-secton 4.0 sq. cm has a resistance of 25 ohms. Calculate the equivalent conductance of solution.

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17. 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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18. Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100Ω. If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520Ω, calculate the conductivity and molar conductivity of 0.02 M KCl solution. The conductivity of 0.1 M KCl solution is 1.29S/m.

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19. The specific conductivity of a solution containing $1.0g$ of anhydrous $BaCI_2$ in $200cm^3$ of the solution has been found to be $0.0058Scm^{-1}$. Calculate the molar and equivalent conductivity of the solution. Molecular wt. of $BaCI_2 = 208$[mu implies λ_m]

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20. Calculate the electrode potential of a copper wire dipped in $0.1\mathrm{M}\ \mathrm{CuSO_4}$ solution at $025^\circ C$. The standard electrode potential of copper is 0.34 Volt.

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21. 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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22. 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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23. The EMF of the following cell is found to be 0.20 V at 298 K

$Cd\left|Cd^{2+}(?)\right|\left|Ni^{2+}(2.0M)\right|Ni$

What is the molar concentration of Cd^{2+} ions in the solution?

$\left(E^{\circ}_{Cd^{2+}/Cd} = -0.40V, E^{\circ}_{Ni^{2+}/Ni} = -0.25V\right)$

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24. At what pH of HCl solution, will hydrogen gas electrode show electrode potential of -0.118 V ? H_2 gas is bubbled at 298 K and 1 atm pressure.

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25. A galvanic cell is constructed with Ag/Ag^+ as one elecrode and Fe^{2+}/Fe^{3+} as the second electrode. Calculate the concentration of Ag^+ ions at which the E.M.F. of the cell will be zero at equimolar concentrations of Fe^{2+} and Fe^{3+} ions. Given $E^{\circ}_{Ag^+/Ag} = 0.80V, E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.77V$

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26. Calculate the potential of the cell at 298 K :

$Cd/Cd^{2+}(0.1M) \mid \mid H^+(0.2M)/Pt, H_2(0.5atm)$

Given E° for $Cd^{2+}/Cd = -0.403V, R = 8.314J^{-1}\ \text{mol}^{-1}, F = 965$

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27. (a) Calculate the standard free energy change and maximum work obtainable for the reaction. $Zn(s) + Cu^{2+}(aq) \Leftrightarrow Cu(s) + Zn^{2+}(aq)$

[Given

$E^{\circ}_{Zn^{2+}/Zn} = -0.76V, E^{\circ}_{Cu^{2+}/Cu} = +0.34V, F = 96500\ \text{C}\ mol^{-1}]$

(b) also calculate the equilibrium constant for the reaction.

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28. Estimate the minimum potential difference needed to reduce Al_2O_3 at $500^{\circ}C$ The gibbs energy change for the decomposition reaction $\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2$is 960 kJ (F=96500 C mol^{-1})

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29. The E° values corresponding to the following two reduction electrode processes are:

(i) $Cu^+/Cu = +0.52V$

(ii) $Cu^{2+}/Cu^+ = +0.16V$

Formulate the galvanic cell for their combination. What will be the standard cell potential for it?

Calculate $\Delta_r G^\circ$ for the cell reaction $\left(F = 96500 \text{ C } mol^{-1}\right)$

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30. The zinc/silver oxide cell is used in hearing aids and electric watches. The following reactions take place: $Zn \rightarrow Zn^{2+} + 2e^-, E^\circ = 0.76V$

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

(a) What is oxidized and reduced?

(b) Find E° of the cell and ΔG in joules.

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31. Calculate ΔG° for the given reaction occuring fuel cell

(i) $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O, E^{\circ} = 1.229$ volt

(ii) $2H_2 \rightarrow 4H^+ + 4e^-, E^{\circ} = 0$ volt

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Sample Problem

1. 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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2. 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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3. 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 $61.9\Omega^{-1}cm^2col^{-1}$ ad $76.3\Omega^{-1}cm^2mol^{-1}$ respectively the solubility of AgCl is

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4. The equilibrium constant for the cell $Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$,at 298K is [Given, $E^o_{\frac{(Ag)^+}{Ag}} = 0.8V$ and $E^o_{\frac{(Cu)^{2+}}{Cu}} = 0.34V$]

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5. If the molar conductivities at infinite dilution of NaCl, HCl and $CH_3COONa(NaAc)$ are 126.4, 425.9 and 91.0 S cm^2mol^{-1} respectively, what will be that of acetic acid (Hac)?

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

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

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

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

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7. Molar conductivities at infinite dilution (at 298 K) of NH_4CI, NaOH and NaCl 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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8. 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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9. Calculate the standard EMF of a cell which invovles the following cell reaction $Zn + 2Ag^+ \rightarrow Zn^{2+} + 2Ag$

Given that $E^\circ_{Zn, Zn^{2+}} = 0.76\text{volt}$ and $E^\circ_{Ag, Ag^+} = -0.80$ volt.

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10. A cell is prepared by dipping a copper rod in 1 M $CuSO_4$ solution and a nickel rod in 1 M $NiSO_4$ solution. The standard reduction potentials of copper electrode and nickel electrode are 0.34 volt and -0.25 volt respectively.

(a) What will be the cell reaction?

(b) What will be the standard EMF of the cell?

(c) Which electrode will be positive?

(d) How will the cell be represented?

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11. Predict whether zinc and silver react with 1 M suphuric acid to give out hydrogen or not given that h standard potentials of zinc and silver are -0.76 vold and +0.80 volt respectively

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

Can nickel spatula be used to stir a solution of copper sulphate? Support your answer with a reason.

$E^{\circ}_{Ni^{2+}/Ni} = -0.25V$, $E^{\circ}_{Cu^{2+}/Cu} = +0.34V$.

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13. Iodine (I_2) and bromine (Br_2) are added to a solution containing iodine and bromide (Br^-) ions. What reaction would occur if the concentration of each species is 1M? The electrode potentials for the reaction are: $E^{\circ}_{I_2/I^-} = 0.54V$, $E^{\circ}_{Br_2/Br^-} = 1.08V$

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14. Calculate the EMF of the following concentration cell at 298K

$Zn|ZnSO_4(0.05M)||ZnSO_4(0.5M)|Zn$

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15. A cell contains two hydrogen electrode. The negative electrode is in contact with a solution of 10^{-6} M hydrogen ions. The emf of the cell is 0.118 V at 25°. Calculate the concentration of hydrogen ions at the positive electrode.

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Curiosity Question

1. Suppose uniusulated copper or aluminium wires are used for flow of electricity from pole to pole in the street. Do you expect a better flow in summer or winter and why?

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2. Teflon coating is done in a number of items of daily use. Name any two such items and for what purpose this coating is done?

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3. Ignoring the water lost by evaporation, some water has still to be added periodically into the battery used in an invertor or car. Why? Why this is not requried in the maintenance free batteries?

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4. When a car is running, its battery gets charged. How?

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5. Why batteries discharge more quickly in cold weather? If not in use why do batteries discharge more slowly in cold weather?

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Problem for Practice

1. How many grams of chlorine can be produced by the electrolysis of molten NaCl with a current of 1.00 A for 15 min? Also calculate the number of chlorine molecules liberated.

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2. Calculate the mass of silver deposited from silver nitrate solution by a current of 2 amperes flowing for 30 minutes (equivalent mass of silver is 108).

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3. A current of 10 amp is passed through molten $AlCl_3$ for 96.5 seconds. Calculate the mass of Al deposited.

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4. How many faradays/coulombs are required to produce (i) 20.0 g of calcium from molten $CaCl_2$?

(ii) 40.0 g of aluminium from molten Al_2O_3?

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5. 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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6. A current of 1.50 A was through an electrolytic cell containing $AgNO_3$ solution with inert electrodes. The weight of silver deposited was $1.50g$. How long did the current flow ? ("Molar mass of" $Ag = 108g \ \text{mol}^{-1}$, $1F = 96500C \ \text{mol}^{-1}$).

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7. How many grams of silver could be plated out on a serving tray be electrolysis of solution containing silver in $+1$ oxidation state for a period of 8.0 hour at a current of 8.46 ampere? What is the area of the tray if the thickness of the silver plating is $0.00254cm$? Density of silver is $10.5g/cm^3$.

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8. A solution of metal salt was electrolysed for 15 minutes with a current of 1.5 A. The mass of the metal deposited was 0.000783 kg. Calculate the equivalent mass of the metal.

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9. 0.3605 g of a metal is deposited on the electrode by passing 1.2 ampere current for 15 minutes through its salt. Atomic weight of the metal is 96.

what will be its valency?

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10. A 100 W, 220 V incandescent lamp is connected in series with an electrolytic cell containing copper sulphate solution. What weight of copper will be deposited by 1 A current flowing for 5 hours? (at. Wt. of Cu=63.54).

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11. 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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12. 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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13. Calculate the mass of Ag deposited at cathode when a current of 2 ampere was passed through a solution for 15 minutes.

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14. The specific conductance of a 0.12 N solution of an electrolyte is $2.4 \times 10^{-2} Scm^{-1}$. Calculate its equivalent conductance.

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15. The specific conductivity of N/50 solution of KCl at 298 K is 0.002765 S cm^{-1}. If the resistance of the same solution placed in the cell is 2000

ohms, what is cell constant?

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16. The resistance of a decinormal solution of an electrolyte in a conductivity cell was found to be 245 Ω. Calculate the equivalent conductance of the solution if the electrodes in the cell were 2 cm part and each had an area of 3.5 sq. cm.

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17. A cell with $N/50$ KCl solution offered a resistance of 550 ohm at 298 K. The specific conductance of $N/50$ KCl at 298 K is 0.002768 $ohm^{-1}cm^{-1}$. When this cell is filled with $N/10 ZnSO_4$ solution, it offered a resistance of 72.18 ohm at 298 K. Find the cell constant and molar conductance of $ZnSO_4$ solution at 298 K.

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18. 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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19. Select the equivalent conductivity of $1.0MH_2SO_4$, if its conductivity is $0.26ohm^{-1}cm^{-1}$:

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20. The molar conductivity of a 1.5 M solution of an electrolyte is found to be $138.9Scm^2mol^{-1}$. Calculate the conductivity of this solution.

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21. The measured resistance of a conductance cell containing $7.5 \times 10^{-3} M$ solution of KCl at $25^{\circ} C$ was 1005 ohms. Calculate (a) specific conductance (b) molar conductance of the solution. Cell constant=1.25 cm^{-1}.

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22. 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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23. The electrical resistance of a column of 0.05 M KOH solution of diameter 1 cm and length 45.5 cm is $4.55 \times 10^{3} ohm$. Calculate its molar conductivity.

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24. Calculte molar conductance at infinite dilution for acetic acid, given $A_m^\infty HCI = 425 ohm^{-1} cm^{-1}$, $A_m^\infty NaCI = 188 ohm^{-1} cm^{-1}$, $A_m^\infty CH_3CO$

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25. The molar conductivity of NH_4Cl at infinite dilution is $149.7\ \text{S}\ cm^2 mol^{-1}$ and the ionic conductivities of OH^- and Cl^- and are 198 and 96.3 S $cm^2 mol^{-1}$ respectively. Calculate the molar conductivity of NH_4OH at this dilution.

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26. 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 $cm^2\ \text{mol}^{-1}$ and ionic conductance of SO_4^{2-} is 160 S $cm^2 \text{mol}^{-1}$ at infinite dilution ?

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27. The molar conductances of NaOH, NaCl and $BaCl_2$ at infinite dilution are $2.481 \times 10^{-2}, 1.265 \times 10^{-2}$ and 2.800×10^{-2} S $m^2 mol^{-1}$ respectively. Calculate $\wedge_m^\circ Ba(OH)_2$.

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28. Given molar conductivity of an infinite dilution: $\wedge_m^\circ$ for $Ba(OH)_2 = 517.6\Omega^{-1} cm^2 mol^{-1}$.

$\wedge_m^\circ$ for $BaCl_2 = 240.6\Omega^{-1} cm^2 mol^{-1}$, $\wedge_m^\circ$ for $NH_4Cl = 129.8\Omega^{-1} cm^2 mol^{-1}$. Calculate $\wedge_m^\circ$ for NH_4OH.

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29. Find out the molar conductivity of an aqueous solution of $BaCl_2$ at infinite dilution when ionic conductances of Ba^{2+} and Cl^- ion are 127.30 S $cm^2 mol^{-1}$ and 76.34 S $cm^2 mol^{-1}$ respectively.

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30. The $\wedge_m^\circ$ values for NaCl and KCl are 126.5 and $149.9 \Omega^{-1} cm^2 mol^{-1}$ respectively. The ionic conductances of Na^+ at infinite dilution is 50.1 $\Omega^{-1} cm^2 mol^{-1}$. Calculate the ionic conductance at infinite dilution for K^+ ion.

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31. If the molar conductivities at infinite dilution at 293K for aqueous hydrochloric acid, sodium acetate and sodium chloride solution are 383.5, 78.4 and 102.0 S cm^2 respectively, calculate themolar conductivity or acetic acid at this temperature and dilution. if the molar conductivity of acetic acid at some other dilution is 100.0 S cm^2 at 293K, calculate the degree of ionization of acetic acid at this dilution.

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32. (a) The molar conductivities at infinite dilution of potassium chloride, hydrochloric acid and potassium acetate are 130.1, 379.4 and 95.6 S

cm^2mol^{-1} respectively. Calculate the value of molar conductivity at infinite dilution for acetic acid.

(b) If the molar conductivity of given acetic acid solution is 48.5 S cm^2mol^{-1} at $25^\circ C$, calculate the degree of dissociation of acetic for acetic acid.

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33. The molar conductivity of acetic acid at infinite dilution is $387\omega^{-1}cm^2mol^{-1}$. At the same temperature, but at a concentration of 1 mole in 1000 litres, it is 55 $\Omega^{-1}cm^2mol^{-1}$. What is the % age dissociation of 0.001 M acetic acid?

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34. 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 $390.5Scm^2mol^{-1}$, what is its dissociation constant ?

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35. Conductivity of saturated solution of $BaSO_4$ at 315 K is 3.648×10^{-6} ohm^{-1} cm^{-1} and that of water is 1.25×10^{-6} ohm^{-1} cm^{-1}. Ionic conductance of Ba^{2+} and SO_4^{2-} are 110 and 136.6 ohm^{-1} cm^2 mol^{-1} respectively. Calculate the solubility of $BaSO_4$ in g/L.

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36. For the cell: $Zn(s)|ZnSO_4(aq)|\ |\ CuSO_4(aq)Cu(s)$, calculate standard cell potential if standard state reduction electrode potentials for Cu^{2+}/Cu and Zn^{2+}/Zn are +0.34V and -0.76V respectively.

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37. Calculate the emf of the following cell:

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

Given that, $E^{\circ}_{Cu^{2+}/Cu} = 0.34V$, $E^{\circ}_{Ag/Ag^{+}} = -0.80V$

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38. The standard EMF of the cell : Ni$|Ni^{2+}||Cu^{2+}|Cu$ is 0.59 volt The standsard elctrode potential (reduction potential of copper electrode is 0.34 volt . Calculate the standsard electrode potential of nickel electrode

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39. The emf (E°) of the following cels are :

$Ag|Ag^{+}(1M)||Cu^{2+}(1M)|Cu, E^{\circ} = -0.46$ volt

$Zn|Zn^{2+}(1M)||Cu^{2+}(1M)|Cu, E^{\circ} = +1.10$ volt

Calculate the emf of the cell :

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

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40. The half cell reactions with their oxidation potentials are

(a) $\text{Pb(s)} - 2e^- \rightarrow Pb^{2+}(aq), E^\circ_{\text{oxi}} = +0.13V$ (b)

$Ag(s) - e^- \rightarrow Ag^+(aq), E^\circ_{\text{oxi}} = -0.80V$

Write the cell reaction and calculate its emf.

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41. The standard reduction potentials of two half cells $Al^{3+}(aq) \mid Al$ and $Mg^{2+}(aq) \mid Mg$ are -1.66V and -2.36V respectively. Calculate the standard cell potential. Write the cell reactions also.

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42. Calculate the EMF of the cell containing chromium and cadmium electrodes (Given $E^\circ_{Cr^{3+}/Cr} = -0.74V, E^\circ_{Cd^{2+}/Cd} = -0.40V$)

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43. Predict reaction of 1N sulphuric acid with following metals : (i) copper (ii) lead (iii) iron Given, $E^0_{Cu^{2+}|Cu}$ = 0.34volt , $E^0_{Pb^{2+}|Pb}$ = -0.13 volt, $E^0_{Fe^{2+}|Fe}$ = -0.44 volt

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44. Can we store (a) copper sulphate solution in zinc vessel?

(b) Copper sulphate solution in silver vessel?

(c) Copper sulphate solution in iron vessel?

Give suitable explanation.

$E^\circ_{Cu^{2+}/Cu} = 0.34V, E^\circ_{Zn^{2+}/Zn} = -0.76V, E^\circ_{Ag^+/Ag} = 0.80V, E^\circ_{Fe^{2+}/Fe} =$

.

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45. 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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46. 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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47. Can chlorine gas be stored in a copper cylinder? Given $E^\circ_{Cu^{2+},Cu} = 0.34V$ and $E^\circ_{Cl^2,Cl^-} = 1.36V$

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48. Using standard electrode potentials, predict the reaction, if any, that ocurs between $Fe^{3+}(aq)$ and $I^-(aq)$

$E^\circ_{Fe^{3+}(aq)/Fe^{2+}(aq)} = 0.77V, E^\circ_{I_2/2I^-(aq)} = 0.54V$

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49. Predict whether the following reaction (s) is (are) feasible or not

(i) $Fe + Zn^{2+} \rightarrow Fe^{2+} + Zn, E^{\circ}_{Zn} = -0.76, E^{\circ}_{Fe} = -0.44V$

(ii) $Zn + 2Ag^{+} \rightarrow Zn^{2+} + 2Ag, E^{\circ}_{Zn} = -0.76V, E^{\circ}_{Ag} = -0.80V$

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50. Can a nickel spoon be used to stir a solution of silver nitrate? Support your answer with reason.

$\left(E^{\circ}_{Ni^{2+},Ni} = -0.25V, E^{\circ}_{Ag^{+},Ag} = +0.80V\right).$

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51. Calculate the electrode potential of the electrode Zn/Zn^{2+} (conc. $= 0.1M$) at $25^{\circ}C$

Given that $E^{\circ}_{Zn/Zn^{2+}} = 0.7618$ volt.

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52. Calculate the emf of the cell, $Cd|Cd^{2+}(0.001M)||Fe^{2+}(0.6M)|Fe$ at $25^{\circ}C$.

The standard reduction potential of Cd/Cd^{2+} and Fe/Fe^{2+} electrodes are -0.403 and -0.441 volt respectively.

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53. A standard voltaic cell is constructed using Cu metal in 1.0 M $Cu(NO_3)_2$(aq) and an unknown metal in a 1.0 M solution of its nitrate salt. The cell voltage is 0.47 V when the Cu half-cell is the cathode. What is the standard reduction potential of the unknown metal ? $[E^{\circ}_{Cu} = 0.34V]$

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54. A galvanic cell consists of a metallic zinc plate immersed in 0.1 M $Zn(NO_3)_2$ solution and metallic plate of lead in 0.02M $Pb(NO_3)_2$

solution. Calculate the emf of the cell.

Write the chemical equation for the electrode reactions and represent the cell.

$\left(\text{Given}: E^{\circ} Zn^{2+} ZN = 0.76V, \qquad E^{\circ} Pb^{2+} / Pb = -0.13V\right)$

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55. 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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56. A voltaic cell is set up at $25^{\circ} C$with the following half cells :

Al^{3+}(0.001 M) and Ni^{2+}(0.50 M)

Write the equation for the reaction when the cell generates the electric current. Also determine the cell potential (Given $E^{\circ}_{Ni^{2+}/Ni} = -0.25V, E^{\circ}_{Al^{3+}/Al} = -1.66V\Big)$.

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57. The measured e.m.f. at $25^\circ C$ for the cell reaction ,

$Zn(S) + Cu^{2+}(1.0M) \rightarrow Cu(s) + Zn^{2+}(0.1M)$ is 1.3 volt, Calculate E° for the cell reaction.

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58. Calculate the potential of the following cell reaction at 298 K

$Sn^{4+}(1.50M) + Zn(s) \rightarrow Sn^{2+}(0.50M) + Zn^{2+}(2.0M)$

The standard potential, E° of the cell is 0.89 V. Whether the potential of the cell will increase or decrease if the concentration of Sn^{4+} is increased in the cell.

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59. Calculate the potential of a zinc-zinc ion electrode in which the zinc ion activity is 0.001M

$\left(E^{\circ}_{Zn^{2+}/Zn} = -0.76V, R = 8.314KJ^{-1}mol^{-1}, F = 96,500 \text{ C } mol^{-1}\right)$

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60. (a) Calculate the electrode potential of silver electrode dipped in 0.1 M solution of silver nitrate of 298 K assuming $AgNO_3$ to be completely dissociated. The standard electrode potential of $Ag^+|Ag$ is 0.80V at 298K.

(b) At what concentration of Ag^+ ions will this electrode have a potential of 0.0 volt?

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61.

$Cu^{2+} + 2e^- \rightarrow Cu, E^{\circ} = +0.34V, Ag^+ + 1e^- \rightarrow Ag, E^{\circ} = +0.80V$

(i) Construct a galvanic cell using the above data.

(ii) For what concentration of Ag^+ ions will the emf of the cell be zero at $25^{\circ}C$, if the concentration of Cu^{2+} is 0.01 M? (log 3.919=0.593).

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62. Calculate the potential for half cell containing 0.10 M $K_2Cr_2O_7(aq)$, 0.20 M $Cr^{3+}(aq)$ and $1.0 \times 10^{-4} M H^+(aq)$. The half-cell reaction is

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

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

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63. Calculate the emf of the following cell at $298K$:

$Fe(s)\left|Fe^{2+}(0.001M)\right|\left|H^+(1M)\right|H_2(g)(1\text{bar}), Pt(s)$ (Given $E^\circ_{\text{Cell}} = +0.44V$)

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64. Calculate emf of the following cell at $25^\circ C$:

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

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

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65. Calculate the e.m.f. of the following cell at 298K:

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

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

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66. Calculate the equilibrium cosntant for the reaction,

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

If $E^{\circ}_{Cd^{2+}/Cd} = -0.403V$ and $E^{\circ}_{Zn^{2+}/Zn} = -0.763V$

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

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

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

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68. 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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69. Calculate the equilibrium constant for the reaction, $2Fe^{3+} + 3I^- \Leftrightarrow 2Fe^{2+} + I_3^-$, the standard reduction potentials in acidic conditions are 0.77V and 0.54V respectively for Fe^{3+}/Fe^{2+} and I_3^-/I^- couples.

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70. Calculate the equilibrium constant for the reaction at 298K:

$NiO_2 + 2Cl^- + 4H^+ \rightarrow Cl^2 + Ni^{2+} + 2H_2O$ if $E^{\circ}_{cell} = 0.320V$.

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71. Calculate the equilibrium constant for the following reaction at 298K.

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

$R = 8.314JK^{-1}mol^{-1}, E^{\circ}_{Cu^{2+}/Cu} = 0.34V, E^{\circ}_{1/2\ \ Cl_2/Cl^-} = 1.36V, F = 9$

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72. 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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73. For the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ at 298K, enthalpy and entropy changes are -92.4 kJ and -198.2 JK^{-1} respectively. Calculate the

equilibrium constant of the reaction $\left(R = 8.314 JK^{-1} mol^{-1}\right)$.

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74. 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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75. For the equilibrium reaction:

$2H_2(g) + O_2(g) \Leftrightarrow 2H_2O(l) at 298K$

$\Delta G^\Theta = -474.78 kJ mol^{-1}$. Calculate log K for it.

$\left(R = 8.314 JK^{-1} mol^{-1}\right)$.

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76. The emf $\left(E_{cell}^{\circ}\right)$ of the cell reaction, $3Sn^{4+} + 2Cr \rightarrow 3Sn^{2+} + 2Cr^{3+}$ is 0.89V.

Calculate ΔG° for the reaction $\left(F = 96,500 \text{ C } mol^{-1} \text{ and } VC \equiv J\right)$

.

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77. Calculate the e.m.f. of the following cell at $25^{\circ}C$

$Mg(s) / Mg^{2+}(0.01M) \mid \mid Sn^{2+}(0.1M) / Sn(s)$

Given $E_{Mg^{2+}/Mg}^{\circ} = -2.34V, E^{\circ} Sn^{2+}/Sn = -0.136V$

Also calculate the maximum work that can be accomplished by the operation of the cell.

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

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

Also calcuate the $\triangle_r G^{\ominus}$ value of the reaction

(given $E^{\ominus}_{cr^{3+}/Cr} = -0.74V, E^{\ominus}_{Cd^{3+}/Cd} = -0.40V$ and $F = 96500 Cmol^{-1}$

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79.

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow Cr^{+++} + 7H_2O, E^{\circ} = 1.33V, 3 \times [2I^- \rightarrow$

Find out the value of the equilibrium constant and Gibbs free energy change in the reaction given above.

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80. 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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Advanced Problem For Competitions

1. 0.5 L of 1.0 M NaCl solution is electrolysed for 965 a using a current of 5 ampere. What will be the pH of the solution after the electrolysis?

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2. By passing a certain amount of cahrge through NaCl solution 9.2 litre of Cl_2 wre liberated at STP. When the same charge is passed through a nitrate solution of a metal M, 7.467 g of the metal was deposited. If the specific heat of the metal is 0.216 cal g^{-1}, what is the formula of metal nitrate?

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3. A constant current flowed for 2 hours through a potassium iodide solution oxidising the iodide ion to iodine $\left(2I^{-} \rightarrow I_2 + 2e^{-}\right)$.

At the end of the experiment, the iodine was titrated with 21.75 mL of 0.0831 M soldium thiosulphate solution.

$\left(I_2 + 2S_2O_3^{2-} \rightarrow 2I^{-} + S_4O_6^{2-}\right)$

What was the average rate of current flow in apmeres ?

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4. Impure copper containing Fe, Au and Ag as impurities is electrolytically refined. A current of 140 A for 482.5 s decreased the mass of the anode by 22.26 g and increased the mass of the cathode by 22.011g. Calculate the percentage of iron in impure copper.

(Given molar mass of Fe=55.5g mol^{-1}, molar mass of Cu=63.54 g mol^{-1}).

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5. 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

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6. Calculate the standard reduction potential of the following half cell

$S^{2-}|CuS|Cu$

Given: $K_{sp}(CuS) = 10^{-35}$ and $E^\circ_{Cu^{2+}/Cu} = 0.34V$

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7. Two electrochemical cells are assembled in which the following reactions occur :

$V^2 = VO^{2+} + 2H^\oplus \rightarrow 2V^{3+} + H_2O$

$V^{3+} + Ag^\oplus + H_2O \rightarrow VO^{2+} + 2H^\oplus + Ag(s)$

Calculate E^{c-} for half reaction $V^{3+} + e^- \rightarrow V^{2+}$

Given : $E^{c-}{}_{\cdot(Ag^{\oplus}|Ag)} = 0.799$

$E^{c-} = E^{c-}{}_{\cdot V^{4+}|V^{3+}} - E^{c-}{}_{\cdot V^{3+}|V^{2+}} = 0.616V$

$E^{c-} = E^{c-}{}_{\cdot Ag^{\oplus}|Ag} - E^{c-}{}_{\cdot V^{4+}|V_{3+}} = 0.439V$

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8. 20 mL of 0.1 M HCl is divided into two equal parts and kept in two separate beakers. To one beaker 10 mL of 0.06 M NaOH is added and to the other 10 mL of 0.02 M NaOH is added. Two hydrogen electrodes are placed in the two solution which are linked through a salt bridge. what will be the emf of the cell formed?

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9. In the concentration cell

$$Pt(H_2)\left|\begin{matrix}HA(0.1M)\\NaA(1M)\end{matrix}\right|\left|\begin{matrix}HA(1M)\\NaA(1M)\end{matrix}\right|(H_2)Pt$$

$(pK_a \text{ of } HA = 4)$

Cell potential will be :

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10. A hydrogen electrode placed in a solution containing sodium acetate and acetic acid in the ratio of $x:y$ and $y:x$ has an electrode potential value E_1 and E_2 volts, respectively, at $25^\circ C$. The pK_a value of acetic acid is

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11. 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

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12. If $No_3^- \rightarrow NO_2$ (acid medium) , $E^\circ = 0.790V$

and $NO_3^- \rightarrow NH_2OH$ (acid medium) , $E^\circ = 0.731V$

At what pH of the above two half reaction will have some E values? Assume the concentrations of all other species be unity.

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13. In the following process of disproportionation

$2ClO_3^- \Leftrightarrow ClO_2^- + ClO_4^-$

$E^\circ_{ClO_4^-/ClO_3^-} = +0.36V, E^\circ_{ClO_3^-/ClO_2^-} = +0.33V$

If initial concentration of chloride ion was 0.1M, calculate the equilibrium concentration of perchlorate ion.

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14. The temperature dependence of the emf of a standard electrochemical cell is given by

$E = 1.02 - 4.0 \times 10^{-5}(T - 20) - 9.0 \times 10^{-7}(T - 20)^2$

where, T is in $.^{\circ} C$ and E is in volts. The temperature coefficient of the emf at $30^{\circ} C$ is :

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15. The e.m.f. of the cell $Cd(s)|CdCl_2(0.1M)||AgCl(s)|Ag(s)$ in which the cell reaction is

$Cd(s) + 2AgCl(s) \rightarrow 2Ag(s) + Cd^{2+}(aq) + 2Cl^{-}(aq)$

is 0.6915 V at $0^{\circ} C$ and 0.6753 at $25^{\circ} C$. Calculate the enthalpy change of the reaction at $25^{\circ} C$.

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16. Two weak acid solutions HA_1 and HA_2 with the same concentration and having pK_a values 3 and 5 are placed in contact with hydrogen electrode $(1atm$ and $25^{\circ} C)$ and are interconnected through a salt bridge. Find the EMF of the cell.

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17. A galvanic is set up from a zinc bar weighing 50 g and 1.0 litre, 1.0 M $CuSO_4$ solution. How long would the cell run assuing it delivers a steady current of 1.0 ampere?

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TEST YOUR GRIP (MUTIPLE CHOICE QUESTION)

1. A dilute aqueous solution of Na_2SO_4 is electrolyzed using platinum electrodes. The products at the anode and cathode are :

A. O_2, H_2

B. SO_2, Na

C. O_2, Na

D. $S_2O_8^{2-}, H_2$

Answer: A

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2. The required time to liberate one gram equivalent of an element by passing one ampere current through its solution is

A. 6.7 hrs

B. 13.4 hrs

C. 19.9 hrs

D. 26.8 hrs

Answer: D

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3. Which of the following solutions has the highest equivalent conductance?

A. 0.01 M KCl

B. 0.05 M KCl

C. 0.02 M KCl

D. 0.005 M KCl

Answer: D

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4. Which of the following expressions correctly represents the equivalent conductance at infinite dilution of $Al_{SO_{4_3}}$. Given that $\overset{\circ}{\Lambda}_{Al^{3+}}$ and $\overset{\circ}{\Lambda}_{SO_4^{2-}}$ are the equivalent conduactance at infinite dilution of the respective ions?

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

B. $\lambda^{\circ}_{Al^{3+}} + \lambda^{\circ}_{SO_4^{2-}}$

C. $\lambda^{\circ}_{Al^{3+}} + \lambda^{\circ}_{SO_4^{2}} \times 6$

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

Answer: B

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5. Unit of ionic mobility is :

A. $m^2 \sec^{-1} \text{volt}^{-1}$

B. ms^{-1}

C. m sec^{-1} volt

D. m sec^{-1} volt

Answer: A

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6. In the electrolytic cell, flow of electrons is form :

A. cathode to anode in the solution

B. cathode to anode through external supply

C. cathode to anode through internal supply

D. anode to cathode through internal supply

Answer: B

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7. Electrode potential of any electrode depends are:

A. nature of the metal

B. temperature of the solutions

C. molarity of the solution

D. all of these

Answer: D

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8. A hypothetical elecrochemical cell is shown below:

$A^{\ominus}|A^{+}(xM)||B^{+}(yM)|\ |\ B^{\oplus}$

The emf measured is $+0.20V$. The cell reaction is

A. The cell reaction cannot be predicted

B. $A + B^{-} \rightarrow A^{+} + B$

C. $A^{+} + B \rightarrow A + B^{+}$

D. $A^{+} + e^{-} \rightarrow A, B^{+} + e^{-} \rightarrow B$

Answer: B

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9. Standard electrode potential of three metal X, Y and Z are $-1.2V,\ +0.5V$ and $-3.0V$ respectively. The reducing power of these metals will be:

A. $X > Y > Z$

B. $Y > Z > X$

C. $Y > X > Z$

D. $Z > X > Y$

Answer: D

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10. Which has the highest oxidizing power?

A. I_2

B. Br_2

C. F_2

D. Cl_2

Answer: C

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11. 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. 1.212 V

B. 0.111 V

C. 0.330 V

D. 1.653 V

Answer: A

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12. A gas X at 1 atm is bubbled through a solution containing a mixture of 1M Y^- and 1M Z^- at $25^{\circ}C$. If the reduction potential of $Z > Y > X$, then

A. Y will oxidize but not Z.

B. Y will oxidize both X and Z

C. Y will oxizide Z but not X

D. Y will reduce both X and Z.

Answer: A

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13. Consider the following four electrodes:

$P = Cu^{2+}(0.0001M)/Cu(s)$ $Q = Cu^{2+}(0.1M)/Cu(s)$

$R = Cu^{2+}(0.01M)/Cu(s)$ $S = Cu^{2+}(0.001M)/Cu(s)$

If the standard electrode potential of Cu^{2+}/Cu is +0.34V, the reduction potentials in volts of the above electrodes follow the order:

A. $P > S > R > Q$

B. $S > R > Q > P$

C. $R > S > Q > P$

D. $Q > R > S > P$

Answer: D

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14. If Zn^{2+}/Zn electrode is diluted 100 times, then the charge in reduction potential is

A. increase of 59 mV

B. decrease of 59 mV

C. increase of 29.5 mV

D. decrease of 29.5 mV

Answer: B

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15. What will be the emf for the given cell ?

$Pt|H_2(g, P_1)|H^+(aq)|H_2(g, P_2)|Pt$

A. $\frac{RT}{F}\ln\frac{P_1}{P_2}$

B. $\frac{RT}{2F}\ln\frac{P_1}{P_2}$

C. $\frac{RT}{F}\ln\frac{P_2}{P_1}$

D. none of these

Answer: B

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16. The standard e.m.f. of a galvanic cell involving 3 moles of electrons in a redox reaction is 0.59V. The equilibrium constnat for the reaction of the cell is

A. 10^{25}

B. 10^{20}

C. 10^{15}

D. 10^{30}

Answer: D

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17. 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. $-98.0kJ$

B. $-89.0kJ$

C. $-89.0J$

D. $-44.5kJ$

Answer: B

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18. Among the following cells Lecianche cell (1), Nickel cadmium cell (II). Lead storage battery (III), Mercury cell (IV), primary cells are

A. I and II

B. I and III

C. II and III

D. I and IV

Answer: D

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19. Which statements is true about a spontaneous cell reaction in galvanic cell?

A. $E_{cell} > 0, \Delta G^{\circ} > 0, Q > K_c$

B. $E^{\circ}_{cell} < 0, \Delta G^{\circ} < 0, Q < K_c$

C. $E_{cell}^{\circ} > 0, \Delta G^{\circ} < 0, Q < K$

D. $E_{cell}^{\circ} > 0, \Delta G^{\circ} < 0, Q > K_c.$

Answer: C

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20. The main factors which affect corroision are

A. position of metl in electrochemical series

B. presence of CO_2 in water

C. presence of impurities in metal

D. ALL OF THESE

Answer: D

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TEST YOUR GRIP (FILL IN THE BLANKS)

1. The arrangment which converts chemical energy of a redox reaction into electrical energy called____.

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2. The arrangement in which electrical energy supplied brings about a redox reaction is called____.

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3. Electrolysis of an aqueous solution of sodium chloride produces___at the cathode and ___at the anode.

Watch Video Solution

4. Electrolysis of an aqueous solution of copper sulphate using platinum electrodes produces___ at the cathode and __at the anode.

Watch Video Solution

5. When one coulomb of electricity is passed through an electrolytic solution, the mass deposited on the electrode is equal to:

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6. When one faraday of electric current is passed, the mass deposited is equal to :

Watch Video Solution

7. In terms of SI base a units, ohm (Ω)=____.

Watch Video Solution

8. Conductivity is a conductance of ___of the solution and its units are_____

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9. If κ is the specific conductivity of a solution with volume V containing 1 g eq of the electrolyte and $\wedge$ is the equivalent conductivity, then $\kappa, \wedge \text{ and } V$ are related as_____.

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10. If every quantity is expressed in SI units, then molar conductivity ($\wedge_m$), conducitivy (κ) and molarity (M) are related as___.

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11. Conductivity (κ), conductance (G) and cell constant (G°) are related as___.

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12. The units of cell constant are .....

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13. Out of specific, equivalent and molar conductivities, the quantity which decreases with dilution is___.

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14. According to Debye-Huckel-Onsager equation, $\wedge_m^c$ = _____.

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15. According to Kohlrausch'a law, $\wedge_m^\circ$ for electrolyte A_xB_y=____.

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16. Ionic mobility $= \frac{\text{Ionic conductance}}{\_\_\_\_}$

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17. In a galvanic cell, the electrode which acts as anode is a_____ pole.

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18. In a galvanic cell, the electrons flow from :

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19. KCl, KNO_3 etc. are preferred in a salt bridge because they have equal___.

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20. CALOMEL ELECTRODE

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21. Out of Fe,Cu,Sn and Hg, the most reactive metal is ___and least reactive metal is____.

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22. If E°_{Red} for $Ag^{+} + e^{-} \rightarrow Ag$ is 0.80 V, then for the reaction $2Ag^{+} + 2e^{-} \rightarrow 2Ag$, E°_{Red} will be____.

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23. Nernst equation halps us to understand the effect of _____ on the electrode of the half-cell and emf of the voltiv cell

A. Concentration of electrolytic solutions

B. temperature

C. Both a& b

D. None

Answer: C

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24. In the electrolysis of aqueous NaCl solution, Cl_2 is produced at the anode and not O_2. This is due to___shown by water for oxidation to O_2.

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25. In Leclanche cell, MnO_2 acts as a___.

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26. In lead storage battery, the cathode consists of___.

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

Watch Video Solution

28. The process of protecting iron by coating with Zinc.

Watch Video Solution

29. The energy of one joule per second given out by a source is called_____.

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CONCEPTUAL QUESTIONS

1. On electrolysis of an aqueous solution NaCl, why H_2 and not Na is liberated at the cathode?

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2. An aqueous solution of $CuSO_4$ is electrolyzed using Pt electrodes in one case and Cu electrodes in another case. What are the products of electrolysis in both the cases ?

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3. (a) Predict the products of electrolysis in each of the following :

(i) An aqueous solution of $AgNO_3$ with platinum electrodes

(ii) An aqueous solution of H_2SO_4 with platinum electrodes

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4. The amount of substance deposited by the passage of 1 A of current for 1s is equal to :

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5. One faraday of electricity deposits one mol of Na from the molten salt but $\frac{1}{3}$ mol of Al from an aluminium salt. Why?

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6. A current of 1 ampere is paased for one hour between nickel electrodes in 0.5 L of 2 M Ni $(NO_3)_2$ solution. What will be the molarity of the

solution at the end of the electrolysis?

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7. Fill in the blanks

(i) Equivalent wt. of a substance divided by 96500 gives____ of the substance

(ii) The weight deposited by one coulomb of electricity is called___ of the substance

(iii) One faraday is the charge present on _____of electrons

(iv) One faraday passed through $CuSO_4$ sol. deposits____ of Cu.

Watch Video Solution

8. In each of the following pairs, which will allow greater conduction of electricity and why? (a) Silver wire at $20^\circ C$, Same silver wire at $50^\circ C$ (b) NaCl solution at $20^\circ C$, same NaCl solution at $50^\circ C$ (c) NH_4OH solution at $20^\circ C$, Sae NH_4OH solutio at $50^\circ C$ (d) 0.1M acetic acid solution, 1M acetic acid solution.

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9. Copper is conducting as such while $CuSO_4$ is conducting only in molten state or in aqueous solution. Why ?

Watch Video Solution

10. Which will have greater molar conductivity and why?

Sol A. 1 mol KCl dissolved in 200 cc of the solution.

Sol. B. 1 mol KCl dissolved in 500 cc of the solution.

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11. Solutions of two electrolytes A and B each having a concentration of 0.2 M have conductivities 2×10^{-2} and 4×10^{-4} S cm^{-1} respectively. Which will offer greater resistance to the flow of current and why?

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12. Taking the example of $Al_2(SO_4)_3$, derive the relation between molar conductivity and equivalent conductivity.

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

Watch Video Solution

14. An aqueous solution of K_2SO_4 is diluted by adding water. How the values of G, k, $\wedge_m$ and $\wedge_{eq}$ vary ?

Watch Video Solution

15. Why in a concentrated solution, a strong electrolyte shows deviation from Debye — Huckel Onsager equation ?

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16. Define limiting molar conductivity. Why does conductivity of an electrolyte decrease with discrease in concentration.

Watch Video Solution

17. Define limiting molar conductivity. Why does conductivity of an electrolyte decrease with discrease in concentration.

Watch Video Solution

18. Why Λ_m° for CH_3COOH cannot be determined experimentally ?

Watch Video Solution

19. 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

20. Write expressions for equivalent conductivity and molar conductivity of $Al_2(SO_4)_3$ at infinite dilutio in terms of their ionic conductivitiies.

Watch Video Solution

21. What would happen if no salt bridge is used in electroChemical cell ?

Watch Video Solution

22. Why is it necessary to use a salt bridge in a galvanic cell ?

Watch Video Solution

23. Formulate the galvanic cell in which the following reaction takes place:

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

State (i) Which one of the electrodes is negatively charged?

(ii) The reaction taking place at each of its electrode. ltBrgt (iii) The carriers of current within this cell.

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24. In a galvanic cell, the following reaction:

$Zn(s) + 2Ag^{2+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s), E^{\circ}_{cell} = 1.50V$

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

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

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25. What is the use of platinum foil in the hydrogen electrode ?

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26. 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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27. 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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28. I_2 and F_2 are added to a solution containing 1M each of I^- and F^-. What reaction will take place? Given that the reduction potential of I_2 and F_2 are 0.54 volt and 2.87 volts respectively.

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29. An electrochemical cell is made of aluminium and tin electrodes with their standard reduction potentials -1.66 V and 0.14 V respectively. Select the anode and the cathode, represent the cell and write the cell reaction. Find the e.m.f. of the cell

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

$Ti^{4+} +_e^- \rightarrow Ti^{3+}, E^{É\,\mu} = +0.01V, Fe^{3+} + e^- \rightarrow Fe^{2+}, E^{É\,\mu} = +0.$

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31. 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 theis reaction favours formation of reaction or product shown in the equation.

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32. How the reduction potential of an electrode can be decreased?

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33. What is the difference between a chemical cell and a concentration cell?

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

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35. Why equilibrium constant is related to E_{cell}^{c-} but not to E_{cell} ?

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36. Why electrolysis of NaBr and NaI gives Br_2 and I_2 respectively while that of NaF gives O_2 instead of F_2?

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37. The following two reaction can occur during electrolysis of aqueous sodium chloride solution

$Na^+(aq) + E^- \rightarrow Na(s) E^\circ = -2.71V$

$2H_2O(l) + 2E^- \rightarrow H_2(g) + 2OH^\circ(aq) E^\circ = -0.83V$

Which reaction takes place preferentially and why ?

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38. Following reactions occur at cathode during electrolysis of aqueous silver chloride solution :

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

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

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

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39. Why fluorine cannot be obtained by electrolysis of aqueous HF solution, though it is a good conductor of electricity?

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

Watch Video Solution

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

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42. Which types of cells are rechargeable ?

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43. Write doewn the reaction that occur at the anode and cathode of $H_2 - O_2$ fuel cell and the overll reaction.

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44. Give reason: (a) Why does an alkaline medium inhibit the rusting of iron.

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

been sued.

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

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45. Give reason :

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

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

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46. Give reason for the following:

(i) Copper displaces silver from silver nitrate solution.

(ii) Iron pipes are usually, coated with zinc.

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NCERT QUESTIONS AND EXERCISES WITH ANSWER

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

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

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

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

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5. Calculate the 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

$2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+}(aq) + + I_2(s)$ 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 decrease 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 0.025 mol L^{-1} methanoic acid is 46.1 S $cm^2 mol^{-1}$. Calculate its degree of dissociation and dissociation constant. Given $\lambda^\circ\left(H^+\right) = 349.6 \text{ S } cm^2 mol^{-1}$ and $\lambda^\circ\left(HCOO^-\right) = 54.6 \text{ S } cm^2 mol^{-}$.

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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 of metals that are extracted electrolytically.

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12. Consider the reaction :

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

What is the quantity of electricity in coulombs needed to reduce 1 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.

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

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NCERT 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 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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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 potentails of the galvanic cells in which the following reactions take place.

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

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

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

Gievn $E^{\circ}_{Ag^{+}/Ag} = 0.80 \text{ V}, E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.77 \text{ V}$

Also calculate ΔG° and equilibrium constant for the reaction.

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

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

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

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

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

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

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

Determine ΔG° and E° for the reaction

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

$Ag_2O + H_2O + 2e^- \rightarrow 2Ag + 2OH^-$

$E^\circ = +0.34\,V$

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

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

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10. 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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11. 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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12. How much electricity in terms of Faraday is required to produce.

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

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

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

(Atomic mass of Ni = 58.7)

[Report your answer by rounding it upto nearset whole number]

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14. 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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15. Using the standard electrode potentials given in Table, predict if the reaction between the following is feasible:

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

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

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

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

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

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16. Predict the products of electrolysis in eaCHM 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_2SSO_4 with platinum electrodes.

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

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NCERT EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS (MULTIPLE QUESTIONS-I)

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

A. $Pt(s)|H_2(g, 0.01 \text{ bar})|H^+(aq., 1M) \mid |Cu^{2+}(aq., 1M)|Cu$

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

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

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

Answer: C

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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.

Answer: B

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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 properties 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.

Answer: C

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

A. Cell potential

B. Cell emf

C. Potential difference

D. Cell voltage

Answer: B

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

A. it does not participate in the cell reaction.

B. it provides surface either for oxidation or for reduction reaction.

C. It provides surface for conduction of electrons.

D. It provides surface for redox reaction.

Answer: D

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

A. $E_{cell} = 0$

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

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

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

Answer: C

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

A. Conductivity of solution depends upon size of ions.

B. Conductivity depends upon viscosity of solution.

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

D. Conductivity of solution increases with temperature.

Answer: C

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8. Using the data given below:

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

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

Mark the strongest reducing agent.

A. Cl^-

B. Cr

C. Cr^{3+}

D. Mn^{2+}

Answer: C

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9. Find out which of the following is the strongest oxidizing agent.

A. Cl^-

B. Mn^{2+}

C. MnO_4^-

D. Cr^{3+}

Answer: C

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10. Find out in which option the order of reducing power is correct.

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

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

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

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

Answer: B

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

A. Cl^-

B. Cr^{3+}

C. Cr

D. Mn^{2+}

Answer: D

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12. Find out the most stable oxidised species.

A. Cr^{3+}

B. MnO_4^-

C. $Cr_2O_7^{2-}$

D. Mn^{2+}

Answer: A

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13. The quantity of charge required to obtain one mole of aluminium from Al_20_3 is

A. 1F

B. 6F

C. 3F

D. 2F

Answer: C

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14. The cell constant of a conductivity cell

A. changes with change of electrolyte

B. changes with chagne of concentration of electrolyte

C. changes with temperature of electrolyte

D. remains constant for a cell

Answer: D

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15. While charging the lead storage battery:

A. $PbSO_4$ anode is reduced to Pb.

B. $PbSO_4$ cathode is reduced to Pb.

C. $PbSO_4$ cathode is oxidised to Pb.

D. $PbSO_4$ anode is oxidised to PbO_2.

Answer: A

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16. $\wedge^\circ m[NH_4OH]$ is equal to ____

A. $\wedge^0_{m(NH_4OH)} + \wedge^0_{m(NH_4Cl)} - \wedge^0_{(HCl)}$

B. $\wedge^0_{m(NH_4Cl)} + \wedge^0_{m(NaOH)} - \wedge^0_{(NaCl)}$

C. $\wedge^0_{m(NH_4Cl)} + \wedge^0_{m(NaCl)} - \wedge^0_{(NaOH)}$

D. $\wedge^0_{m(NaOH)} + \wedge^0_{m(NaCl)} - \wedge^0_{(NH_4Cl)}$

Answer: B

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

A. $Na^+(aq) + e^- \rightarrow Na(s), E^{\Theta}_{Cell} = -2.71V$

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

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

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

Answer: C

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

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

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

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

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

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

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

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24. 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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25. What is electrode potential?

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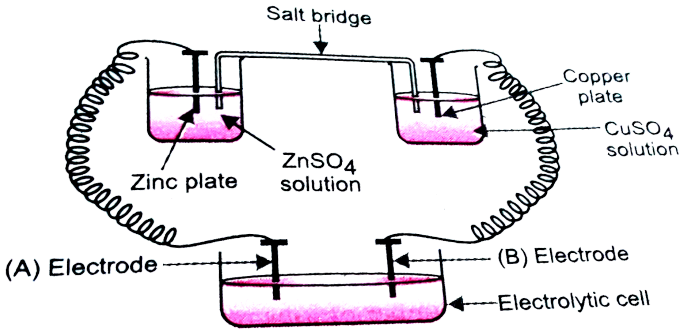
26. Consider the following diagram in which an electrochemical cell is coupled to an electrolytic cell. What will be the polarity of electrodes 'A'

and 'B' in the electrolytic cell?



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

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

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

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

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31. 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.

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

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

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

Watch Video Solution

35. Consider a cell given below.

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

Write the reactions that occur at anode and cathode.

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36. 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?

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

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

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

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NCERT EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS (MULTIPLE QUESTIONS-II)

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

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

B. This redox couple is a stronger oxidising agent than H^+/H_2.

C. Cu can displace H_2 from acid.

D. Cu cannot displace H_2 from acid.

Answer: B::D

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

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

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

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

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

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

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

D. in dilute sulphuric acid solution, SO_4^{2-} ion will be oxidised to tetrathionate ion at anode.

Answer: C

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

A. $1.1 = K_c$

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

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

D. $\log K_c = 1.1$

Answer: B::C

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4. Conductivity of an electrolytic solution depends on

A. nature of electrolyte

B. Concentration of electrolyte

C. Power of AC source

D. Distance between the electrodes

Answer: B::D

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5. $\wedge_m^0 H_2O$ is equal to ___

A. $\wedge_{m(HCl)}^0 + \wedge_{m(NaOH)}^0 - \wedge_{m(NaCl)}^0$

B. $\wedge_{m(HNO_3)}^0 + \wedge_{m(NaNO_3)}^0 - \wedge_{m(NaOH)}^0$

C. $\wedge_{(HNO_3)}^0 + \wedge_{m(NaOH)}^0 - \wedge_{m(NaOH_3)}^0$

D. $\wedge_{m(NH_4OH)}^0 + \wedge_{m(HCl)}^0 - \wedge_{m(NH_4Cl)}^0$

Answer: A::D

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

A. Coper will deposit at cathode.

B. Copper will deposti at anode.

C. Oxygen will be released at anode.

D. Copper will dissolve at anode.

Answer: A::C

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

A. Copper will deposit at cathode.

B. Copper will dissolve at anode.

C. Oxygen will be released at anode.

D. Copper will deposit at anode.

Answer: A::B

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8. Conductivity κ, is equal to ____

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

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

C. $\wedge_m$

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

Answer: B

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9. Molar conductivity of ionic solution depends on____.

A. temperature

B. distance between electrodes

C. concentration of electrolysis in solution

D. surface area of electrodes.

Answer: A::C

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

A. Mg is cathode

B. Cu is cathode

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

D. Cu is the oxidising agent.

Answer: B::C

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NCERT EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS (MATCHING TYPE QUESTIONS)

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

	Column I		Column II
(*i*)	$\wedge_m$	(*a*)	S cm^{-1}
(*ii*)	E_{cell}	(*b*)	m^{-1}
(*iii*)	κ	(*c*)	S cm^2 mol^{-1}
(*iv*)	G*	(*d*)	V

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

Column I		Column II	
(i)	κ	(a)	$I \times t$
(ii)	$\wedge_m$	(b)	$\wedge_m / \wedge_m^\circ$
(iii)	α	(c)	$\frac{\kappa}{c}$
(iv)	Q	(d)	$\frac{G^*}{R}$

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3. Match the terms given in column I with the units given in column II

$E^\circ_{F_2/F^-} = 2.87, E^\circ_{Li^+/Li} = -3.5V, E^\circ_{Au^{3+}/Au} = 1.4V \quad E^\circ_{Br_2/Br^-} = 1.0$

(i) F_2	(a) metal is the strongest reducing agent
(ii) Li	(b) metal ion which is the weakest oxidising agent
(iii) Au^{3+}	(c) non metal which is the best oxidising agent
(iv) Br	(d) unreactive metal
(v) Au	(e) anion that can be oxidised by Au^{3+}
(vi) Li^+	(f) anion which is the weakest reducing agent
(vii) F^-	(g) metal ion which is an oxidising agent

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NCERT EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS (ASSERTION AND REASON TYPE QUESTIONS)

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

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

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

B. Both assertion and reason are true and 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

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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

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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

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5. Assertion: Mercury cell does not give steady potential.

Reason: In the cell reaction, inons are not involved in 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. Assertion is false but reason is true.

Answer: D

View Text Solution

6. Assertion: Electrolysis of NaCl solution gives chlorine at anode instead of O_2.

Reason: Formation of oxygen at anode requires overvoltage.

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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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. 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: A

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

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

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

B. Both assertion and reason are true and 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

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10. Assertion : Copper sulphate can be stored in zinc vessel.

Reason : Zinc is less reactive than copper.

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

B. Both assertion and reason are true and 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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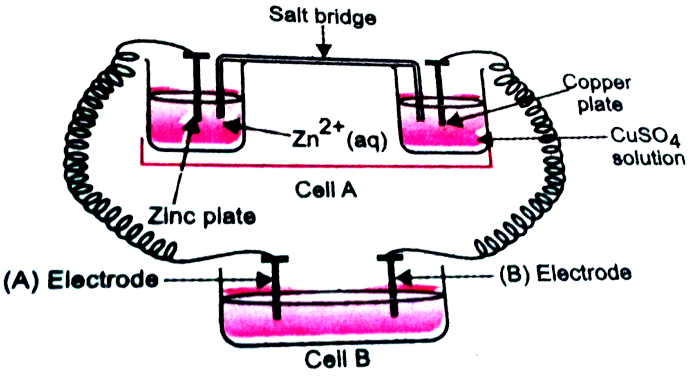
NCERT EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS (LONG ANSWER QUESTIONS)

1. Consier the Fig. given below and answer the following questions:

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

(ii) If cell 'A' has $E_{cell} = 0.5V$ and cell 'B' has $E_{cell} = 1.1$V then what will

be the reactions at anode and cathode?



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2. Consider the Fig. given below and answer the questions (i) to (vi)

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

(ii) Is silver plate the anode or cathode?

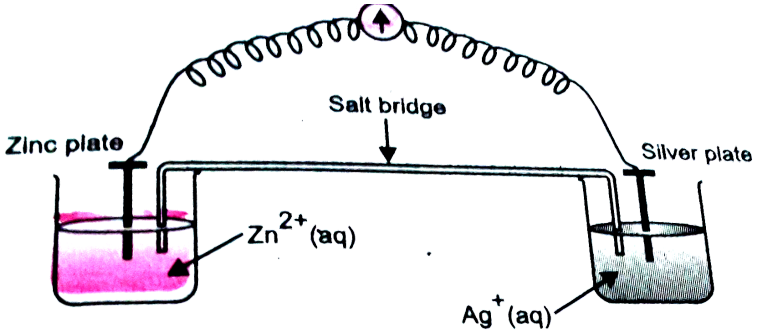
(iii) What will happen if salt bridge is removed?

(iv) when will the cell stop functioning?

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

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

after the cell becomes 'dead'?



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

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ADDITIONAL QUESTIONS(VERY SHORT ANSWER QUESTIONS)

1. What is meant by faraday 's constant?

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2. How many faradays of electric charge is required to liberate $5600cm^3$ of oxygen at STP?

Watch Video Solution

3. What is the effect of temperature on the electrical conduction of (i) metallic conductor (ii) electrolytic conductor?

Watch Video Solution

4. How do metallic and ionic substances differ in conducting electricity ?

Watch Video Solution

5. The units of molar conductance are

Watch Video Solution

6. Give the relationship between molar conducitivity and specific conductivity.

Watch Video Solution

7. What is the relationship between specific conductance and equivalent conductance?

Watch Video Solution

8. Express the relation among conductivity of the solution in the cell, the cell constant and resistance of solution in the cell.

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9. Give the relationship between equivalent and molar conductance of a givne solution?

Watch Video Solution

10. The cell constant of a conductivity cell

Watch Video Solution

11. Which equation gives the relationship between equivalent or molar conductance and concentration of a strong electrolyte ?

Watch Video Solution

12. What is the effect of decreasing concentration on the mlar conductivity of a weak electrolyte?

Watch Video Solution

13. State Kohlraush's law of independent migration of ions.

Watch Video Solution

14. What is meant by limiting molar conductivity?

Watch Video Solution

15. Write an expression to co-relate molar conductivity of the electroyte to the degree of dissociation.

Watch Video Solution

16. What is the direction of electric current or conventional current?

Watch Video Solution

17. What flows in the internal circuit of a galvanic cell?

Watch Video Solution

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

Watch Video Solution

19. 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.

Watch Video Solution

20. Define reference electode.write two applications of electrochemical series.

Watch Video Solution

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

Watch Video Solution

22. Why does zinc react with dilute sulphuric acid to give hydrogen gas but copper does not?

Watch Video Solution

23. The Nernst equation giving dependence of electrode reduction potential on concentration is

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24. State the factors which influence the value of cell potential in the following cell.

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

Watch Video Solution

25. Write Nernst equation for the reaction

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

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

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26. Why a cell stops working after some time ?

Watch Video Solution

27. concentration cells

Watch Video Solution

28. How is free energy change of a cell reaction related to (i) its emf (ii) equilibrium constant of the cell reaction?

Watch Video Solution

29. Is free enegy change of a cell reaction an intensive property or extensive property?

Watch Video Solution

30. What is overvoltage?

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31. 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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32. Name the electrolyte used in (i) dry cell (ii) mercury cell.

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33. What is a primary cell? Give an example.

Watch Video Solution

34. Give an example of a secondary cell.

Watch Video Solution

35. Write the name of a cell used in small watches.

Watch Video Solution

36. Which cells were used in the Apollo space program? What was the product used for?

Watch Video Solution

37. Define fuel cell?

Watch Video Solution

38. How does $H_2 - O_2$ fuel cell operate?

Watch Video Solution

39. State two advantages of $H_2 - O_2$ fuel cell over ordinary cell.

Watch Video Solution

40. Write the name of the electrolyte used in fuel cell.

Watch Video Solution

41. What is the overall electrochemical reaction taking place in rusting?

Watch Video Solution

42. Out of zinc and tin which one protects iron better even after cracks and why?

Watch Video Solution

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

Watch Video Solution

44. Why Cr is used for coating Fe ?

Watch Video Solution

45. What would happen if the protective tin coating over an iron bucket is broken in some places ?

Watch Video Solution

46. Which metals can be used in the cathodic protection of Fe against rusting.

Watch Video Solution

47. Rusting of Fe is quicker in saline water than in ordinary water.

Watch Video Solution

ADDITIONAL QUESTIONS(SHORT ANSWER QUESTIONS)

1. Defin electrochemical equivalent. How is it related to the equivalent weight of the element?

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2. List the points of difference between metallic conductors and electrolytic conductors?

Watch Video Solution

3. Define the following and write the formula and unit of each: (a) Conductivity (b) Molar conductivity (c) Cell constant.

Watch Video Solution

4. What is cell constant? How is it determined?

Watch Video Solution

5. What is conductivity water? How is it obtained?

Watch Video Solution

6. Describe the construction and working of a periscope.

Watch Video Solution

7. Why is it not possible to determine Λ_m^∞ for weak electrolytes graphically ? Explain.

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8. Define Kohlrausch's law. How can it be used to find the degree of dissociation of a weak electrolyte?

Watch Video Solution

9. How does the molar conductance of an electrolyte vary with dilution ?

Watch Video Solution

10. Express the relationship between degree of dissociation of an electrolyte and its molar conductivities.

Watch Video Solution

11. An electrochemical cell stops working after sometime because

Watch Video Solution

12. Write the functions of salt bridge in an electrochemical cell.

Watch Video Solution

13. Explain difference between galvanic cell (Electrochemical cell) and Electrolytic cell?

Watch Video Solution

14. What is understood by hydrogenation?

Watch Video Solution

15. What do you understand by the following?

(i) negative standard electrode potential (ii) Positive standard electrode potential.

Watch Video Solution

16. (a) Standard reduction potentials of zinc and copper electrodes are -0.76 V and 0.34 V respectively.Which electrode will undergo oxidation and which lelctrode reduction?

`(b) Can we store copper suphate in zinc vessel? Give expalnation support of your answer.

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17. Define electrode potentia., oxidation potential and reduction potential. Why is it not possible to determine the absolute value of electrode potential?

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18. Give three differences between e.m.f. and terminal potential difference of a cell.

Watch Video Solution

19. What iis electrochemical series ? How does it help in predicting whether a particular redox reaction is feasible in a given direaction or not.

Watch Video Solution

20. What is an electrochemical series? How does it help in calculating the e.m.f. of a standard cell?

Watch Video Solution

21. 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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22. The cell reaction as written is spontaneous if the overall EMF of the cell is positive. Comment on this statement.

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23. Daniell cell is a galvanic cell mae of zinc and copper electrodes

(i) Writes anode and cathode reaction in Daniell cell

(ii) Nernst equation for the electrode reaction, $M^{n+} + ne^{-} \rightarrow M$ is

$$E_{M^{n+}/M} = E^{\circ}_{M^{n+}/M} - \frac{2.303RT}{nF}\log\frac{1}{[M^{n+}]}$$

Derive Nernst equation for Daniell cell.

Watch Video Solution

24. Write Nernst equation for the general electrochemical change of the following type at $25^{\circ} C$

$aA = bB \xrightarrow{ne^-} cC + dD.$

Watch Video Solution

25. What is a concentration cell? Give one example. How is the emf of such a cell calculated?

Watch Video Solution

26. How can Nernst equation be applied in calculating the equilibrium constant for any cell reaction ?

Watch Video Solution

27. The correct relationship between Gibb's free energy change and the EMF of a cell is

Watch Video Solution

28. Wha is menat by free energy of a system? How is it related to enthalpy and entropy of the system? How is it useful for predicting the feasibility of a process?

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29. Derive relationship between Gibbs energy and equilibrium constant of a reaction.

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30. (a). Explain why electrolysis of an aqueous solution of $NaCl$ gives H_2 at cathode and Cl_2 at anode. Given

$E^{\circ}_{Na^+/Na} = -2.71V, E_{H_2\frac{\emptyset}{H_2^{\circ}}} = -0.83V$

$E^{\circ}_{Cl_2/2Cl^-} = +1.36V, E^{\circ}_{2H^+/\frac{1}{2}O_2/H_2O} = +1.23V$

(b). The resistance of a conductivity cell when filled with 0.05 M solution of an electrolyte X is 100Ω at $40^{\circ}C$. the same conductivity cell filled with 0.01 M solution of electrolyte Y has a resistance of 50Ω. The conductivity of 0.05M solution of electrolyte X is $1.0 \times 10^{-4} scm^{-1}$ calculate

(i). Cell constant

(ii). conductivity of 0.01 M Y solution

(iii). Molar conductivity of 0.01 M Y solution.

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31. Draw a neat and labelled diagram for $H_2 - O_2$ fuel cell. Write the reaction which occurs at cathode of the cell.

Watch Video Solution

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

Watch Video Solution

33. What type of a battery is lead storage battery? Write the anode and the cathode reactions and the overall reactions occurring in a lead storage battery.

Watch Video Solution

34. Give following information about 'Nickel-Cadmium storage cell':

(i) Material of the cathode (ii) Material of the anode (iii) Electrolyte ued

(iv) Reactions involved at the anode and cathode (v) approximate voltage of the cell.

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35. What is mercury cel? Give the electrode reaction?

Watch Video Solution

36. What is an electric cell ? What is a primary and a secondary cell ?

Watch Video Solution

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

Watch Video Solution

38. What is the basis of working of a fuel cell?

Watch Video Solution

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

Watch Video Solution

40. What is a fuel cell ? Write its one advantage over other ordinary cells.

Watch Video Solution

41. 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?

Watch Video Solution

42. What do you understand by corrosion? Give one example of corrosion.

Watch Video Solution

43. Name the following:

Metal used to galvanise iron to protect it from rusting.

Watch Video Solution

44. What is corrosion? Explain any four factors affecting corrosion.

Watch Video Solution

45. Explain any three methods used for preventing Corrosion of metals?

Watch Video Solution

46. Rusting of Fe is quicker in saline water than in ordinary water.

Watch Video Solution

47. Which metals can be used in the cathodic protection of Fe against rusting.

Watch Video Solution

48. Why does not iron rust even if zinc coating is broken in a galvanised iron pipe ?

Watch Video Solution

49. Give reason :

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

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

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

Watch Video Solution

51. Write Faraday's Laws of electrolysis.

Watch Video Solution

ADDITIONAL QUESTIONS(LONG ANSWER QUESTIONS)

1. State and explain Faraday's laws of electrolysis

Watch Video Solution

2. Explain the terms specific conductivity and molar conductivity.

Watch Video Solution

Watch Video Solution

3. Electrolysis of an aqueous solution of sodium chloride produces___at the cathode and ___at the anode.

Watch Video Solution

4. Dry cell is a

Watch Video Solution

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

Watch Video Solution

6. What do you understand by corrosion? Give one example of corrosion.

Watch Video Solution

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

Watch Video Solution

8. (a) Define molar conductivity of a substance and describe how for weak and strong electrolytes , molar conductivity changes with concentration of solute . How is such change explained ?

(b) A voltaic cell is set up at $25^{\circ} C$ with the following half cells :

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

What would be the voltage of this cell ? $\left(E_{\text{cell}}^{\circ} = 0.46V\right)$

Watch Video Solution

9. (a) Define the term molar conductivity . How is it related to conductivity of the related solution ?

(b) One half-cell in a voltaic cell is constructed from a silver wire dipped in

silver nitrate solution of unknown concentration . Its other half-cell consists of a zinc electrode dipping in 1.0M solution of $Zn(NO_3)_2$. A voltage of 1.48 V is measured for this cell . Use this information to calculate the concentration of silver nitrate solution used. $\left(E^{\circ}_{Zn^{2+}|Zn} = -0.76V, E^{\circ}_{Ag^{+}|Ag} = +0.80V\right)$.

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10. 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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11. 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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12. (a) State Faraday's first law of electrolysis . How much charge in terms of Faraday is required for the reduction of 1mol of Cu^{2+} to Cu.

(b) Calculate emf of the following cell at 298 K :

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

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

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HIGHER ORDER THINKING SKILLS

1. If E_1°, E_2° and E_3° are the standard electrode potential for $Fe/Fe^{2+}, Fe^{2+}, Fe^{2+}/Fe^{3+}$ and Fe/Fe^{3+} electrodes respectively, derive a relation between E_1°, E_2° and E_3°.

Watch Video Solution

2. The following electrochemical cell has been set-up,

$Pt(1)\left|Fe^{3+}, Fe^{2+}(a=1)\right| \mid Ce^{4+}, Ce^{3+}(a=1)Pt(2)$

$E^\circ\left(Fe^{3+}/Fe^{2+}\right) = 0.77V, E^\circ\left(Ce^{4+}/Ce^{3+}\right) = 1.61V$

If an ammeter is connected between the two platinum electrodes, predict the direction of flow of current. Will the current increase or decrease with time ?

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3. 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 :

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

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

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4. There iron sheets have been coated separately with three metals (A,B and C) whose standard electrode potentials are given below.

Metal	A	B	C	$Iron$
	-0.46 V	-0.66 V	-0.20 V	-0.44 V

Identify in which case rusting will take place faster when coating is damaged.

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5. 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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HIGHER ORDER THINKING SKILLS (HOTS PROBLEMS)

1. Calculate the stability constant of the complex $\left[Zn(NH_3)_4\right]^{2+}$ formed in the reaction

$Zn^{2+} + 4NH_4 \Leftrightarrow \left[Zn(NH_3)_4\right]^{2+}$.

Given that $E^{\circ}_{Zn^{2+}/Zn} = -0.76V$ and $E^{\circ}_{\left(Zn(NH_3)_4\right]^{2+}/Zn, 4NH_3}\Big)^{\circ} = -1.03V$

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2. The standard reduction potentials of Cu^{2+}/Cu and Cu^{2+}/Cu^{+} are 0.337 V and 0.153V respectively. The standard electrode potential of Cu^{+}/Cu half-cell is

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3. The emf of a cell corresponding to the reaction

$Zn + 2H^+(aq) \rightarrow Zn^{2+}(0.1M) + H_2(g)1$ atm is 0.28 volt at $25^\circ C$. Calculate the pH of the solution at the hydrogen electrode.

$E^\circ_{Zn^{2+}/Zn} = -0.76$ volt and $E^\circ_{H^+/H_2} = 0$

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4. A current of 1.70 A is passed through 300.0 mL of 0.160 M solution of a $ZnSO_4$ for 230 s with a current efficiency of 90% . Find out the molarity of Zn^{2+} after the deposition Zn. Assume the volume of the solution to remain cosntant during the electrolysis.

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5. Find the solubility product of a saturated solution of Ag_2CrO_4 in water at $298K$, if the EMF of the cell :

$Ag|Ag^{\oplus}(satAg_2CrO_4sol)||Ag(0.1M)|Agis0.164V$ at $298K$.

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Watch Video Solution

6. A cell, $Ag|Ag^{\oplus}||Cu^{2+}\ |\ Cu$, initially contains $1MAg^{\oplus}$ and $1MCu^{2+}$ ions. Calculate the change in the cell the potential after the passage of $9.65A$ of current for $1h$.

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7. Two students use same stock solution of $ZnSO_4$ and a solution of $CuSO_4$. The EMF of one cell is 0.03 higher than the other. The concentration of $CuSO_4$ in the cell with higher EMF value is $0.5M$. Find the concentration of $CuSO_4$ in the other cell.

(Take $2.303RT/F = 0.06$)

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8. A graph is plotted between E_{cell} and $\log.\ \dfrac{[Zn^{2+}]}{[Cu^{2+}]}$. The curve is linear with intercept on E_{cell} axis equals to $1.10V$. Calculate E_{cell} for the cell.

$Zn(s)||Zn^{2+}(0.1M)||Cu^{2+}(0.01M)\mid Cu$

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9. Given: $E^0_{Sn^{2+}/Sn} = -0.14V$, $E^0_{Pb^{2+}/Pb} = -0.13V$. Determine $\left[\left(Sn^{2+}\right)/\left(Pb^{2+}\right)\right]$ at equilibrium. For cell reaction $Sn|Sn^{2+}||Pb^{2+}|Pb$, Take $(2.303RT)/F = 0.06V$

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10. The molar conductance of acetic acid at infinite dilution is $390.7Scm^2mol^{-1}$. 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} .

Watch Video Solution

11. What will be the EMF of the following electrode concentration cel at $25^{\circ} C$

$Hg - Zn(C_1 M) \left| Zn^{2+}(CM) \right| Hg - Zn(C_2 M)$

If the concentrations of zinc amalgam are 2 g per 100 g of mercury and 1 g per 100 g of mercury in the aniodic and the cathodic compartments respectively.

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12. The equivalent conctance at infinite dilution of the salt MX is 160.84 $ohm^{-1} cm^2 eq^{-1}$. If the transport number of M^+ is 0.40, calculate the ionic mobility of the ion.

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13. During discharging of lead-storage acid battery following reaction takes place:

$Pb(S) + PbO_2(S) + 2H_2SO_4$

$\rightarrow 2PbSO_4(S) + 2H_2O$

If 2.5 amp of current is drawn for 965 minutes, H_2SO_4 consumed is :

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VALUE BASED QUESTIONS WITH ANWER (Multiple Choice Questions-I)

1. Rechargable batteries include which of the those below?

(P) Dry cell

(Q) Lead-acid storage battery

(R) Nickel -cadmium battery

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2. Select the correct direct form of the given sentence.

She asked her mother why she was so upset that day.

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3. What current is to be passed for 0.25 s for deposition of a certain weight of metal, which is equal to its electrochemical equivalent?

A. $4A$

B. $100A$

C. $200A$

D. $2A$

Answer: A

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4. In an exper iment 0.04F was passed through 400mL of 1 M solution of NaCl. What would be the pH of the solution after electrolysis?

A. 8

B. 10

C. 13

D. 6

Answer: C

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5. 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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6. 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=63.5u)

A. 2 g

B. 127 g

C. 0 g

D. 63.7 g

Answer: D

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7. 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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8. 9.65C of electric current is passed through fused anhydrous magnesium chloride. The magnesium metal thus obtained is completely converted into Grignard reagen t. the number of m oles of the original reagent obtained of

A. 5×10^{-4}

B. 1×10^{-4}

C. 5×10^{-5}

D. 1×10^{-5}

Answer: C

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9. A current is passed through two cells connected in series. The first cell contains $X(NO_3)_{3\,(aq)}$ and the second cell contains $Y(NO_3)_{2\,(aq)}$. The relative atomic masses of X and Y are in the ratio $1:2$. What is the ratio of liberated mass of X to that of Y ?

A. $3:2$

B. $1:2$

C. $1:3$

D. $3:1$

Answer: C

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10. A current of 2.0A passed for 5 hours through a molten metal salt deposits 22.2 g of metal (At. Wt. =177). The oxidation state of the metal in

the metal salt is

A. $+1$

B. $+2$

C. $+3$

D. $+4$

Answer: C

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11. Salts of A (atomic mass 15) B (atomic mass 27) and C (atomic mass 48) were electrolysed using same amount of charge . It was found that when 4.5 g of A was deposited , the masses of B and C deposited were 2.7 g and 9.6 g. The valencies of A, B and C were respectively

A. 3,2 and 1

B. 1,2 and 3

C. 1,3 and 2

D. 2,3 and 2

Answer: C

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12. Al_2O_3 is reduced by electrolysis at ow potentials and high currents, If 4.0×10^4 amperes of current is passed through molten Al_2O_3 fro 6 hours , what mass of aluminum is produced ? (Assume $100\,\%$ current efficiency gt At mass of $Al = 27g$ "mol"^(-))`.

A. $8.1 \times 10^4 g$

B. $2.4 \times 10^5 g$

C. $1.3 \times 10^4 g$

D. $9.0 \times 10^3 g$

Answer: A

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13. 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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14. The weight of silver (at $wt. = 108$) displaced by a quantity of electricity which displaced $5600 mL$ of O_2 at STP will be:

A. 5.4 g

B. 10.8 g

C. 54.0 g

D. 108.0 g

Answer: D

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15. 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 minutes

B. 110 minutes

C. 220 minutes

D. 330 minutes

Answer: B

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16. The number of electrons delivered at the cathode during electrolysis by a current of 1 ampere in 60 seconds is (charger on electron $= 1.60 \times 10^{-19} C$)

A. 6×10^{23}

B. 6×10^{20}

C. 3.75×10^{20}

D. 7.48×10^{23}

Answer: C

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17. The resistance of a 0.10 M weak acid HA in a conductivity cell is $2.0 \times 10^{3} ohm$. The cell constat of the cell is 0.78 cm^{-1} and $\wedge_0$ of the acid is 390 S $cm^{2} mol^{-1}$.

Consider the following statements:

1. pH of the acid solution=3

2. pK_a of the acid=5

3. Degree of dissociation the acid=0.01

Which of the statements given above are correct?

A. 1 ad 2 only

B. 1 and 3 only

C. 2 and 3 only

D. 1,2 and 3

Answer: D

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

A. Increase in number of ions

B. Increase in ionic mobility of ions

C. 100% ionisation of electrolyte at normal dilution

D. Increase in both, i.e., number of ions and ionic mobility of ions.

Answer: B

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19. The seqeunce of ionic mobility in the aqueous solution is

A. $K^+ > Na^+ > Rb^+ > Cs^+$

B. $Cs^+ > Rb^+ > K^+ > Na^+$

C. $Rb^+ > K^+ > Cs^+ > Na^+$

D. $Na^+ > K^+ > Rb^+ > Cs^+$

Answer: B

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20. 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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21. 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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22. The molar conductivity of a $0.5 mol / dm^{3}$ solution of $AgNO_{3}$ with electrolytic conductivity of $5.76 \times 10^{-3} Scm^{-1}$ at $298 K$ is

A. $2.88 \text{ S } cm^{2} / mol$

B. $11.52 \text{ S } cm^{2} / mol$

C. $0.086 \text{ S } cm^{2} / mol$

D. $28.8 \text{ S } cm^{2} / mol$

Answer: B

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23. The limiting molar conductivities of HCl, CH_3COONa and NaCl are respectively 425, 90 and 250 mho cm^2mol^{-1} at $25^\circ C$.t he molar conductivity of 0.1 M CH_3COOH solution is 7.8 mho cm^2mol^{-1} at the same temperature. The degree of dissociation of 0.1 M acetic acid solution at the same temperature is

A. 0.10

B. 0.02

C. 0.15

D. 0.03

Answer: B

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24. Ionic mobility of which of the following alkali metal ions is lowest when aqueous solution of their salts are put under an electric field ?

A. Na

B. K

C. Rb

D. Li

Answer: D

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25. Ionic mobility of Ag^+ is $\left(\lambda_{Ag^+} = 5 \times 10^{-4} ohm^{-1} cm^2 eq^{-1}\right)$

A. 5.2×10^{-9}

B. 2.4×10^{-9}

C. 1.52×10^{-9}

D. 8.25×10^{-9}

Answer: A

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26. For pure water degree of dissociation of water is 1.9×10^{-9}

$\wedge_m^\infty \left(H^+\right) = 350 Scm^2 mol^{-1}$

$\wedge_m^\infty \left(OH^-\right) = 200 Scm^2 mol^{-1}$

Hence molar conductance of water is

A. 3.8×10^{-7} S $cm^2 mol^{-1}$

B. 5.7×10^{-7} S $cm^2 mol^{-1}$

C. 9.5×10^{-7} S $cm^2 mol^{-1}$

D. 1.045×10^{-6} S $cm^2 mol^{-1}$

Answer: D

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27. Equivalent condictance of $BaCI_2, H_2SO_4$ and HCI are x_1, x_2 and $x_3 Scm^2 \text{equiv}^{-1}$ at infinite dilution , if specific condictance of structured $BaSO_4$ solution is of $yScm^{-1}$ then K_p of $BaSO_4$ is

A. $\frac{10^6 y^2}{2(x_1 + x_2 - 2x_3)}$

B. $\frac{10^9 y^3}{8(x_1 + x_2 - 2x_3)^3}$

C. $\frac{10^3 y}{2(x_1 + x_2 - 2x_3)}$

D. $\frac{10^6 y^2}{4(x_1 + x_2 - 2x_3)^2}$

Answer: D

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28. Equivalent conductivity at infinite dilution for sodium potassium oxalate, $(COO^-)_2 Na^+ K^+$, will be (given, molar conductivities of oxalate, K^+ and Na^+ ions at infinite diluton are $148.2, 50.1, 73.5$ S $cm^2 mol^{-1}$ respectively).

A. $271.8 \ \mathrm{S} \ cm^2 eq^{-1}$

B. $67.96 \ \mathrm{S} \ cm^2 eq^{-1}$

C. $543.6 \ \mathrm{S} \ cm^2 eq^{-1}$

D. $135.9 \ \mathrm{S} \ cm^2 eq^{-1}$.

Answer: D

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29. The reaction taking place in the cell $Pg|H_2(g)|HCl(1.0M)|AgCl|Ag$ is 1 atm

A. $AgCl + (1/2)H_2 \rightarrow Ag + H^+ + Cl^-$

B. $Ag + H^+ + Cl^- \rightarrow AgCl + (1/2)H_2$

C. $2Ag^+ + H_2 \rightarrow 2Ag + 2H^+$

D. $2Ag + 2H^+ \rightarrow 2Ag^+ + H_2$.

Answer: A

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30. When measured against a standard calomel electrode, an electrode is found to have a standard reduction potential of 0.100 V. if standard reduction potential of calomel electrode is +0.244 V and it acts as anode, the standard electrode potential of the same electrode against standard hydrogen electrode will be

A. $-0.144V$

B. $+0.100V$

C. $-0.344V$

D. $-0.100V$

Answer: B

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31. Which has maximum potential for the half-cell reaction : $2H^+ 2e^- \rightarrow H_2(g)$

A. $1.0M$ HCl

B. 1.0 M NaOH

C. Pure water

D. A solution with pH=4

Answer: A

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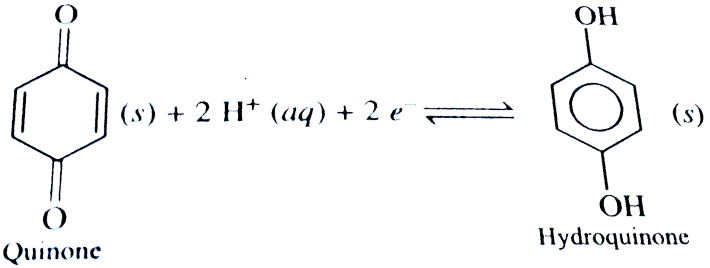
32. Quinhydrone electrode is sometimes used to find the pH of a solution.

It is based on the following electrode reaction:



Its standard electrode potential is 0.70 V. if in a particular solution, the electrode potential is found to be 0.58 V, the pH of the solution is

A. 2

B. 4

C. 6

D. 8

Answer: A

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33. Given $E_{Cr^{3+}/Cr^{\circ}} = -O \cdot 74V, E^{\circ}_{MnO_4^-/Mn^{2+}} = 1.51V$

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

Based on the given above , Strongest oxidising agent will be:

A. MnO_4^-

B. Cl^-

C. Cr^{3+}

D. Mn^{2+}

Answer: A

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34. 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^{3+}

B. Cl^-

C. Cr

D. Mn^{2+}

Answer: C

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35. Standard reduction potentials of the half reactions are given below

$$F_{2(g)} + 2e^- \rightarrow 2F^-_{(aq)} \qquad E^\circ = +2.85V$$
$$Cl_{2(g)} + 2e^- \rightarrow 2Cl^-_{(aq)} \qquad E^\circ = +1.36V$$
$$Br_{2(l)} + 2e^- \rightarrow 2Br^-_{(aq)} \qquad E^\circ = +1.06V$$
$$l_{2(s)} + 2e^- \rightarrow 2l^-_{(aq)} \qquad E^\circ = +0.53V$$

The strongest oxidising and reducing agents respectively are

A. Cl_2 and Br^-

B. Cl_2 and I_2

C. F_2 and I^-

D. Br_2 and Cl^-

Answer: C

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36. Small quantities of compounds TX, TY and TZ are put into separate test tubes containing X, Y and Z solutions. TX does not react with any of these. TY reacts with both X and Z. TZ reacts only with X. The decreasing order of ease of oxidation of the anions X^-, Y^- and Z^- is

A. Y^-, Z^-, X^-

B. Z^-, X^-, Y^-

C. Y^-, X^-, Z^-

D. X^-, Z^-, Y^-

Answer: A

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37. Which of the following statements are correct concerning redox properties?

(i) A metal M for which E° for the half cell reaction $M^{n+} + ne^- \Leftrightarrow M$ is very negative will be a good reducing agent.

(ii) The oxidizing power of the halogen decreases from chlorine to iodine.

(iii) The reducing power of hydrogen halides increases from hydrogen chloride to hydrogen iodide.

A. (i),(ii) and (iii)

B. (i) and (ii)

C. (i) only

D. (ii) and (iii) only

Answer: A

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38. The standard reduction potentials 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. $X = Zn, Y = Ni$

B. $X = Ni, Y = Fe$

C. $X = Ni, Y = Zn$

D. $X = Fe, Y = Zn$

Answer: A

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39. 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. $+1.83V$

B. $+1.19V$

C. $+0.89V$

D. $+0.18V$

Answer: C

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40. A button cell used in watched funcations as follwing

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

If half cell potentials are

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

$Ag_2O(s) + H_2O(l) + 2e^- \rightarrow 2Ag(s) + 2OH^-(aq.),, E^\circ = 0.34V$

The cell potential will be

A. 1.10 V

B. 0.42 V

C. 0.84 V

D. 1.34V

Answer: A

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41. A solution contains Fe^{2+}, Fe^{3+} and T^- ions. This solution was treated with iodine at $35^\circ C$. E° for Fe^{3+}, Fe^{2+} is $0.77V$ and E° for $I_2/2I^-$ = 0.536 V. The favourable redox reaction is:

A. I_2 will be reduced to I^-

B. There will be no redox reaction

C. I^- will be oxidized to I_2

D. Fe^{2+} will be oxidised to Fe^{3+}

Answer: C

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42. Given that $E^{\cdot}_{Fe^{2+}/Fe} = -0.44V, E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.77V$ if Fe^{2+}, Fe^{3+} and Fe solid are kept together then

A. Fe^{3+} increases

B. Fe^{3+} decreases

C. Fe^{2+}/Fe^{3+} remains unchanged

D. Fe^{2+} decreases

Answer: B

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43. Zn gives H_2 gas with H_2SO_4 and HCl but not with HNO_3 because

A. Zn acts as oxidizing agent when reacts with HNO_3

B. HNO_3 is weaker acid than H_2SO_4 and HCl

C. In electrochemical series, Zn is above hydrogen

D. NO_3^- is reduced in preference to hydronium ion

Answer: B

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44. $Cr_2O_7^{2-} + I^- \rightarrow I_2 + Cr^{3+}$

$E^\circ_{cell} = 0.79V$, $E^\circ_{Cr_2O_7^{2-}} = 1.33V$, $E^o_{I_2}$ is

A. $0.54V$

B. $-0.054V$

C. $+0.18V$

D. $-0.18V$

Answer: D

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45. Aluminium displaces hydrogen from dilute HCl whereas silver does not. The e.m.f. of a cell prepared by combining Al/Al^{3+} and Ag/Ag^{+} is 2.46V. The reduction potential of silver electrode is +0.80V. The reduction potential of aluminium electrode is

A. $+1.66V$

B. $-3.26V$

C. $3.26V$

D. $-1.66V$

Answer: D

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46. An aqueous solution containing one mole per litre of each $Cu(NO_3)_2, AgNO_3, Hg(NO_3)_2$ is being electrolysed using inert electrodes. The values of standard electrdoe potential in volts (reduction potential) are

$Ag^+|Ag = +0.802 Hg^{2+}|Hg = +0.79$

$Cu^{2+} | Cu = +0.34 Mg^{2+}|Mg = -2.37$

With increasing voltage, the sequence of deposition of metals on cathode will be

A. Ag,Hg,Cu,Mg

B. Mg,Cu,Hg,Ag

C. Ag,Hg,Cu

D. Cu,Hg,Ag

Answer: C

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47. The EMF of a cell formed by combining a particular electrode with standard calomel electrode is found to be 0.344 V and calomel electrode is found to act as cathode. If the same electrode is combined with standard hydrogen electrode, the EMF of the cell will be (Given standard reduction potential, $E^{\circ}_{\text{calomel}} = +0.244V$)

A. 0.344V

B. 0.244 V

C. 0.588 V

D. 0.100 V

Answer: D

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48. Given below are the half -cell reactions

$Mn^{2+} + 2e^{-} \rightarrow Mn, E^{\circ} = -1.18V$

$Mn^{3+} + e^- \rightarrow Mn^{2+}, E^\circ = +1.51V$

The E° for $3Mn^{2+} \rightarrow Mn + 2Mn^{3+}$ will be _____.

A. $-0.33V$, the reaction will occur

B. $-2.69V$, the reaction will not occur

C. $-2.69V$, the reaction will occur

D. $-0.33V$, the reaction will not occur

Answer: C

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49. 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. 0.059 V

B. 0.59 V

C. 0.118 V

D. 0.18 V

Answer: C

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50. How much will the reduction potential of a hydrogen electrode change when its solution initially at $pH = 0$ is neutralized to $pH = 7$?

A. Increases by 0.059 V

B. Decreases by 0.59 V

C. Increases by 0.41 V

D. Decreases by 0.41 V

Answer: C

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

A. 0.653 V

B. 0.889 V

C. 0.683 V

D. 2.771 V

Answer: A

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52. The reduction potential of hydrogen half cell will be negative if :

A. $p(H_2) = 1atm$ and $\left[H^+\right] = 1.0M$

B. $p(H_2) = 2atm$ and $\left[H^+\right] = 1.0M$

C. $p(H_2) = 2atm$ and $\left[H^+\right] = 2.0M$

D. $p(H_2) = 1atm$ and $\left[H^+\right] = 2.0M$

Answer: A

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53. If E_1, E_2 and E_3 are the emf values of the three galvanic cells respectivley

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

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

(iii) $Zn\left|Zn^{2+}(0.1)\right|\left|Cu^{2+}(1M)\right|Cu.$

Which one of the following is true.

A. $E_2 > E_3 > E_1$

B. $E_3 > E_2 > E_1$

C. $E_1 > E_2 > E_3$

D. $E_1 > E_3 > E_2.$

Answer: A

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54. The cell , $Zn\left|Zn^{2+}(1M)\right| \mid Cu^{2+}(1M)Cu\left(E_{\text{cell}}^{\circ}=1.10V\right)$,

Was allowed to be completely discharfed at $298K$. The relative concentration of $2+$ to $Cu^{2+}\left[\frac{Zn^{2=}}{Cu^{2+}}\right]$ is :

A. 9.65×10^{4}

B. antilog 24.08

C. 37.3

D. $10^{37.3}$

Answer: B

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55. An alloy of Pb-Ag weighing $1.08g$ was dissolved in dilute HNO_3 and the volume made to 100 mL.A ? Silver electrode was dipped in the solution and the emf of the cell dipped in the solution and the emf of the

cell set-up as $Pt(s), H_2(g)|H^+(1M)||Ag^+(aq.)|Ag(s)$ was $0.62V$. If E°_{cell} is $0.80V$, what is the percentage of Ag in the alloy ? (At $25^\circ C, RT/F = 0.06$)

A. 25

B. 2.5

C. 10

D. 1

Answer: D

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56. The potential of the cell for the reaction, $M(s) + 2H^+(1M) \rightarrow H_2(g)(1atm) + M^{2+}(0.1m)$' is 1.500 V. The standard reduction potential for M^{2+} / M(s) couple is :

A. $0.1470V$

B. $1.470V$

C. $1.47V$

D. none of these

Answer: C

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57. 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 $25^\circ C$ is

A. 1.47

B. 1.77

C. 1.87

D. 1.57

Answer: D

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58. The value of $\left(E_{H_2O}/H_2^{\circ}\right)$ (1atm) Pt at 298K would b e

A. $-0.207V$

B. $+0.207V$

C. $-0.414V$

D. $+0.414V$

Answer: C

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

A. $10^{-10}m$

B. $10^{-4}atm$

C. $10^{-14} atm$

D. $10^{-12} atm$

Answer: C

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60. In a cell that utilizes the reactions.

$Zn(s) + 2H^{+}(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$

addition of H_2SO_4 to cathode compartment, will

A. Lower the E and shift equilibrium to the left

B. lower the E and shift equilibrium to the right

C. increase the E and shift equilibrium to the right

D. Increase the E and shift equilibrium to the left

Answer: C

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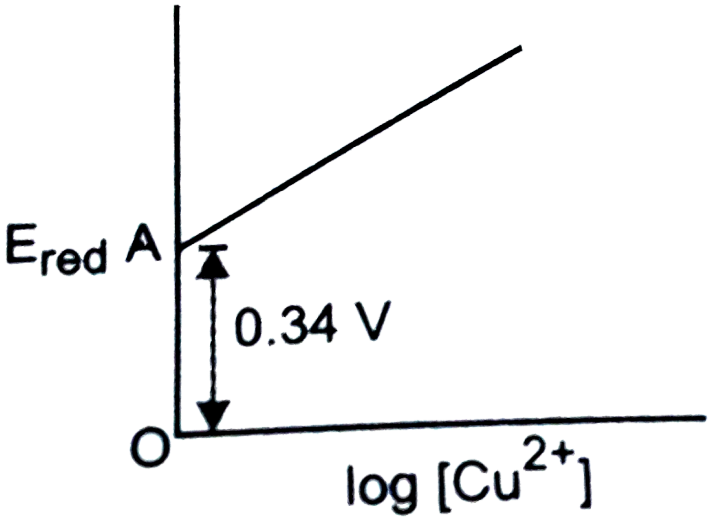
61. For the electrode $Cu/Cu^{2+}, \log[Cu^{2+}]$ (along X-axis) is plotted against E_{red} (along Y-axis). The plot obatained is shown in figure. The electrode potential of the half cell $Cu \mid Cu^{2+}(0.1M)$ will be



A. $-0.34+\frac{0.0591}{2}V$

B. $0.34V$

C. $0.34+\frac{0.0591}{2}V$

D. $-0.34-\frac{0.0591}{2}V$

Answer: B

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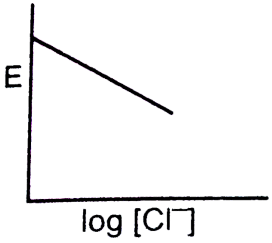
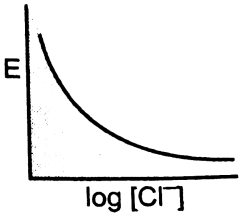
62. For the calomel half-cell, $Hg, Hg_2Cl_2 \mid Cl^-(aq)$ values of electrode potentials are plotted at different log $\left[Cl^-\right]$. Variation is represented by

A.


B.


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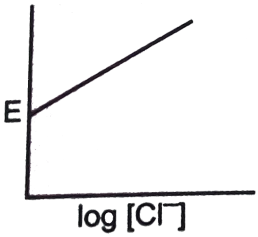
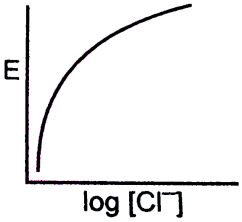


D.


Answer: A

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63. The following cell is found to have EMF equal to zero.

$Pt,\ H_2(\text{x atm})|0.01MH^+||0.1MH^+|H_2(yatm),\ Pt$

The ratio x/y is,

A. 0.01

B. 0.1

C. 10

D. 100

Answer: A

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64. The emf of the cell,

$Zn\left|Zn^{2+}(0.01M)\right|\left|Fe^{2+}(0.001M)\right|Fe$

at 298 K is 0.2905 then the value of equilibrium constant for the cell reaction is:

A. $e^{\frac{0.32}{0.0295}}$

B. $10^{\frac{0.32}{0.295}}$

C. $10^{\frac{0.26}{0.0295}}$

D. $10^{\frac{0.32}{0.0591}}$

Answer: B

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65. Find K_c for the complex:

$\left[Ag(NH_3)_2\right]^{\oplus} \Leftrightarrow Ag^{\oplus} + 2NH_3$

$E^{c-}{}_{\cdot(Ag^{\oplus}/Ag)} = 0.8V$ and $E^{c-}{}_{\cdot\left[Ag(NH_3)_2\right]^{\oplus}|Ag|NH_3} = 0.37V$

A. 10^{-8}

B. 10^{-10}

C. 10^{-12}

D. 10^{-14}

Answer: D

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66. Given :

$Hg_2^{2+} \rightarrow 2Hg, E^\circ = 0.789V$ and $Hg^{2+} + 2e^- \rightarrow Hg, E^\circ = 0.854V$

Calculate the equilibrium consant for $Hg_2^{2+} \rightarrow Hg + Hg^{2+}$.

A. 89

B. 82.3

C. 79

D. none of these

Answer: C

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67. For the following electrochemical cell at $298K$

$$Pt(s) + H_2(g, 1\text{bar}) \left| H^+(aq, 1M) \right| \left| M^{4+}(aq), M^{2+}(aq) \right| Pt(s)$$

$E_{cell} = 0.092V$ when $\dfrac{\left[M^{2+}(aq)\right]}{\left[M^{4+}(aq)\right]} = 10^x$

Given, $E^{\circ}_{M^{4+}/M^{2+}} = 0.151V$, $2.303\dfrac{RT}{F} = 0.059$

The value of x is-

A. -2

B. -1

C. 1

D. 2

Answer: D

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68. 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. $E_2 = 0 \neq E_2$

Answer: C

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69. 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 ΔG

(in J mol^{-1})

[F is Faraday constant, R is gas constant] T is temperaure, $E^{\circ}(\mathrm{cell}) = 1.1V$

A. $2.303RT + 1.1F$

B. $1.1F$

C. $2.303RT - 2.2F$

D. $-2.2F$

Answer: C

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70. Standard free energies of formation (I kJ/mol) at $298K$ are $-237.2, -394.4$ and -8.2 for $H_2O(1), CO_2(g)$ and pentange (g) , respectively . The value of E°_{cell} for the pentane-oxygen fuel cell is .

A. 1.968 V

B. 2.0968V

C. 1.0968V

D. 0.0968V

Answer: C

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71. A fuel cell involves combustion of butane at at 1 atm and 298 K

$$\underset{(g)}{C_4H_{10}} + \frac{13}{2}\underset{(g)}{O_2} \rightarrow 4\underset{(g)}{CO_2} + 5\underset{(l)}{H_2O}$$

$\Delta G^\circ = -2746\text{kJ}//\text{mol}$ The value of E°_{cell} is nearly ?

A. 0.545 V

B. 1.09 V

C. 0.922 V

D. 0.755 V

Answer: B

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72. 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: A

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73. The half cell reaction for rusting of iron are:

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

$$Fe^{2+} + 2e^{-} \rightarrow Fe(s), E^{\circ} = -0.44V$$

ΔG° (in KJ) for the reaction is

A. -76

B. -322

C. -122

D. -176

Answer: B

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74. In the electrolysis of which solution OH^- ions are discharged in preference to Cl^- ions?

A. Dilute NaCl

B. very dilute NaCl

C. fused NaCl

D. solid NaCl

Answer: B

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75. Which pair of electrolytes could not be distinguished by the products of electrolysis using inert electrodes?

A. 1 M $CuSO_4$ solution, 1 M $CuCl_2$ solution

B. 1 M KCl solution, 1 M KI solution

C. 1 M $AgNO_3$ solution, 1 M $Cu(NO_3)_2$ solution

D. 1 M KCl solution, 1 M NaCl solution

Answer: D

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76. The metal that cannot obtained by electrolysis of an aqueous solution of its salts is :

A. Cr

B. Ag

C. Ca

D. Cu

Answer: C

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77. In the lead-acid battery during charging, the cathode reaction is

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

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78. In a fuel cell methanol is used as fuel and oxygen gas is used as an oxidizer. The reaction is :

$$CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \rightarrow CO_2((g)) + 2H_2O_{(l)}$$

At $298K$ standard Gibb's energies of formation for $CH_3OH(l)$, $H_2O(l)$ and $CO_2(g)$ are -166.2, -237.2 and $-394.4kJmol^{-1}$ respectively. If standard enthalpy of combustion of methanol is $-726kJmol^{-1}$, efficiency of the fuel cell will be :

A. 0.8

B. 0.87

C. 0.9

D. 0.97

Answer: D

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79. Rust is a mixture of

A. FeO and $Fe(OH)_2$

B. FeO and $Fe(OH)_3$

C. Fe_2O_3 and $Fe(OH)_3$

D. Fe_3O_4 and $Fe(OH)_3$.

Answer: C

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80. Galvanisation is applying a coating of

A. Cr

B. Cu

C. Zn

D. Pb

Answer: C

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81. 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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82. A galvanic cell is set up from a zinc bar weighing $100g$ and $1.0L$ of $1.0MCuSO_4$ solution. How long would the cell run if it is assumed to deliver a steady current of $1.0A$. (Atomic mass of $Zn = 65$).

A. 82.47 hrs

B. 53.61 hrs

C. 41.23 hrs

D. 26.80 hrs

Answer: B

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83. For the half-cell raction, $2H_2O + 2e^- \rightarrow H_2 + 2OH^-, E^\circ = -0.8277V$ at 298K. Autoprotolysis constant of water calculted from this value will be

A. 1×10^{-10}

B. 1×10^{-12}

C. 1×10^{-13}

D. 1×10^{-14}

Answer: D

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84. A lead storage battery has been used for one month (30 days) at the rate of one hour per day by drawing a constant current of 2 amperes. H_2SO_4 consumed by the battery is:-

A. 1.12 mole

B. 2.24 mole

C. 3.36 mole

D. 4.48 mole

Answer: B

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85. Given the data at $25^\circ C$,

$Ag + I^- \rightarrow AgI + e^-, E^\circ = 0.152V,$

$A > oAg^{+} + e^{-}, E^{\circ} = -0.800V$ What is the value of log K-sp For AgI ? $\left(\left(2.303\frac{RT}{F} = 0.059V\right)\right)$

A. -37.83

B. -16.13

C. -8.13

D. $+8.612$

Answer: B

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86. The Gibbs energy for the decomposition of Al_2O_3 at $500^{\circ}C$ is as follows:

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

The potential difference needed for electrolytic reeduction of Al_2O_3 at $500^{\circ}C$ is at least:

A. 2.5 V

B. 5.0 V

C. 4.5V

D. 3.0V

Answer: A

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87. For a cell reaction $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ $\triangle_r S^{\circ}_{198} = -0.32KJ/k$. What is the value of $\triangle_f H^{\circ}_{298}(H_2O, l)$?

Given: $O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O(l), E^{\circ} = 1.23V$

A. -189.71 kJ mol^{-1}

B. -285.08 kJ mol^{-1}

C. -379.42 kJ mol^{-1}

D. -570.16 kJ mol^{-1}

Answer: B

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88. consider the following statements:

When a direct current is passed through an aqueous concentrated soluton of NaCl.

1. pH of the solution decreases.

2. metallic sodium will be deposited at the cathode.

3. Chlorie gas will be liberated at th anode.

4. pH of the solution increases.

Which of the statements given above are correct?

A. 1 and 2

B. 2 and 3

C. 3 and 4

D. 1 and 3

Answer: C

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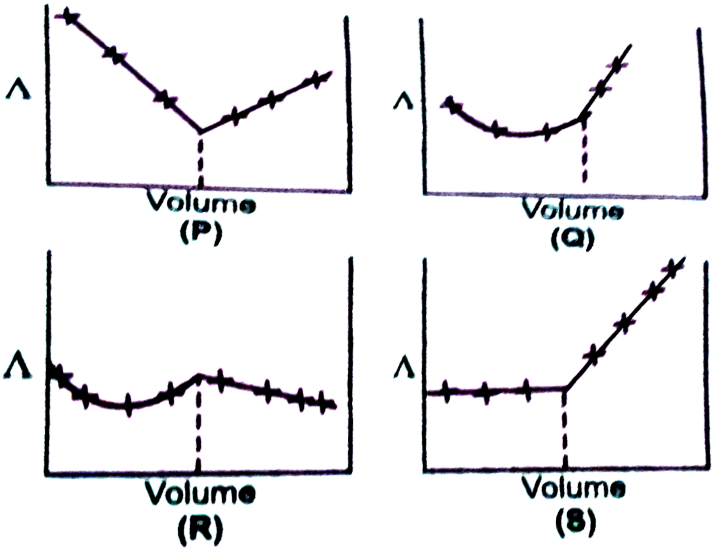
89. $AgNO_3(aq)$ was added to an aqueous KCl soluton gradually and the coductivity of the solution was measured. The plot of conductanec ($\wedge$) versus the volume of $AgNO_3$ is



A. (P)

B. (Q)

C. (R)

D. (S)

Answer: D

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90. The electrode potentials for

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

$Cu^+ e^- \rightarrow Cu_s$

are $+0.15$V and $+0.50V$ respectively the value of $E^\circ_{\frac{Cu^{2+}}{Cu}}$ will be?

A. 0.150 V

B. 0.500 V

C. 0.325 V

D. 0.650 V

Answer: C

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VALUE BASED QUESTIONS WITH ANWER (Multiple Choice Questions-II)

1. Which of the following statements are not correct?

A. Same quantity of electricity deposits more of iron from ferric sulphate solution than from ferrous sulphate solution

B. Electrochemical equivalent of an element can be obtained by dividing its equivalent weight by 96,500

C. 1 Faraday always liberates 1 mole of the substance at the electrode

D. A 60 watt bulb emits 60 Joules of energy per second.

Answer: A::C

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2. 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 $\left[Cu^{2+}\right]$

B. by increasing $\left[TI^{+}\right]$

C. by decreasing $\left[Cu^{2+}\right]$

D. by decreasing $\left[TI^{+}\right]$

Answer: A::D

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3. Which of the followingg are correct?

A. Electrolysis of dilute NaOH solution given H_2 at cathode and O_2 at anode.

B. Electrolysis of sulphuric acid (dilute or concentrated) gives H_2 at cathode and O_2 at anode.

C. Electrolysis of aqueous KF solution gives fluorine at the anode

D. oxidation of copper anode occurs in the electrolysis of aqueous copper sulphate solution using solution copper electrodes.

Answer: A::D

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4. Which of the following relationships are not correct?

A. pH of solutio in hydrogen electrode $= \frac{\text{Electrode potential}}{0.0591}$ at 298K

B. $E_{cell} = \frac{0.0591}{n} \log K_c$

C. Cell cnstant=Conductivity/Conductance

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

Answer: A::B::D

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5. 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. $Ni^{2+}(aq) + Cu(s) \rightarrow Ni(s) + Cu^{2+}(aq)$

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

C. $Cu(s) + 2H^{+}(aq) \rightarrow Cu^{2+}(aq) + H_2(g)$

D. $Zn(s) + 2H^{+}(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$

Answer: A::C

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6. Which of the followig is false?

A. Saline water slows down rusting

B. In daniell cel, if concentrations of the solutions are doubled, the emf of the cell is also doubled.

C. EMF of a cell is an intensive whereas free energy change, ΔG is extensive.

D. Galvanised iro sheets remain protected from rusting even if a crack is developed.

Answer: A::B::D

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7. In a galvanic cell, the salt bridge.

A. does not participate chemically in the cell reaction

B. stops the diffusion ofions from one electrode to another

C. is necessary for the occurrence of the cell reaction

D. ensures mixing of the two electrolytic solutions.

Answer: A::B

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VALUE BASED QUESTIONS WITH ANWER (Multiple Choice Questions-III Based on the given Passage/Comprehension)

1. There are two principal types of electrochemical cells. A galvanic cell is an electrochemical cell that produces electricity as a result of spontaneous reaction occurring inside it. An electrolytic cell is an electrochemical cell in which a non-spontaneous reaction is driven by an external source of current. any redox reaction may be expressed in terms of two half reactions which are conceptual reactions showing the lowss and gain of electrons. each half reaction has a difinite value of standard electrode potential. the overall reaction is represented by a universally accepted method. knowing the standard electrode potential of the half reactions, the standard EMF of the cell can be calculted. the standard EMF further helps in the calculation of free energy change, equilibrium constant of the cell reaction as well as parameters like solublity products

of a sparingly soluble salt. a cell can also be set up in which the two electrodes may be of the same (type, e.g., both may be hydrogen electrodes but the concentration of H^+ ions in the two solutions may be different. Such cells are called concentration cells.

Q. The reaction

$$\frac{1}{2}H_2(g) + AgCl(s) \rightarrow H^+(aq) + Cl^-(aq) + Ag(s)$$

occurs in the galvanic cell

A. $Ag|AgCl(s)|KCl(aq)|AgNO_3(aq)|Ag$

B. $Pt|H_2(g)|HCl(aq)|AgNO_3(aq)|Ag$

C. $Pt|H_2(g)|HCl(aq)|AgCl(s)|Ag$

D. $Pt|H_2(g)|KCl(aq)|AgCl(s)|Ag$

Answer: C

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2. (A) An electrochemical cell can be set-up only if the redox reaction is spontaneous.

(R) A reaction is spontaneous if free energy change is negative.

A.

B.

C.

D.

Answer: B

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3. 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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4. There are two principal types of electrochemical cells. A galvanic cell is an electrochemical cell that produces electricity as a result of spontaneous reaction occurring inside it. An electrolytic cell is an electrochemical cell in which a non-spontaneous reaction is driven by an external source of current. any redox reaction may be expressed in terms of two half reactions which are conceptual reactions showing the lowss and gain of electrons. each half reaction has a difinite value of standard electrode potential. the overall reaction is represented by a universally accepted method. knowing the standard electrode potential of the half reactions, the standard EMF of the cell can be calculted. the standard EMF further helps in the calculation of free energy change, equilibrium constant of the cell reaction as well as parameters like solublity products

of a sparingly soluble salt. a cell can also be set up in which the two electrodes may be of the same (type, e.g., both may be hydrogen electrodes but the concentration of H^+ ions in the two solutions may be different. Such cells are called concentration cells.

Q. If hydrogen electrodees dipped in two solutions of pH=3 and pH=6 are connected by a salt bridge, the emf of the resulting cell is

A. 0.177 V

B. 0.3 V

C. 0.052 V

D. 0.104V

Answer: A

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5. 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.

A. $Pb^{2+} + 2e^- \rightarrow Pb$

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

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

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

Answer: D

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6. A lead storage battery consists of a lead anode and a grid of lead packed with lead dioxide as the cathode. The electrolyte taken is 39% H_2SO_4 by mass having a density of 1.294 g mL^{-1}. The battery holds 3.5 L of the acid. During the discharge of the battery, the density H_2SO_4 falls

from 1.294 g mL^{-1} to 1.139 g mL^{-1} which is 20% H_2SO_4 by mass

Q. Moles of sulphuric acid lost during discharge is

A. 9.88

B. 8.88

C. 2.32

D. 1.16

Answer: A

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7. A lead storage battery consists of a lead anode and a grid of lead packed with lead dioxide as the cathode. The electrolyte taken is 39% H_2SO_4 by mass having a density of 1.294 g mL^{-1}. The battery holds 3.5 L of the acid. During the discharge of the battery, the density H_2SO_4 falls from 1.294 g mL^{-1} to 1.139 g mL^{-1} which is 20% H_2SO_4 by mass

Q. Molarity of the solution after the discharge is

A. 8.136

B. 4.068

C. 2.32

D. 1.16

Answer: C

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8. A lead storage battery consists of a lead anode and a grid of lead packed with lead dioxide as the cathode. The electrolyte taken is 39% H_2SO_4 by mass having a density of 1.294 g mL^{-1}. The battery holds 3.5 L of the acid. During the discharge of the battery, the density H_2SO_4 falls from 1.294 g mL^{-1} to 1.139 g mL^{-1} which is 20% H_2SO_4 by mass

Q. The amount of charge in coulombs used up by the battery is nearly

A. 954180

B. 477090

C. 95418

D. 47709

Answer: A

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9. A lead storage battery consists of a lead anode and a grid of lead packed with lead dioxide as the cathode. The electrolyte taken is 39% H_2SO_4 by mass having a density of 1.294 g mL^{-1}. The battery holds 3.5 L of the acid. During the discharge of the battery, the density H_2SO_4 falls from 1.294 g mL^{-1} to 1.139 g mL^{-1} which is 20% H_2SO_4 by mass

Q. The number of ampere-hour for which the battery must have been used is

A. 2650.5

B. 265.05

C. 26.505

D. 2.6505

Answer: B

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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 $|E_{cell}| = 70mV$.

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

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11. If the 0.05 molar solution of M^{+} is replaced by a 0.0025 Molar M^{+} solution. then the magnitude of the cell potential would be :

A. 35 mV

B. 70 mV

C. 140 mV

D. 700 mV

Answer: C

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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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13. 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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VALUE BASED QUESTIONS WITH ANWER (Matching Type Question)

1.

Column I (Element)		Column II (Electrochemical equivalent)	
(A)	Copper	(p)	0·00112
(B)	Silver	(q)	0·000093
(C)	Zinc	(r)	0·00029
(D)	Aluminium	(s)	0·000339

(Atomic masses : Cu = 63·5, Ag = 108, Zn = 65·4, Al = 27)

A. A-q,B-r,C-p,D-s

B. A-r,B-p,C-s,D-q

C. A-s,B-p,C-q,D-r

D. A-p,B-r,C-q,D-s

Answer: B

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2.

	Column I		Column II
	For the Daniell cell using Zn & Cu electrodes		
(A)	Concentration of copper sulphate solution is doubled	(p)	EMF of the cell increases
(B)	Concentrations of zinc sulphate solution is doubled	(q)	EMF of the cell decreases
(C)	Concentrations of both the solutions are doubled	(r)	EMF of cell becomes equal to standard EMF
(D)	Concentrations of both the solutions are kept equal	(s)	No effect on EMF

A. A-p,B-q,C-s,D-r

B. A-s,B-r,C-p,D-q

C. A-q,B-r,C-s,D-p

D. A-r,B-s,C-q,D-p

Answer: A

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3.

List I		List II
P.	$(C_2H_5)_3N$ (X) + CH_3COOH (Y)	1. Conductivity decreases and then increases
Q.	KI (0·1 M) (X) + $AgNO_3$ (0·01 M) (Y)	2. Conductivity decreases and then does not change much
R.	CH_3COOH (X) + KOH (Y)	3. Conductivity increases and then does not change much
S.	NaOH (X) + HI (Y)	4. Conductivity does not change much and then increases

A. P-3,Q-4,R-2,S-1

B. P-4,Q-3,R-2,S-1

C. P-2,Q-3,R-4,S-1

D. P-1,Q-4,R-3,S-2

Answer: A

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4.

List I	List II
$E^\circ (Fe^{3+}, Fe)$	1. – 0·18 V
$E^\circ (4\ H_2O \rightleftharpoons 4\ H^+ + 4\ OH^-)$	2. – 0·4 V
$E^\circ (Cu^{2+} + Cu \longrightarrow 2\ Cu^+)$	3. – 0·04 V
$E^\circ (Cr^{3+}, Cr^{2+})$	4. – 0·83 V

A. P-4,Q-1,R-2,S-3

B. P-2,Q-3,R-4,S-1

C. P-1,Q-2,R-3,R-4

D. P-3,Q-4,R-1,S-2

Answer: D

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VALUE BASED QUESTIONS WITH ANWER (Matrix-Type Questions)

1.

Column I		Column II	
(A)	Copper	(p)	Most active metal
(B)	Zinc	(q)	Least active metal
(C)	Silver	(r)	Reacts with acid to give H_2 gas
(D)	Aluminium	(s)	Does not react with acid to give H_2 gas

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2.

Column I (Cell)		Column II (Electrolyte used)	
(A)	Dry cell	(p)	Mercuric oxide
(B)	Ruben-Mallory cell	(q)	Zinc chloride
(C)	Nicad cell	(r)	Potassium hydroxide
(D)	$H_2 - O_2$ fuel cell	(s)	Ammonium chloride

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VALUE BASED QUESTIONS WITH ANWER (Integer Type Question)

1. Three litres of 0.5 M $K_2Cr_2O_7$ soluton have to be completely reduced in th acidic medium. The number of faradays of electricity required will be.

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2. In the Mg-Al cell, the number of electrons involved in the cell reaction is.

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3. For the Mg-Ag cell, how many times the difference between the EMF of the cell and its standard EMF will change if concentration of Mg^{2+} ions is changed from 0.1 M to 0.01 M and that of Ag^{+} ions is chagned from 0.5 M to 0.25 M?

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4. The equilibrium constant for the following reaction at 298K is expressed as $x \times 10^{y}$

$2Fe^{3+} + 2I^{-} \rightarrow 2Fe^{2+} + I_2, E^{\circ}_{cell} = 0.235V$

The value of y is.

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5. 0.25 mole of propane is subjected to combustion. If this reaction is used for making a fuel cell, the number of moles of electrons involved in each half cell for this amount of propane will be

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6. All the energy released from the reaction $X \to Y, \Delta_r G^\circ = -193 kJ \text{mol}^{-1}$ is used for oxidising M° as $M^+ \to M^{3+} + 2e^-, E^\circ = -0.25V.$

Under standard conditions, the number of moles of M^+ oxidised when one mole of X is converted to Y is $\left[F = 96500 C \text{mol}^{-1}\right]$

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7. 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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8. The conductance of a 0.0015 M aqueous solution of a weak monobasic acid was determined by using a conductivity cell consisting of 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. The value of limiting molar conductivity (Λ°) of this monobasic acid in aqueous solution is $Z \times 10^2 Scm^{-1}mol^{-1}$. The value of Z is ..... .

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VALUE BASED QUESTIONS WITH ANWER (Assertion-Reason Type Question Type-I)

1. Statement-1: Specific conductivity of an electrolytic solution decreases with dilution whereas molar conductivity.

Statement-2: Specific conductivity is the conductance of a specific amount of the electrolyte whereas molar conductivity is for 1 mole of the electrolyte.

A. Statement-1 is True, statement-2 is true, statement-2 is a correct explanation of statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation of statement-1.

C. Statement-1 is true, statemet-2 is false

D. Statement-1 is false, statement-2 is true

Answer: C

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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.

A. Statement-1 is True, statement-2 is true, statement-2 is a correct explanation of statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation of statement-1.

C. Statement-1 is true, statemet-2 is false

D. Statement-1 is false, statement-2 is true

Answer: A

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3. 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 :

The cell constant of a conductivity cell depends upon the nature of material of the electrodes .

The electrodes of the cell are coated with platinum black to avoid polacrization effects.

A. Statement-1 is True, statement-2 is true, statement-2 is a correct explanation of statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation of statement-1.

C. Statement-1 is true, statemet-2 is false

D. Statement-1 is false, statement-2 is true

Answer: D

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4. Assertion(A): Whne acidified $ZnSO_4$ solution is electrolyzed between Zn electrodes, it is Zn that is deposited at the cathode and $H_2(g)$ is not evolved.

Reason (R): The electrode potential of Zn is more negative than hydrogen as the overpotential for hydrogen evolution in Zn is quite large.

A. Statement-1 is True, statement-2 is true, statement-2 is a correct explanation of statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation of statement-1.

C. Statement-1 is true, statemet-2 is false

D. Statement-1 is false, statement-2 is true

Answer: A

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5. Statement-1 :Addition of NH_4OH to an aqueous solution of $BaCl_2$ in presence of NH_4Cl (excess) precipitates $Ba(OH)_2$. Statement-2: $Ba(OH)_2$ is water soluble.

A. Statement-1 is True, statement-2 is true, statement-2 is a correct explanation of statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation of statement-1.

C. Statement-1 is true, statemet-2 is false

D. Statement-1 is false, statement-2 is true

Answer: B

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VALUE BASED QUESTIONS WITH ANWER (Assertion-Reason Type Question Type-IO)

1. Assertion (A): The electrolysis of $NaCl$ solution gives $H_2(g)$ at cathode and $Cl_2(g)$ at anode.

Reason (R): Cl_2 has higher oxidation potential than H_2O

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: C

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2. Assertion : Electrolysis of molten CaH_2 produces hydrogen gas at anode.

Reason : In CaH_2, hydrogen is present in the form of hydride H^-.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: A

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3. Assertion Molar conductance of an electrolyte increases with dilution

Reason Ions move fast in dilute solutions.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: B

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4. 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 : On dilution the equivalent as well molar conductivity of the solution increases .

Reason : With dilution, the number of current carrying particles per cm^3 increases.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: C

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5. 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.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: D

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6. Statement-1: Molar conductivity of a weak electrolyte at inifinite dilution cannot be dtermined experimentally.

Statement-2: Kohlrausch law helps to find the molar conductivity of a weak electrolyte at infinite dilution.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: B

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7. Assertion (A) : The Daniell cell becomes dead after sometimes.

Reason (R) : The oxidation protential of Zn anode decreases and that of Cu increases.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: A

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8. 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

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: B

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9. Assertion: Copper sulphate solution can be kept in a zinc vessel.

Reason: The position of copper is higher than zinc is the electrochemical series.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: D

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10. Assertion A: Copper does not liberate hydrogen from the solution of dilute hydrochloric acid.

Reason (R): Hydrogen is below copper in the electrochemical series.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: D

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11. 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.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: D

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12. Assertion: The emf of a cell is related with equilibrium constant of the cell reaction as $E_{cell} = \frac{0.0591}{n}\log \quad K.$

Reason: As E_{cell} changes with concentration of the electrodes, K of cell reaction also changes with concentration.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: D

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13. Assertion: In the electrolysis of aqueous NaCl, Na is preferentially discharged at mercury cathode forming sodium amalgam.

Reason: It is due to the fact that hydrogen gas a high over voltage at mercury cathode.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: A

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14. Assertion: The cell potential of mercury cell is 1.35V which remains constant.

Reason: In mercury cell, the electrolyte is a paste of KOH and ZnO.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: B

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15. Assertion: As a lead storage battery gets discharged, density of the electrolyte present in it decreases.

Reason: lead and lead dioxide both react with sulphuric acid to form lead sulphate.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: A

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16. Statement-I: $H_2 + O_2$ fuel cell gives a constant voltage throughout its life.

Because Statement-II: In this fuel cell, H_2 reacts with OH^- ions yet the overall concentration of OH^- ions does not change.

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: A

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

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

A. If both assertion and reason are true, and reason is the true explanation of the assertion

B. if both assertion and reason are true, but reason is not the true explanation of the assertion.

C. if assertion is true, but reason is false.

D. If both assertion and reason are false.

Answer: A

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IMPORTANT QUESTIONS FOR BOARD EXAMINATION

1. A current is passed through two cells connected in series. The first cell contains $X(NO_3)_{3(aq)}$ and the second cell contains $Y(NO_3)_{2(aq)}$. The relative atomic masses of X and Y are in the ratio $1:2$. What is the ratio of liberated mass of X to that of Y ?

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2. Predict the products of electrolysis in eaCHM 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_2SSO_4 with platinum electrodes.

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

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3. On passing electric current of one ampere for 16 min and 5 sec through one litre solution of $CuCl_2$, all copper of solution was deposited at cathode. The normality of $CuCl_2$ solution was:

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4. 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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5. Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100Ω. If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520Ω, calculate the conductivity and molar conductivity of 0.02 M KCl solution. The conductivity of 0.1 M KCl solution is 1.29S/m.

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

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8. (a) What do you mean by Electrolytic cell?

(b) An electrochemical cell is made of nickel and copper electrodes with their standard reduction potentials -0.25 V and +0.34 V respectively. Select the anode and cathode. Represent the cell and find e.m.f. of the cell.

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9. What is the effect of increase in concentration of $CuSO_4$ solution on electrode potential of copper electrode?

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

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11. What do you understand by normal hydrogen electrode? Give its construction and working.

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

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13. The emf (E°) of the following cels are :

$Ag|Ag^{+}(1M)||Cu^{2+}(1M)|Cu, E^{\circ} = -0.46$ volt

$Zn|Zn^{2+}(1M)||Cu^{2+}(1M)|Cu, E^{\circ} = +1.10$ volt

Calculate the emf of the cell :

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

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14. 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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15. I_2 and F_2 are added toa asolution containing 1M each of I^{-} and F^{-}. What reaction will take place? Given that the reduction potential of I_2 and F_2 are 0.54 volt and 2.87 volts respectively.

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16. On the basis of the standard electroe potential values stated for acid solution, predict whether, Ti^{4+} species may be used to oxidise

Fe^{II} to Fe^{III}. Given.

$Ti^{4+} +_e^- \rightarrow Ti^{3+}, E^{É\,\mu} = +0.01V, Fe^{3+} + e^- \rightarrow Fe^{2+}, E^{É\,\mu} = +0.$

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17. 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 theis reaction favours formation of reaction or product shown in the equation.

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

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20. Calculate the potential for half cell containing 0.10 M $K_2Cr_2O_7(aq)$, 0.20 M $Cr^{3+}(aq)$ and $1.0 \times 10^{-4} M H^+(aq)$. The half-cell reaction is

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

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

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21. Calculate the potential of the cell at 298 K :

$$Cd\,/\,Cd^{2+}(0.1M)\;||\;H^+(0.2M)\,/\,Pt,\,H_2(0.5atm)$$

Given E° for $Cd^{2+}/Cd = -0.403V, R = 8.314J^{-1}\ \text{mol}^{-1}, F = 965$

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22. By passing a certain amount of charge through $NaCl$ solution, 9.2 lit of Cl_2 were liberated at STP. When the same charge is passed through a nitrate solution of metal M i.e. $M(NO_3)x7.467$ gm of the metal was deposited . If the specific heat of metal is $0.16cal/gm$, what is the value of x (x is integer).

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

?

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25. In the electrolysis of fused salt, the weight of the substance deposited on an electrode will not depend on:

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