CHEMISTRY

BOOKS - G.R. BATHLA & SONS CHEMISTRY (HINGLISH)

ELECTROCHEMISTRY

Example

1. How much coulomb charge is present on 1g ion ofN^{3-} ?

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2. How much charge is required to reduce (a) 1 mole of Al^{3+} to Al and (b) 1 mole of MnO_4^- to Mn^{2+} ?

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

(a) 1 mol of H_2O to O_2,

(b) 1 mole of FeO to Fe_2O_3 ?

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4. Exactly 0.4 faraday electric charge is passed through three electrolytic cells in series, first containing $AgNO_3$, second $CuSO_4$ and third $FeCl_3$ solution. How many grams of each metal will be deposited assuming only cathodic reaction in each cell ?

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5. An electric current of 100 ampere is passed through a moltan liquid of sodium chloride for 5 hours. Calculate the volume of chlorine gas liberated at the electrode at NTP.

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6. A 100 watt, 110 volt incandescent lamp is connected in series with an electrolytic cell containing cadmium sulphate solution. What mass of cadmium will be deposited vy the current flowing for 10 hours ?

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7. In an electrolysis experiment, current was passed for $5h$ through two cells connected in series. The first cell contains a solution of gold and second contains copper sulphate solution. In the first cell, $9.85g$ of gold was deposited. If the oxidation number of gold is $+3$, find the amount of copper deposited at the cathode of the second cell. Also calculate the magnitude of the current in ampere, $($ Atomic weight of Au is 197 and atomic weight of Cu is $63.5)$.

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8. How long has a current of 3 ampere to be applied through a solution of silver nitrate to coat a metal surface of $80cm^2$ with 0.005 mm thick layer ?

Density of silver is $10.5g/cm^3$.

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9. 19 g of molten $SuCl_2$ is electrolysed for some time using inert electrodes until 0.119 g of Sn is deposited at the cathode. No substance is lost during electrolysis. Find the ratio of the masses of $SnCl_2 : SnCl_4$ after electrolysis.

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10. A current of $2.68A$ is passed for 1.0 hour through an aqueous solution of $CuSO_4$ using copper electrodes.

Which of the following statements is $/$ are correct ?

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11. An ammeter and copper voltmeter are connected in aseries in an electric circuit through which a constant direct current flows. The ammeter shows 0.525 ampere. If $0.6354g$ of Cu is deposited in 1 hr, what is the percentge error of ammeter ? $[\text{At. wt. of } Cu = 63.54]$

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12. A current of 3.7 ampere is passed for 6 hours between platinum electrodes in 0.5 litre of a 2 M solution of $Ni(NO_3)_2$. What will be the molarity of the solution at the end of electrolysis ? What will be the molarity of the solution if nickel electrodes are used ? (1 F=96500 coulomb, Ni=58.7)

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13. An acidic solution of Cu^{2+} salt contaning 0.4 of Cu^{2+} is electrolyzed untill all the copper is deposited. The electrolysis is continued for seven more minutes with the volume of solution kept at 100mL and the current at 1.2 amp. Calculate the volume of gases evolved at NTP during the entire electrolysis.

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14. 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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15. An aqueous solution of $NaCl$ on electrolysis gives $H_2(g), Cl_2(g)$, and $NaOH$ accroding to the reaction :

$2Cl^{c-}(aq) + 2H_2O \rightarrow 2\overset{c-}{O}H(aq) + H_2(g) + Cl_2(g)$

A direct current of $25A$ with a current efficiency of 62% is passed through $20L$ of $NaCl$ solution $(20\%$ by weight). Write down the reactions taking place at the anode and cathode. How long will it take to produce $1kg$ of Cl_2? What will be the molarity of the solution with respect to hydroxide ion ? (Assume no loss due to evaporation .)

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

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

$a.$ How many grams of chromium will be plated out by $24000C$?

$b.$ How long will take to plate out $1.5g$ of chromium by using $12.5A$ current ?

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17. After electrlysis of $NaCI$ solution with inert electrodes for a certain period of time $600mL$ of the solution was left. Which was found to be $1N$ in $NaOH$. During the same time, $31.75g$ of Cu deposited in the copper voltameter in series the electrolytic cell. calculate the percentage yield of $NaOH$ obtained.

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18. Peroxy disulphuric acid $(H_2S_2O_8)$ can be prepared by electrolytic oxidation of H_2SO_4 as :

$2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^+ + 2e^-$

Oxygen and hydrogen are by products. In such an electrolysis 9.72 litre of H_2 and 2.35 litre of O_2 were generated at NTP. What is the mass of peroxy disulphuric acid formed ?

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19. Cadmium amalgam is prepared by electrolysis of a sodium of $CdCl_2$ using a mercury cathode. How long should a current of 4 A be passed in order to prepare 10% by mass Cd in Cd-Hg amalgam on cathode of 4.5 g Hg? (atomic mass of Cd=112)

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20. Assume that impure copper contains only iron, silver and a gold as impurities. After passage of $140A$, for 482.5 sec, of the mass of the anode decreased by $22.260g$ and the cathode increased in mass by $22.011g$. Estimate the $\%$ iron and $\%$ copper originaly present.

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21. 1.0 N solution of a salt surrounding two platinum electrodes 2.1 cm apart and 4.2 sq cm in area was found to offer a resistance of 50 ohm. Calculate the equivalent conductivity of the solution.

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22. Specific conductance of a decinormal solution of KCl is 0.0112 $ohm^{-1}cm^{-1}$. The resistance of a cell containing the solution was found to be 56. What is the cell constant ?

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23. The specific conductivity of 0.02 M KCl solution at $25^\circ C$ is $2.768 \times 10^{-3} ohm^{-1} cm^{-1}$. The resistance of this solution at $25^\circ C$ when measured with a particular cell was 250.2 ohm. The resistance of 0.01 M $CuSO_4$ solution at $25^\circ C$ measured with the same cell was 8331 ohm. Calculate the molar conductivity of the copper sulphate solution.

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24. The equivalent conductances of sodium chloride, hydrochloric acid and sodium acetate at infinite dilution are 126.45, 426.16 and $91.0 ohm^{-1} cm^2 eq^{-1}$, respectively at $25^\circ C$. Calculate the equivalent conductance of acetic acid at infinite dilution.

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25. The equivalent conductivity of N/10 solution of acitic acid at $25^\circ C$ is $14.3 ohm^{-1} cm^2 eq^{-1}$. Calculate the degree of dissociation of CH_3COOH if $\Lambda_{\infty CH_3COOH}$ is 390.71.

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26. A decinormal solution of $NaCl$ has specific conductivity equal to 0.0092. If ionic conductances of Na^{+} and Cl^{-} ions at the same temperature are 43.0 and $65.0 ohm^{-1}$ respectively, calculate the degree of dissociation of NaCl solution.

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27. At $18^{\circ}C$, the conductivities at infinite dilution of NH_4Cl, $NaOH$ and $NaCl$ are 129.8, 217.4 and 108.9 mho respectively. If the equivalent conductivity of N/100 solution of NH_4OH is 9.93 mho, calculate the degree of dissociation of NH_4OH at this dilution.

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28. Construct the cells in which the following reactions are taking place. Which of the electrodes shall act as anode (negative electrode) and which

one as cathode (positive electrode) ?

(a) $Zn + CuSO_4 = ZnSO_4 + Cu$

(b) $Cu + 2AgNO_3 = Cu(NO_3)_3 + 2Ag$

(c) $Zn + H_2SO_4 = ZnSO_4 + H_2$

(d) $Fe + SnCl_2 = FeCl_2 + Sn$

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29. Consider the reaction,

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

The standard electrode potentials for $Ag^{+} \rightarrow Ag$ and $Cd^{2+} \rightarrow Cd$ couples are 0.80 volt and -0.40 volt respectively.

(i) What is the standard potential E° for this reaction ?

(ii) For the electrochemical cell, in which this reaction takes place which electrode is negative electrode ?

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30. Will Fe be oxidised to Fe^{2+} by reaction with 1.0 M HCl? E° for $Fe/Fe^{2+} = +0.44$ volt.

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31. The values of E° of some of the reactions are given below :

$$
\begin{array}{ll}
I_2 + 2e^- \rightarrow 2I^- & E^{\circ} = +0.54 \text{ volt} \\
Cl_2 + 2e^- \rightarrow 2Cl^- & E^{\circ} = +1.36 \text{ volt} \\
Fe^{3+} + e^- \rightarrow Fe^{2+} & E^{\circ} = +0.76 \text{ volt} \\
Ce^{4+} + e^- \rightarrow Ce^{3+} & E^{\circ} = +1.60 \text{ volt} \\
Sn^{4+} + 2e^- \rightarrow Sn^{2+} & E^{2} = +0.15 \text{ volt}
\end{array}
$$

On the basis of the above data, answer the following questions :

(a) Whether Fe^{3+} oxidises Ce^{3+} or not ?

(b) Whether I_2 displaces chlorine from KCl ?

(c) Whether the reaction between $FeCl_3$ and $SnCl_2$ occurs or not ?

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32. Calculate the electrode potential at a copper electrode dipped in a 0.1 M solution of copper sulphate at $25^{\circ}C$. The standard electrode potential of Cu^{2+} / Cu system is 0.34 volt at 298 K.

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33. What is the single electrode potential of a half-cell for zinc electrode dipping in 0.01 M $ZnSO_4$ solution at $25^{\circ} C$? The standard electrode potential of Zn / Zn^{2+} system is 0.763 volt at $25^{\circ} C$.

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34. The standard oxidation potential potential of zinc is 0.76 volt and of silver is - 0.80 volt. Calculate the emf of the cell :

$$Zn \left| \underset{0.25M}{Zn(NO_3)_2} \right\| \left| \underset{0.1M}{AgNO_3} \right| Ag$$

at $25^{\circ} C$.

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35. The e.m.f. (E^0)of the following cells are

$Ag|Ag^+(1M)||Cu^{2+}(1M)|Cu,\ E^0 = -0.46V,$

$Zn|Zn^{2+}(1M)||Cu^{2+}(1M)|Cu : E^0 = +1.10V$

Calculate the e.m.f. of the cell $Zn|Zn^{2+}(1M)||Ag^+(1M)|Ag$

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36. Calculate the emf of the cell.

$Mg(s)|Mg^{2+}(0.2M)||Ag^+(1\times10^{-3})|Ag$

$E^\circ_{Ag^+/Ag} = +0.8$ volt, $E^\circ_{Mg^{2+}/Mg} = -2.37$ volt

What will be the effect on emf If concentration of Mg^{2+} ion is decreased to $0.1M$?

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37. To find the standard potential of M^{3+}/M electrode , the following cell is constituted : $Pt|M|M^{3+}\left(\left(.001moLL^{-1}\right|\left|Ag^+\left(\left(0.01moLL^{-1}\right)\right|\right.\right.$ Ag. The emf of the cell is found to be 0.421 volt at 298 K. The standard potential of half reaction $M^{3+} + 3e^{-} \to M$ at 298 K will be :

(Given $E_{Ag^{+} / Ag^{\circ}}$ at 298 K = 0.80 Volt)

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

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39. The observed emf of the cell,

$Pt|H_2(1\text{ atm})|H^{+}(3 \times 10^{-4}M)||H^{+}(M_1)|H_2(1\text{ atm})|Pt$

is 0.154 V. Calculate the value of M_1 and pH of cathodic solution.

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40. In a fuel cell H_2 and O_2 react to produce electricity. In the process H_2 gas is oxidised at the anode and O_2 is reduced at the cathode. If 6.72 litre of H_2 at NTP reacts in 15 minute, what is the average current produced ? If the entire current is used for electro-deposition of Cu from Cu^{2+}, how many g of Cu are deposited ?

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41. Neglecting the liquid-liquid junction potential, calculate the emf of the following cell at $25^\circ C$

$H_2(1atm)|0.5MHCOOH||1MCH_3COOH|(1atm)H_2$

K_a for $HCOOH$ and CH_3COOH are 1.77×10^{-4} and 1.8×10^{-5} respectively.

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42. During the discharge of a lead storage battery, the density of sulphuric acid fell from $1.294gmL^{-1}$ to $1.139gmL^{-}$. Sulphuric acid of density $1.294 gmL^{-1}$ is 39% by weight and that of density $1.139 gmL^{-1}$ is 20% by weight. The battery hold 3.5 litre of acied and discharge. Calculate the no. of ampere hour for which the battery must have been used. The charging and discharging reactions are:

$Pb + SO_4^{2-} \rightarrow PbSO_4 + 2e$ (charging)

$PbO_2 + 4H^+ + SO_4^{2-} + 2e \rightarrow PbSO_4 + 2H_2O$ (discharging)

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43. Anodic oxidation of ammonium hydrogen sulphate produces ammonium persulphate.

$NH_4HSO_4 \rightarrow NH_4SO_4^- + H^+$

$2NH_4SO_4^- \rightarrow (NH_4)_2S_2O_8 + 2e^-$ (Anodic oxidation)

$2H^+ + 2e^- \rightarrow H_2$ (Cathodic reduction)

Hydrolysis of ammonium persulphate forms H_2O_2

$(NH_2)_2S_2O_8 + 2H_2O \rightarrow 2NH_4HSO_4 + H_2O_2$

Current efficiency in electrolytic process is 60%. Calculate the amount of current required to produce 85 g of H_2O_2 per hour: Hydrolysis reaction shows 100% yield.

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44. In a zinc manganese dioxide dry cell, the anode is made up of zinc and cathode of a carbon rod surrounded by a mixture of MnO_2, carbon NH_4Cl and $ZnCl_2$ in aqueous base.

The cathodic reaction may be represented as:

$2MnO_2(s) + Zn^{2+} + 2e^- \rightarrow ZnMn_2O_4(s)$

Let there be 8g MnO_2 in the cathodic compartment. How many days will the dry cell continue to give a current of 4×10^{-3} ampere ?

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45. 10g fairly concentrated solution of $CuSO_4$ is electrolyzed using $0.01F$ of electricity. Calculate:

(a) The weight of resulting solution

(b) Equivalents of acid or alkali in the solution.

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46. A current of 40 microampere is passed through silver nitrate solution for 16 minutes using platinum electrodes.

50% of the cathode is occupied by a single atom thick silver layer. Calculate the total surface area of the cathode if one silver atom occupies $5.5 \times 10^{-16} cm^2$ surface area.

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47. A pin of 2 cm length and 0.4 cm diameter was placed in $AgNO_3$ solution through which a 0.2 ampere current was passed for 10 minute to deposit silver on the pin. The pin was used by a surgeon in lachrymal duct operation. The density of silver and electrochemical equivalent are $1.05 \times 10^4 kgm^{-1}$ and $1.118 \times 10^{-6} kg / \text{coulomb}$ respectively. What is the thickness of silver deposited on the pin? Assume that the tip of the pin contains negligible mass of silver.

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48. The specific conductivity of a saturated solution of silver chloride is $2.30 \times 10^{-6} mhocm^{-1}$ at $25^{\circ} C$. Calculate the solubility of silver chloride at $25^{\circ} C$ if $\lambda_{Ag^{+}} = 61.9 mhocm^2 mol^{-1}$ and $\lambda_{Cl^{-}} = 76.3 mhocm^2 mol^{-1}$

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49. The resistance of a solution A is $50 ohm$ and that of solution B is $100 ohm$, both solutions are taken in the same conductivity cell. If equal volumes of solution A and B are mixed, what is the resistance of the mixture using the same cell ? (Assume there is no change or increase in the $\propto$ of A and B on mixing).

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50. A big irrengular shaped vessel contained waer the sp conductance of which was $2.56 \times 10^{-5} mhocm^{-1} 500g$ of $NaCI$ was then added to the water and the specific conductance after the addition of $NaCI$ was found to be $3.10 \times 10^{-5} mhocm^{-1}$. find the capacity of the vessel if it is fulfilled with water $(\lambda_{\infty} NaCI = 149.9)$

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51. A 0.05 N solution of a salt occupying a volume between two platinum electrodes separated by a distance of 1.72 cm and having an area of $4.5 cm^2$ has a resistance of 250 ohm. Calculate the equivalent conductance of the solution.

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52. At $18^{\circ} C$ the mobilities of NH_4^+ and CIO_4^- ions are 6.6×10^{-4} and $5.7 \times 10^{-4} cm^2 \text{volt}^{-1} \sec^{-1}$ at infinite dilution. Calculate equivalent conductance of ammonium chlorate solution.

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53. 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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54. Zinc granules are added in excess to $500mL$ OF $1.0m$ nickel nitrate solution at $25^{\circ}C$ until the equilibrium is reached. If the standard reduction potential of $Zn^{2+} \mid Zn$ and $Ni^{2+} \mid Ni$ are $-0.75V$ and $-0.24V$, respectively, find out the concentration of Ni^{2+} in solution at equilibrium.

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55. The standard reduction potentials of Cu^{2+}/Cu and Ag^{+}/Ag electrodes are 0.337 volt and 0.799 volt respectively. Construct a galvanic cell using these electrodes so that its standard e.m.f. is positive. For what concentration of Ag^{+}, will the e.m.f. of the cell at $25^{\circ}C$ be zero if the concentration of Cu^{2+} is 0.01 M.

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56. The standard reduction potential for the half cell :

$NO_{3}^{c-}(aq) + 2H^{c-} + e^{-} \rightarrow NO_{2}(g) + H_{2}O$ is $0.78V$.

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

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

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57. 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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58. Calculate the solubility product constant of AgI from the following values of standard electrode potentials.

$E^{\circ}_{Ag^{+}/Ag} = 0.80$ volt and $E^{\circ}_{I/AgI/Ag} = -0.15$ volt at $25^{\circ}C$

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59. The standard reduction potential of the $Ag^{\oplus}|Ag$ electrode at $298K$ is $0.799V$. Given that for AgI, $K_{sp} = 8.7 \times 10^{-17}$, evaluate the potential of the $Ag^{\oplus}|Ag$ electrode in a saturated solution of AgI. Also calculate the standard reduction potential of the I^{c-}|AgI|Ag` electrode.

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60. Calculate the pH of the following half-cells solutions :

(a) $PtH_2(1 \text{ atm}) \mid H^{+}(HCl), \quad E = 0.25 \text{ volt}$

(b) $PtH_2(1 \text{ atm}) \mid H^{+}(H_2SO_4), \quad E = 0.3 \text{ volt}$

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61. The emf of the cells obtained by combining zinc and copper electrodes of the Daniell cell with calomel electrodes are 1.083 volt and -0.018 volt respectively at $25^{\circ}C$. If the reduction potential of normal calomel electrode is + 0.28 volt, find the emf of the Daniell cell.

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62. The Edison storage cell is represented as,

$Fe_{(s)}|FeO_S||KOH_{(aq.)}||Ni_2O_{3(S)}|No_{(S)}$

the half-cell reactions are :

$Ni_2O_{3(S)}+H_2O_{(l)}+2e^- \rightarrow 2NiO_{(S)}+2OH^-, E^{\circ}=+0.40V$

$FeO_{(S)}+H_2O_{(I)}+2e^- \rightarrow Fe_{(S)}+2OH^-, E^{\circ}=-0.87V$

(i) What is the cell reaction ?

(ii) What is the cell e.m.f. ? How does ir depend on the concentration of KOH ?

(iii) What is the maximum amount of electrical energy that can be obtained from one mole of Ni_2O_3 ?

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63. The normal oxidation potential of zinc referred to the standard hydrogen electrode is 0.76 volt and that of copper is -0.34 volt at $25^\circ C$. When excess of zinc is added to a solution of copper sulphate the zinc displace copper till equilibrium is reached. What is the ratio of concentration of Zn^{2+} to Cu^{2+} ions at equilibrium ?

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64. An excess of liquid mercury is added to an acidicfied solution of $1.0 \times 10^{-3} MFe^{3+}$. It is found that 5% of Fe^{3+} remains at equilibrium at $25^\circ C$. Calculate $E^{c-}._{(Hg_2^{2+}|Hg)}$ assuming that the only reaction that occurs is

$2Hg + 2Fe^{3+} \rightarrow Hg_2^{2+} + 2Fe^{2+}$

Given : $E^{c-}._{(Fe^{3+}|Fe^{2+})} = 0.77V$

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

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

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66. What is the standard potential of the Tl^{3+} / Tl electrode ?

$$Tl^{3+} + 2e^- \rightarrow Tl^+, \quad E^\circ = 1.26 \text{ volt}$$

$$Tl^+ + e^- \rightarrow Tl, \quad E^\circ = -0.336 \text{ volt}$$

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67. Calculate the minimum mass of NaOH required to be added in RHS to consume all the H^+ present in RHS of the cell of emf + 0.701 volt at $25^\circ C$ before its use. Also report the emf of the cell after addition of

NaOH.

$$Zn\left|\underset{0.1\text{ M}}{Zn^{2+}}\right|\left|\underset{1\text{ litre}}{HCl}\right|\underset{1\text{ atm}}{Pt(H_2g)}, E^{\circ}_{Zn/Zn^{2+}}=0.760V$$

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68. For the galvanic cell :

$Ag \mid AgCl(s)), KCl(0.2M) \mid |KBr(0.001M), AgBr(s)|Ag,$ calculate the EMF generated and assign correct polarity to each electrode for a spontaneous process after taking into account the cell reaction at $25^{\circ}C$.

$\left[K_{sp}(AgCl)=2.8\times10^{-10}, K_{sp}(AgBr)=3.3\times10^{-13}\right]$

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69. 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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70. Copper sulphate solution $(250ML)$ was electrolyzed using a platinum anode and a copper cathode. A constant current of $2mA$ was passed for $16min$. It was found that after electrolysis the absorbance of the solution was reducted to 50% of its original value . Calculate the concentration of copper sulphate in the solution to begin with.

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71. A silver electrode is immersed in saturated $AgSO_{4(aq.)}$. The potential difference between the silver and the standard hydrogen electrode is found to be $0.711V$. Determine $K_{SP}(Ag_2SO_4)$. Given $E^{\circ}_{Ag^+/Ag} = 0.799V$.

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72. Calculate the equilibrium constant for the reaction : $Fe^{2+} + Ce^{4+} \Leftrightarrow Fe^{3+} + Ce^{3+}$ Given, $E^{\circ}_{Ca^{4+}/Ce^{3+}} = 1.44V$ and $E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.68V$

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73. 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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74. The standard potential of the following cell is $0.23V$ at $15^{\circ}C$ and $0.21V$ at $35^{\circ}C$:

$Pt \mid H_{2(g)} \mid HCl(aq) \mid AgCl(s) \mid Ag(s)$

$a.$ Write the cell reaction.

$b.$ Calculate ΔH^{c-} and ΔS^{c-} for the cell reaction by assuming that these quantities remain unchanged in the range $15^\circ C$ to $35^\circ C$

$c.$ Calculate the solubility of $AgCl$ in water at $25^\circ C$.

Given : The standard reduction potential of $Ag^{\oplus}(aq) \mid Ag(s)$ is $0.80V$ at $25^\circ C$.

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75. 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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76. Find the equilibrium constant that the reaction

$In^{2+} + Cu^{2+} \rightleftharpoons In^{3+} + Cu^{+}$ at 298 K

Given

$E_{Cu^{2+}/Cu^{+}} = 0.15V, E^{\circ}_{In^{2+}/In^{+}} = -0.40V$

$E^{\circ}_{In^{3+}/In^{+}} = +0.42V$

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77. The overall reaction electrochemical cell at 298K.

$Ag(s)|AgI(s)|I^{-}(aq)||Cl^{-}(aq)|Hg_2Cl_2|Hg(l) \mid Pt(s)$

[Given: $E^{\circ}_{Cl^{-}|Hg_2Cl_2|Hg} = 0.26V. E^{\circ}_{Ag^{+}|Ag} = 0.8V.$

$K_{sp}(Agl) = 10^{-16}$ and $\dfrac{2.303RT}{F} = 0.06$]

At equilibrium ratio of $\dfrac{[Cl^{-}]}{[I^{-}]}$ in the above cell will be:

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78. Consider an electrochemical cell :

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

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

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ILLUSTRATIONS

1. The amount of energy expended during the passage of 1 ampere current for 100 sec under a potential of $115V$:

A. 20 kJ

B. 11.5 kJ

C. 115 kJ

D. 0.115 kJ

Answer: B

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2. $1L$ of $1MCuSO_4$ solution is electrolyzed using Pt cathode and Cu anode. After passing $2F$ of electricity, the $\left[Cu^{2+}\right]$ will be

A. $M/2$

B. $M/4$

C. M

D. zero

Answer: D

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3. The time required to coat a metal surface of $80cm^2$ with $5 \times 10^{-3}cm$ thick layer of silver (density $1.05gcm^{-3}$) with the passage of $3A$ current through a silver nitrate solution is:

A. 115 sec

B. 125 sec

C. 135 sec

D. 145 sec

Answer: B

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4. $4.5g$ of aluminium (at mass $27u$) is deposited at cathode from Al^{3+} solution by a certain quantity of electric charge. The volume of hydrogen gas produced at STP from H^+ ions in solution by the same quantity of electric charge will be:

A. 44.8 L

B. 22.4 L

C. 11.2 L

D. 5.6 L

Answer: D

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5. Cost of electricity for the production of X litre H_2 at STP at cathode is Rs. X, then cost of electricity for the production of X litre O_2 gas at STP at anode will be :(assume 1 "mole" of electrons as one unit of electricity)

A. 2x

B. 4x

C. 16x

D. 32x

Answer: A

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6. What current is to be passed for 0.25 sec for deposition of 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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7. If the aqueous solutions of the following salts are electrolysed for 1 hour with 10 ampere current, which solution will deposit the maximum mass of the metal at cathode ? The atomic weights are : $Fe = 56, Zn = 65, Ag = 108, Hf = 178$ and $W = 184$.

A. $ZnSO_4$

B. $FeCl_3$

C. $HfCl_4$

D. $AgNO_3$

Answer: D

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8. When a quantity of electricity is passed through $CuSO_4$ solution, 0.16 g of copper gets deposited. If the same quantity of electricity is passed through acidulated water, then the volume of H_2 liberated at STP will be : (given atomic weight of Cu=64)

A. $4cm^3$

B. $56cm^3$

C. $604cm^3$

D. $8cm^3$

Answer: B

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9. Number of faraday's required to generate one gram atom of magnesiu

from molten $MgCl_2$ is :

A. 1

B. 2

C. 3

D. 4

Answer: B

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10. A direct current deposits deposits 54 g of silver (Atomic mass = 108) during electrolysis. How much aluminimum (Atomic mass =27) would be deposited from aluminium chloride solution by the same amount of electricity ?

A. 4.5 g

B. 5.4 g

C. 54 g

D. 2.7 g

Answer: A

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11. The charge required for the reduction of $1 mol\ Cr_2O_7^{2-}$ ions to Cr^{3+} is

A. 1 F

B. 2 F

C. 6 F

D. 4 F

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12. The equivalent conductance of $1M$ benzoic acid is $12.8 ohm^{-1} cm^2$. If the conductance of benzoate ion and H^+ ion are 12 and $288.42 ohm^{-1} cm^2$ respectively. Its degree of dissociation is :

A. 0.39

B. $3.9\ \%$

C. $0.35\ \%$

D. $0.039\ \%$

Answer: B

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13. Equivalent conductances of $NaCl$, HCl and CH_3COONa at infinite dilution are 126.45, 426.16 and 91 $ohm^{-1} cm^2 eq^{-1}$ respectively. The equivalent conductance of CH_3COOH at infinite dilution would be :

A. $101.38 ohm^{-1} cm^2 eq^{-1}$

B. $253.62 ohm^{-1} cm^2 eq^{-1}$

C. $390.71 ohm^{-1} cm^2 eq^{-1}$

D. $678.90 ohm^{-1} cm^2 eq^{-1}$

Answer: C

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14. The specific conductance of saturated solution of AgCl is found to be $1.86 \times 10^{-6} ohm^{-1} cm^{-1}$ and that of water is $6 \times 10^{-8} ohm^{-1} cm^{-1}$. The solubility of agCl is .... .

Given, $\Lambda^{\circ}_{AgCl} = 137.2 ohm^{-1} cm^2 eq^{-1}$

A. $1.7 \times 10^{-3} M$

B. $1.3 \times 10^{-5} M$

C. $1.3 \times 10^{-4} M$

D. $1.3 \times 10^{-6} M$

Answer: B

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15. The specific conductivity of N/10 KCl solution at $20^{\circ}C$ is $0.0212 ohm^{-1} cm^{-1}$ and the resistance of the cell containing this solution at $20^{\circ}C$ is 55 ohm. The cell constant is :

A. $4.616 cm^{-1}$

B. $1.166 cm^{-1}$

C. $2.173 cm^{-1}$

D. $3.324 cm^{-1}$

Answer: B

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

A. $4.6 ohm^{-1} cm^2 eq^{-1}$

B. $9.2 ohm^{-1} cm^2 eq^{-1}$

C. $18.4 ohm^{-1} cm^2 eq^{-1}$

D. $0.023 ohm^{-1} cm^2 eq^{-1}$

Answer: A

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17. Resistance of a conductvity cell filled with a solution of an electrolyte of concentration 0.1 M is 100 Ω. The conductivity of this solution is 1.29 Sm^{-1}. Resistance of the same cell when filled with 0.02M of the same solution is 520Ω. the molar conductivity of 0.02M solution of the electrolyte will be:

A. $124 \times 10^{-4} Sm^2 mol^{-1}$

B. $1240 \times 10^{-4} Sm^2 mol^{-1}$

C. $1.24 \times 10^{-4} Sm^2 mol^{-1}$

D. $12.4 \times 10^{-4} Sm^2 mol^{-1}$

Answer: A

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18. If the molar conductance values of Ca^{2+} and Cl^- at infinite dilution are respectively $118.88 \times 10^{-4} m^2$ mho mol^{-1} and $77.33 \times 10^{-4} m^2$ mho mol^{-1} then that of $CaCl_2$ is :

(in m^2 mho mol^{-1})

A. 118.88×10^{-4}

B. 154.66×10^{-4}

C. 273.54×10^{-4}

D. 196.21×10^{-4}

Answer: C

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19. The molar conductivities of KCl, NaCl and KNO_3 are 152,128 and $111 \ \mathrm{S\,cm}^2 mol^{-1}$ respectively. What is the molar conductivity of $NaNO_3$?

A. 101 S $cm^2 mol^{-1}$

B. $87 Scm^2 mol^{-1}$

C. $-101 Scm^2 mol^{-1}$

D. $-391 Sc^2 mol^{-1}$

Answer: B

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20. At a particular temperature, the ratio of molar conductance to specific conductance of 0.01 M NaCl is :

A. $10^5 cm^3 mol^{-1}$

B. $10^3 cm^3 mol^{-1}$

C. $10 cm^3 mol^{-1}$

D. $10^5 cm^2 mol^{-1}$

Answer: C

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21. The oxidation potential of a hydrogen electrode at $pH = 10$ and $P_{H_2} = 1$ is

A. 0.51 V

B. 0.00 V

C. $+0.59V$

D. 0.059 V

Answer: C

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22. The value of equilibrium constant for a feasible cell reaction is :

A. < 1

B. $= 1$

C. > 1

D. zero

Answer: C

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23. E° for the electrochemical cell

$Zn(s)\left|Zn^{2+}1M(Aq.)\right|\left|Cu^{2+}1M(aq.)\right|Cu(s)$

is 1.10 V at $25^{\circ}C$. The equilibrium constant for the cell reaction,

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

Will be :

A. 10^{-37}

B. 10^{37}

C. 10^{-39}

D. 10^{39}

Answer: B

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24. The value of the reaction quotient, Q for the following cell is

$Zn(s)\left|Zn^{2+}(0.01M)\right|\left|Ag^{+}(1.25M)\right|Ag(s)$

A. 156

B. 125

C. 1.25×10^{-2}

D. 6.4×10^{-3}

Answer: D

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25. Calculate the emf of the following concentration cell at $25^{\circ} C$:

$Ag(s)|AgNO_3(0.01M)||AgNO_3(0.05M)|Ag(s)$

A. $-0.414V$

B. $0.828V$

C. $0.414V$

D. $0.0414V$

Answer: D

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26. The equivalent constant of the reaction:

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

$E^{\circ} = 0.46V$ at $298K$,is:

A. 2.0×10^{10}

B. 4.0×10^{10}

C. 4.0×10^{15}

D. 2.4×10^{10}

Answer: C

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27. Consider the cell reaction :

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

If $E^{c-}{\cdot}_{Mg^{2+}|Mg(s)}$ and $E^{c-}{\cdot}_{Cu^{2+}|Cu(s)}$ are -2.37 and $0.34V$, respectively. $E^{c-}{\cdot}_{cell}$ is

A. 2.03 V

B. $-2.03V$

C. $+2.71V$

D. $-2.71V$

Answer: C

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

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

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

A. $+1.006V$

B. $-1.006V$

C. $+0.77V$

D. $-0.77V$

Answer: C

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PRACTICE PROBLEMS

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

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

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

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

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2. How many faradays are needed to reduce 2 gram-mole of Cu^{2+} to Cu metal ?

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3. How many faradays are released when 12.7 g of copper metal is changed into copper ions ?

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

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

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5. Calculate the number of coulombs required to deposit 50 g of silver at cathode from silver nitrate solution.

(Atomic mass of silver = 108)

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6. How much electric charge is required to produce 20.0 g of calcium from molten $CaCl_2$?

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7. If 3 faradays of electricity are passed through an iron (II) bromide solution, how many grams of iron metal will be deposited ? (At. Mass of iron = 56)

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8. A certain quantity of electricity deposits 0.54 g of Ag from silver nitrate solution. What volume of hydrogen will be liberated by the same quantity of electricity at $27^{\circ} C$ and 750 mm of Hg pressure ?

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9. In the electrilysis of an aqueous cupric bromide solution, how many grams of bromine are formed on passing a current of 1 ampere for 16 minutes and 5 seconds ? Write the anode and the cathode half reactions.

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10. A current of 1.5 amperes is passed through a solution of a salt of a bivalent metal for 30 minutes. Increase in mass of cathode is 0.8898 g. Find the atomic mass of the metal.

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11. The chemical reaction given below :

$$Cl_2(g) + SO_2(g) + 2H_2O(l) \rightarrow 2Cl^-(aq.) + 3H^+(aq.) + HSO_4^-(aq.)$$

proceeds readily in aqueous acid solution.

(i) Give the half-cell reactions.

(ii) If a fully charged cell initially held 1 mole of Cl_2 for how many days could it sustain a current of 0.05 ampere, assuming the cell becomes non0operative when 90% of initial Cl_2 has been used up ?

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12. A current of 80 microampere is passed through a solution of $AgNO_3$ for 32 minutes using platinum electrodes. A uniform single atom thick layer is deposited covering 86% of the cathode surface. If total surface area of cathode is $601.7cm^2$, calculate the are covered by one Ag atom.

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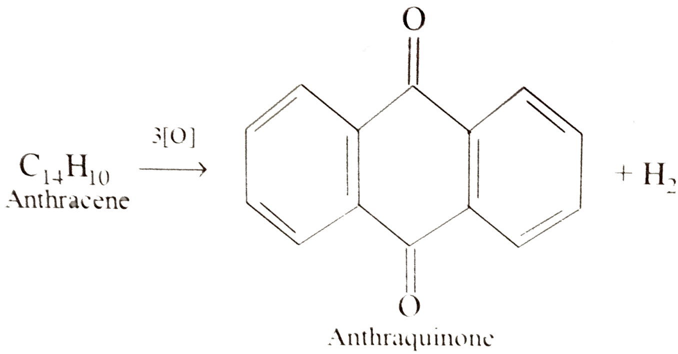
13. Anthracene can be electrokytically oxidised to anthraquinone



What mass of anthraquinone can be produced by the passage of 1 ampere current foe an hour at 100 % afficiency ?

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14. How many coulombs of electricity would be required to reduce the iron in 36.0 g of potassium hexacyano ferrate (III), $K_3Fe(CN)_6$, to metallic iron ?

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15. What current strength in ampere will be required to liberate 5 g of iodine from potassium iodide solution in 30 minutes ?

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16. The mass of copper deposited from a solution of copper sulphate by a uniform current of 0.25 ampere flowing for one hour is 0.295 g. Find the equivalent mass of copper. (1 faraday = 96500 coulomb)

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17. The solution of a salt of a metal of atomic mass 112 was electrolysed for 15 minutes with a current of 1.5 ampere. The mass of the metal deposited was 0.788 g. Find the valency of the metal.

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18. If a monovalent metal ion carries 1.6×10^{-19} coulomb of electricity, what is the amount of electricity carried by one gram molecular mass of the metal ions ?

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19. Calculate aprooximately how much current is necessary to produce oxygen gas at rate of 1 mL per second ?

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20. 0.5 faraday of electricity was required to deposit all the copper in 500 mL of a copper sulphate solution. What is the normality of the copper sulphate solution ?

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21. Calculate the mass and volume at NTP of hydrogen and chlorine that will be formed by passing 10,000 coulomb of charge through an aqueous solution of potassium chloride. The cell reaction is :

$2KCl + 2HOH \rightarrow 2KOH + Cl_2 + H_2$

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22. An electric current passing for 6 minutes through a dilute H_2SO_4 solution gave 40 mL of the electrolytic gas $(H_2 + O_2)$meausred at NTP. What was the average value of current ?

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23. The same quantity of electricity that liberated 2.158 g silver was passed through a solution of a gold salt and 1.314 g of gold was deposited. The equivalent mass of silver is 107.9. Calculate the equivalent mass of gold. What is the oxidation state of gold salt ? (At. mass of gold =197)

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24. Calculate the volume of Cl_2 at NTP produced during electrolysis of $MgCl_2$ which produces 6.50 g Mg.

(At. Mass of Mg = 24.3)

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25. How long does it take to deposit 100 g of Al from an electrolytic cell containing Al_2O_3 using a current of 125 ampere ?

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26. 10g farily concentrated solution of $CuSO_4$ is electrolysed using 1.01 faraday of electricity. Calculate the mass of the resulting solution.

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27. The density of copper is $8.94 gmL^{-1}$. Find out the number of coulombs needed to plate an area $10 \times 10 cm^2$ to a thickness of 10^{-2} cm using $CuSO_4$ solution as electrolyte. (At mass of Cu = 63.6)

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28. What mass of Ag (At. Mass 108) could be plated on a spoon from electrolysis of $AgNO_3$ solution by one ampere current for 10 minutes ?

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29. If a current of 0.3 ampere is drawn from a Daniell cell for 1 hour, what would be the change in mass of electrodes ? (At. Mass of Cu-63.5 and Zn =65.37)

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30. How many coulombs must be applied to a cell for the electrolytic production of 245 g $NaClO_4$ from $NaClO_3$. The anode efficiency for the desired reaction is 60%.

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31. Calculate the mass of Hg_2Cl_2 which can be propared by the reduction of mercury (II) ions in the presence of chloride ions by the passage of 5.0 ampere current for 3.0 hours.

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32. How long will it take for a uniform current of 6.0 ampere to deposite 78.0 g gold from asolution of $AuCl_4^-$? What mass of chlorine gas will be formed simultaneously at the anode in the electrolytic cell ?

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33. How long will it taje 5 ampere of current to deposit 2 g of copper from a solution of copper sulphate ?

(Given : CE of copper =32, F=96500 coulomb)

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34. The amount of lactic acid, $HC_3H_5O_3$, produced in a sample of muscle tissue was analysed by reaction with hydroxide ion. Hydroxide ion was produced in the sample mixture by electrolysis. The cathode reaction was,

$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq.)$

Hydroxide ion reacts with lactic acid as soon as it is produced. The end point of the reaction is detected with an acid-base indicator. It required 115 seconds for a current of 15.6 mA to reach end point. How many grams of lactic acid (a monoprotic acid) were present in the sample ?

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35. In what direction, can the reaction :

$$2NaCl + Fe_2(SO_4)_3 \Leftrightarrow 2FeSO_4 + Cl_2 + Na_2SO_4$$

proceed spontaneously ?

$$\left(\text{Given: } \ E^{\circ}_{Fe^{3+} \, / \, Fe^{2+}} = 0.77V, E^{\circ}_{Cl^{-} \, / \, Cl^{2}} = 1.36V\right)$$

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36. How many faradays of electricity will be required to completely electrolyse one mole of molten Al_2O_3 to produce Al metal and O_2 gas ?

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37. The resistance of 0.01 N solution at $25^{\circ}C$ is 200 ohm. Cell constant of the conductivity cell is unity. Calculate the equivalent conductance of the solution.

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38. A conductivity cell was filled with 0.01 M solution of KCl which was known to have a specific conductivity of 0.1413 $ohm^{-1}m^{-1}$ at 298 K. Its measured resistance at 298 K was 94.3 ohm. When the cell was filled with 0.02 M $AgNO_3$ solution, its resistance was 50.3 ohm. Calculate (i) cell constant and (ii) the specific conductance of $AgNO_3$ solution.

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39. A conductance cell was calibrated by filling it with a 0.02 M solution of potassium chloride (specific conductance $= 0.2768 ohm^{-1}m^{-1}$) and measuring the resistance at 298 K which was found to be 457.3 ohm. The cell was then filled with a calcium chloride solution containing 0.555 g of $CaCl_2$ per litre. The measured resistance was 1050 ohm. Calculate the molar conductivity of $CaCl_2$ solution.

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40. The molar conductivities at infinite dilution of KCl, KNO_3 and $AgNO_3$ at 298 K are 0.01499 mho $m^2 mol^{-1}$, 0.01250 mho $m^2 mol^{-1}$ and 0.01334 mho $m^2 mol^{-1}$ respectively. What is the molar conductivity of AgCl at infinite dilution at this temperature ?

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41. The electrodes in a conductivity cell have area $1.2 \times 10^{-4} m^2$ and they are fixed 3×10^{-3} m apart. A solution containing 200 g equivalent of the electrolyte per m^3 of the solution has a resistance of 60 ohm at 298 K. Calculate the equivalnt conductivity of the solution .

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42. The molar conductivities of NH_4^+ ion and Cl^- ion are 73.5 mho $cm^2 mol^{-1}$ and 76.2 mho $cm^2 mol^{-1}$ respectively. The specific conductivity of 0.1 M NH_4Cl is 1.288×10^{-2} mho cm^{-1}. What is the dissociation constant of NH_4Cl ?

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43. The specific conductivity of a saturated solution of silver chloride at $18^{\circ} C$ is 1.24×10^{-6} mho after subtracing that of water. Ionic conductances at infinite dilute of Ag^{+} and Cl^{-} ions at this temperature are 53.8 and 65.3 respectively. Calculate the solubility of silver chloride in gram per litre.

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44. Given

$\lambda^{\infty}\left[1/2Mg^{2+}\right] = 53.06 ohm^{-1} cm^2 mol^{-1}$

$\lambda^{\infty}\left[1/2SO_4^{2-}\right] = 80 ohm^{-1} cm^2 mol^{-1}$

$\lambda^{\infty}\left[1/3Al^{3+}\right] = 63 ohm^{-1} cm^2 mol^{-1}$

Calculate the values of $\Lambda_m^{\infty}\left[Al_2(SO_4)_3\right]$ and $\Lambda^{\infty}[MgSO_4]$

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45. Hydrofluoric acid is a weak acid. At $25^{\circ} C$, the molar conductivity of 0.002 M HF is $176.2 ohm^{-1} cm^2 mol^{-1}$. If its $\Lambda_m^{\infty} = 405.2 ohm^{-1} cm^2 mol^{-1}$, calculate its degree of dissociation and equilibrium constant at the given concentration.

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46. For mercury at $0^{\circ} C$ specific conductance.

$k = 1.062963 \times 10^6 S/m$

(a) If the resistance of a cell containing mercury is 0.243166 ohm, what is the cell constant of the cell ?

(b) If the same cell is filled with KCl solution at $0^{\circ} C$, the resistance of the cell is 3.966×10^4 ohm. What is the conductivity of KCl solution ?

(c) If the average cross-sectional area of the cell is $0.9643 mm^2$, what is the effective distance between the electrodes ?

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47. The mobility of the NH_4^+ ions is $7.623 \times 10^{-8} m^2 / Vs$. Caculate :

(a) the molar conductivity of NH_4^+ ions:

(b) velocity of the ions if 15 volt are applied across the electrodes 25 cm apart

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48. Predict whether the following reaction will occur spontaneously or not:

$Co^{2+} + Sn \rightarrow Co + Sn^{2+}$

$E^\circ_{Co / Co^2} = 0.277$ volt and $E^\circ_{Sn / Sn^{2+}} = 0.136$ volt

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

(i) Iron reduces Zn^{2+} ions (ii) Iron reduces Ni^{2+} ions. Given :

$E^{\circ}_{Zn^{2+}/Zn} = -0.76$ volt, $E^{\circ}_{Fe^{2+}/Fe} = -0.44$ volt and $E^{\circ}_{Ni^{2+}/Ni} = -0.25$ volt

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50. Answer, whether under standard conditions, the following reactions are possible or not:

(i) Will copper reduce Ag^{+} to Ag? Given $E^{\circ}_{Ag^{+}/Ag} = 0.799$ volt, $E^{\circ}_{Cu^{2+}/Cu} = -0.337$ volt

(ii) Will Fe^{3+} be reduced to Fe^{2+} by Sn^{2+} ions? given

$$Fe^{3+} \mid Fe^{2+} = 0.771 \text{ volt}$$
$$Sn^{2+} \mid Sn^{4+} = -0.250 \text{ volt}$$

(iii) would you use a silver spon to stir a solution of $Cu(NO_3)_2$?

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51. The electrode potentials of two half reactions are as follows :

$$Fe^{3+} + e^{-} \rightarrow Fe^{2+} \qquad E^{\circ} = +0.76 \text{ volt}$$
$$Ce^{4+} + e^{-} \rightarrow Ce^{3+} \qquad E^{\circ} = +1.60 \text{ volt}$$

Giving reason, describe if Ce^{3+} can be oxidised by Fe^{3+}.

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52. Calculate the half-cell potential at 298 K for the reaction,

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

If $\left[Zn^{2+}\right] = 0.1M$ and $E^{\circ} = -0.76$ volt.

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53. A galvanic cell consists of a metallic zinc plate immersed in 0.1 M $Zn(NO_3)_2$ solution. Calculate the emf of the cell at $25^{\circ}C$. Write the chemical equations for the electrode reactions and represent the cell. (Given : $E^{\circ}_{Zn^{2+}/Zn} = -0.76$ volt and $E^{\circ}_{Pb^{2+}/Pb} = -0.13$ volt)

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54. Calculate the E and E° of the cell

$Ni|Ni^{2+}||Cu^{2+}|Cu$

from the following half-cell reactions:

$Ni^{2+} + 2e^- \rightarrow Ni \quad E^\circ = -0.25$ volt

$Cu^{2+} + 2e^- \rightarrow Cu \quad E^\circ = +0.34$ volt

(Given: $[Ni^{2+}] = 1M$ and $[Cu^{2+}] = 10^{-3}M$)

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55. Use E° values to calculate ΔG° for the reaction

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

$E^\circ_{Ag/Ag} = 0.80$ volt and $E^\circ_{Pt/Fe^{3+}} = 0.77$ volt

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56. A piece of zinc metal is dipped in a 0.1 M solution of zinc salt. The salt is dissociated to the extent of 20%. Calcualte the electrode potential of Zn^{2+}/Zn

(Given $E^\circ_{Zn^{2+}/Zn} = -0.77$ volt

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57. Calculate equilibrium constant for the following reaction :

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

$E^\circ_{Zn/Zn^{2+}} = 0.765 \text{ volt}, \quad E^\circ_{Cu^{2+}/Cu} = 0.347$ volt

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58. For the cell reaction,

$$Ni|Ni^{2+}||Ag^+|Ag$$

Calculate the equilibrium constant at $25^\circ C$. How much maximum work would be obtained by the operation of this cell ?

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59. Calculate the emf of the cell

$$Cr|Cr^{3+}(0.1M)||Fe^{2+}(0.01M)|Fe$$

$$\left(\text{Given: } E^\circ_{Cr^{3+}/Cr} = -0.75 \text{ volt}, \quad E^\circ_{Fe^{2+}/Fe} = -0.45 \text{ volt}\right)$$

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60. Calculat the equilibrium constant for the reaction,

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

when $E^{\circ}_{cell} = 1.11$ at 298 K.

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61. The standard reduction potential of $Ag^{+}|Ag$ electrode is 0.80 volt. Calculate the standard electrode potential of $Cl^{-}|AgCl|Ag$ at $25^{\circ}C$. Given solubility product, $K_{sp}(AgCl) = 1.8 \times 10^{-10}$.

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62. Derive Nernst equation for the cell.

$Ni(s)|Ni^{2+}(aq.\ 0.1M)||Ag^{+}(aq.\ 0.1M)|Ag(s)$ and also find its cell potential. Given :

$E^{\circ}_{Ag^{+}/Ag} = 0.80$ volt and $E^{\circ}_{Ni^{2+}/Ni} = -0.25$ volt

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63. Determine the equilibrium constant of the following reaction at 298 K

:

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

$\left(\text{Given: } E^{\circ}_{Sn^{4+}/Sn^{2+}} = 0.15 \text{ volt}, \; E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.771 \text{ volt}\right)$

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64. An excess of Hg was added to $10^{-3}M$ acidified solution of Fe^{3+} ions. It was found that only 4.6% of the ions remained as Fe^{3+} at equilibrium at $25^{\circ}C$. Calculate E° for $2Hg/Hg_2^{2+}$ at $25^{\circ}C$ for

$2Hg + 2Fe^{3+} \Leftrightarrow Hg_2^{2+} + 2Fe^{2+}$

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65. The emf of the cell,

$Ag|AgI(0.05)MKI||(0.05)MAgNO_3|Ag$

is 0.788 volt. Calculate the solubility product of AgI.

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66. At equimolar concentrations of Fe^{2+} and Fe^{3+}, what must $[Ag^{+}]$ be so that voltage of the galvanic cell made from Ag^{+}/Ag and Fe^{3+}/Fe^{2+} electrodes equals zero ? The reaction is $Fe^{2+}+Ag^{+} \Leftrightarrow Fe^{3+}+Ag$. Determine the equilibrium constant at $25^{\circ}C$ for the reaction.

$\left(\text{Given: } E^{\circ}_{Ag^{+}/Ag}=0.799 \text{ volt and } E^{\circ}_{Fe^{3+}/Fe^{2+}}=0.771 \text{ volt}\right)$

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67. Using Nernst equation for the cell reaction,

$Pb+Sn^{2+} \rightarrow Pb^{2+}+Sn$

Calculate the ratio $\dfrac{[Pb^{2+}]}{[Sn^{2+}]}$ for which $E_{cell}=0$

(Given : $E^{\circ}_{Pb/Pb^{2+}}=0.13$ volt and $E^{\circ}_{Sn^{2+}/Sn}=-0.14$ volt)

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68. Determine the potential of a Daniell cell, initially containing 1.00 L each of 1.0 M copper (II) ion, after passage of 10^5 coulomb charge. The E° of the daniell cell is 1.10 volt.

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69. Calculate the standard potential for the reaction,

$$Hg_2Cl_2 + Cl_2 \to 2Hg^{2+} + 4Cl^-$$

Given :

$$\begin{array}{ll} Hg_2Cl_2 + 2e^- \to 2Hg + 2Cl^- & E^\circ = 0.270 \text{ volt} \\ Hg_2^{2+} \to 2Hg^{2+} + 2e^- & E^\circ = -0.92 \text{ volt} \\ 2Hg \to Hg_2^{2+} + 2e^- & E^\circ = -0.79 \text{volt} \\ Cl_2 + 2e^- \to 2Cl^- & E^\circ = 1.36 \text{ volt} \end{array}$$

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70. Given :

$$\begin{array}{ll} Cu^{2+} + e^- \to Cu^+ & E^\circ = 0.15 \text{ volt} \\ Cu^+ + e^- \to Cu & E^\circ = 0.5 \text{ volt} \end{array}$$

Calculate potential for $Cu^{2+} + 2e^- \to Cu$.

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71. What is the standard electrode potential for the electrode MnO_4^- / MnO_2 in solution ?

$\left(\text{Given: } E^{\circ}_{MnO_4^- / Mn^{2+}} = 1.51 \text{ volt}, E^{\circ}_{MnO_2 / Mn^{2+}} = 1.23\text{volt}\right)$

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72. What ratio of Pb^{2+} to Sn^{2+} concentration is needed to reverse the following cell reaction ?

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

$E^{\circ}_{Sn^{2+} / Sn} = -0.136$ volt and $E^{\circ}_{Pb^{2+} / Pb} = -0.126$ volt

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73. For the cell $Mg|Mg^{2+}||Ag^{+}|Ag$, calculate the equilibrium constant at $25^{\circ}C$ and the maximum work that can be obtained during the

operation of the cell.

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

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74. Determine the potential for the cell :

$Pt|Fe^{2}, Fe^{3+}||Cr_2O_7^{2-}, Cr^{3+}, H^{+}|Pt$

in which $[Fe^{2+}]$ and $[Fe^{3+}]$ are 0.5 M and 0.75 M respectively and $[Cr_2O_7^{2-}]$, $[Cr^{3+}]$ and $[H^{+}]$ are 2M, 4 M and 1M respectively. Given :

$$Fe^{3+} + e^{-} \rightarrow Fe^{2+} \qquad E^{\circ} = 0.770\text{volt}$$
$$14H^{+} + 6e^{-} + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 7H_2O \qquad E^{\circ} = 1.35 \text{ volt}$$

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75. For the measurement of the solubility product of AgCl the following cell is constructed :

$Ag|AgCl||KCl(0.1M)||AgNO_3(0.1M)|Ag$

The emf of the cell is 0.45 volt. In the cell, KCl is dissociated to the extent of 83% and $AgNO_3$ is dissociated to the extent of 86%. Calculate the solubility product of AgCl at 298 K.

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76. Excess of AgCl is added to 0.1 M solution of KBr at 298 K. Calculate the equilibrium concentrations of Br^- and Cl^- ions.

$E^\circ_{Cl^- / AgCl / Ag} = 0.222 \text{ volt} \quad E^\circ_{Br^- / AgBr / Ag} = 0.095$ volt

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77. The emf of the cell $Cu \left| \underset{a=0.1}{CuSO_4} \right| \left| \underset{x}{CuSO_4} \right| Cu$ is -0.03 V at $25^\circ C$. Calculate the activity of copper sulphate solution in the right hand side electrode.

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78. The cell, $Pt|H_2 \quad (1 \text{ atm})||H^+(pH = x)|$

normal calomel electrode, has an emf of 0.67 volt as $25^\circ C$. Calculate the pH of the solution. The oxidation potential of calomel electrode on the hydrogen scale is -0.28 volt.

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79. The standard reduction potential for Cu^{2+}/Cu is +0.34 V. Calculate the reduction potential at $pH = 14$ for the above couple. K_{sp} of $Cu(OH)_2$ is 1.0×10^{-19}.

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80. The standard free enrgy change for the reaction,

$H_2(g) + 2AgCl(s) \rightarrow 2Ag(s) + 2H^+(aq.) + 2Cl^-(aq.)$

is $-10.26 \text{ kcal mol}^{-1}$ at $25^\circ C$. A cell using the above reaction is operated at $25^\circ C$ under $P_{H_2} = 1$ atm, $[H^+]$ and $[Cl^-] = 0.1$. Calculate the emf of the cell.

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81. For the reaction, $Fe^{3+}+3e^{-}\Leftrightarrow Fe, E^{\circ}$ is -0.036 volt and the standard electrode potential for $Fe^{3+}+e^{-}\Leftrightarrow Fe^{2+}$ is 0.771 volt. Calculate the E° for $Fe^{2+}+2e^{-}\Leftrightarrow Fe$.

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82. The standard reduction potential at $25^{\circ}C$ of the reaction $2H_2O+2e^{-}\rightarrow H_2+2OH^{-}$ is -0.8277 volt. Calculate the equuilibrium constant for the reaction,

$2H_2O\Leftrightarrow H_3O^{+}+OH^{-}$ at $25^{\circ}C$

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83. calculate the emf of the following cell:

$Pt(H_2\quad 1\text{ atm})|CH_3CH_2COOH(0.15M)||0.01MNH_4OH|H_2\quad(1\text{ atm})Pt$

K_a for $CH_3CH_2COOH = 1.4 \times 10^{-5}$

K_b for $NH_4OH = 1.8 \times 10^{-5}$

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84. Calculate equilibrium constant for

$I_2 + I^- \Leftrightarrow I_3^-$

at 298 K from the following information :

$$\begin{array}{ll} I_2(aq.) + 2e^- \rightarrow 2I^- & E^\circ = 0.6197 \text{ volt} \\ I_3^- + 2e^- \rightarrow 3I^- & E^\circ = 0.5355 \text{ volt} \end{array}$$

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85. A lead storage battery has initially 200 g of lead and 200 g of PbO_2, plus excess H_2SO_4. How long could this cell deliver a current of 10 amp, without recharging, if it was possible to operate it so that the reaction goes to completion ?

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86. $Zn(s) + 2AgCl(s) \Leftrightarrow ZnCl_2(0.555M) + 2Ag(s)$

$E_{0^\circ C} = 1.015 \text{ volt} \left(\frac{dE}{dT}\right)_P = -4.02 \times 10^{-4}$ volt per degree. Find $\Delta G, \Delta S$

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87. Calculate the equilibrium constant for the reaction,

$2Fe^{3+} + 3I^- \Leftrightarrow 2Fe^{2+} + I_3^-$

The standard reduction potentials in acidic conditions are 0.77 and 0.54 V respectively for Fe^{3+} / Fe^{2+} and I_3^- / I^- couples.

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88. Electrolysis of a solution of $MnSO_4$ in aqueous sulphuric acid is a method for the preparation of MnO_2 as the per reaction,

$Mn^{2+}(aq.) + 2H_2O \rightarrow MnP_2 + 2H^+(aq.) + H_2$

Passing a current of 27 A for 24 hours gives one kg of MnO_2. what is the value of current efficiency ? Write the reactions taking place at the cathode and at the anode.

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89. Calculate the number of kWh of electricity is necessary to produce 1 metric ton (1000 kg) of aluminium by Hall process in a cell operating at 15 V.

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90. What will be the value of a for a 0.001 M aqueous NH_3 solution ?

$[K_b = 1.6 \times 10^{-5} \text{ and } \Lambda_0 = 2.38 \times 10^{-2} ohm^{-1} m^2 mol^{-1}]$

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91. A weak monobasic acid is 5% dissociated in 0.01 mol dm^{-3} solution. The limiting molar conductivity at infinite dilution is

$4.00 \times 10^{-2} ohm^{-1} m^2 mol^{-1}$. Calculate the conductivity of a 0.05 mol dm^{-3} solution of the acid.

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92. 1.05 g of a lead ore containing impurity of Ag was dissolved in quantity of HNO_3 and the volume was made 350 mL . A Ag electrode was dipped in the solution and E_{cell} of

$Pt(H_2)|H^+(1M)| \mid Ag^+|Ag$

was 0.503 V at 298 K. calculate % of lead in the ore.

$E^{\circ}_{Ag^+ / Ag} = 0.80V$

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93. calculate E° of the following half -cell reaction at 298 K:

$Ag(NH_3)_2^+ + e^- \rightarrow Ag + 2NH_3$

$Ag^+ + e^- \rightarrow Ag \qquad E^{\circ}_{Ag^+ / Ag} = 0.80V$

$Ag(NH_3)_2^+ \Leftrightarrow Ag^+ + 2NH_3 \qquad K = 6 \times 10^{-8}$

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94. For the electrochemical cell,

$Mg(s)|Mg^{2+}(aq.\ 1M)||Cu^{2+}(aq.\ 1M)|Cu(s)$

the standard emf of the cell is 2.70 V at 300 K. When the concentration of Mg^{2+} is chaged to x M, the cell potential changes to 2.67 V at 300 K. The value of x is _______ .

(Given $\frac{F}{R} = 11500 kV^{-1}$. where F is the Faraday constant and R is the gas constant, ln (10) = 2.30)

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OBJECTIVE TYPE QUESTION (LEVEL -A)

1. An electrolyte is a substance which

A. conducts electricity

B. decomposes on heating

C. is acidic in nature

D. when dissolved in water, dissociates into ions

Answer: D

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2. The theory of ionisation was presented by:

A. Faraday

B. Arrhenius

C. Ostwald

D. Rutherford

Answer: B

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3. Dissociation of an electrolyte in water into negative and positive ions is called

A. ionisation

B. electrolysis

C. decomposition

D. hydrolysis

Answer: A

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4. Degree of ionisation is equal to:

A. total number of moles of the electrolyte present in solution

B. total number of moles of the electrolyte dissociated into ion

C. number of moles dissociated/total number of moles dissolved

D. total number of moles dissolved/number of moles dissociated

Answer: C

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5. Conductivity of aqueous solution of an electrolyte depends on

A. molecular mass of the electrolyte

B. boiling point of solvent

C. degree of ionisation

D. volume of the solvent

Answer: C

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6. Degree of ionisation does not depend on:

A. Temperature

B. Current

C. Nature of solvent

D. Concentration

Answer: D

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7. Substance which give good conducting aqueous solution are called :

A. weak electolytes

B. strong electrolytes

C. non-electrolytes

D. catalysts

Answer: B

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8. The number of ions given by one molecule of $K_4Fe(CN)_6$ after complete dissociation is:

A. 5

B. 11

C. 2

D. 10

Answer: A

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

A. 1 faraday

B. 2.33 faraday

C. 2 faraday

D. 1.33 faraday

Answer: C

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10. The process in which chemical change occurs on passing electricity is termed

A. ionisation

B. neutralisation

C. electrolysis

D. hydrolysis

Answer: C

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11. Which of the following conditions is correct for operation of electrolytic cell ?

A. $\Delta G = 0, E = 0$

B. $\Delta G < 0, E > 0$

C. $\Delta G > 0, E < 0$

D. $\Delta G > 0, E > 0$

Answer: C

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12. Which one is the correct equation that represents the first law of electrolysis ?

A. $mZ = ct$

B. $m = cZt$

C. $mc = Zt$

D. $c = mZt$

Answer: B

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

A. equivalent weight

B. molecular weight

C. electrochemical equivalent

D. one gram

Answer: C

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14. One faraday is equal to

A. 9650 coulomb

B. 10,000 coulomb

C. 19640 coulomb

D. 96500 coulomb

Answer: D

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

A. one gram equivalent

B. one gram mole

C. electrochemical equivalent

D. half gram equivalent

Answer: A

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16. On passing one faraday of electricity through a dilute solution of an acid, the volume of hydrogen obtained at NTP is:

A. 22400 mL

B. 1120 mL

C. 2240 mL

D. 11200 mL

Answer: D

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17. wg of copper is deposited in a copper voltameter when an electric current of 2 ampere is passed for 2 hours. If one ampere of electric

current is passed for 4 hours in the same voltameter, copper deposited will be:

A. w

B. $w/2$

C. $w/4$

D. $2w$

Answer: A

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18. Copper sulphate solution is electrolysed between two platinum electrodes. A current is passed unit 1.6 g of oxygen is liberated at anode. The amount of copper deposited at the cathode during the same period is:

A. $6.36g$

B. $63.6g$

C. $12.7g$

D. $3.2g$

Answer: A

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19. When electricity is passed through a solution of $AlCl_3$, 13.5 g of Al is discharged. The amount of charge passed is :

A. $1.5F$

B. $0.5F$

C. $1.0F$

D. $2.0F$

Answer: A

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20. When the same electric current is passed through the solution of different electrolytes in series, the amounts of elements deposited on the electrodes are in the ratio of their

A. atomic number

B. atomic masses

C. specific gravities

D. equivalent masses

Answer: D

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21. Faraday's laws of electrolysis are related to :

A. atomic number of the cation

B. atomic number of the anion

C. equivalent mass of the electrolyte

D. speed of the cation

Answer: C

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22. The specific conductance of a 0.01 M solution of KCl is 0.0014 $ohm^{-1}cm^{-1}$ at $25^{\circ}C$. Its equivalent conductance is:

A. 14

B. 140

C. 1.4

D. 0.14

Answer: B

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23. The equivalent conductivity of $0.1 N CH_3COOH$ at $25^{\circ} C$ is 80 and at infinite dilution 400 ohm^{-1}. The degree of dissociation of CH_3COOH is:

A. 1

B. 0.2

C. 0.1

D. 0.5

Answer: B

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24. The number of electron involved when one faraday of electricity is passed through an electrolytic solution is:

A. 96500

B. 8×10^6

C. 12×10^{16}

D. 6×10^{23}

Answer: D

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25. One faraday of charge was passed through the electrolytic cells placed in series containing solution of Ag^+, Ni^{2+} and Cr^{3+} respectively. The amount of Ag (At. mass 108), Ni (At. mass 50) and Cr(At. mass 52) deposited will be:

A. $\begin{matrix} Ag & Ni & Cr \\ 108g & 29.5g & 17.5g \end{matrix}$

B. $\begin{matrix} Ag & Ni & Cr \\ 108g & 59.0g & 52.0g \end{matrix}$

C. $\begin{matrix} Ag & Ni & Cr \\ 108g & 108.0g & 108.0g \end{matrix}$

D. $\begin{matrix} Ag & Ni & Cr \\ 108g & 117.5g & 166.0g \end{matrix}$

Answer: A

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26. One faraday of electricity will liberate one gram mole of the metal from the solution of

A. $BaCl_2$

B. $CuSO_4$

C. $AlCl_3$

D. $NaCl$

Answer: D

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27. A solution of sodium sulphate in qater is electrolysed using inert electrodes, The products at the cathode and anode are respectively.

A. H_2, O_2

B. O_2, H_2

C. O_2, Na

D. O_2, SO_2

Answer: A

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28. The electric conduction of a salt solution in water depends on the :

A. shape of molecules

B. size of its molecules

C. size of solvent molecules

D. extent of its ionisation

Answer: D

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29. In electroplating, the article to be electoplated serves as:

A. cathode

B. electrolyte

C. anode

D. conductor

Answer: A

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30. A certain current liberated 0.504 g of hydrogen in 2 hours. How many gram of copper can be liberated by the same current flowing for the same time in $CuSO_4$ solution ?

A. $12.7g$

B. $15.9g$

C. $31.8g$

D. $63.5g$

Answer: B

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31. If the specific resistance of a solution of concentration C g equivalent litre^{-1} is R, then its equivalent conductance is:

A. $\frac{100R}{C}$

B. $\frac{RC}{1000}$

C. $\frac{1000}{RC}$

D. $\frac{C}{1000R}$

Answer: C

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

A. 1

B. 0

C. 10

D. 100

Answer: A

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

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

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

A. 52.4×10^{-4}

B. 524×10^{-4}

C. 402×10^{-4}

D. 262×10^{-4}

Answer: B

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34. The electrochemical cell stops working after some time because:

A. electrode potential of both the electrodes becomes zero

B. electrode potential of both the electodes becomes equal

C. one of the electrodes is eaten away

D. the cell reaction gets reversed

Answer: B

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35. The equation representing the process by which standard reduction potential of zinc can be defined is:

A. $Zn^{2+}(s) + 2e^{-} \rightarrow Zn$

B. $Zn(g) \rightarrow Zn^{2+}(g) + 2e^{-}$

C. $Zn^{2+}(g) + 2e^{-} \rightarrow Zn$

D. $Zn^{2+}(a.\,q) + 2e^{-} \rightarrow Zn(s)$

Answer: D

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36. The measured potential for, $Mg^{2+} + 2e^{-} \Leftrightarrow Mg(s)$ does not depend upon:

A. raising the temperature

B. increasing the concentration of Mg^{2+} ions

C. making the magnesium plate bigger

D. purity of magnesium plate

Answer: C

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37. When lead accumulator is charged, it is

A. an electrolytic cell

B. a galvanic cell

C. a Daniell cell

D. none of these

Answer: D

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38. The standard electrode potentials for the reactions,

$Ag^+(a.q) + e^- \rightarrow Ag(s)$

$Sn^{2+}(a.q) + 2e^- \rightarrow Sn(s)$ at $25^\circ C$ are 0.80 volt and -0.14 volt respectively. The emf of the cell

$Sn|Sn^{2+}(1M)||Ag^+(1M)|Ag$ is:

A. 0.66 volt

B. 0.80 volt

C. 1.08 volt

D. 0.94 volt

Answer: D

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39. The cathodic reaction in electrolysis of dilute H_2SO_4 with platinum electrode is:

A. oxidation

B. reduction

C. both oxidation and reduction

D. neutralization

Answer: D

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40. The metal oxide which decomposes on heating, is:

A. ZnO

B. HgO

C. Al_2O_3

D. CuO

Answer: B

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41. The reaction, $\frac{1}{2}H_2(g) + AgCl(s) = H^+(a.q) + Cl^-(a.q) + Ag(s)$

occurs in the galvanic cell:

A. $Ag|AgCl_s|KCl(\text{soln}) \mid |AgNO_3(\text{soln.})|Ag$

B. $Pt|H_2(g)|HCl(\text{soln.}) \mid |AgNO_3(\text{soln.})|Ag$

C. $Pt|H_2(g)|HCl(\text{soln.}) \mid |AgCl(s)|Ag$

D. $Pt|H_2(g)|KCl(\text{soln.}) \mid |AgCl_s|Ag$

Answer: C

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42. The standard oxidation potentials, E°, for the half reactions are as,

$Zn \rightarrow Zn^{2+} + 2e^-, \qquad E^\circ = +0.76$ volt

$Fe \rightarrow Fe^{2+} + 2e^-, \qquad E^\circ = +0.41$ volt

The emf of the cell, $Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ is:

A. $+0.35$ volt

B. -0.35 volt

C. $+1.17$ volt

D. -1.17 volt

Answer: A

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43. The standard reduction potentials at $25^{\circ}C$ for the following half reactions are given against each:

$Zn^{2+}(a.q) + 2e^{-} \Leftrightarrow Zn(s): \quad -0.762$

$Cr^{3+}(a.q)3e^{-} \Leftrightarrow Cr(s), \quad -0.740$

$2H^{+} + 2e^{-} \Leftrightarrow H_2(g), \quad 0.00$

$Fe^{3+} + e^{-} \Leftrightarrow Fe^{2+}, \quad 0.77$

Which is the strongest reducing agent?

A. Zn

B. Cr

C. $H_2(g)$

D. $Fe^{2+}(aq)$

Answer: A

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44. Which one of the following is correct ?

A. Equivalent conductance decreases with dilution

B. Specific conductance increases with dilution

C. Specific conductance decreases with dilution

D. Equivalent conductance increases with increase in concentration

Answer: C

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45. A solution containing one mole per litre of each $Cu(NO_3)_2$, $AgNO_3$, $Hg_2(NO_3)_2$ is being electrolysed by using inert electrodes. The values of standard electrode potentials in volts (reduction potentials) are

$Ag^+ / Ag = +0.80V$, $HG_2^{2+} / Hg = +0.79V$

$Cu^+ / Cu = +0.34V$, $Mg^{2+} / Mg = -2.37V$

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

A. Ag, Hg, Cu

B. Cu, Hg, Ag

C. Ag, Hg, Cu, Mg

D. Mg, Cu, Hg, Ag

Answer: A

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46. Four colourless salt solutions are placed in separate test tubes and a strip of copper is dipped in each. Which solution finally turns blue ?

A. $Pb(NO_3)_2$

B. $AgNO_3$

C. $Zn(NO_3)_2$

D. $Cd(NO_3)_2$

Answer: B

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47. Red hot carbon will remove oxygen from the oxide XO and YO but not from ZO. Y will remove oxygen from XO. Use this evidence to deduce the order of acitivity of the three metals X, Y and Z putting the most active frist:

A. XYZ

B. ZYX

C. YXZ

D. ZXY

Answer: B

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48. The standard electrode potentials (E°) for OCl^{-}/Cl^{-} and $Cl^{-}/\frac{1}{2}Cl_2$ respectively are 0.94 V and $-1.36V$. The E° value for $OCl^{-}/\frac{1}{2}Cl_2$ will be:

A. $-0.42V$

B. $-2.20V$

C. $+0.52V$

D. $+1.04V$

Answer: A

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49. If a spoon of copper metal is placed in a solution of ferrous sulphate:

A. Cu will precipitate out

B. iron will precipitate

C. Cu and Fe will precipitate

D. no reaction will take place

Answer: D

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50. Among Na, Hg, S, Pt and graphite, which can be used as electrodes in electrolystic cells having aqueous solutions?

A. Hg and Pt

B. Hg, Pt and graphite

C. Na and S

D. Na, Hg and S

Answer: B

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51. The most reactive metal among the following is:

A. Al

B. Ni

C. Pb

D. Cu

Answer: A

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52. Which of the following metals is most readily corroded in moist air ?

A. Copper

B. Iron

C. Silver

D. Nickel

Answer: B

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53. Which one of the following is not the correct representation?

A. E°_{cell} = Red. Pot. Of cathode + Oxide pot. of anode

B. E°_{cell} = Red. Pot of cathode - Oxid. pot. of anode

C. E°_{cell} = Red. Pot. Of cathode + Red. pot. of anode

D. E°_{cell} = Red. Pot of cathode - Red. pot of anode

Answer: B

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54. Which of the following represents the reduction potential of silver wire dipped into $0.1 M AgNO$ solution at $25^{\circ} C$:-

A. E°_{red}

B. $\left(E^{\circ}_{\text{red}} + 0.059\right)$

C. $\left(E^{\circ}_{\text{oxid}} - 0.059\right)$

D. $\left(E^{\circ}_{\text{red}} - 0.059\right)$

Answer: D

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

A. increases by 0.030 volt

B. decreases by 0.030 volt

C. increases by 0.059 volt

D. decreases by 0.0059 volt

Answer: B

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56. A solution of Cu(II) sulphate is reacted with KCl and KI. In which case will the Cu^{2+} be reduced to $Cu(+)$?

A. In both the cases

B. When reacted with KCl

C. When reacted with KI

D. In both the cases but in presence of H^{+}

Answer: C

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57. From the electrochemical series, it can be concluded that :

A. Zn^{2+} will libreate H_2 from 1 M HCl

B. Ag metal reacts spontaneously with Zn^{2+}

C. Zn metal will liberate H_2 from 1M HCl

D. Ag metal will liberate H_2 from `1M HCl

Answer: C

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58. The oxidation potential of a hydrogen electrode at $pH = 1$ is $(T = 298K)$

A. 0.059 volt

B. 0 volt

C. -0.059 volt

D. 0.59 volt

Answer: C

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59. Which are true for a standard hydrogen electrode ?

A. The hydrogen ion concentrated is 1M

B. Temeprature is $25^{\circ}C$

C. Pressure of hydrogen is 1 atmosphere

D. It contains a metallic conductor which does not absorb hydrogen

Answer: D

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60. For the half-cell reaction,

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

the value of n used in Nernest equation is:

A. 3

B. 2

C. 1

D. 3×96500

Answer: A

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61. When a piece of sodium metal is dropped in water, a reaction takes place to yield hydrogen because:

A. sodium loses electrons

B. sodium acts as an oxidising agent

C. water loses electrons

D. water acts as a reducing agent

Answer: A

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62. Which one is the wrong statement about electrochemical series?

A. Active metals have negative reduction potentials

B. Active non-metals have positive reduction potentials

C. Metals above hydrogen liberate hydrogen from acids

D. Metals below hydrogen are strong reducing agents

Answer: D

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63. The reduction potential values are given below

$AI^{3+}/AI = -1.67\text{volt}\,Mg^{2+}/Mg = -2.34\text{volt}\,Cu^{2+}/Cu = +0.34$ volt

$I_2/2I^- = +0.53$ volt. Which one is the best reducing agenet?

A. Al

B. Mg

C. Cu

D. I_2

Answer: B

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64. From the values given in question No. 63, which one is the oxidising agent ?

A. Al

B. Mg

C. I_2

D. Cu

Answer: C

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65. The standard electrode potentials of four elements A, B, C and D are $-3.05, 1.66, \ -0.40$ and 0.80 volt. The highest chemical activity will be shown by :

A. A

B. B

C. C

D. D

Answer: A

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66. Which of the following methods does not liberate hydrogen ?

A. $Zn + H_2SO_4$ (dil.)

B. $Mg + H_2SO_4$(dil.)

C. $Cu + H_2SO_4$(dil.)

D. $Zn + HCl$ (dil.)

Answer: C

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67. A depolarizer used in dry cell is :

A. ammonium chloride

B. manganese dioxide

C. potassium oxide

D. sodium phosphate

Answer: B

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68. The oxide which can be reduced by hydrogen is :

A. Na_2O

B. CaO

C. K_2O

D. CuO

Answer: D

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69. The reference calomel electrode is made from which of the following ?

A. $ZnCl_2$

B. $CuSO_4$

C. Hg_2Cl_2

D. $HgCl_2$

Answer: C

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70. Given, standard electrode potentials,

$$\begin{array}{ll} Fe^{3+} + 3e^- \rightarrow Fe & E^\circ = -0.036 \text{ volt} \\ Fe^{2+} + 2e^- \rightarrow Fe & E^\circ = -0.440 \text{ volt} \end{array}$$

The standard electrode potential E° for $Fe^{3+} + e^- \rightarrow Fe^{2+}$ is :

A. -0.476volt

B. -0.404volt

C. 0.440volt

D. -0.772volt

Answer: D

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71. K, Ca and Li metals may be arranged in the decreasing order of their standard electrode potentials as

A. K, Ca and Li

B. Li, K and Ca

C. Li, Ca and K

D. Ca, Li and K

Answer: B

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72. Which of the following is incorrect in a galvanic cell ?

A. Oxidation occurs at anode

B. Reduction occurs at cathode

C. The electrode at which electrons are gained is called cathode

D. The electrode at which electrons are lost is called cathode

Answer: D

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

A. positively and negatively charged ions

B. positively and negatively charged electrodes

C. negatively and positively charged electrodes

D. negatively and positively charged ions

Answer: C

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74. Is the reaction, $2Al + 3Fe^{2+} \Leftrightarrow 2Al^{3+} + 2Fe$ possible ?

A. No, because standard oxidation potential of $Al < Fe$

B. Yes, because standard oxidation potential of $Al > Fe$

C. Cannot be predicted

D. Yes, because aluminium is a strong oxidising agent

Answer: B

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75. In an experiment setup for the measurement of EMF of a half cell using a reference electrode and a salt bridge, when the salt bridge is removes, the voltage

A. does not change

B. increases to maximum

C. decreases half the value

D. drops to zero

Answer: D

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76. A secondary cell is one :

A. can be recharged

B. can be recharged by passing the current through it in the same direction

C. can be recharged by passing the current through it in the opposite direction

D. can not recharged

Answer: C

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77. The reduction potential of a hydrogen electrode at $pH10$ at $298K$ is :

$(p = 1$ atm)

A. 0.51 volt

B. 0 volt

C. -0.591volt

D. 0.059 volt

Answer: C

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78. The standard emf of the cell, $Ni|Ni^{2+}(1.0M)||Ag^{+}(1.0M)|Ag[E^{\circ}$ for $Ni^{2+}/Ni = -0.25$ volt, E° for $Ag^{+}/Ag = 0.80$ volt]

A. $-0.25 + 0.80 = 0.55\text{volt}$

B. $-0.25 - (+0.80) = 1.05\text{volt}$

C. $0 + 0.80 - (-0.25) = +1.05\text{volt}$

D. $0.80 - (-0.25) = -0.55\text{volt}$

Answer: C

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79. Consider ΔG° for the following cell reaction :

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

$E^{\circ}_{Ag^{+}/Ag} = +0.80$ and $E^{\circ}_{Zn^{2+}/Zn} = -0.76V$

A. $-305kJ/mol$

B. $-301kJ/mol$

C. $+305kJ/mol$

D. $+301kJ/mol$

Answer: B

Watch Video Solution

80. The position of some metals in the electrochemical series in dectreasing electropositeve character is given as $Mg > Al > Zn > Cu > Ag$. What will happen if a copper spoon is used to stir a solution of aluminimum nitrate ?

A. The spoon will get coated with aluminium

B. An alloy of aluminium and copper is formed

C. The solution becomes blue

D. There is no reaction

Answer: D

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81. A half cell reaction is one that

A. takes place at one electrode

B. consumes half a unit of electricity

C. involves half a mole of electrolyte

D. goes half way to completion

Answer: A

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82. Which Nernst equation is true to find out the potential of non-standard electrochemical cell from the following ?

$Fe(s)\left|Fe^{2+}(xM)\right| \mid I^{-}(s)(Pt)$

A. $E_{cell} = E^{\circ}_{cell} - \dfrac{0.592}{n}\log_{10}\left[Fe^{2+}\right]\left[I^{-}\right]^{2}$

B. $E_{cell} = E^{\circ}_{cell} - \dfrac{0.0592}{n}\log_{10}\left[Fe^{2+}\right]\left[I^{-}\right]^{2}$

C. $E_{cell} = E^{\circ}_{cell} - \dfrac{0.0592}{n}\log_{10}\left[Fe^{2+}\right]\left[I^{-}\right]$

D. $E_{cell} = E^{\circ}_{cell} - \dfrac{0.0592}{nF}\log_{10}.\dfrac{\left[Fe^{2+}\right]\left[I^{-}\right]^{2}}{[Fe][I_2]}$

Answer: B

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83. During the electrolysis of fused NaCl, which reaction occurs at anode ?

A. Chloride ions are oxidised

B. Sodium ions are oxidised

C. Chloride ions are reduced

D. Sodium ions are reduced

Answer: A

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84. $E^{\circ}(Ni^{2+}/NI) = -0.25\text{volt}, E^{\circ}(Au^{3+}/Au) = 1.50\text{volt}$. The emf of the voltaic cell, $Ni|Ni^{2+}(1.0M)||Au^{3+}(1.0M)|Au$ is :

A. 1.25 volt

B. -1.75volt

C. 1.075 volt

D. 4.0 volt

Answer: C

Watch Video Solution

85. The strong oxidising agent has :

A. high value of reduction potential

B. high value of oxidation potential

C. low value of reduction potential

D. high tendency to lose electrons

Answer: A

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86. The passage of electricity in the Daniell cell when Zn and Cu electrodes are connected is from :

A. Cu to Zn in the cell

B. Cu to Zn outside the cell

C. Zn to Cu outside the cell

D. Zn to Cu in the cell

Answer: B

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87. H^+ ions are reduced at platinum electrode prior to :

A. Zn^{2+}

B. Cu^{2+}

C. Ag^+

D. I_2

Answer: A

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88. Which of the following statements is wrong ?

A. F_2 is the strongest oxidising agent as its reduction potential is high.

B. Li is the weakest reducing agent as its reduction potential is low.

C. Li is the strongest reducing agent as its oxidation potential is high.

D. F^- ion does not show reducing property.

Answer: B

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89. Out of Cu, Ag, Fe and Zn, the metal which can displace all others from their salt solutions is :

A. Ag

B. Cu

C. Fe

D. Zn

Answer: D

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90. When the electric current is passed through a cell having an electrolyte, the positive ions move towards cathode and negative ions toqards the anode. If the cathode is pulled out of the solution .

A. the positive and negative ions will move towards anode

B. the positive ions will start towards the anods while negative ions will stop moving

C. the negative ions will continue to move towards anode while positive ions will stop moving

D. the positive and negative ions will start moving randomly

Answer: D

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91. The oxidation potentials of Zn, Cu, Ag, H_2 and Ni are 0.76, -0.34, 0.80, 0 and 0.25 volt respectively. Which of the following reactions will provide maximum voltage ?

A. $Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$

B. $Zn + 2Ag^{+} \rightarrow 2Ag + zn^{2+}$

C. $H_2 + Cu^{2+} \rightarrow 2H^{+} + Cu$

D. $H_2 + Ni^{2+} \rightarrow 2H^{+} + Ni$

Answer: B

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92. Which one of the following will increase the voltage of the cell ? $(T = 298K)$

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

A. Increase in the size of silver rod

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

C. Increase in the concetration of Sn^{2+} ions

D. None of the above

Answer: C

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93. A chemist wants to produce $CI_2(g)$ from molten $NaCI$. How many grams could be produced if he uses a steady current of 2 ampere for 2.5 minutes:-

A. 3.55 g

B. 1.775 g

C. 0.110 g

D. 0.1775 g

Answer: C

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94. In the electrolysis of $CuCl_2$ solution, the mass of cathode increased by 6.4 g. What occurred at copper anode ?

A. 0.224 litre of Cl_2 was liberated

B. 1.12 litre of oxygen was liberated

C. 0.05 mole Cu^{2+} passed into the solution

D. 0.1 mole Cu^{2+} passed into the solution

Answer: D

Watch Video Solution

95. Cosoder the reactopm: $(T = 298K)$

$Cl_2(g) + 2BR^-(aq) \rightarrow 2Cl^-(aq) + Br_2(aq.)$

The emf of he cell, when $[Cl^- = (Br_2] = [Br^-] = 0.01M$ and Cl_2 gas is at 1 atm pressure, will be :

(E° for the above reaction is $= 29$ volt).

A. 0.54 volt

B. 0.35 volt

C. 0.24 volt

D. -0.29volt

Answer: B

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96. How much silver will be obtained by that quantity of current which displaces 5.6 litre of H_2 ?

A. 54g

B. 13.5 g

C. 20 g

D. 108 g

Answer: A

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97. The specific conductance of a salt of 0.01 M concentration is 1.061×10^{-4}. Molar conductance of the same solution will be :

A. 1.062×10^{-4}

B. 1.061

C. 10.61

D. 106.1

Answer: C

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98. What is the number of coulombs required for the conversion of one mole of MnO_4^- to one mole of Mn^{2+} ?

A. 5×96500

B. 3×96500

C. 96500

D. 9650

Answer: A

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99. Which of the following solutions of NaCl will have the highest specific conductance ?

A. $0.001N$

B. $0.1N$

C. $0.01N$

D. $1.0N$

Answer: D

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100. The equivalent conductance of a 1 N solution of an electrolyte is nearly:

A. 10^3 times its specific conductance

B. 10^{-3} times its specific conductance

C. 100 times its specific conductance

D. the same as its specific conductance

Answer: A

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101. Zinc is coated over ion iron to prevent rusting of iron because :

A. it is cheaper than iron

B. $E^{\circ}_{(Zn^{2+}/Zn)} = E^{\circ}_{(Fe^{2+}/Fe)}$

C. $E^{\circ}_{(Zn^{2+}/Zn)} < E^{\circ}_{(Fe^{2+}/Fe)}$

D. $E^{\circ}_{(Zn^{2+}/Zn)} > E^{\circ}_{(Fe^{2+}/Fe)}$

Answer: C

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102. The standard reduction potentials at $25^{\circ}C$ of $Li^{+}/Li, Ba^{2+}/Ba, Na^{+}/Na$ and Mg^{2+}/Mg are $-3.05, -2.73, -2.71$ and -2.37 volt respectively. Which one of the following is the strongest oxidising agent ?

A. Na^{+}

B. Li^{+}

C. Ba^{2+}

D. Mg^{2+}

Answer: D

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103. Three faradays of electricity was passed through an aqueous solution of iron (II) bromide. The mass of iron metal (at mass 56) deposited at the cathode is:

A. 56g

B. 84 g

C. 112g

D. 168 g

Answer: B

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104. The standard electrode potentials of Zn, Ag and Cu are -0.76, 0.80 and 0.34 volt respectively, then:

A. Ag can oxidised Zn and Cu

B. Ag can reduce Zn^{2+} and Cu^{2+}

C. Zn can reduce Ag^{+} and Cu^{2+}

D. Cu can oxidise Zn and Ag

Answer: C

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105. The standard emf for the cell cell reaction $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ is 1.10 volt at $25^{\circ} C$. The emf for the cell reaction when $0.1 M Cu^{2+}$ and $0.1 M ZN^{2+}$ solutions are used at $25^{\circ} = C$ is .

A. 1.10 volt

B. 0.110 volt

C. -1.10 volt

D. -0.110 volt

Answer: A

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106. Three mole of electrons are passed through three solutions in succession containing $AgNO_3$, $CuSO_4$ and $AuCl_3$ respectively. The ratio of amounts of cations reduced at cathode will be :

A. $1:2:3$

B. $2:1:3$

C. $3:2:1$

D. $6:3:2$

Answer: D

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107. In the electroysis of an aqueous solution of NaOH, 2.8 litre of oxygen gas at NTP was libreated at anode. How much of hydrogen gas was liberated at cathode ?

A. 2.8 litre

B. 5.6 litre

C. 11.2 litre

D. 22.4 litre

Answer: B

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108. Two half-cells potentials -0.44 and 0.799 volt respectively. These two are coupled to make a galvanic cell. Which of the following will be true ?

A. Electrode of half-cell potential -0.44 V will act as anode

B. Electrode of half-cell potential -0.44 V will act as cathode

C. Electrode of half-cell potential 0.799 V will act as anode

D. Electrode of half-cell potential -0.44 V will act as a positive terminal

Answer: A

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109. When a lead storage battery is charged:

A. PbO_2 dissolves

B. the lead electrode becomes coated with lead sulphate

C. sulphuric acid s regenerated

D. the amount of acid decreases

Answer: C

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110. An example of a simple fuel cell is:

A. lead storage battery

B. $H_2 - O_2$ cell

C. Daneill cell

D. Lechlanche cell

Answer: B

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111. For the cell reaction, $Mg(s) + 2Ag^{+}(aq.) \Leftrightarrow Mg^{2+}(aq.) + 2Ag(s)$ E°_{cell} is +3.17 V at 298 K. The value of E_{cell}, ΔG° and Q at Ag and Mg^{2+} concentration of 0.001 M and 0.02 M respectively are :

A. $3.04V, \ -605.8kJmol^{-1}, 20000$

B. $3.04V, 611.8kJmol^{-1}, 20000$

C. $3.13V, \ -604kJmol^{-1}, 20$

D. $3.04V, \ -611.8kJ, 20000$

Answer: D

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112. Which of the following statements is correct ?

A. The temperature coefficient of electrolytic conductance is positive.

B. The temperature coefficient of electroplytic resistance is negative.

C. The resistance of an electrolyte decreases with decreasing temperature

D. The resistance of electrolytic conductors is independent of temperature.

Answer: D

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113. Kohlrausch's law states that at:

A. infinite dilution, each ion makes difinite contribution to conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte

B. infinite dilution, each ion makes definite contribution to the equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte

C. finite dilution, each ion makes definite contribution to the equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte

D. infinite dilution, each ion make definite contribution to equivalent conductance of an electrolyte depending on the nature of the other ion of the electrolyte

Answer: A

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114. Which one of the following conditions will increase the voltage of the cell represented by the equation ?

A. Increase in the dimension of Cu electrode

B. Increase in the dimension of Ag electrode

C. Increase in the concentration of Cu^{2+} ion

D. Increase in the concentration of Ag^{+} ion

Answer: D

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115. Which of the following reactions occurs at cathode during charging of storage battery ?

A. $Pb^{2+} + 2e^{-} \rightarrow Pb$

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

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

D. $PbSO_4 + 2H_2 \rightarrow PbO_2 4H^{+} + SO_2^{2-} + 2e^{-}$

Answer: A

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116. The amount of silver deposited on passing 2F of electricity through aqueous solution of $AgNO_3$ is :

A. 54 g

B. 108 g

C. 216 g

D. 324 g

Answer: C

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117. Statements:

(i) Unit of specific conductivity is $ohm^{-1}cm^{-1}$.

(ii) Specific conductivity of strong electrolytes decreases on dilution.

(iii) The amount of an ion discharged during electrolysis does not depend upon resistance.

(iv) The unit of electrochemical equivalence is g/coulomb.

A. All are correct

B. All are wrong

C. Only (i), (ii) and (iv) are correct

D. Only (ii), (iii) and (iv) are correct

Answer: A

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118. Which among the following expressions is/are not correct?

A. $\mu^{\infty} = \gamma_{+}\lambda_{+}^{\infty} + \gamma_{-}\gamma_{-}^{\infty}$

B. $\lambda^{\infty} = \frac{1}{n^{+}}\lambda_{+}^{\infty} + \frac{1}{n^{-}}\lambda_{-}^{\infty}$

C. $\lambda_{\text{cation}}^{\infty} = \mu_{\text{cation}}^{\infty} \times \text{faraday}$

D. $\lambda_{\text{cation}}^{\infty} = \mu_{\text{cation}}^{\infty} \times \text{faraday}$

Answer: D

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119. For the electrochemical cell, $M|M^{+}||X^{-}|X$, $E^{\circ}_{M^{+}/M} = 0.44V$ and $E^{\circ}_{X/X^{-}} = 0.33V$. From this data we can deduce that :

A. $M + X \to M^{+} + X^{-}$ is the spontaneous reaction

B. $M^{+} + X^{-} \to M + X$ is the spontaneous reaction

C. $E_{\text{cell}} = 0.77V$

D. $E_{\text{cell}} = -0.77V$

Answer: B

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120. For the cell reaction,

$$\underset{(C_1)}{Cu^{2+}}(aq.) + Zn(s) \rightarrow \underset{(C_2)}{Zn^{2+}}(aq.) + Cu(s)$$

the change in free energy (ΔG) at a given temperature is a function of:

A. $\ln C_1$

B. $\ln\left(\frac{C_2}{C_1}\right)$

C. $\ln(C_1 + C_2)$

D. $\ln C_2$

Answer: B

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121. The standard reduction potential values of three metallic cation X, Y, Z are $0.52, \ -3.03$ and $-1.18V$ respectively. The order of reducing power to the corresponding metals is:

A. $Y > Z > X$

B. $X > Y > Z$

C. $Z > Y > X$

D. $Z > X > Y$

Answer: A

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

A. Y will oxidise X and not Z

B. Y will oxidise Z and not X

C. Y will oxidise both Z and X

D. Y will reduce both X and Z

Answer: A

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123. At $25^{\circ} C$, the standard emf of a cell having reaction involving two electrons change is found to be 0.295 V. The equilibrium constant of the reaction is :

A. 29.5×10^{-2}

B. 10

C. 1×10^{10}

D. 29.5×10^{10}

Answer: C

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124. The emf of the cell in which the following reactions,

$Zn(s) + Ni^{2+}(0.1M) \rightarrow Zn^{2+}(1.0M) + Ni(s)$ occurs, is found to 0.5105 V at 298 K. The standard emf of the cell is :

A. $0.4810V$

B. $0.5696V$

C. $-0.5105V$

D. $0.5400V$

Answer: D

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125. The molar conductance of NaCl, HCl and CH_3COONa at infinite dilution are 126.45, 426.16 and 91 $ohm^{-1}cm^2mol^{-1}$ respectively. The molar conductance of CH_3COOH at infinite dilution is :

A. $201.28 ohm^{-1} cm^2 mol^{-1}$

B. $390.71 ohm^{-1} cm^2 mol^{-1}$

C. $698.28 ohm^{-1} cm^2 mol^{-1}$

D. $540.48 ohm^{-1} cm^2 mol^{-1}$

Answer: B

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126. The specific conductance of a $0.1 N KCl$ solution at $23^{\circ} C$ is $0.012 ohm^{-1} cm^{-1}$. The resistance of cell containing the solution at the same tempreature was found to be $55 ohm$. The cell constant will be

A. $0.142 cm^{-1}$

B. $0.918 cm^{-1}$

C. $1.12 cm^{-1}$

D. $0.616 cm^{-1}$

Answer: D

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127. The standard reduction potentials for Cu^{2+}/Cu and Cu^{2+}/Cu^{+} are 0.337 V and $0.153V$ respectively. The standard electrode potenials of Cu^{+}/Cu half cell is :

A. $0.184V$

B. $0.827V$

C. $0.521V$

D. $0.490V$

Answer: C

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128. $2Ag^{+}(aq) + Cu(s) \rightarrow Cu^{2+}(aq) + 2Ag(s)$

The standard potential for this reaction is 0.46 V. Which change will increase the potential the most?

A. Doubling the $[Ag^{+}]$

B. Halving the $[Cu^{2+}]$

C. Doubling the size of Cu electrode

D. Halving the size of Ag electrode

Answer: A

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129. As a lead storage battery is charged:

A. lead dioxide dissolves

B. sulphuric acid is reagenerated

C. lead electrode becomes coated with lead sulphate

D. the concentration of sulphuric acid decreases

Answer: B

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130. In the electrochemical reaction, $2Fe^{3+} + Zn \rightarrow Zn^{2+} + 2Fe^{2+}$ increasing the concentration of Fe^{2+}:

A. increases the cell emf

B. increases the current flow

C. decreases the cell emf

D. alters the pH of the solution

Answer: C

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131. Consider the following cell reaction

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

$E^\circ_{\text{cell}} = 0.46V$ By boubling the concentration of Cu^{2+}, E_{cell} is

A. doubled

B. halved

C. increased but less then double

D. decreased by a small fraction

Answer: D

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132. The conductivity of 0.01 mol/dm^3 aqueous acetic acid at 300 K is $19.5 \times 10^{-5} ohm^{-1} cm^{-1}$ and the limiting molar conductivity of acetic acid at the same temperature is $390 ohm^{-1} cm^2 mol^{-1}$. The degree of dissociattion of acetic acid is :

A. 0.5

B. 0.05

C. 5×10^{-3}

D. 5×10^{-7}

Answer: B

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133. The ionization constant of a weak electrolyte is 25×10^{-6} while the equivalent conductance of its 0.01 M solution is 19.6 s $cm^2 eq^{-1}$. The equivalent conductance of the electrolyte at infinite dilution (in S $cm^2 eq^{-1}$) will be

A. 250

B. 196

C. 392

D. 384

Answer: C

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134. What is the amount of chlorine evoled when 2 amperes of current is passed for 30 minumtes in an aqueous solution of $NaCI$?

A. 66 g

B. 1.32 g

C. 33 g

D. 99 g

Answer: B

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135. When 9.65 coulomb of electricity is passed through a solution of silver nitrate (Atomic mass of Ag = 108 g mol^{-1}, the amount of silver deposited is :

A. 16.2 mg

B. 21.2 mg

C. 10.8 mg

D. 6.4 mg

Answer: C

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136. The quantity of electricity needed to deposit 127.08 g of copper is :

A. 1 faraday

B. 4 coulomb

C. 4 faraday

D. 1 ampere

Answer: C

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137. The change required to deposite 9 g of Al from Al^{3+} solution is (at. Wt. of Al = 27.0) :

A. 3216.3 C

B. 96500 C

C. 9650 C

D. 32163 C

Answer: B

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138. The standard reduction for the following reactions are :

$Fe^{3+} + 3e^{-} \rightarrow Fe$ with $E^{\circ} = -0.036V$

$Fe^{2+} + 2e^{-} \rightarrow Fe$ with $E^{\circ} = -0.44V$

What would be the standard electrode potential for the reaction

$Fe^{3+} + e^{-} \rightarrow Fe^{2+}$?

A. 0.772 V

B. 0.077 V

C. $-0.404V$

D. $0.772V$

Answer: A

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139. 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 $\left(F = 96, 500Cmol^{-1}\right)$:

A. $-89kJ$

B. $-89J$

C. $-44.5kJ$

D. $-98kJ$

Answer: B

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140. In electrolysis of $NaCl$ when Pt electrode is taken H_2 is liberated at cathode while Hg cathode it forms sodium amalgam because

A. Hg is more inert than Pt

B. more voltage is required to reduce H^+ at Hg than at Pt

C. Na is dissolved in Hg while it does not dissolves in Pt

D. concentration of H^+ ions is larger when Pt electrode is taken

Answer: B

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141. A current is passed through 2 voltmeters connected in series. The first voltmeter contians $XSO_4)(aq)$ and second has Y_2SO_4(aq). The relative atomic masses of X and Y are in the ratio $2:1$. The ratio of the mass of X liberated to the mass of Y liberated is:

A. $1:1$

B. $1:2$

C. $2:1$

D. none of these

Answer: A

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142. Which reaction is possible at anode?

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

B. $F_2 \rightarrow 2F^-$

C. $\frac{1}{2}O_2 + 2H^+ \rightarrow H_2O$

D. None of the above

Answer: A

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143. When the sample of copper with the zinc impurity is to be purified by electrolysis, the appropriate electrodes are

A. $\begin{array}{ll}\text{Cathode} & \text{Anode}\\ \text{Pure zinc} & \text{Pure copper}\end{array}$

B. $\begin{array}{ll}\text{Cathode} & \text{Anode}\\ \text{Impure sample} & \text{Pure copper}\end{array}$

C. $\begin{array}{ll}\text{Cathode} & \text{Anode}\\ \text{Impure zinc} & \text{Impure sample}\end{array}$

D. $\begin{array}{ll}\text{Cathode} & \text{Anode}\\ \text{Pure copper} & \text{Impure sample}\end{array}$

Answer: D

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144. Conductivity (Unit Siemen's 'S') is directly proportional to area of the vessel and the concentration of the solution in it and is inversely proportionals to the length of the vessel, then the unit of constant of proportionality is :

A. $Smmol^{-1}$

B. Sm^2mol^{-1}

C. $S^{-2}m^2mol$

D. $S^2m^2mol^{-2}$

Answer: A

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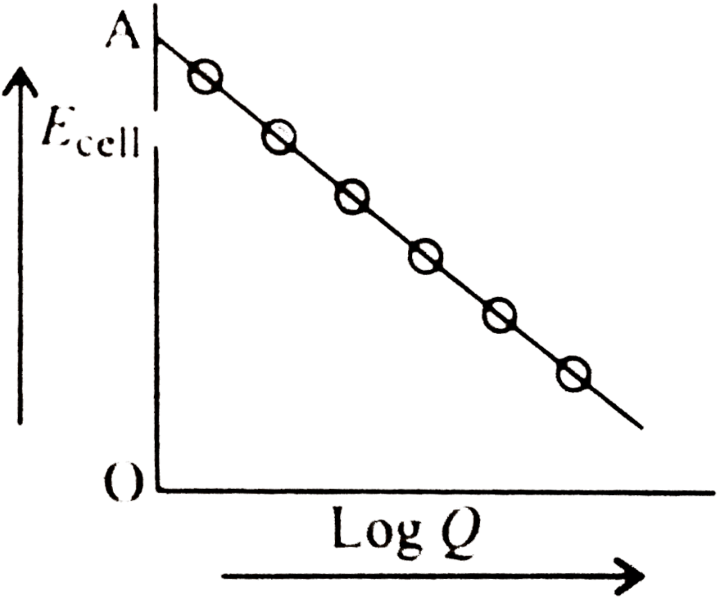
145. $Zn + Cu^{2+}(aq) \Leftrightarrow Cu + Zn^{2+}(aq)$.

Reaction quotient is $Q = \dfrac{[Zn^{2+}]}{[Cu^{2+}]}$. Variation of E_{cell} with log Q is of the type with $OA = 1.10$ $V. E_{cell}$ will be $1.1591V$ when



A. $\left[Cu^{2+}\right] / \left[Zn^{2+}\right] = 0.01$

B. $\left[Zn^{2+}\right] / \left[Cu^{2+}\right] = 0.01$

C. $\left[Zn^{2+}\right] / \left[Cu^{2+}\right] = 0.1$

D. $\left[Zn^{2+}\right] / \left[Cu^{2+}\right] = 1$

Answer: B

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146. In which of the following cells with the emf be independent of the activity of the chloride ions ?

A. $Zn|ZnCl_2(aq.)|Pt(Cl_2)$

B. $Zn|ZnCl_2(aq.)||KCl(aq.)|AgCl(s), Ag(s)$

C. $Ag, AgCl(s)|KCl(aq.)|Pt(Cl_2)$

D. $Hg, Hg_2Cl_2(s)\Big|\dot{K}Cl(aq.)\Big||AgNO_3(aq.)|Ag(s)$

Answer: C

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147. Standard electrode potential data are useful for understanding the suitability of an oxidant in a redox titration. Some half cell reaction and their standard potentials are given below:

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

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l), E^\circ = 1.38V$

$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq), E^\circ = 0.77V$

$CI_2(g) + 2e^- \rightarrow 2CI^-(aq), E^\circ = 1.40V$

Identify the only correct statement regarding quantitative estimation of aqueous $Fe(NO_3)_2$

A. MnO_4^- can be used in aqueous HCl

B. $Cr_2O_7^{2-}$ can be used in aqueous HCl

C. MnO_4^- can be used in aqueous H_2SO_4

D. $Cr_2O_7^{2-}$ can be used in aqueous H_2SO_4

Answer: A

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148. The standard reduction potential E°, for the half reaction are :

$$Zn \rightarrow Zn^{2+} + 2e^- \qquad E^\circ = 0.76V$$
$$Cu \rightarrow Cu^{2+} + 2e^- \qquad E^\circ = 0.34V$$

The emf for the cell reaction, $Zn(s) + Cu^{2+} \rightarrow Zn^{2+} + Cu(s)$ is :

A. $0.42V$

B. $-0.42V$

C. $-1.1V$

D. $+1.1V$

Answer: D

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

A. atomic a cathode through the solution

B. cathode to anode through the solution

C. anode to cathode through the external circuit

D. cathode to anode through the external circuit

Answer: C

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150. The standard emf of a galvanic cell involving cell reaction with $n = 2$ is found to be $0.295V$ at $25^{\circ} C$. The equilibrium constant of the reaction would be (Given$F = 96, 500 C mol^{-1}, R = 8.314 J K^{-1} mol^{-1}$):

A. 2×10^{11}

B. 4×10^{12}

C. 1×10^{2}

D. 1×10^{2}

Answer: D

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151. The emf of the cell,

$Zn | Zn^{2+}(0.01M) || Fe^{2+}(0.001M) | Fe$ at 298 K is 0.2905 V then the value of equilibrium constant for the cell reaction is :

A. $e^{0.32/0.0295}$

B. $10^{0.32 / 0.0295}$

C. $10^{0.26 / 0.0295}$

D. $10^{0.32 / 0.0591}$

Answer: B

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152. Consider the following E^{o} values :

$E^{o} \_ Fe^{3+} / FE^{2+} o = +0.77V$

$E_{Sn^{2+} / Sn} = -0.14V$

Under standard conditions the potential for reaction

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

A. $1.68V$

B. $1.40V$

C. $0.91V$

D. $0.63V$

Answer: C

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153. The highest electrical conductivity of the following aqueous solutions is of

A. 0.1 M acetic acid

B. 0.1 M chloroacetic acid

C. 0.1 M fluoroacetic acid

D. 0.1 M difluoroacetic acid

Answer: D

Watch Video Solution

154. Aluminium oxide may be electrolysed at 1000° C to furnish aluminium metal (Atomic mass = 27 amu, 1 Faraday = 96500 Coulomb). The cathode reaction is $Al^{3+} + 3e^- \rightarrow Al$. To prepare 5.12 kg of aluminium metal by this method would require:

A. $5.49 \times 10^7 C$ of electricity

B. $1.83 \times 10^7 C$ of electricity

C. $5.49 \times 10^4 C$ of electricity

D. $5.49 \times 10^{10} C$ of electricity

Answer: A

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155. During the process of electroytic refining of copper some metals present as impurity settle as 'anode mud'. These are

A. Sn and Ag

B. Pb and Zn

C. Ag and Au

D. Fe and Ni

Answer: C

Watch Video Solution

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

A. 96500 C

B. $1.93 \times 10^5 C$

C. $4.83 \times 10^5 C$

D. $9.65 \times 10^6 C$

Answer: C

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157. The standard electrode potential a Ag^+/Ag is +0.80 V and of Cu^{2+}/Cu is +0.34 V. These electrodes are connected through a salt bridge and if :

A. copper electrode acts as cathode, then E°_{cell} is +0.46 volt

B. silver electrode acts as anode, then E°_{cell} is + 0.46 volt

C. copper electrode acts as cathode, then E°_{cell} is - 0.34 volt

D. silver electrode acts as anode, then E°_{cell} is + 1.14 volt

Answer: C

Watch Video Solution

158. The half-cell reaction for the corrosion,

$$2H^+ + \frac{1}{2}O_2 + 2e^- \rightarrow H_2O \qquad E_{\circ} = 123V$$

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

Find the $DelyaG^{\circ}$ (in kJ) for the overall reaction :

A. $-76kJ$

B. $-322kJ$

C. $-161kJ$

D. $-152kJ$

Answer: B

Watch Video Solution

159. What is the cell reaction occurring in Daneill cell (galvanic cell) ?

A. $Cu(s)+ZnSO_4(aq.)\rightarrow CuSO_4(aq.)+Zn(s)$

B. $Zn(s)+CuSO_4(aq.)\rightarrow Cu(s)+ZnSO_4(aq.)$

C. $Ni(s)+ZnSO_4(aq.)\rightarrow NiSO_4(aq.)+Zn(s)$

D. $2Na(s)+CdSO_4(aq.)\rightarrow Na_2SO_4(aq.)+Cd(s)$

Answer: B

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160. What are the units of equivalent conductivity of a solution ?

A. mho cm^{-1}

B. ohm cm^{-1} g equiv^{-1}

C. mho cm^{-2} g equiv^{-1}

D. mho cm^{2} g equiv^{-1}

Answer: D

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161. The reduction potential values of M, N and O are +2.46 V, -1.13 V, -3.13 V respectively. Which of the following orders is correct regarding their reducing property ?

A. $O > N > M$

B. $O > M > N$

C. $M > N > O$

D. $M > O > N$

Answer: A

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162. The molar conductivities Λ°_{NaOAc} and Λ°_{HCI} at infinite dilution is watter at $25^{\circ}C$ are 91.0 and $426.2 Scm^{\circ}$ / mol respectively. To calculate Λ^{2}_{HOAc}, the additional value required is:

A. $\Lambda^{\circ}_{H_2O}$

B. Λ°_{KCl}

C. Λ°_{NaOH}

D. Λ°_{NaCl}

Answer: D

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163. The equivalent conductances at infinite dilution of HCl and NaCl are 426.15 and 126.15 mho $cm^2 geq^{-1}$ respectively. It can be said that the mobility of :

A. H^+ ions is much more than that of Cl^- ions

B. Cl^- ions is much more than that of H^+ ions

C. H^+ ions is much more than that of Na^+ ions

D. Na^+ ions is much more than that of H^+ ions

Answer: C

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

A. $Zn > Ag > Cu$

B. $Cu > Zn > Ag$

C. $Zn > Cu > Ag$

D. $Ag > Cu > Zn$

Answer: C

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165. The electrode reactions that takes place at the anode of $CH_4 - O_2$ fuel cell is :

A. $2O_2 + 8H^+ + 8e^- \rightarrow 4H_2O$

B. $CH_4 + 2H_2O \rightarrow CO_2 + 8H^+ + 8e^-$

C. $CH_4 + 2O_2 \rightarrow O_2 + 2H_2O$

D. $2H^+ + 2e^- \rightarrow H_2$

Answer: B

Watch Video Solution

166. The cell , $Zn|Zn^{2+}(1M)||Cu^{2+}(1M)Cu(E^{\circ}_{\text{cell}} = 1.10V)$,

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: D

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167. The production potential of hydrogen half-cell will be negative if:

A. $pH_2 = 2atm$ and $[H^+] = 2.0M$

B. $pH_2 = 1atm$ and $[H^+] = 2.0M$

C. $pH_2 = 1atm$ and $[H^+] = 1.0M$

D. $pH_2 = 2atm$ and $\left[H^{+}\right] = 1.0M$

Answer: D

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168. An electric current of 1 amp is passed through acidulated water for 160 minutes and 50 seconds. What is the volume of the hydrogen liberated at the anode (as reduced to NTP)?

A. 1.12 litre

B. 2.24 litre

C. 11.2 litre

D. 22.4 litre

Answer: A

View Text Solution

169. The equivalent conductance of solution is ....

[If cell constant is $1.25 cm^{-1}$ and resistance of $N/10$ solution is $2.5 \times 10^{3} \Omega$].

A. $2.5 ohm^{-1} cm^{2}\ \text{ equiv}^{-1}$

B. $5 ohm^{-1} cm^{2}\ \text{ equiv}^{-1}$

C. $2.5 ohm^{-1} cm^{-2}\ \text{ equiv}^{-1}$

D. $5 ohm^{-1} cm^{-2}\ \text{ equiv}^{-1}$

Answer: B

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170. For strong electrolytes, the plot or molar conductance versus $\sqrt{C}$ is:

A. parabolic

B. linear

C. sinusoidal

D. circular

Answer: B

View Text Solution

171. How long (in hours) must a current of 5 ampere be maintained to electroplate 60 g of calcium from molten $CaCl_2$?

A. 27 hours

B. 8.3 hours

C. 11 hours

D. 16 hours

Answer: D

View Text Solution

172. Emf of hydrogen electrode in tern of pH is (at 1 atm pressure):

A. $E_{H_2} = \frac{RT}{F} \times pH$

B. $E_{H_2} = \frac{RT}{F} \frac{1}{pH}$

C. $E_{H_2} = \frac{2.303RT}{F} pH$

D. $E_{H_2} = -0.0591pH$

Answer: D

View Text Solution

173. Zinc is coated over ion iron to prevent rusting of iron because :

A. E°_{red} of zinc is greater than that of Fe

B. $E^{\circ}_{\otimes.}$ of Zn is greater than that of Fe

C. E°_{red} of Zn is nearly equal to that of Fe

D. Zn is cheap

Answer: B

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174. On the basis of the following E° values, the stongest oxidizing agent is $\left[Fe(CN)_{6}\right]^{4-} \rightarrow \left[Fe(CN)_{6}\right]^{3-} + e^{-}, E^{\circ} = -0.35V$

$Fe^{2+} \rightarrow Fe^{3+} + e^{-}, E^{\circ} = -0.77V$

A. Fe^{3+}

B. $\left[Fe(CN)_{6}\right]^{3-}$

C. $\left[Fe(CN)_{6}\right]^{4-}$

D. Fe^{2+}

Answer: A

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

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

A. -0.26 V

B. 0.26 V

C. 0.339 V

D. $-0.339V$

Answer: B

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176. Electrolysis of dilute aqueous NaCl solution was carried out by passing 10 milli ampere current. The time required to liberate 0.01 mol of H_2 gas at the cathode is (1 Faraday=96500 C mol^{-1})

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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177. The emf of a cell containing sodium/copper electrode is 3.05 V, if the electrode potential of copper electrode is +0.34 V, the electrode potential of sodium is :

A. $-2.71V$

B. $+2.71V$

C. $-3.71V$

D. $+3.71V$

Answer: A

View Text Solution

178. The number of moles of oxygen obtained by the electrolytic decomposition of 90g water is :

A. 2.5

B. 5.0

C. 7.5

D. 10.0

Answer: B

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

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

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

A. $-2.5V$

B. $5.0V$

C. $4.5V$

D. $3.0V$

Answer: A

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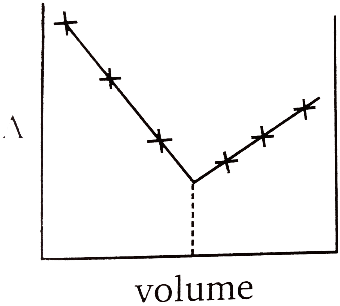
180. $AgNO_3(aq.)$ was added to an aqeous KCl solution gradually and the conductivity of the solution was measured. The plot of conductance (Λ) versus the volume of $AgNO_3$ is :



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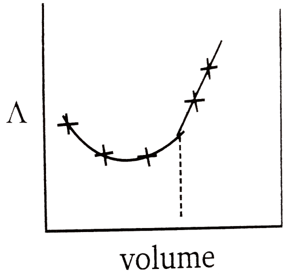

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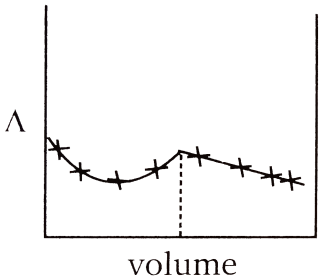

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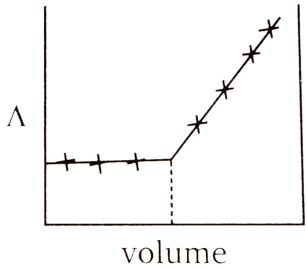

(S)

A. (P)

B. (Q)

C. (R)

D. (S)

Answer: D

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181. Consider the following cell reation :

$2Fe(s) + O_2(g) + 4H^{\oplus}(aq) \rightarrow 2Fe^{2+}(aq) + 2H_2O(l) \qquad E^{c-} = 1.67V$

$At\left[Fe^{2+}\right] = 10^{-3}M, p(O_2) = 0.1atm$ and $pH = 3$.

The cell potential at $25^{\circ}C$ is

A. 1.47 V

B. 1.77 V

C. 1.87 V

D. 1.57 V

Answer: D

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182. The standard reduction potential for $Zn^{2+}/Zn, Ni^{2+}/Ni$ and Fe^{2+}/Fe are $-0.76, -0.23$ and $-0.44V$ respectively. The reaction $X + Y^{2} \rightarrow X^{2+} + Y$ will be spontaneous when:

A. $X = Ni, Y = Fe$

B. $X = Ni, Y = Zn$

C. $X = Fe, Y = Zn$

D. $X = Zn, Y = Ni$

Answer: D

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

Among the following, the strongest reducing agent is

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

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

Based on the data given above strongest oxidising agent will be

A. Mn^{2+}

B. MnO_4^-

C. Cl^-

D. Cr^{3+}

Answer: B

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185. Resistance of $0.2M$ solution of an electrolyte is $50 ohm$. The specific conductance of the solution is $1.4 Sm^{-1}$. The resistance of $0.5M$ solution of the same electrolyte is 280Ω. The molar conductivity of $0.5M$ solution of the electrolyte in $Sm^2 mol^{-1}$ id

A. 5×10^3

B. 5×10^2

C. 5×10^{-4}

D. 5×10^{-3}

Answer: C

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186. The equivalent conductances 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 si positive)

A. $\lambda_c = \lambda_\infty - b\sqrt{c}$

B. $\lambda_c = \lambda_\infty + b\sqrt{c}$

C. $\lambda_c = \lambda_\infty + bc$

D. $\lambda_c = \lambda_\infty - bc$

Answer: A

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187. 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 not occur

B. $-0.33V$, the reaction wil occur

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

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

Answer: C

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188. Two faraday of electricity is passed through a solution of $CuSO_4$.

The mass of copper deposited at the cthode is :

(at mass of cu = 63.5 amu)

A. 127 g

B. 0 g

C. 63.5 g

D. 2 g

Answer: C

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189. On electrolysis of brine solution, the amounts of NAOH and Cl_2 produced at cathode and anode respectively are :

A. 40 parts and 35.5 parts

B. 35.5 parts and 40 parts

C. 100 parts and 80 parts

D. 80 parts and 100 parts

Answer: A

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190. Galvanization is applying a coating of :

A. Pb

B. Cr

C. Cu

D. Zn

Answer: D

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191. The products obtained at the cathode and anode respectively during the electrolysis of aqueous K_2SO_4 solution using platinum electrodes are :

A. O_2, H_2

B. H_2, O_2

C. H_2, SO_2

D. K, SO_2

Answer: B

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192. 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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193. How long (approximate) should water be electrolysed by passing through 100 ampere current so that oxygen released can completely burn 27.66 g diborane ?

(Atomic weight of B = 10.8 u)

A. 0.8 hours

B. 3.2 hours

C. 1.6 hours

D. 6.4 hours

Answer: B

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194. At T (K), the molar conductivity of 0.04 M acetic acid is 7.8 S $cm^2 mol^{-1}$. If the limiting molar conductivities of H^+ and CH_3COO^- at T (K) are 349 and 41 S $cm^2 mol^{-1}$ repsectively, the dissociation constant of acetic acid is :

A. 1.63×10^{-5}

B. 8.33×10^{-5}

C. 1.63×10^{-4}

D. 8.33×10^{-4}

Answer: A

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OBJECTIVE TYPE QUESTION (LEVEL -B)

1. When aluminium oxide (Al_2O_3) is electrolysed for the production of aluminium metal. For a given quantity of electricty, the number of moles of aluminium obtained if the volume of O_2 gas obtained is 201.6 litre measured at NTP, is

A. 9

B. 6

C. 12

D. 4.5

Answer: C

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2. A smuggler could not carry gold by depositing iron on the gold surface since :

A. gold is denser

B. iron rusts

C. gold has higher reduction potential than iron

D. gold has lower reduction potential than iron

Answer: C

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3. On electrolysis, which of the following does not give out oxygen ?

A. Acidic water using Pt electrode

B. Fused NaOH using Pt electrode

C. Dilute H_2SO_4 using Pt electrode

D. Dilute H_2SO_4 using Cu electrode

Answer: D

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4. When, during electrolysis of a solution of $AgNO_3 9650$ colombs of charge pass through the electroplating path, the mass of silver deposited on the cathode will be:

A. 21.6 g

B. 108 g

C. 10.8 g

D. 1.08 g

Answer: C

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5. An electrolytic cell contains a solution of Ag_2SO_4 and have platinum electrodes. A current is passed until 1.6gm of O_2 has been liberated at anode. The amount of silver deposited at cathode would be

A. 108 g

B. 1.6 g

C. 0.8 g

D. 21.60 g

Answer: D

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6. In an electroplating experiment, m gm of silver is deposited when 4 ampere of current flows for 2 minute . The amount (in gm) of silver deposited by 6 ampere of current for 40 second will be

A. 4 m

B. $\frac{m}{2}$

C. $\frac{4m}{3}$

D. 3m

Answer: B

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7. Four moles of electrons were transferred from anode to cathode in an experiment on electrolysis of water. The total volume of the tow gases (dry and at STP) produced will be approximately (in litres)

A. 224 L

B. 72.6 L

C. 67.2 L

D. 89.4 L

Answer: C

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8. On passing one faraday of elecricity throuth the electrolytic cells containing Ag^{+}, Ni^{+3} and Cr^{+3} ion solutions, the deposited Ag $(AT.Wt.=108)Ni(At.Wt=59)$ and $Cr(Atwt.=52)$ is .

A. $\begin{matrix} Ag & Ni & Cr \\ 108g & 29.5g & 17.3g \end{matrix}$

B. $\begin{matrix} Ag & Ni & Cr \\ 108g & 59g & 52g \end{matrix}$

C. $\begin{matrix} Ag & Ni & Cr \\ 108g & 108g & 17.3g \end{matrix}$

D. $\begin{matrix} Ag & Ni & Cr \\ 108g & 29.5g & 166g \end{matrix}$

Answer: A

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9. Which of the following reactions occur at the cathode during the charging of lead storage battery ?

A. $Pb^{2+} + 2e^{-} \rightarrow Pb$

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

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

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

Answer: D

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10. A current of strength $2.5A$ was passed through $CuSO_4$ solution for 6 minute 265 seconds. The amount of copper deposited is (At. Of $Cu = 63.\ 5, 1F = 96500C$) .

A. 0,3175 g

B. 0.0031 g

C. 6.35 g

D. 3.175 g

Answer: A

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11. In the electrolysis of fused salt, the weight of the substance deposited on an electrode will not depend on:

A. temperature of the bath

B. current intensity

C. time of electrolysis

D. electrochemical equivalent of the ions

Answer: A

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12. When an aqueous solution of sodium chloride is electrolysed using platinum electrodes, the ion discharged at the electrodes are

A. sodium and hydrogen

B. sodium and chloride

C. hydrogen and chloride

D. hydroxyl and chloride

Answer: C

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13. How many coulombs are required for the oxidation of 1 mol of H_2O_2 ?

A. $9.65 \times 10^4 C$

B. $93000C$

C. $1.93 \times 10^5 C$

D. $19.3 \times 10^2 C$

Answer: C

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14. 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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15. When water is electrolysed, hydrogen and oxygen gas are produced. If 1.008 g of H_2 is liberated at the cathode. What mass of O_2 is formed at the anode?

A. 32g

B. 16g

C. 8g

D. 4g

Answer: C

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16. The cell potential (E) and the free energy change (ΔG) accompanying an electrochemical reaction are related by

A. $\Delta G = nF\log E$

B. $\Delta G = nFE$

C. $-\Delta G = nFE$

D. $-\Delta G = nF \quad \log E$

Answer: C

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17. The units of conducivity are :

A. $\text{siemens}^{-1} cm^{-1}$

B. siemens cm

C. siemens cm^{-1}

D. siemens $cm^{-2}mol^{-1}$

Answer: C

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18. The reference calomel electrode is made from which of the following ?

A. $PbO_2 - PbSO_4$ mixture

B. $HgCl_2$

C. Hg_2Cl_2

D. $ZnCl_2$

Answer: C

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19. In preparing a salt bridge we sue KCl because

A. it forms a good jelly with agar-agar

B. it is a strong electrolyste

C. it is a good conductor of electricity

D. the transference number of K^{+} and Cl^{-} ions are almost equal

Answer: D

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20. The increase in the equivalent conductance of a salt solution on dilution is due to increase in the

A. attraction between the ions

B. degree of ionization of the salt

C. molecular attraction

D. association of the salt

Answer: B

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21. When 96500 coulombs of electricity are passed through nickel sulphate solution, the amount of nickel deposited will be

A. 1 mol

B. 0.5 mol

C. 0.1 mol

D. 2 mol

Answer: B

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

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

What voltage is produced under standard conditions by combining the half-reactions witih these standard Electrode Potential?

A. 1.32 V

B. 2.00 V

C. 2.30 V

D. 4.34 V

Answer: B

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23. For which of these oxidation/reduction pairs will the reduction potential vary with pH?

I AmO_2^{2+} / AmO_2^{+} II. AmO_2^{2+} / Am^{4+} III Am^{4+} / Am^{2+}

A. I only

B. II only

C. I and II only

D. I, II only III

Answer: B

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24. $2Ag^{+}(aq) + Cu(s) \rightarrow Cu^{2+}(aq) + 2Ag(s)$

The standard potential for this reaction is 0.46 V. Which change will increase the potential the most?

A. Doubling the $[Ag^{+}]$

B. Halving the $[Cu^{2+}]$

C. Doubling the size of the $Cu(s)$ electrode

D. Decreasing the size of the Ag electrode by one-half

Answer: A

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25.

$\left(10Cl^{-}(aq)+2MnO_4^{-}(aq)+16H^{+}(aq)\rightarrow 5Cl_2(g)+2Mn^{2+}+8H_2O\right)$(

The value of E° for this reaction at $25^{\circ}C$ is 0.15 V. What is the value of K for this reaction?

A. 2.4×10^{25}

B. 4.9×10^{12}

C. 1.2×10^{5}

D. 3.4×10^{2}

Answer: A

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26. What takes place when zinc metal is added to an aqueous solution containing magnesium nitrate and silver nitrate ?

1. Zn is oxidised 2. Mg^{2+} is reduced 3. Ag^{+} is reduced 4. No reaction takes place

A. 1 and 2 only

B. 1 and 3 only

C. 1, 2 and 3 only

D. 4 only

Answer: B

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27. In the galvanizing process, iron is coated with zinc. The resulting chemical protection is most similar to that provided when:

A. a magnesium bar is connected to an iron pipe

B. an iron can is plated with tin

C. copper pipes are connected using lead solder

D. a copper pipes is covered with epoxy paint

Answer: A

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28. What is the sign of ΔG^{Θ} and the values of K for an electrochemical cell for which E^{Θ}_{cell} = 0.80volt`?

A. $\begin{matrix} \Delta G^{\circ} & K \\ - & > 1 \end{matrix}$

B. $\begin{matrix} \Delta G^{\circ} & K \\ + & > 1 \end{matrix}$

C. $\begin{matrix} \Delta G^{\circ} & K \\ + & < 1 \end{matrix}$

D. $\begin{matrix} \Delta G^{\circ} & K \\ - & < 1 \end{matrix}$

Answer: A

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29. Consider a volatic cell based on these half -cell :

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

$Cd^{2+}(aq) + 2e^{-} \rightarrow Cd(s), E^{\circ} = -0.40V$

Identify the anode and give the voltage of this cell under standard conditions

A. $Ag, E_{\text{cell}} = 0.40V$

B. $Ag, E_{\text{cell}} = 2.00V$

C. $Cd, E_{\text{cell}} = 1.20V$

D. $Cd, E_{\text{cell}} = 2.00V$

Answer: C

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30. If $E^{\ominus}_{cell}$ for a given reaction is negative, which gives the correct relationships for the values of $\Delta G^{\ominus}$ 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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31. Which of the following solutions is used as an anti-rusting solution

A. Na_2SO_4

B. Na_3PO_4

C. Na_3BO_3

D. Na_2S

Answer: B

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32. If the pressure of H_2 gas is increase from (1) atm to 100 atm. Keeping H^+ concentration constatn at 1 M, the veltage of hydrogen half cell at $25^\circ C$ will be .

A. 0.059V

B. 0.59 V

C. 0.0295 V

D. 0.118V

Answer: D

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33. The efficiency of a hypothetical cell is about 84% which involves the following reactions:

$A(s) + B^{2+}(aq) \rightarrow A^{2+}(aq)_B(s)\ \Delta H = -285kJ$

Then, the standard electrode potential of the cell will be: (Asume `DeltaS = 0)

A. 1.20 V

B. 2.40 V

C. 1.10 V

D. 1.24 V

Answer: D

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34. A chemical reaction will be non-spontaneous if

A. E°_{cell} is positive

B. ΔG° is negative

C. reaction quotient, $Q < K$

D. E_{cell} is negative

Answer: D

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35. Match the List-I with List-II

	List-I (Electrode)		List-II (Type)
1	Calomel	(A)	Reference
2	Glass	(B)	Redox
3	Hydrogen	(C)	Membrane
4	Quinhydrone	(D)	Gas

A. $1-A, 2-C, 3-D, 4-B$

B. $1-B, 2-A, 3-D, 4-C$

C. $1-C, 2-B, 30A, 4-D$

D. $1-D, 2-A, 3-C, 4-B$

Answer: A

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36. The conductivity of saturated solution of $BaSO_4$ is $3.06 \times 10^{-6} ohm^{-1} cm^{-1}$ and its equivalent conductance is 1.53

$ohm^{-1}cm^2\text{equiv}^{-1}$. The K_{sp} for $BaSO_4$ will be:

A. $4 \times 10^{-12}M$

B. $4 \times 10^6 M$

C. $4 \times 10^{-12}M^2$

D. $4 \times 10^{-6}M^2$

Answer: D

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37. A standard hydrogen electrode has zero electrode potential because :

A. it is assumed

B. hydrogen is easiest to oxidise

C. hydrogen has single electron

D. hydrogen is electronegative

Answer: A

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38. I. Conductance of electolyte solution increases with temperature

II. Resistivity is reciprocal of molar conductivity of electrolyte.

III. Cell constant has unit cm^{-1}

A. if all the statement are correct

B. if II and III are correct

C. if I and III are correct

D. if only II is correct

Answer: C

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39. I. The conductivity of molten NaCl is due to movement of Na^{+} and Cl^{-} ions

II. Solide NaCl is also conductor of electricity.

III. Molten sodium is a good conductor because of mobile electrons

A. if all the statement are correct

B. if II and III are correct

C. if I and III are correct

D. if only II is correct

Answer: C

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

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

III. Chemical charge in electolytic cell is non-spontaneous

A. if all the statement are correct

B. if II and III are correct

C. if I and III are correct

D. if only II is correct

Answer: B

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41. In an experiment, 0.04 F was passed through 400 mL of a 1M solution of NaCl. What would be the pH of the solution after the electrolysis ?

A. 8

B. 10

C. 13

D. 6

Answer: C

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42. 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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43. Select the incorrect statements about dry cell:

A. It is also called Leclanche cell

B. It is alos called Daniell cell

C. Electrolyte used is moist paste of NH_4Cl and $ZnCl_2$

D. Cathodic process is:

$$2MnO_2(s) + 2NH_4^+(aq) + 2e^- \rightarrow Mn_2O_3(s) + 2NH_3(g) + H_2O(l$$

Answer: B

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44. Given the standard oxidation potentials

$$Fe \xrightarrow{+0.4V} Fe^{2+}(aq.) \xrightarrow{-0.8V} Fe^{3+}(aq.)$$

$$Fe \xrightarrow{+0.9V} Fe(OH)_2 \xrightarrow{0.6V} Fe(OH)_3$$

It is easier to oxidise `Fe^(2+) " to " Fe^(3+)in

A. acidic medium

B. alkaline medium

C. neutral medium

D. both in acidic and alkaline mediums

Answer: B

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45. Dipping iron article into a strongly alkaline solution of sodium phosphate :

A. does not affect the article

B. forms $Fe_2O_3. XH_2O$ on the surface

C. forms iron phosphate film

D. forms ferric hydroxide

Answer: C

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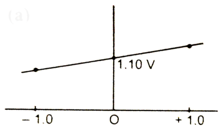
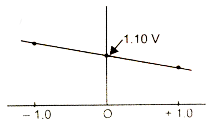
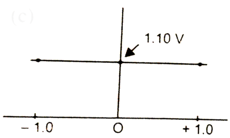
46. For the redox process

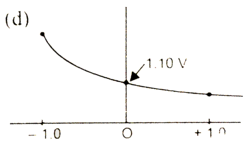
$$Zn(s) + Cu^{2+} \Leftrightarrow Zn^{2+} + Cu(s) E^{\circ}_{\text{cell}} = +1.10V$$

which graph correctly represents E_{cell} (Y-axis) as a function of log $\frac{[Zn^{2+}]}{[Cu^{2+}]}$ (X-axis) ?

A. 

B. 

C. 

D. 

Answer: B

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47. $C_4H_{10} + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l), \Delta H = -2878kJ$

ΔH is the heat of..........of butane gas.

A. $+4.74V$

B. $+0.547V$

C. $+1.09V$

D. $+4.37V$

Answer: C

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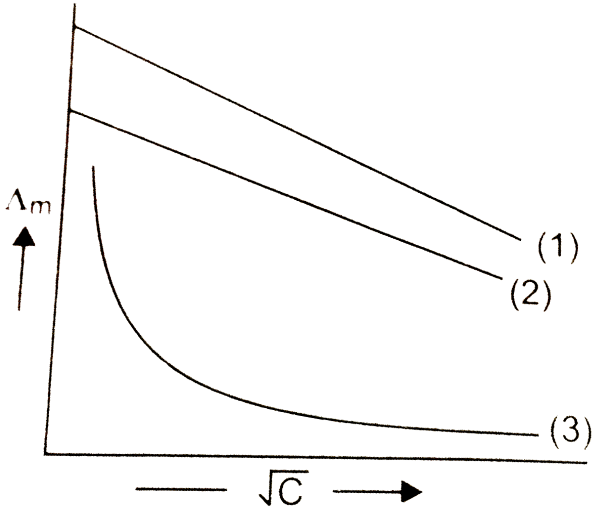
48. Molar conductance Λ_m is plotted against $\sqrt{C}$ (mol litre^{-1}) for three electrolytes $(NaCl, HCl, NH_4OH)$



which of the following is correct ?

A. $\begin{array}{ccc} 1 & 2 & 3 \\ NaCl & HCl & NH_4OH \end{array}$

B. $\begin{array}{ccc} 1 & 2 & 3 \\ HCl & NaCl & NH_4OH \end{array}$

C. $\begin{array}{ccc} 1 & 2 & 3 \\ NH_4OH & NaCl & HCl \end{array}$

D. $\begin{array}{ccc} 1 & 2 & 3 \\ NH_4OH & HCl & NaCl \end{array}$

Answer: B

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49. 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 :

A. 0.03V

B. 0.06V

C. $-0.06V$

D. $-0.03V$

Answer: C

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50. In the following process of disproportionation:

$$\underset{\text{Chlorate ion}}{2ClO_3^-} \Leftrightarrow \underset{\text{Per chlorate ion}}{ClO_4^-} \quad \begin{matrix} E^\circ_{ClO_4^- / ClO_3^-} & = +0.36V \\ E^\circ_{ClO_3^- / ClO_2^-} & = +0.33V \end{matrix}$$

Initial concentration of chlorate ion was 0.1 M. The equilibrium concentration of per chlorate ion will be :

A. 0.19 V

B. 0.1 M

C. 0.024 M

D. 0.019 M

Answer: D

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51. For the following electrochemical cell at 298 K,

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

$E_{\text{cell}} = 0.92V$ when $\dfrac{[M^{2+}(aq.)]}{[M^{4+}(aq.)]} = 10^x$

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

The value of x is :

A. -2

B. -1

C. 1

D. 2

Answer: D

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52. For the following cell,

$Zn(s)|ZnSO_4(aq)||CuSO_4(aq)| \mid Cu(s)$

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, $E^{\circ}(\text{cell}) = 1.1V$

A. $2.303RT + 1.1F$

B. $2.303RT - 2.2F$

C. $1.1F$

D. $-2.2F$

Answer: B

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One or more than correct answer

1. What is the difference between galvanic cell and electrolytic cell ?

A. In galvanic cell, electrical energy is profuced while in electrolytic cell electrical energy is consumed

B. In galvanic cell, anode is (-) ve while in electrolytic cell anode is (+) ve

C. In galvanic cell, cathode is (+) ve while in electrolytic cell anode is (-) ve

D. All are correct

Answer: D

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2. $Ag|Ag^+, KI||AgI|Ag$ emf is E, then K_{sp} of AgI is given as:

A. $K_{sp} = \frac{nF}{2.303RT}\log \quad E^{\circ}$

B. In $K_{sp} = nF\left[\frac{\delta E^{\circ}}{\delta T} - E^{\circ}\right]$

C. In $K_{sp} = \frac{nF}{E^{\circ}}$

D. log $K_{sp} = \frac{nFE^{\circ}}{2.303RT}$

Answer: D

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3. A hydrogen electrode X was placed in a buffer solution of sodium acetate and acetic acid in the ratio $a : n$ and another hydrogen electode Y was placed in a buffer solution of sodium acetate and acetic acid in the ratio $b : a$. If reduction potential values for two cells are found to be E_1 and E_2 respectively w.r.t standard hydrogen electrode, the pK_a value of the acid can be given as:

A. $\dfrac{E_1 + E_2}{0.118}$

B. $\dfrac{E_2 - E_1}{0.118}$

C. $\dfrac{-E_1 + E_2}{0.118}$

D. $\dfrac{E_1 - E_2}{0.118}$

Answer: A

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4. For which electrolyte $\alpha = \dfrac{\lambda_v}{\lambda_\infty}$ doesn't hold good ?

A. CH_3OH

B. $HCiO_4$

C. $HCOOH$

D. $NaNH_2$

Answer: B

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5. The main factors which affect corrosion are:

A. position of metal in electrochemical series

B. presence of CO_2 in water

C. presence of impurities in metal

D. preence of protective coating

Answer: A::B::C::D

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6. Which is correct about silver plating

A. Anode - pure Ag

B. Cathode - object to be electroplated

C. Electrolyte $-Na\left[Ag(CN)_2\right]$

D. Electrolyte $-AgNO_3$

Answer: A::B::C

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7. Lead storage battery contains

A. Pb rod as anode

B. Pb rod as cathode

C. Pb plants coated with PbO_2 act as cathode

D. electrolyte is H_2SO_4

Answer: A::C::D

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8. During the electrolyte of $AgNO_3$ (using Pt electrodes) concentration around cathode as well as anode falls from 4M to 3M. What will happened with Ag electrodes ?

A. Result will remain same

B. Concetration around cathode will fall from 4 M to 3 M but around anode will increase from 4 M to 5M

C. Reverse of statement (b)

D. Concentration increases from 4M to 5M on both the electrodes

Answer: B

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9. The EMF of the cell :

$Pt, H_2(1atm)|H^{\oplus}(aq)||AgCl|Ag$ is 0.27 and $0.26V$ at $25^{\circ}C$, respectively. The heat of the reaction occuring inside the cell at $25^{\circ}C$ is $\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots kJK^{-1}$

A. $-54.8kJ$

B. $26.05kJ$

C. $-26.05kJ$

D. $+54.8kJ$

Answer: A

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10. 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. $Zn(s) + 2H^{+}(aq.) \rightarrow Zn^{2+}(aq.) + 3H_2(g)$

Answer: A::C::D

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11. Which of the following statement is/are correct ?

A. One faraday is the charge carried by one mole of electrons

B. If same quantity of electricity flows through the solutions of 0.1 M $AgNO_3$ and 0.1 M $CuSO_4$ solutions, same weight of silver and copper will be deposited

C. Electrochemical equivalent has the units of grams per coulomb

D. Passage of one faraday of electricity produces one gram equivalent of the substance at the electode

Answer: A::C::D

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12. Which of the following statement is/are not correct ?

A. Zn-Cu cell is called Daniell cell

B. Rust is Fe_2O_3

C. Saline water slows down rusting

D. Pure metals undergo corrosion faster than impure metals

Answer: B::C::D

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13. In electrolysis of very dilute of $NaOH$ using platinum electrodes

A. H_2 is evolved at cathode

B. H_2 is produced at anode

C. Na is obatined at cathode

D. O_2 is produced at anode

Answer: A::D

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14. We observe blue colour if :

A. Cu electrode is placed in the $AgNO_3$ solution

B. Cu electrode is placed in the $ZnSO_4$ solution

C. Cu electrode is placed in the dil. HNO_3

D. Cu electrode is placed in dil. H_2SO_4

Answer: A::C

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15. In which of the following cell(s): $E_{\text{cell}} = E^{\circ}_{\text{cell}}$?

A. $Cu(s)|Cu^{2+}(0.01M)||Ag^{+}(0.1M)|Ag(s)$

B. $Pt(H_2)|pH = 1||Zn^{2+}(0.01M)|Zn(s)$

C. $Pt(H_2)|pH = 1||Zn^{2+}(1M)|Zn(s)$

D. $Pt(H_2)|H^{+} = 0.01M||Zn^{2+}(0.01M)|Zn(s)$

Answer: A::B

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16. Rusting on the surface of iron involves :

A. $Fe(s) \rightarrow Fe^{2+}(aq.) + 2e^{-} \quad (\text{at anodic site})$

B. $O_2(g) + 4H^+(aq.) + 4e^- \rightarrow 2H_2O(l) \quad$ (at cathodic site)

C. $4Fe^{2+}(aq.) + O_2(g) + 4H_2O(l) \rightarrow 2Fe_2O_3(s) + 8H^+$

D. $Fe_2O_3(s) + xH_2O(l) \rightarrow Fe_2O_3 . xH_2O$

Answer: A::B::C::D

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17. Fuel cell involves following reaction (s) :

A. $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq.) \quad$ (at cathode)

B. $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq.) \quad$ (at anode)

C. $2H_2(g) + 4OH^-(aq.) \rightarrow 4H_2O(l) + 4e^- \quad$ (at anode)

D. $2H_2(g) + 4OH^-(aq.) \rightarrow 4H_2O(l) + 4e^- \quad$ (at cathode)

Answer: A::C

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18. In the following question, more than one of the answers given may be correct. Select answers and mark it according to the code :

In a cell $Zn(s)|Zn^{2+}||H^+|H_2(Pt)$, the addition of H_2SO_4 to the cathode compartment, will :

1. decrease E

2. increase E

3. shift equilibrium to left

4. shift equilibrium to right

A. 1, 2 and 3 are correct

B. 1 and 2 are correct

C. 2 and 4 are correct

D. 1 and 3 are correct

Answer: C

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19. For the reduction of NO_3^- ion in an aqueous solution E° is $+0.96V$.

Value of E° for some metal ions are given below

$V^{2+}(aq) + 2e^- \rightarrow VE^\circ = -1.19V$

$Fe^{3+}(aq) + 3e^- \rightarrow FeE^\circ = -0.04V$

$Au^{3+}(aq) + 3e^- \rightarrow AuE^\circ = +1.40V$

$Hg^{2+}(aq) + 2e^- \rightarrow HgE^\circ = +0.86V$

The pair(s) of metal that is/are oxidised by NO_3^- in aqueous solution is(arE):

A. V and Hg

B. Hg and Fe

C. Fe and Au

D. Fe and V

Answer: A::B::D

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Assertion- Reason

1. 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. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: A

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2. Statement-I: In electrolysis the quantity needed for depositing 1 mole of silver is different from that required for 1 mole of copper.

Because Statement-II: The molecular weights of silver and copper are different.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: B

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

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

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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4. Statement-1: Zinc displaces copper from copper sulphate solution.

Statement-2: The E°_{298} of Zn is -0.76 volts and that of Cu is +0.34 volts.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: A

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5. (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. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: B

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6. Statement-1: If an aqueous solution of NaCl is electrolysed the product obtained at the cathode is H_2 gas notn Na.

Statement-2: Gases are liberated faster than the metals during the electrolysis of an electrolyte.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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7. (A) Specific conductance decreases with dilution whereas equivalent conductance increases.

(R) On dilution, number of ions per cc decreases but total number of ions increases considerably.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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8. (A) The cell constant of a cell depends upon the nature of the material of the electrodes.

(R) The observed conductance of a solution depends upon the nature of the material of the electrodes.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: D

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9. Assertion (A): The ration of specific conductivity to the observed conductance does not depend upon the concentration of the solution taken in the conductivity cell.

Reason (R): Specific conductivity decreases with dilution whereas observed conductance increases with the dilution.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: B

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10. 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 (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: B

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11. STATEMENT-1: 1 coulomb charge deposits 1 g-equivalent of a substance.

STATEMENT-2: 1 faraday is charge is charge on 1 mole of electrons.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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12. (A) If standard reduction potential for the reaction, $Ag^{+} + e^{-} \rightarrow Ag$ is 0.80 volt, then for the reaction, $2Ag^{+} + 2e^{-} \rightarrow 2Ag$, it will be 1.60 volt.

(R) If concentration of Ag^{+} ions is doubled, the electrode potential is also doubled.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: D

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13. Statement-1: Gold chloride $(AuCl_3)$ solution cannot be stored in a vessel made of copper, iron, nickel, chromium, zinc or tin.

Statement-2 Gold is a very precious metal.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: B

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14. 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 (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: D

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15. 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 (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: A

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16. Assertion (A): The presence of CO_2 in the air accelerates corrosion.

Reason (R): CO_2 is a poisonous gas.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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17. Assertion (A): For a Daniell cell :

$Zn|Zn^{2+}||Cu^{2+}|Cu$ 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 (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: B

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18. Assertion (A): A current of 96.5 amperes is passed into aquesous $AgNO_3$ solution for 100 seconds. The weight of silver deposited is $10.8g$ (At.wt. of Ag=108).

Reason (R): The mass of a substance deposited during the electrolysis of an electrolyte is inveresly propotional to the quantity passing through the electrolyte.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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19. (A) According to Kohlrausch's law, the molar conductance of a strong electrolyte at infinite dilution is sum of molar conductivities of its ions.

(R) The current carried by cation and anion is always equal.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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20. 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 : The cell potential of mercury cell is $1.35V$, which remains constant .

Reason : In mercury cell, the electrolute is a paste of KOH and ZnO.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: B

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21. (A) The charge of one mole of electron is one faraday.

(R) The quantity of current required to deposite one mol of Mg from Mg^{2+} electrolyte solution is two faradays.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: B

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22. Statement -1 : During the electrolysis of water, two faraday of charge will produce a total of 33.6 litre of gases at STP at electrodes.

Statement -2 : In the electrolysis of water, two faraday of charge will produce half mole of H_2 gas and one fourth mole of O_2 gas.

A. Statement-1 is true, Statement-2 is true, statement-2 is a correct explanation for statement-1.

B. Statement-1 is true , statement-2 is true, statement-2 is not a correct explanation for statement-1.

C. Statement-1 is true, statement-2 is false.

D. statement-1 is false, statement-2 is true.

Answer: C

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23. Statement -1 : Aqueous solution of $CuSO_4$ turns colourless on complete electrolysis using platinum electrode.

Statement -2 : $CuSO_4$ is converted into $Cu(OH)_2$ on electrolysis.

A. Statement-1 is true, Statement-2 is true, statement-2 is a correct explanation for statement-1.

B. Statement-1 is true , statement-2 is true, statement-2 is not a correct explanation for statement-1.

C. Statement-1 is true, statement-2 is false.

D. statement-1 is false, statement-2 is true.

Answer: C

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24. Statement -1 : Sodium ions are discharged at a mercury cathode in perference to hydrogen ion.

Statement -2 : Na^{+} is stronger reducing agent than H^{+}.

A. Statement-1 is true, Statement-2 is true, statement-2 is a correct explanation for statement-1.

B. Statement-1 is true , statement-2 is true, statement-2 is not a correct explanation for statement-1.

C. Statement-1 is true, statement-2 is false.

D. statement-1 is false, statement-2 is true.

Answer: B

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25. Statement -1 : KCl and NH_4Cl cannot be used in salt bridge of a cell containing Ag^+, Hg_2^{2+} and Tl^+ ions.

Statement -2 : Cell will be destroyed due to precipitation of metal chlorides.

A. Statement-1 is true, Statement-2 is true, statement-2 is a correct explanation for statement-1.

B. Statement-1 is true , statement-2 is true, statement-2 is not a correct explanation for statement-1.

C. Statement-1 is true, statement-2 is false.

D. statement-1 is false, statement-2 is true.

Answer: A

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

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

A. Statement-1 is true, Statement-2 is true, statement-2 is a correct explanation for statement-1.

B. Statement-1 is true , statement-2 is true, statement-2 is not a correct explanation for statement-1.

C. Statement-1 is true, statement-2 is false.

D. statement-1 is false, statement-2 is true.

Answer: A

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27. Statement -1 : In alkaline version of dry cell, NH_4Cl is replaced by KOH.

Statement -2 : Zinc container does not undergo corrosion in alkaline medium.

A. Statement-1 is true, Statement-2 is true, statement-2 is a correct explanation for statement-1.

B. Statement-1 is true , statement-2 is true, statement-2 is not a correct explanation for statement-1.

C. Statement-1 is true, statement-2 is false.

D. statement-1 is false, statement-2 is true.

Answer: A

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Matching Type Question

1. Match the List -I with List -II and List -III :

List-I (Quantity)	List-II (Symbol)	List-III (Unit)
(a) Conductivity	(p) Λ_m	(u) mho cm^{-1}
(b) Cell constant	(q) κ	(v) cm^{-1}
(c) Molar conductance	(r) Λ_e	(w) $ohm^{-1}\ cm^2\ mol^{-1}$
(d) Equivalent conductance	(s) l/A	(x) $ohm^{-1}\ cm^2\ eq^{-1}$

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2. Match the salts in the Column-I with their use in Column -II :

Column-I	Column-II
(a) Hg_2Cl_2	(p) Salt bridge
(b) Agar-agar	(q) Calomel electrode
(c) 0.1 N KCl	(r) Used in ice cream
(d) Quinhydrone	(s) Redox electrode

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3. Match the Column-I with Column-II :

Column-I (Term)	Column-II (Relation)
(a) α (Degree of ionisation)	(p) λ^{+}/Λ
(b) t_{+} (Transport number)	(q) Λ_m^c/Λ_m^0
(c) Fraction of a mole undergoing ionization	(r) $U^{+}/U^{+}+U^{-}$
(d) NaCl	(s) Λ_e^c/Λ_e^0
	(t) $\Lambda_m = \Lambda_e$

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4. Match the physical quantities in the List-I with their units in List-II :

Match the physical quantities in ... List-II:

List-I	List-II
(a) Resistance	(p) ohm
(b) Resistivity	(q) volt amp^{-1}
(c) Conductivity	(r) ohm m
(d) Specific conductance	(s) ohm^{-1} m^{-1}

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5. Match the Column-I with Column-II :

5. Match the Column-I with Column-II:

Column-I	Column-II
(a) Specific conductance, κ	(p) Λ_m^c / Λ_m
(b) Molar conductance, Λ_m	(q) Decreases with dilution
(c) Resistance of electrolyte solution R	(r) Increases with dilution
(d) Degree of ionization of weak electrolyte, α	(s) Increases with increase in the distance between parallel plates

6. Match the Column-I with Column-II :

Column-I (Combination of half-cell reactions)	Column-II (Potential of overall process)
(a) $6OH^- + Br^- \rightleftharpoons BrO_3^- + 3H_2O + 6e^-$ $E^\circ = -0.61\ V$; $2OH^- + Br^- \rightleftharpoons BrO^- + H_2O + 2e^-$ $E^\circ = -0.76\ V$; $4OH^- + BrO^- \rightleftharpoons BrO_3^- + 2H_2O + 4e^-$ $E^\circ = ?$	(p) $E^\circ = 0.56\ V$
(b) $H_2SO_3 + 4H^+ + 4e^- \rightleftharpoons S + 3H_2O$ $E^\circ = 0.45\ V$; $SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons H_2SO_3 + H_2O$ $E^\circ = 0.17\ V$; $SO_4^{2-} + 8H^+ + 6e^- \rightleftharpoons S + 4H_2O$ $E^\circ = ?$	(q) $E^\circ = -0.535\ V$
(c) $ClO_3^- + 6H^+ + 6e^- \rightleftharpoons Cl^- + 3H_2O$ $E^\circ = +1.45\ V$; $Cl_2 + 2e^- \rightleftharpoons 2Cl^-$ $E^\circ = +1.36\ V$; $ClO_3^- + 6H^+ + 5e^- \rightleftharpoons \frac{1}{2}Cl_2 + 3H_2O$ $E^\circ = ?$	(r) $E^\circ = +0.36\ V$
(d) $Zn^{2+}_{(aq.)} + 2e \longrightarrow Zn(s)$ $E^\circ = -0.76\ V$; $Ag^+ + e^- \longrightarrow Ag(s)$ $E^\circ = +0.80\ V$; $Zn(s) + 2Ag^+ \rightleftharpoons Zn^{2+}(aq.) + 2Ag(s)$ $E^\circ = ?$	(s) $E^\circ = +1.47\ V$

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7. Match the Column-I with Column-II :

Column-I	Column-II
(a) Concentration cell	(p) Fe is oxidised by Ni_2O_3
(b) Edison cell	(q) Zinc anode
(c) Mercury cell	(r) HgO cathode
(d) Dry cell	(s) $E^\circ = 0$

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8. Match the Column-I with Column-II :

Column-I (Electrode)	Column-II (Type)
(a) Calomel	(p) Reference
(b) Glass	(q) Redox
(c) Hydrogen	(r) Membrane
(d) Quinhydrone	(s) Gas

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9. Match the Column-I with Column-II :

Column-I	Column-II
(a) Kohlrausch law	(p) $\Lambda_m / \Lambda_m^\circ$
(b) Λ_m	(q) $\frac{1}{R} \times \frac{1}{A}$
(c) κ (kappa)	(r) $\Lambda_m Ca_3(PO_4)_2 = 3\lambda^\circ Ca^{2+} + 2\lambda^\circ PO_4^{3-}$
(d) α	(s) $\kappa \times \frac{1000}{M}$

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10. Match the Column-I with Column-II :

Match the Column-I with Column-II.

Column-I	Column-II
(a) $E^\circ = 0$	(p) Cell is discharged
(b) $E = 0$	(q) $Q = K$
(c) $\Delta G = 0$	(r) 96500 coulomb
(d) 1 Faraday	(s) 1 mol electrons
	(t) Concentration cell

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11. The standard reduction potential data at $25^{\circ}C$ is given below

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

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

$$E^{\circ}\left(Cu^{2+}, Cu\right) = +0.34V,$$

$$E^{\circ}\left(Cu^{+}, Cu\right) = +0.52V,$$

$$E^{\circ}\left(O_2(g) + 4H^{+} + 4e^{-} \rightarrow 2H_2O\right] = +1.23V$$

$$E^{\circ}\left[\left(O_2(g) + 2H_2O + 4e^{-} \rightarrow 4OH^{-}\right)\right] = +0.40V,$$

$$E^{\circ}\left(Cr^{3+}, Cr\right) = -0.74V,$$

$$E^{\circ}\left(Cr^{2+}, Cr\right) = -0.91V,$$

Match E° of the redox pair in List-I with the values given in List-II and select the correct answer using the code given below teh lists:

$List - I$	$List - II$
$(P) E^{\circ}\left(Fe^{3+}, Fe\right)$	$(1) - 0.18V$
$(Q) E^{\circ}\left(4H_2O \Leftrightarrow 4H^{+} + 4OH^{+}\right)$	$(2) - 0.4V$
$(R) E^{\circ}\left(Cu^{2+} + Cu \rightarrow 2Cu^{+}\right)$	$(3) - 0.04V$
$(S) E^{\circ}\left(Cr^{3+}, Cr^{2+}\right)$	$(4) - 0.83V$

Codes:

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, S = 4

D. P = 3, Q = 4, R = 1, S = 2

Answer: D

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Integer Type Question

1. How many grams of water will be electrolysed by 96500 coulomb charge ?

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2. The charge required for the reduction of 1 mole of $Cr_2O_7^{2-}$ ions to Cr^{3+} is

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3. At what pH the potential of hydrogen electrode will be 0.059 V ?

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4. The ratio of $\left(\frac{\Lambda_m}{\Lambda_e}\right)$ for $Ca_3(PO_4)_2$ will be equal to :

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5. $I_2(s) \mid I^-$(0.1M) half cell is connected to a H^+ (aq)|H_2(1 bar)|Pt half celland e.m.f. is found to be 0.7714 V. If $E^\circ_{I_2 \mid I^-}$=0.535 V, find the pH of $H^+ \mid H_2$ half cell.

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6. If an aqueous solution of NaCl is electrolysed using platinum electrode by a currect of 5 amp, then what volume of Cl_2 gas in litres at STP will be produced ?

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7. Charge of 6.24×10^{18} electrons will be (in coulomb) :

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8. 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

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9. $Cr(s)|Cr^{3+}||Fe^{2+}|Fe(s)$

In above cell, the value of n in the Nernst equation :

i.e., $E = E^{\circ} - \frac{0.059}{n} \log_{10} Q$ will be :

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10. The Nernst equation E=E°-RT/nF in Q indicates that the Q will be equal to equilibrium constant K_c when:

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11. 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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12. All the energy realesed from the reation $X \rightarrow Y, \Delta_r G^{\circ} = -193kJmol^{-1}$, is used for oxidizing M^+ as $M^+ \rightarrow M^{3+} + 2e^-, E^{\circ} = -0.25V$. Under standard consistions, the number of moles of M^+ oxidized when on e mol of X is converted to Y is $\left[F = 96, 500C\text{mol}^{-1}\right]$

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13. The conductance of 0.0015 M aqueous solution of a weak monobasic acid was determined by using a conductivity cell consisting of platinized Pt electrodes. The distance between the electrodes is 120 cm with an area of cross-section of $1 cm^2$. The conductance of this solution was found to be $5 \times 10^{-7} S$. The pH of the solution is 4. Calculate the value of limiting molar conductivity.

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14. In lead storage battery, how many moles of electrons will be involved in the consumption of 98 g of sulphuric acid ?

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15. The cell potential of dry cell when it is discharged will be :

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16. For the cell :

$Cr(s)|Cr^{3+}||Fe^{2+}|Fe(s)$

$\Delta G^{\circ} = -nFE^{\circ}$, the value of n will be :

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LINKED COMPREHENSION TYPE QUESTION

1. In a lead storag battery, Pb (anode) and PbO_2 (cathode) are used. Concentrated H_2SO_4 is used as electrolyte. The battery holds 3.5 litre acid with it . In the discharge process, the density of acid fell from 1.294 to 1.139 g/mL. The sulphuric acid of density 1.294 g mL^{-1} is 39 % by mass and that of density 1.139 g/mL is 20% by mass.

Equivalent mass of sulphuric acid in lead storage battery is :

A. 49

B. 98

C. 24.5

D. none of these

Answer: B

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2. During the discharge of a lead storage battery, the density of sulphuric acid fell from $1.294 gmL^{-1}$ to $1.139 gmL^{-}$. Sulphuric acid of density $1.294 gmL^{-1}$ is 39% by weight and that of density $1.139 gmL^{-1}$ is 20% by weight. The battery hold 3.5 litre of acied and discharge. Calculate the no. of ampere hour for which the battery must have been used. The charging and discharging reactions are:

$Pb + SO_4^{2-} \rightarrow PbSO_4 + 2e$ (charging)

$PbO_2 + 4H^+ + SO_4^{2-} + 2e \rightarrow PbSO_4 + 2H_2O$ (discharging)

A. 5.15, 2.32

B. 2.32, 5.15

C. 5.15, 5.15

D. 2.32, 2.32

Answer: A

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3. During the discharge of a lead storage battery, the density of sulphuric acid fell from $1.294 gmL^{-1}$ to $1.139 gmL^{-}$. Sulphuric acid of density $1.294 gmL^{-1}$ is 39% by weight and that of density $1.139 gmL^{-1}$ is 20% by weight. The battery hold 3.5 litre of acied and discharge. Calculate the no. of ampere hour for which the battery must have been used. The charging and discharging reactions are:

$Pb + SO_4^{2-} \rightarrow PbSO_4 + 2e$ (charging)

$PbO_2 + 4H^+ + SO_4^{2-} + 2e \rightarrow PbSO_4 + 2H_2O$ (discharging)

A. 26504 amp-hrs

B. 2650.4 amp-hrs

C. 265.04 amp-hrs

D. 26.504 amp-hrs

Answer: C

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4. In a lead storag battery, Pb (anode) and PbO_2 (cathode) are used. Concentrated H_2SO_4 is used as electrolyte. The battery holds 3.5 litre acid with it . In the discharge process, the density of acid fell from 1.294 to 1.139 g/mL. The sulphuric acid of density 1.294 g mL^{-1} is 39 % by mass and that of density 1.139 g/mL is 20% by mass.

The amount of charge which the battery must have been used is :

A. 9.88 F

B. 8.98 F

C. 8.89 F

D. 7.88 F

Answer: A

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5. In a lead storag battery, Pb (anode) and PbO_2 (cathode) are used. Concentrated H_2SO_4 is used as electrolyte. The battery holds 3.5 litre acid with it . In the discharge process, the density of acid fell from 1.294 to 1.139 g/mL. The sulphuric acid of density 1.294 g mL^{-1} is 39 % by mass and that of density 1.139 g/mL is 20% by mass.

Which of the following takes place in discharge process at anode ?

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

B. $PbSO_4 + 2H_2O \rightarrow PBO_2 + 4H^+ + SO_4^{2-} + 2e^-$

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

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

Answer: C

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6. Electrolysis is the process in which electrical energy is converted to chemical energy. In electrolytic cell, oxidation takes place at anode and reduction at cathode. Electrode process depends on the electrode taken for electrolysis. Amount of substance liberated at an electrode is directly propertional to the amount of charge passed through it. The mass of substance liberated at electrode is calculated using the following relation :

$$m = \frac{\text{ItE}}{96500}$$

Here, E represents the equivalent mass and 96500 C is called the Faraday constant. Faraday (96500 C) is the charge of 1 mole electron, i.e., 6.023×10^{23} electrons, it is used to liberate one gram equivalent of the substance.

The platinum electrodes were immersed in a solution of cupric sulphate $(CuSO_4)$ and electric current is passed through the solution. after sometime, it was observed that the colour of copper sulphate disappeared with evolution of a gas at the electrode. The colourless solution contains :

A. platinum sulphate

B. copper nitrate

C. copper sulphate

D. sulphuric acid

Answer: D

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7. Electrolysis is the process in which electrical energy is converted to chemical energy. In electrolytic cell, oxidation takes place at anode and reduction at cathode. Electrode process depends on the electrode taken for electrolysis. Amount of substance liberated at an electrode is directly propertional to the amount of charge passed through it. The mass of substance liberated at electrode is calculated using the following relation :

$$m = \frac{\mathrm{ItE}}{96500}$$

Here, E represents the equivalent mass and 96500 C is called the Faraday constant. Faraday (96500 C) is the charge of 1 mole electron, i.e.,

6.023×10^{23} electrons, it is used to liberate one gram equivalent of the substance.

The passage of current liberates H_2 at cathode and Cl_2 at anode. The solution is :

A. copper chloride in water

B. NaCl in water

C. mercuric chloride in water

D. $AuCl_3$ in water

Answer: B

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8. Electrolysis is the process in which electrical energy is converted to chemical energy. In electrolytic cell, oxidation takes place at anode and reduction at cathode. Electrode process depends on the electrode taken for electrolysis. Amount of substance liberated at an electrode is directly propertional to the amount of charge passed through it. The mass of

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$$m = \frac{\text{ItE}}{96500}$$

Here, E represents the equivalent mass and 96500 C is called the Faraday constant. Faraday (96500 C) is the charge of 1 mole electron, i.e., 6.023×10^{23} electrons, it is used to liberate one gram equivalent of the substance.

On electrolysis of dilute sulphuric acid using platinum electrodes, the product obtained at the anode will be :

A. hydrogen

B. oxygen

C. hydrogen sulphide

D. sulphur oxide

Answer: B

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9. Electrolysis is the process in which electrical energy is converted to chemical energy. In electrolytic cell, oxidation takes place at anode and reduction at cathode. Electrode process depends on the electrode taken for electrolysis. Amount of substance liberated at an electrode is directly propertional to the amount of charge passed through it. The mass of substance liberated at electrode is calculated using the following relation :

$$m = \frac{\mathrm{ItE}}{96500}$$

Here, E represents the equivalent mass and 96500 C is called the Faraday constant. Faraday (96500 C) is the charge of 1 mole electron, i.e., 6.023×10^{23} electrons, it is used to liberate one gram equivalent of the substance.

How many faradays are required to reduce 1 mol BrO_3^- to Br^- ?

A. 3

B. 5

C. 6

D. 4

Answer: C

Watch Video Solution

10. Electrolysis is the process in which electrical energy is converted to chemical energy. In electrolytic cell, oxidation takes place at anode and reduction at cathode. Electrode process depends on the electrode taken for electrolysis. Amount of substance liberated at an electrode is directly propertional to the amount of charge passed through it. The mass of substance liberated at electrode is calculated using the following relation :

$$m = \frac{\mathrm{ItE}}{96500}$$

Here, E represents the equivalent mass and 96500 C is called the Faraday constant. Faraday (96500 C) is the charge of 1 mole electron, i.e., 6.023×10^{23} electrons, it is used to liberate one gram equivalent of the substance.

Calculate the volume of gas liberated at the anode at STP during the electrolysis of a $CuSO_4$ solution by a current of 1 A passed for 16 minutes and 5 seconds :

A. 224 mL

B. 56 mL

C. 112 mL

D. 448 mL

Answer: B

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11. Electrolysis is the process in which electrical energy is converted to chemical energy. In electrolytic cell, oxidation takes place at anode and reduction at cathode. Electrode process depends on the electrode taken for electrolysis. Amount of substance liberated at an electrode is directly propertional to the amount of charge passed through it. The mass of substance liberated at electrode is calculated using the following relation :

$$m = \frac{\text{ItE}}{96500}$$

Here, E represents the equivalent mass and 96500 C is called the Faraday constant. Faraday (96500 C) is the charge of 1 mole electron, i.e., 6.023×10^{23} electrons, it is used to liberate one gram equivalent of the substance.

The quantity of electricity required to liberate 112 cc hydrogen at S.T.P. from acidified water is :

A. 965 C

B. 9650 C

C. 96500 C

D. 4825 C

Answer: A

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12. 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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13. The concentration of potassium ions inside a biological cell is at least 20 times higher than outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simplel model for a concentration cell involving a metal M is

$M(s) \mid M^{\oplus}(aq, 0.05 \text{ molar}) \mid \mid M^{\oplus}(aq, 1 \text{ molar}) \mid M(s)$

For the abov electrolytic cell, the magnitude of the cell potential is $|E_{cell}| = 70mV$.

If the 0.05 moolar solution of $M^{\oplus}$ is replaced by a 0.0025 molar $M^{\oplus}$ solution, then the magnitude of the cell potential would be

A. 35 mV

B. 70 mV

C. 140 mV

D. 700 mV

Answer: C

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14. For an electrode reaction written as

$M^{n+} + ne^{-} \rightarrow M$,

$$E_{\text{red}} = E^{\circ}_{\text{red}} - \frac{RT}{nf}\frac{\ln(1)}{[M^{n+}]}$$

$$= E^{\circ}_{\text{red}} - \frac{0.059}{n}\text{llog}\frac{1}{[M^{n+}]}$$ at 298 k

For the cell reaction $aA + bB \rightarrow xX + yY$

$$\Rightarrow E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{RT}{nf}\log\frac{[X]^x[Y]^y}{[A]^a[B]^b}$$

For pure solids, liquids or gases at lampt.

molarconc = 1

Std. free energy change $\Delta G^{\circ} = -nfE^{\circ}$ where f - for faraday = 96,500

c, n = no. of e^{-}

$\Delta G = -2.303RT\log K_c$ where K_c is equilibrium constant K_c can be

calculated by using E° of cell.

On the basis if information avaliable from the reaction

$$\frac{4}{3}Al + O_2 \rightarrow \frac{2}{3}Al_2O_3\Delta G = -827kJ/mol^{-1}$$

The minimum emf required to carry out an electrolysis of Al_2O_3 is

A. 2.14 V

B. 4.28 V

C. 6.42 V

D. 8.56 V

Answer: A

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15. The driving force ΔG diminishes to zero on the way to equilibrium, just as in any other spontaneous process. Both ΔG and the corresponding cell potential $\left(E = -\dfrac{\Delta G}{nF}\right)$ are zero when the redox reaction comes to equilibrium. The Nernst equation for the redox process of the cell may be given as :

$$E = E^\circ - \frac{0.059}{n} \log Q$$

The key to the relationship is the standard cell potential E°, derived from the standard free energy changes as :

$$E^\circ = -\frac{\Delta G^\circ}{nF}$$

At equilibrium, the Nernst equation is given as :

$$E^\circ = \frac{0.059}{n} \log K$$

the equilibrium constant K_c will be equal to Q, when :

A. $E = E^\circ$

B. $RT/nF = 1$

C. $E = 0$

D. $E^\circ = 1$

Answer: C

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16. The driving force ΔG diminishes to zero on the way to equilibrium, just as in any other spontaneous process. Both ΔG and the corresponding cell potential $\left(E = -\frac{\Delta G}{nF}\right)$ are zero when the redox reaction comes to equilibrium. The Nernst equation for the redox process of the cell may be given as :

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$$E^\circ = -\frac{\Delta G^\circ}{nF}$$

At equilibrium, the Nernst equation is given as :

$$E^\circ = \frac{0.059}{n}\log K$$

The nature of graph of E°_{cell} against $\log K_c$ is a/an :

A. straight line

B. parabola

C. hyperbola

D. elliptical curve

Answer: A

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17. The driving force ΔG diminishes to zero on the way to equilibrium, just as in any other spontaneous process. Both ΔG and the corresponding cell potential $\left(E = -\dfrac{\Delta G}{nF}\right)$ are zero when the redox reaction comes to equilibrium. The Nernst equation for the redox process of the cell may be given as :

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$$E^\circ = -\frac{\Delta G^\circ}{nF}$$

At equilibrium, the Nernst equation is given as :

$$E^\circ = \frac{0.059}{n} \log K$$

The equilibrium constant K_c for the reaction :

$Cu(s) + 2Ag^+(aq.) + 2Ag(s) \quad (E^\circ_{cell} = 0.46V)$ will be :

A. antilog 15.6

B. antilog 2.5

C. antilog 1.5

D. antilog 12.2

Answer: A

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18. E° for the cell

$Zn(s)\left|Zn^{2+}(aq)\right|Cu^{2+}(aq) \mid Cu(s)$ is 1.1V at $25^\circ C$ the equilibrium constant for the cell reaction is about

A. 10^{-37}

B. 10^{37}

C. 10^{-39}

D. 10^{39}

Answer: B

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19. Conductors allow the passage of electric current through them. Metallic and electrolytic are the two type of conductors. Current carriers in metallic and electrolytic conductors are free electrons and free ions respectively. Specific conductance or consuctivity of the electrolyte solution is given by the following relation :

$$\kappa = c \times \frac{l}{A}$$

where, $c = 1/R$ is the conductance and l/A is the cell constant. Molar conductance (Λ_m) and equivalence conductance (Λ_e) of an electrolyte solution are calculated using the following similar relations :

$$\Lambda_m = \kappa \times \frac{1000}{M}$$

$$\Lambda_e = \kappa \times \frac{1000}{N}$$

Where, M and N are the molarity and normality of the solution respectively. Molar conductance of strong electrolyte depends on concentration :

$$\Lambda_m = \Lambda_m^\circ - b\sqrt{c}$$

where, $\Lambda_m^\circ =$ molar conductance at infinite dilution

c= concentration of the solution

b= constant

The degrees of dissociation of weak electrolytes are calculated as :

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{\Lambda_e}{\Lambda_e^\circ}$$

Which of the following decreases on dilution of electrolyte solution ?

A. Equivalent conductance

B. Molar conductance

C. Specific conductance

D. Conductance

Answer: C

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20. Conductors allow the passage of electric current through them. Metallic and electrolytic are the two type of conductors. Current carriers in metallic and electrolytic conductors are free electrons and free ions respectively. Specific conductance or consuctivity of the electrolyte solution is given by the following relation :

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c= concentration of the solution

b= constant

The degrees of dissociation of weak electrolytes are calculated as :

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{\Lambda_e}{\Lambda_e^\circ}$$

The correct order of equivalent conductances at infinite dilution of LiCl, NaCl and KCl is :

A. $LiCl > NaCl > KCl$

B. $KCl > NaCl > LiCl$

C. $NaCl > KCl > LiCl$

D. $LiCl > KCl > NaCl$

Answer: B

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21. Conductors allow the passage of electric current through them. Metallic and electrolytic are the two type of conductors. Current carriers in metallic and electrolytic conductors are free electrons and free ions respectively. Specific conductance or consuctivity of the electrolyte solution is given by the following relation :

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$$\Lambda_m = \Lambda_m^\circ - b\sqrt{c}$$

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c= concentration of the solution

b= constant

The degrees of dissociation of weak electrolytes are calculated as :

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{\Lambda_e}{\Lambda_e^\circ}$$

For which of the following electrolytic solution Λ_m and Λ_e are equal ?

A. $BaCl_2$

B. KCl

C. $Al_2(SO_4)_3$

D. $CaCl_2$

Answer: B

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22. Conductors allow the passage of electric current through them. Metallic and electrolytic are the two type of conductors. Current carriers in metallic and electrolytic conductors are free electrons and free ions respectively. Specific conductance or consuctivity of the electrolyte solution is given by the following relation :

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Where, M and N are the molarity and normality of the solution respectively. Molar conductance of strong electrolyte depends on concentration :

$$\Lambda_m = \Lambda_m^\circ - b\sqrt{c}$$

where, $\Lambda_m^\circ =$ molar conductance at infinite dilution

c= concentration of the solution

b= constant

The degrees of dissociation of weak electrolytes are calculated as :

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{\Lambda_e}{\Lambda_e^\circ}$$

The conductance of a solution of an electrolyte is equal to that of its specific conductance. The cell constant of the conductivity cell is equal to :

A. resistance

B. faraday

C. zero

D. unity

Answer: D

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23. Conductors allow the passage of electric current through them. Metallic and electrolytic are the two type of conductors. Current carriers in metallic and electrolytic conductors are free electrons and free ions respectively. Specific conductance or consuctivity of the electrolyte solution is given by the following relation :

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$$\Lambda_m = \Lambda_m^\circ - b\sqrt{c}$$

where, $\Lambda_m^\circ =$ molar conductance at infinite dilution

c= concentration of the solution

b= constant

The degrees of dissociation of weak electrolytes are calculated as :

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{\Lambda_e}{\Lambda_e^\circ}$$

Which of the following equality holds good for the strong electrolytes ?

A. $\Lambda = \Lambda^\circ$ as $c \to 1$

B. $\Lambda = \Lambda^\circ$ as $c \to 0$

C. $\Lambda = \Lambda^\circ$ as $c \to \infty$

D. $\Lambda = \Lambda^\circ$ as $c \to \sqrt{b}$

Answer: B

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24. At infinite dilution, when the dissociation of electrolyte is complete, each ion makes a definite contribution towards the molar conductance of electrolyte, irrespective of the nature of the other ion with which it is associated.

the molar conductance of an electrolyte at infinite dilution can be expressed as the sum of the contributions from its individual ions.

$$A_xB_y \to xA^{y+} + yB^{x-}$$

$$\Lambda_m^\circ(A_xB_y) = x\lambda^\circ_{A^{y+}} + y\lambda^\circ_{B^{x-}}$$

where, x and y are the number of cations and anions respectively.

The degree of ionisation $'\alpha'$ of weak electrolyte can be calculated as :

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$$

The ionic conductances of Al^{3+} and SO_4^{2-} ions at infinite dilution are x and y $ohm^{-1}cm^2mol^{-1}$ respectively. If Kohlrausch's law is valid then molar conductance of aluminium sulphate at infinite dilution will be :

A. 3x + 2y

B. 3y + 2x

C. 2x + 2y

D. 3x + 3y

Answer: B

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25. At infinite dilution, when the dissociation of electrolyte is complete, each ion makes a definite contribution towards the molar conductance of electrolyte, irrespective of the nature of the other ion with which it is associated.

the molar conductance of an electrolyte at infinite dilution can be expressed as the sum of the contributions from its individual ions.

$$A_xB_y \rightarrow xA^{y+} + yB^{x-}$$

$$\Lambda_m^\circ(A_xB_y) = x\lambda_{A^{y+}}^\circ + y\lambda_{B^{x-}}^\circ$$

where, x and y are the number of cations and anions respectively.

The degree of ionisation $'\alpha'$ of weak electrolyte can be calculated as :

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$$

The molar conductances at infinite dilution for electrolytes BA and CA are 140 and 120 $ohm^{-1}cm^2mol^{-1}$. If the molar conductance at infinite dilute dilution of BX is 198 $ohm^{-1}cm^2mol^{-1}$, then at infinite dilution, the molar conductance of CX is :

A. 178

B. 198

C. 218

D. 130

Answer: A

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26. At infinite dilution, when the dissociation of electrolyte is complete, each ion makes a definite contribution towards the molar conductance of electrolyte, irrespective of the nature of the other ion with which it is associated.

the molar conductance of an electrolyte at infinite dilution can be expressed as the sum of the contributions from its individual ions.

$A_xB_y \rightarrow xA^{y+} + yB^{x-}$

$\Lambda_m^{\circ}(A_xB_y) = x\lambda_{A^{y+}}^{\circ} + y\lambda_{B^{x-}}^{\circ}$

where, x and y are the number of cations and anions respectively.

The degree of ionisation $'\alpha'$ of weak electrolyte can be calculated as :

$\alpha = \dfrac{\Lambda_m}{\Lambda_m^{\circ}}$

The molar conductance of 0.001 M acetic acid is $50 ohm^{-2} cm^2 mol^{-1}$. The maximum value of molar conductance of acetic acid is $250 ohm^{-1} cm^2 mol^{-1}$. What is the degree of dissociation (α) of acetic acid ?

A. 0.5

B. 0.2

C. 0.3

D. 0.4

Answer: B

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27. At infinite dilution, when the dissociation of electrolyte is complete, each ion makes a definite contribution towards the molar conductance of electrolyte, irrespective of the nature of the other ion with which it is associated.

the molar conductance of an electrolyte at infinite dilution can be expressed as the sum of the contributions from its individual ions.

$A_xB_y \rightarrow xA^{y+} + yB^{x-}$

$\Lambda_m^\circ(A_xB_y) = x\lambda_{A^{y+}}^\circ + y\lambda_{B^{x-}}^\circ$

where, x and y are the number of cations and anions respectively.

The degree of ionisation $'\alpha'$ of weak electrolyte can be calculated as :

$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$

Which of the following solution will have highest value of the molar conductance of CH_3COOH ?

A. $1MCH_3COOH$

B. $0.5MCH_3COOH$

C. $0.3MCH_3COOH$

D. $0.1MCH_3COOH$

Answer: D

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28. At infinite dilution, when the dissociation of electrolyte is complete, each ion makes a definite contribution towards the molar conductance of electrolyte, irrespective of the nature of the other ion with which it is associated.

the molar conductance of an electrolyte at infinite dilution can be expressed as the sum of the contributions from its individual ions.

$A_xB_y \rightarrow xA^{y+} + yB^{x-}$

$\Lambda_m^\circ(A_xB_y) = x\lambda_{A^{y+}}^\circ + y\lambda_{B^{x-}}^\circ$

where, x and y are the number of cations and anions respectively.

The degree of ionisation $'\alpha'$ of weak electrolyte can be calculated as :

$\alpha = \dfrac{\Lambda_m}{\Lambda_m^\circ}$

The unit of molar conductance of an electrolyte solution will be :

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

B. mho cm^2mol^{-1}

C. Scm^2mol^{-1}

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

Answer: A::B::C

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29. The potential associated with each electrode is known as electrode potential. If the concentration of each species taking part in the electrode reaction is unity (if any appears in the electrode reaction, it is confined to 1 atmospheric pressure) and further the reaction is carried out at 298 K, then the potential of each electrode is said to the standard electrode potential. By convention, the standard electrode potential of hydrogen electrode is 0.0 volt. The electrode potential value for each electrode process is a measure of relative tendency of the active species in the process to remain in the oxidised/reduced form. A negative E° means that the redox couple is a stronger reducing agent than the H^+/H_2 couple. A positive E° means that the redox couple is a weaker reducing agent than the H^+/H_2 couple. The metal with greater positive value of standard reduction potential forms the oxide of greater thermal stability.

Given the stadard reduction potentials,

$E^\circ_{K^+/K} = -2.93V, E^\circ_{Ag^+/Ag} = +0.80V, E^\circ_{Hg^{2+}/Hg} = 0.79V$

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

The correct increasing order of reducing power is :

A. $K > Mg > Cr > Hg > Ag$

B. $Ag > Hg > Cr > Mg > K$

C. $Mg > K > Cr > Hg > Ag$

D. $Cr > Hg > K > Mg > Ag$

Answer: A

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30. The potential associated with each electrode is known as electrode potential. If the concentration of each species taking part in the electrode reaction is unity (if any appears in the electrode reaction, it is confined to 1 atmospheric pressure) and further the reaction is carried out at 298 K, then the potential of each electrode is said to the standard electrode potential. By convention, the standard electrode potential of hydrogen electrode is 0.0 volt. The electrode potential value for each electrode process is a measure of relative tendency of the active species in the process to remain in the oxidised/reduced form. A negative E° means that the redox couple is a stronger reducing agent than the H^{+}/H_2

couple. A positive E° means that the redox couple is a weaker reducing agent than the H^+/H_2 couple. The metal with greater positive value of standard reduction potential forms the oxide of greater thermal stability. Which of the following oxides will be thermally most stable ?

A. ZnO

B. MgO

C. Cu_2O

D. Ag_2O

Answer: D

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31. The potential associated with each electrode is known as electrode potential. If the concentration of each species taking part in the electrode reaction is unity (if any appears in the electrode reaction, it is confined to 1 atmospheric pressure) and further the reaction is carried out at 298 K, then the potential of each electrode is said to the standard electrode potential. By convention, the standard electrode potential of hydrogen electrode is 0.0 volt. The electrode potential value for each electrode process is a measure of relative tendency of the active species in the process to remain in the oxidised/reduced form. A negative E° means that the redox couple is a stronger reducing agent than the H^+/H_2 couple. A positive E° means that the redox couple is a weaker reducing agent than the H^+/H_2 couple. The metal with greater positive value of standard reduction potential forms the oxide of greater thermal stability.

Which of the following reactions is not correct ?

A. $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

B. $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$

C. $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

D. $Cu + H_2SO_4 \rightarrow CuSO_4 + H_2$

Answer: D

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32. The potential associated with each electrode is known as electrode potential. If the concentration of each species taking part in the electrode reaction is unity (if any appears in the electrode reaction, it is confined to 1 atmospheric pressure) and further the reaction is carried out at 298 K, then the potential of each electrode is said to the standard electrode potential. By convention, the standard electrode potential of hydrogen electrode is 0.0 volt. The electrode potential value for each electrode process is a measure of relative tendency of the active species in the process to remain in the oxidised/reduced form. A negative E° means that the redox couple is a stronger reducing agent than the H^+/H_2 couple. A positive E° means that the redox couple is a weaker reducing agent than the H^+/H_2 couple. The metal with greater positive value of standard reduction potential forms the oxide of greater thermal stability.

Which of the following couples will have highest value of emf ?

A. $Mg|Mg^{2+}||Ag^+|Ag$

B. $Zn|Zn^{2+}||Cu^{2+}|Cu$

C. $Zn|Zn^{2+}|\,|\,Ag^+|Ag$

D. $Cu|Cu^{2+}||Ag^{+}|Ag$

Answer: A

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33. The potential associated with each electrode is known as electrode potential. If the concentration of each species taking part in the electrode reaction is unity (if any appears in the electrode reaction, it is confined to 1 atmospheric pressure) and further the reaction is carried out at 298 K, then the potential of each electrode is said to the standard electrode potential. By convention, the standard electrode potential of hydrogen electrode is 0.0 volt. The electrode potential value for each electrode process is a measure of relative tendency of the active species in the process to remain in the oxidised/reduced form. A negative E° means that the redox couple is a stronger reducing agent than the H^{+}/H_2 couple. A positive E° means that the redox couple is a weaker reducing agent than the H^{+}/H_2 couple. The metal with greater positive value of standard reduction potential forms the oxide of greater thermal stability.

Which of the following metals will not displace hydrogen from water ?

A. Mg

B. Zn

C. Sn

D. Ag

Answer: D

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34. Chemical reaction involve interaction of atoms and molecules. A large number of atoms/molecules (approximately 6.022×10^{23})are present in a few grams of any chemical compound varying with their atomic/molrcular mass. To handle such a large numbers conveniently, the mole concept was introduced. This concept has implications in diverse areas such as analytical in diverse areas such as analytical chemistry, biochemistry, electrochemistry and radiochemistry. The following example illustrates a typical case, involving chemical/ electrochemical reaction, which requires a clear understanding of the mole concept.

A 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one of teh electrodes (atomic mass: Na=23, Hg=200, 1F=96500 coulombs)

The total number of moles of chlorine gas evolved is

A. 0.5

B. 1.0

C. 2.0

D. 3.0

Answer: B

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35. Chemical reaction involve interaction of atoms and molecules. A large number of atoms/molecules (approximately 6.022×10^{23})are present in a few grams of any chemical compound varying with their atomic/molrcular mass. To handle such a large numbers conveniently, the mole concept was introduced. This concept has implications in diverse areas such as analytical in diverse areas such as analytical chemistry, biochemistry, electrochemistry and radiochemistry. The following example illustrates a typical case, involving chemical/ electrochemical reaction, which requires a clear understanding of the mole concept.

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If cathode is a Hg electrode, the maximum weight(g) of amalgam formed from the solution is

A. 200

B. 225

C. 400

D. 446

Answer: D

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36. Chemical reaction involve interaction of atoms and molecules. A large number of atoms/molecules (approximately 6.022×10^{23})are present in a few grams of any chemical compound varying with their atomic/molrcular mass. To handle such a large numbers conveniently, the mole concept was introduced. This concept has implications in diverse areas such as analytical in diverse areas such as analytical chemistry, biochemistry, electrochemistry and radiochemistry. The following example illustrates a typical case, involving chemical/ electrochemical reaction, which requires a clear understanding of the mole concept.

A 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one of teh electrodes (atomic mass: Na=23, Hg=200, 1F=96500 coulombs)

The total charge in couloms required to complete the electrolysis

A. 24125

B. 48250

C. 96500

D. 193000

Answer: D

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37. The electrochemical cell shown below is a concentration cell

M / M^{2+} (saturated solution of a sparingly soluble salt, MX_2) $| \, |M^{2+}(0.001 mol dm^{-3})|M$

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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38. The electrochemical cell shown below is a concentration cell.

$$M \left| M^{2+} \begin{pmatrix} \text{Saturated solution} \\ \text{of sparingly soluble} \\ \text{salt, } MX_2 \end{pmatrix} \right\| M^{2+} \left(0.001 \ \text{mol dm}^{-3}\right) \Big| M$$

The emf of the cell depends on the difference in concentrations of M^{2+} ions at the two electrodes. The emf of the cell at 298 K is 0.059 V.

The solubility product $\left(K_{sp}, mol^3 dm^{-9}\right)$ of MX_2 at 298 K based on the information available for the given concentration cell is $(\text{take } \ 2.303 \times R \times 298 / F = 0.059V)$:

A. 1×10^{-15}

B. 4×10^{-15}

C. 1×10^{-12}

D. 4×10^{-12}

Answer: B

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39. Redox reactions play a pivotal role in chemistry and biology. The values standard redox potential $\left(E^{c-}\right)$ of two half cell reactions decided which way the reaction is expected to preceed. A simple example is a Daniell cell in which zinc goes into solution and copper sets deposited. Given below are a set of half cell reactions (acidic medium) along with their E^{c-} (V with respect to normal hydrogen electrode) values. Using this data, obtain correct explanations for Question.

$I_2 + 2e^- \rightarrow 2I^{c-}, \qquad E^{c-} = 0.54$

$Cl_2 + 2e^- \rightarrow 2Cl^{c-}, \qquad E^{c-} = 1.36$

$Mn^{3+} + e^- \rightarrow Mn^{2+}, \qquad E^{c-} = 1.50$

$Fe^{3+} + e^- \rightarrow Fe^{2+}, \qquad E^{c-} = 0.77$

$O_2 + 4H^{\oplus} + 4e^- \rightarrow 2H_2O, \qquad E^{c-} = 1.23$

While Fe^{3+} is stable, Mn^{3+} is not stable in acid solution because

A. Chloride ion is oxidised by O_2

B. Fe^{2+} is oxidised by iodine

C. Iodide ion is oxidised by chlorine

D. Mn^{2+} is oxidised by chlorine

Answer: c

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$O_2 + 4H^{\oplus} + 4e^- \rightarrow 2H_2O, \qquad E^{c-} = 1.23$

While Fe^{3+} is stable, Mn^{3+} is not stable in acid solution because

A. O_2 oxidises Mn^{2+} to Mn^{3+}

B. O_2 oxidises both Mn^{2+} and Fe^{2+}

C. Fe^{3+} oxidises H_2O to O_2

D. Mn^{3+} oxidises H_2O to O_2

Answer: d

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Straight Objective Type Questions

1. The specific conductance (κ) of an electrolyte of 0.1 N concentration is related to equivalent conductance (Λ_e) by the following formula :

A. $\Lambda_e = \kappa$

B. $\Lambda_e = 10\kappa$

C. $\Lambda_e = 100\kappa$

D. $\Lambda_e = 10000\kappa$

Answer: D

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2. The standard E°_{Red} values of A,B,C are 0.68V, - 2.54V,- 0.50V respectively. The order of their reducing power is

A. $A > B > C$

B. $A > C > B$

C. $C > B > A$

D. $B > C > A$

Answer: D

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3. In the electrochemical reaction,

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

increasing the concentration of Fe^{2+} :

A. increasing the cell emf

B. increasing the current flow

C. decrease the cell emf

D. alter the pH of the solution

Answer: C

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4. Fully charges lead storage battery contains 1.5 L of $5MH_2SO_4$. If 2.5 amp of currect is taken from the cell for 965 minutes, then what will be the molarity of remaining H_2SO_4 ? Assume that volume of battery fluid to be constant :

A. 4 M

B. 3.5 M

C. 2 M

D. 4.25 M

Answer: A

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5. In a gydrogen - oxygen fuel cell, 67.2 litre of H_2 at S.T.P is used in 5 min. What is the average current produced?

A. 549.4 amp

B. 643.33 amp

C. 965 amp

D. 129.8 amp

Answer: B

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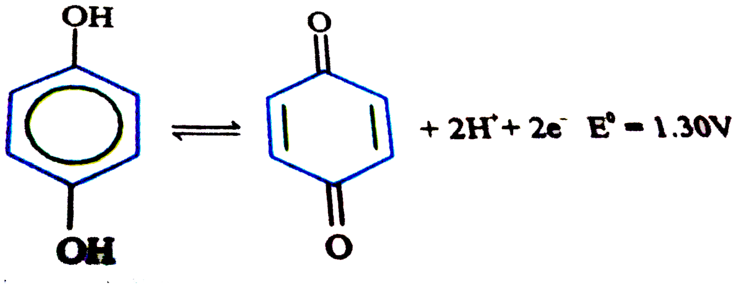
6. For the half cell



At pH = 3 electrode potential is

A. 1.48 V

B. 1.20 V

C. 1.10 V

D. 1.30 V

Answer: A

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7. The standard reduction potentials E° for OCl^{-}/Cl^{-} and for $Cl^{-}/1/2Cl_2$ are 0.86 V and -1.10 volt respectively. The E° value of $OCl^{-}/1/2Cl_2$ will be :

A. $+1.96V$

B. $-1.96V$

C. $+0.24V$

D. $-0.24V$

Answer: D

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8. 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. $1.613 \times 10^{-5} M^2$

B. $1.535 \times 10^{-8} M^2$

C. $3.213 \times 10^{-10} M^2$

D. $1.535 \times 10^{-10} M^2$

Answer: B

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9. The equilibrium constant for the reaction,

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

$E^{\circ}_{Cu^{2+}/Cu} = 0.34V \qquad E^{\circ}_{Cu^{2+}/Cu} = 0.15V$

(Given : log 3.72 = 0.571)

A. 3.72×10^{-6}

B. 3.72×10^{-5}

C. 3.72×10^{-7}

D. 3.72×10^{-8}

Answer: C

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10. Cations absorb 6.023×10^{22} electrons for their reduction. How many equivalents of the ion are reduced ?

A. 0.1

B. 0.01

C. 0.001

D. 0.0001

Answer: A

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Multiple Answer Type Question

1. In an electrolytic cell :

A. anode is positively charged

B. cathode is negatively charged

C. oxidation takes place at anode

D. reduction takes at cathode

Answer: A::B::C::D

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2. One gram equivalent of a substance is liberated at an electrode by :

A. 6.023×10^{23} electrons

B. $96500C$

C. 1 amp current for 1 second

D. 1 amp current for 96500 sec

Answer: A::B::D

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3. If 9 gm H_2O is electrolysed completely with the currect of 50 % efficiency then :

A. 96500 charge is required

B. 2×96500 C charge is required

C. 5.6 L of O_2 at STP will be formed

D. 11.2 L of O_2 at STP will be formed

Answer: B::C

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4. A galvanic cell involves the following reaction:

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

Select the correct statements among the following :

A. Zinc is negatively charged

B. The given redox process is spontaneous

C. $Ag^+ + e^- \rightarrow Ag$, takes place at anode

D. $Zn(s) \rightarrow Zn^{2+} + 2e^-$, takes place at cathode

Answer: A::B

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5. Given that,

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

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

Which of the following redox processes will not take place in 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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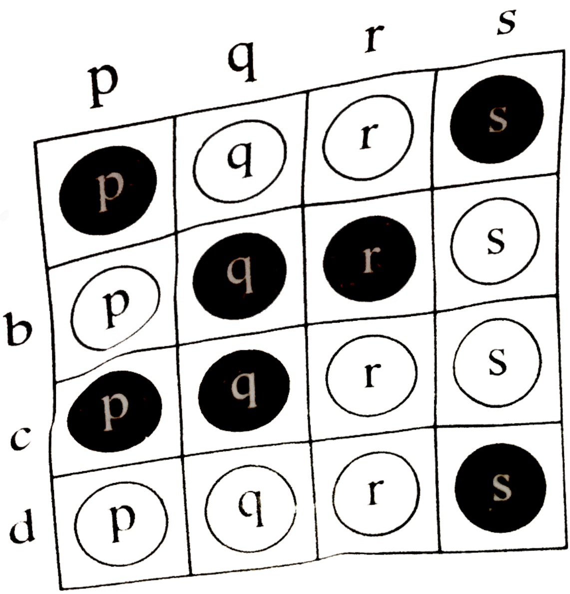
Matrix-Matching Type Question

1. This section contains 3 questions. Each question contains statement given in two columns which have to be matched. Statement (a, b, c and d) in Column-I have to be matched with statement (p, q, r and s) in Column-II. The answers to these questions have to be appropriately bubbled as illustrated in the following examples :

If the correct matches are (a-p, s), (b-q, r), (c-p, q) and (d-s), then correct bubbled 4×4 matrix should be as follows:



Match the column-I with Column-II :

Column-I	Column-II
(a) Nickel-Cadmium cell	(p) Used in auto vehicles
(b) Lithium battery	(q) Secondary cell
(c) $H_2 - O_2$ cell	(r) Fuel cell
(d) Lead storage battery	(s) Used in Apollo space craft

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2. This section contains 3 questions. Each question contains statement given in two columns which have to be matched. Statement (a, b, c and d) in Column-I have to be matched with statement (p, q, r and s) in Column-II. The answers to these questions have to be appropriately bubbled as illustrated in the following examples :

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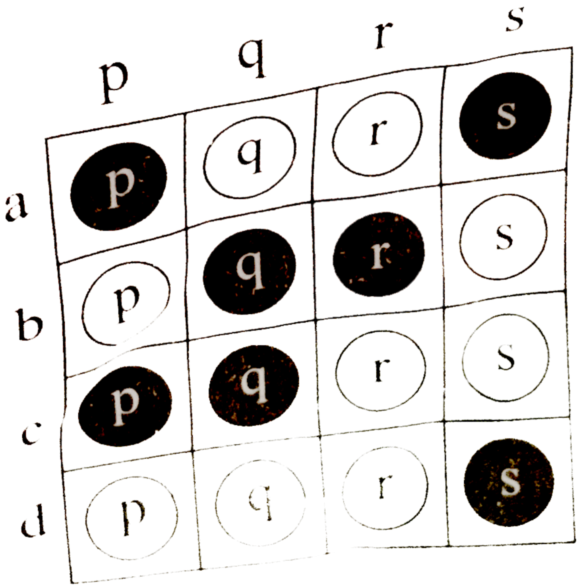

Match the column-I with Column-II :

Column-I	Column-II
(a) Specific conductance, κ	(p) $\Lambda_m^c / \Lambda_m^o$
(b) Molar conductance, Λ_m	(q) Decreases with dilution
(c) Resistance of electrolyte solution, R	(r) Increases with dilution
(d) Degree of ionization of weak electrolyte, α	(s) Increases with increase in the distance between parallel plates

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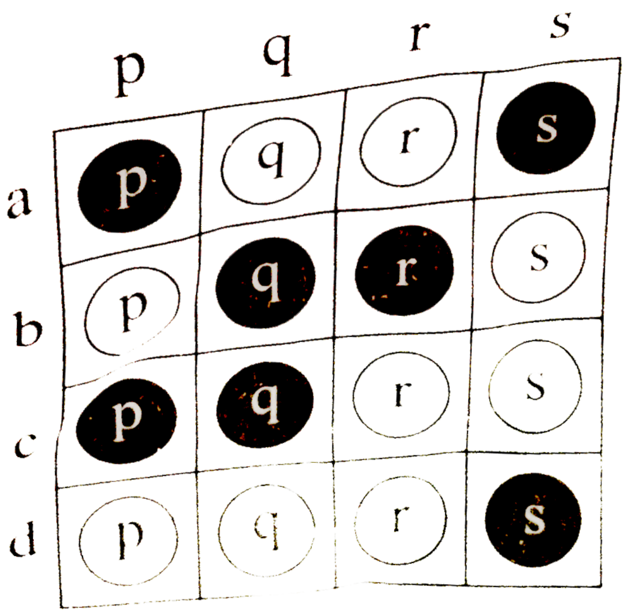

Match the column-I with Column-II :

Column-I	Column-II
(a) Concentration cell	(p) Fe is oxidised by Ni_2O_3
(b) Edison cell	(q) Zinc anode
(c) Mercury cell	(r) HgO cathode
(d) Dry cell	(s) $E^{\circ} = 0$

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