CHEMISTRY

BOOKS - P BAHADUR CHEMISTRY (HINGLISH)

ELECTROCHEMISTRY

Exercise

1. Calculate the number of electrons lost or gained during electrolysis of :

(a) $2gBr^{-}$ ions,

(b) $1gCu^{2+}$ ions.

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2. How many electrons per sec pass through a cross-section of a copper wire carrying 10^{-15} ampere?

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

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4. 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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5. Calculate current strength in ampere required to deposit $10 g Zn$ in 2 hr. $At. Wt.$ of $Zn = 65$.

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6. How many hour are required for a current of 3.0 ampere to decompose $18g$ water?

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7. Calculate the Avogadro's number using the charge on the electron $1.60 \times 10^{-19} C$ and the fact that $96500C$ deposits $107.9g$ silver from its solution.

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

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9. Calculate the volume of gases liberated at anode and cathode at NTP from the electrolysis of $Na_2SO_4(aq.)$ solution by a current of 2 ampere passed for 10 minute.

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

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11. A current of $3.7A$ is passed for $6h$ between nickel electrodes in $0.5L$ of a $2M$ solution of $Ni(NO_3)_2$. What will be the molarity of the solution at the end of electrolysis?

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12. A $100-W, 110-V$ incardescent lamp is connected in series with an electrolyte cell containing cadmium sulphate solution. How much cadmium will be deposited by the current flowing for $10h$?

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13. Calculate the volume of Cl_2 at $27^{\circ}C$ and $2atm$ produced during electrolysis of $MgCl_2$ which produced $6.50gMg$. $(At. wt.$ of $Mg=24.3)$

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14. How long would it take to reduce completely $80mL$ of $0.1MFe_2(SO_4)_3$ to $FeSO_4$ by passing a current of 2 ampere?

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15. An inaccurate ammeter and silver coulometer connnected in series in an electric circuit through which a constant direct current flows. If ammeter reads 0.6 ampere throughout one hour, the silver deposited on coulometer was found to be $2.16g$. What $\%$ error is in the reading of ammeter? Assume 100% current efficiency.

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16. What is the current efficiency of an electro-deposition of copper is deposited of copper metal from $CuSO_4$ solution in which $9.80g$

copper is deposited by the passage of 5 ampere current for 2 hour?

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17. A metal is known to form fluoride MF_2. When 10 ampere electricity is passed through a molten salt for 330 sec, $1.95g$ metal is deposited. Find out the atomic weight of metal. What will be the quantity of charge required to deposit the same mass of Cu from $CuSO_4(aq.)$? ($At. wt.$ of $Cu = 63.6$)

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18. Same quantity of charge is being used to liberate iodine (at anode) and a metal M (at cathode). The mass of metal M liberated is $0.617g$ and the liberated iodine is completely reduced by $46.3mL$ of $0.124M$ sodium thio-sulphate. Calculate equivalent weight of metal. Also calculate the total time to bring this change if 10 ampere current passed through solution of metal iodide.

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19. A current of 2.0 ampere is passed for 5.0 hour through a molten tin salt to deposit $22.2g$ tin. What is the oxidation state of tin in salt? Atomic $wt.$ of $Sn = 118.69g.$

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20. Calculate the number of $kw-h$ of electricity is necessary to produce 1.0 metric ton $(1000kg)$ of aluminium by the Hall process in a cell operating at $15.0V$.

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21. How long a current of $3A$ has to be passed through a solution of silver nitrate to coat a metal surface of $80cm^2$ with a $0.005-mm-$ thick layer ? The density of silver is $10.5gcm^{-3}$.

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22. For the cell : $Zn\left|\begin{array}{l} Zn^{2+}_{aq.} \\ 1M \end{array}\right|\left|\begin{array}{l} Cu^{2+}_{aq.} \\ 2M \end{array}\right| Cu$

Calculate the values for ,

(a) cell reaction,

(b) E°_{cell}

(c) E_{cell}

(d) the minimum concentration of Cu^{2+} at which cell reaction is spontaneous if Zn^{2+} is $1M$,

(e) does the displacement of Cu^{2+} goes almost to completion.

Given : $E^{\circ}_{RP_{Cu^{2}/Cu}} = +0.35V$

$E^{\circ}_{RP_{Zn^{2}/Zn}} = -0.76V$

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23. Calculate $e.m.f.$ of half cells given below :

(a) $\begin{array}{l} Pt_2 \\ 4atm \end{array} \Big| \begin{array}{l} H_2SO_4 \\ 0.02M \end{array} E^{\circ}_{OP} = 0V$

(b) $Fe \mid \begin{array}{c} FeSO_4 \\ 0.2M \end{array} E^{\circ}_{OP} = 0.44V$

(c) $\begin{array}{c} Pt_{Cl_2} \\ 10atm \end{array} \mid \begin{array}{c} HCl \\ 0.02M \end{array} E^{\circ}_{OP} = -1.36V$

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24. For the reaction : $2Ce^{4+} + Co \rightarrow 2Ce^{3+} + Co^{3+}$, $E^{\circ}_{cell} = 1.89V$,

If E°_{RP} for Co^{2+} / Co is $-0.28V$. Calculate of E°_{RP} for Ce^{4+} / Ce^{3+}.

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25. Calculate the pH of the following half cells solutions and also the molarity of acids: $\begin{array}{c} Pt_{H_2} \\ atm \end{array} \mid H_2SO_4 \quad E = 0.05$

(b) $\begin{array}{c} Pt_{H_2} \\ atm \end{array} \mid HCl \quad E = 0.1V$

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26. If the oxidation of oxalic acid by acidic MnO_4^{c-} solution is carried out in a reversible cell, then what is the electrode reaction and equilibirum constant of the cell reaction.

Given :

$$E^{c-}\cdot_{(MnO_4^{c-}|Mn^{2+})} = 1.51V$$

$$E^{c-}\cdot_{(CO_2|C_2O_4^{2-})} - 0.49V$$

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27. The $e.m.f.$ of a cell corresponding to the reaction :

$$Zn_{(s)} + 2H^+_{(aq.)} \rightarrow \underset{(0.1M)}{Zn^{2+}} + \underset{(1atm)}{H_{2(g)}}$$

is $0.28V$ at $25^\circ C$ and $E^\circ_{Zn/Zn^{2+}} = 0.76V$.

(i) Write half cell reactions.

(ii) Calculate pH of the solution at H electrode.

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28. Can $1.0MH^{+}$ solution under H_2 gas at $1.0atm$ capable of oxidising Ag metal in the presence of $1.0MAg^{+}$ ions. $E^{\circ}_{OP_{Ag/Ag^{+}}} = -0.80V$.

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29. The $e.m.f$ of the $M|M^{n+}(0.02M)||H^{+}(1M)H_{2(g)}(1atm)pt$ at $25^{\circ}C$ is $0.81V$. Calculate the valence of metal if $E^{\circ}_{M/M^{n+}} = 0.76V$.

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30. The $e.m.f$ of cell $Ag|AgI_{(s)}, 0.05MKI||0.05MAgNO_3|Ag$ is $0.788V$. Calculate solubility product of AgI.

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

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32. Given $E^{\circ}_{Mn^{7+}/M^{n+}}$ and $E^{\circ}_{Mn^{4+}/M^{2+}}$ are $1.51V$ and $1.23V$. Calculate $E^{\circ}_{Mn^{7+}/M^{n+}}$.

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33. Calculate ΔG°_{298} and ΔS°_{298} for the reaction :

$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)} : \Delta H^{\circ}_{298} = -136.64kcal.$

Given that

$O_{2(g)} + 4H^{+} + 4e \rightarrow 2H_2O_{(l)}, E^{\circ} = 1.23V$

$2H_{2(g)} \rightarrow 4H^{+} + 4e, E^{\circ} = 0.00V$

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34. Given standard electrode potentials

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

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

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

Arrange these metals in their increasing order of reducing power.

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35. Two metals A and B have $E^{\circ}_{RP} = +0.76V$ and $-0.80V$ respectively. Which will liberated H_2 from H_2SO_4 ?

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36. Calculate the standard cell potential of galvanic cell in which the following reaction take place :

(Given $E^{\circ}_{OP} Cr, Cd, Fe^{2+}, Ag$ are $0.74V, 0.40V, -0.77V$ and

$-0.80V$ respectively)

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

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

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

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37. 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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38. 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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39. Electrolysis of a solution of $MnSO_4$ in aqueous sulphuric acid is a method for the preparation of MnO_2 as per reaction,

$Mn^{2+}_{aq.} + 2H_2O \rightarrow MnO_{2(s)} + 2H^+(aq.) + H_{2(g)}$

Passing a current of 27 ampere for 24 hour gives one kg of MnO_2. What is the value of current efficiency ? Write the reaction taking place at the cathode and at the anode.

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40. In a fuel cell, hydrogen and oxygen react to produce electricity. In process, hydrogen gas is oxidized at the anode and oxygen at the cathode. If $67.2L$ of H_2 at STP reacts in $15min$, what is the average current produced ? If the entire current is used for electro – deposition of copper from copper (II) solution, how many grams of copper will be deposited ?

Anode reaction : $H_2 + 2\overset{c-}{O}H \rightarrow 2H_2O + 2e^-$

Cathode reaction : $O_2 + 2H_2O + 2e^- \rightarrow 4\overset{c-}{O}H$

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

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43. An acidic solution of Cu^{2+} salt containing $0.4g$ of Cu^{2+} is electrolyzed until 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 $1.2A$. Calculate the volume of gases evolved at STP during the entire electrolysis.

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

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45. 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)

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

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47. Compute standard $e.m.f.$ of cell

$Zn_{(s)}+Co^{2+}\rightarrow Co_{(s)}+Zn^{2+}$

Given $E^{\circ}_{Zn/Zn^{2+}}=+0.76V$ and $E^{\circ}_{Co/Co^{2+}}=+0.28V$

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48. A solution contaning $4.5mM$ of $Cr_2O_7^{2-}$ and $15mM$ of Cr^{3+} shows a pH of 2.0. Calculater the potential of half reaction. (Standard potential of the reaciton

$Cr_2O_7^{2-}\rightarrow Cr^{3+}$ is $1.33V$)

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49. Calculate the equilibrium constant for the reaction :

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

Given : $E^{c-} \cdot_{(Ce^{4+}|Ce^{3+})} = 1.44V$

$E^{c-} \cdot_{(Fe^{3+}|Fe^{2+})} = 0.68V$

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50. Calculate the euilibrium constant for the reaction,

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

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

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51. 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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52. The standard reduction potential for $Cu^{2+} \mid Cu$ is $+0.34V$. 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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53. The standard reduction potential of $Cu^{2+} \mid Cu$ and $Ag^{\oplus} | Ag$ electrodes are 0.337 and $0.799V$, respectively. Construct a galvanic cell using these electrodes so that its standard EMF is positive. For what concentration of $Ag^{\oplus}$ will the EMF of the cell , at $25^{\circ}C$, be zero if the concentration fo Cu^{2+} is $0.01M$?

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54. 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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55. A silver electrode is immersed in saturated $Ag_2SO_{4(aq)}$. The potential difference between the silver and the standard hydrogen electrode is found to be $0.711V$ Determine $K_{SP}(AgSO_4)$. Given $E^{\circ}_{Ag^+/Ag} = 0799V$.

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56. The standard reduction potential at $25^{\circ}C$ of the reaction

$2H_2O + 2e^- \Leftrightarrow H_2 + 2\overset{\ominus}{O}H$ is $-0.8277V$. Calculate the equilibrium constant for the reaction.

$2H_2O \Leftrightarrow H_3O^{\oplus} + \overset{\ominus}{O}H$ at $25^{\circ}C$.

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

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

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

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58. 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 $0.118V$ at $25^{\circ} C$. Calculate the concentration of hydrogen ions at the positive electrode.

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59. 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 $25^\circ C$.

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

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60. 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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61. The Edison storage cell is represented as :

$Fe(s)|FeO(s)|KOH(aq)|Ni_2O_3(s)|Ni(s)$

The half – cell reactions are :

$$Ni_2O_3(s) + H_2O(l) + 2e^- \rightleftharpoons 2NiO(s) + 2\overset{\ominus}{O}H ;$$

$$E^{\ominus} = +0.40 \text{ V}$$

$$FeO(s) + H_2O(l) + 2e^- \rightleftharpoons Fe(s) + 2\overset{\ominus}{O}H ; E^{\ominus} = -0.87 \text{ V}$$

$a.$ What is the cell reaction ?

$b.$ What is the cell EMF ? How does it depend on the concentration of KOH ?

$c.$ What is maximum amount of electrical energy that can be obtained from $1mol$ of Ni_2O_3 ?

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62. The standard reduction potential for the half cell :

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

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

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

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

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

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

$a.$ 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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65. 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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66. We have taken a saturated solution of $AgBr$, whose K_{sp} is 12×10^{-14}. If $10^{-7}M$ of $AgNO_3$ are added to $1L$ of this solutino, find the conductivity (specific conductance) of the solution in terms of $10^{-7} Sm^{-1}$ units.

Given :

$\lambda^{\circ}{\cdot}_{(Ag^{\oplus})} = 6 \times 10^{-3} Sm^2 mol^{-1}$

$\lambda^{\circ}{\cdot}_{(Br^{c-})} = 8 \times 10^{-3} Sm^2 mol^{-1}$

$\lambda^{\circ}{\cdot}_{\left(NO_3^{C-}\right)} = 7XX10^{-3} Sm^2 mol^{-1}$

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67. At $25^{\circ} C$, the resistance of $0.01 N NaCl$ solution is $200 ohm$. If cell constant of the conductivity cell is unity, then the equivalent conductance of the solution is:

A. $400 Scm^2 eq^{-1}$

B. $900 Scm^2 eq^{-1}$

C. $500 Scm^2 eq^{-1}$

D. $0.05 Scm^2 eq^{-1}$

Answer: C

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

A. $130 Scm^2 eq^{-1}$

B. $65 Scm^2 eq^{-1}$

C. $260 Scm^2 eq^{-1}$

D. None of these

Answer: A

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69. At $25^\circ C$, a conductivity cell was filled with $0.1 M NalL$ solution. The conductivity of this solution is $9.2 \times 10^3 scm^{-1}$ and resistance is $176.6 ohm$. The cross-sectional is $176.6 ohm$. What must have been the distance between the electrodes ?

A. $4.5 cm$

B. $6.5cm$

C. $9.8cm$

D. $5.9cm$

Answer: B

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

A. 1.78×10^{-5}

B. 1.87×10^{-6}

C. 2.05×10^{-5}

D. 1.78×10^{-6}

Answer: A

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

A. 288

B. 302

C. 156

D. 128

Answer: D

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72. 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. $39\ \%$

B. $3.9\ \%$

C. $0.35\ \%$

D. $0.039\ \%$

Answer: B

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

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

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

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

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

Answer: B

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74. Molar conductance of $BaCl_2$, H_2SO_4 and HCl at infinite dilutions are x_1, x_2 and x_3, respectively. Equivalent conductance of $BaSO_4$ at infinite dilution will be:-

A. $\frac{(x_1+x_2-x_3)}{2}$

B. $\frac{(x_1-x_2-x_3)}{2}$

C. $2(x_1+x_2-2x_3)$

D. $\frac{(x_1+x_2-2x_3)}{2}$

Answer: D

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75. The equivalent conductivity of KCl at infinite dilution is $130 Scm^2 eq^{-1}$. The transport number of Cl^- ion in KCl at the same temperature is 0.505. The limiting ionic mobility of K^+ ion is :

A. $6.67 \times 10^{-4} cm^2 s^{-1} V^{-1}$

B. $3.22 \times 10^{-4} cm^2 s^{-1} V^{-1}$

C. $2.20 \times 10^{-4} cm^2 s^{-1} V^{-1}$

D. $5.01 \times 10^{-4} cm^2 s^{-1} V^{-1}$

Answer: A

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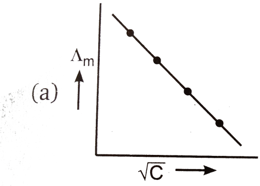
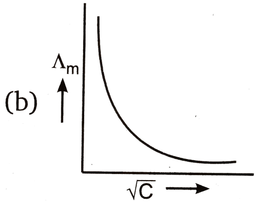
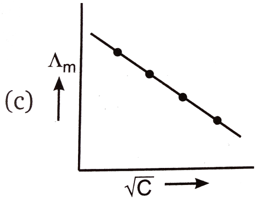
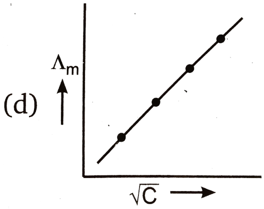
76. Which of the following curve gives the variation of λ_m with $\sqrt{C}$ for CH_3COOH ?

A. 

B. 

C. 

D. 

Answer: c

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77. Which of the following is correct ?

A. equivalent conductance decreases with dilution

B. specific conductance increases with dilultion

C. equivalent conductance increases with dilution

D. specific conductance decreases with dilution

Answer: C,D

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78. The ionization constant of a weak electrolyte is 2.5×10^{-5}, while of the equivalent conductance of its $0.01M$ solution is $19.6 scm^2 eq^{-1}$. The equivalent conductance of the electrolyte at infinite dilution is :

A. $250 Scm^2 eq^{-1}$

B. $392 Scm^2 eq^{-1}$

C. $284 Scm^2 eq^{-1}$

D. $384 Scm^2 eq^{-1}$

Answer: B

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

A. 6.25×10^{-4}

B. 1.25×10^{-6}

C. 6.25×10^{-5}

D. 1.25×10^{-5}

Answer: D

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80. $0.04N$ solution of a weak acid has specific conductance $4.23 \times 10^{-4} \text{mho cm}^{-1}$. If the degree of dissociation of acid at this dilution is 0.0612, then equivalent conductivity at infinite dilution is :

A. $150.8 \text{mho cm}^2 eq^{-1}$

B. $172.8 \text{mho cm}^2 eq^{-1}$

C. $180.6 \text{mho cm}^2 eq^{-1}$

D. $160.9 \text{mho cm}^2 eq^{-1}$

Answer: B

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81. During the electrolysis of an aqueous salt solution, the pH in the space near one of the electrode was increased and the other one was decreased. The salt solution was:

A. $Cu(NO_3)_2$

B. $ZnCl_2$

C. $NaCl_{conc.}$

D. $NaCl$ very dilute

Answer: D

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82. The calomel electrode is reversible with repect to :

A. Hg

B. H^{+}

C. Hg^{2+}

D. Cl^{-}

Answer: D

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83. Select the incorrect statement for a dry cell:

A. Mn is reducded from $+4$ to $+3$ state

B. NH_3 gas is liberateed out

C. Zn is used as anode

D. A paste of NH_4Cl and $ZnCl_2$

Answer: B

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84. The variation of E_{cell} with temperature i.e., $\left(\frac{\delta E}{\delta T}\right)_P$ is equal to :

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

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

C. $\left[n\frac{\Delta H}{nF}\right]/T$

D. All of these

Answer: D

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85. The cell reaction for the given cell is spontaneoous if:

$Pt|Cl_2(P_1)|Cl^-(1M)||Cl^-(1M)|Pt|Cl_2(P_2)$

A. $P_1 > P_2$

B. $P_1 < P_2$

C. $P_1 = P_2$

D. $P_2 = 1$ atm

Answer: B

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86. Electrolytic reduction of alumina to aluminium by Hall-Heroult process is carried out:

A. In the presence of $NaCl$

B. In the presence of fluoride

C. In the presence of cryolite which forms a melt with lower melting temperature

D. In the presence of cryolite which forms a melt with higher melting temperature

Answer: C

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87. Among Na, Hg, S, Pt and graphite which can be used as electodes in electrolytic cell having aqueous solutions?

A. Na and S

B. Na, Hg and Pt

C. Na, Hg and S

D. Hg, Pt and graphite

Answer: D

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88. Ostwald dilution law of weak electrolyte HA can be given as :

A. $K_a = \frac{C.\alpha^2}{(1-\alpha)}$

B. $K_a = C.\alpha^2 \quad \text{if} \quad \alpha \to 0$

C. $K_a = \frac{C\Lambda^2}{\Lambda_0(\Lambda_0 - \Lambda)}$

D. All of these

Answer: D

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89. Zn acts as sacrifical or cathodic protect iont to prevent rusting of iron because

A. E_{OP}° of $Zn < E_{OP}^{\circ}$of Fe

B. E_{OP}° of $Zn > E_{OP}^{\circ}$of Fe

C. E_{OP}° of $Zn = E_{OP}^{\circ}$of Fe

D. Zn is cheaper than iron

Answer: B

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90. Beryllium is placed above magnesium in the II group. Beryllium dust, therefore, when added to $MgCl_2$ solution will:

A. Have no effect

B. Precipitate Mg metal

C. Precipitate MgO

D. Lead to dissolution of Be metal

Answer: A

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91. In the equation $\overset{\circ}{\Lambda} = \Lambda + B\sqrt{C}$, the constant B depends upon :

A. $C^{1} / (2)$

B. Stoichiometry of electrolyte

C. Resistance

D. Conductivity

Answer: B

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92. Mobility of H^{+} (In aq. Medium) is high because:

A. of the small size of H^{+}

B. Of the high hydration energy of H^{+}

C. It exhibits of Grotthus type of conduction

D. Hydrogen is the lightest element

Answer: C

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93. $Cu^{2+}+2e^{-}\rightarrow Cu$. For this, graph between E_{red} versus $\ln\left[Cu^{2+}\right]$ is a straight line of intercept $0.34V$, then the electrode oxidation potential of the half cell $Cu\mid Cu^{2+}(0.1M)$ will be

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

B. $0.34+0.0591V$

C. $0.34V$

D. None of these

Answer: A

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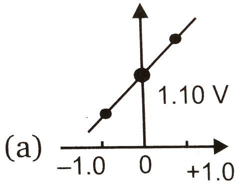
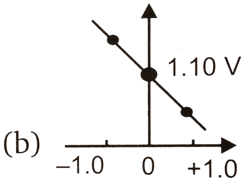
94. Which graph correctly correlates E_{cell} as a funcation of concentrations for the cell (for different values of M and M')?

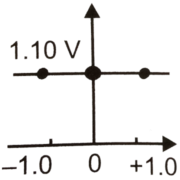
$Zn(s) + Cu^{2+}(M) \rightarrow Zn^{2+}(M') + Cu(s), E^{\circ}_{cell} = 1.10V$

X-axis : $\frac{\log_{10}[Zn^{2+}]}{[Cu^{2+}]}$ Y-axis : E_{cell}

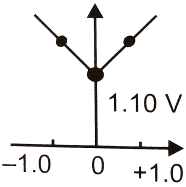
A. 

B. 

C. (c)



D. (d)



Answer: B

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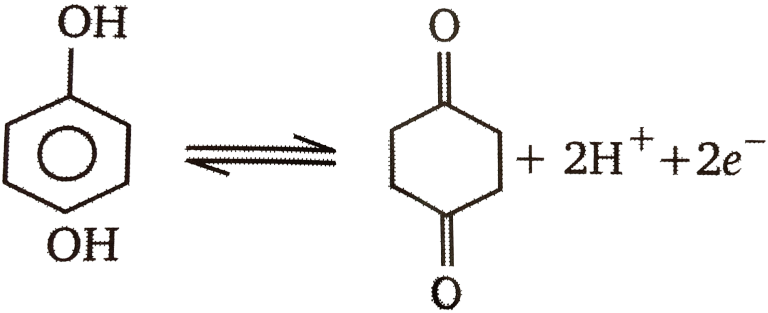
95. At $pH = 2$, $E^{\circ}_{(\text{Quinhydrone})} = 1.30V$, $E_{\text{Quinhydrone}}$ will be :



A. $1.36V$

B. $1.30V$

C. $1.42V$

D. $1.20V$

Answer: C

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96. Copper from copper sulphate solution can be displaced by ....

The standard reducation potentials of some electrodes are given below:

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

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

(c) $E^{\circ}(Cu^{2+}, Cu) = +0.34V$

(d) $E^{\circ}(H^{+}, 1/2H_2) = +0.34V$

A. H^2

B. Zn

C. Cr

D. Fe

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97. The oxidation potential of a hydrogne electrode at $pH = 10$ and $p_{H_2} = 1atm$ is

A. $0.51V$

B. $0.00V$

C. $+0.59V$

D. $0.059V$

Answer: C

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98. Normal aluminimum electrode cupled with normal hydrogen electrode gives an emf of $1.66V$. So the standard electrode potential of aluminimu is ,

A. $-1.66V$

B. $+1.66V$

C. $-0.83V$

D. $+0.83V$

Answer: B

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99. The number of electrode passing per second through a cross-section of copper wire carrying 10^{-6} ampere:

A. 6.2×10^{23}

B. 6.2×10^{12}

C. 6.2×10^{10}

D. None of these

Answer: B

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100. A solution containing H^{+} and D^{+} ions is in equilibrium with a mixture of H_2 and D_2 gases at $25^{\circ} C$. If the partial pressure of both the gases are 1.0 atm. The ration $\frac{H^{+}}{D^{+}}$.

Given, $E^{\circ}_{D^{+}/D} = -0.003C, E_{\text{cell}} = 0.006V$:

A. 1.2

B. 1.1

C. 0.11

D. 1.0

Answer: B

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

A. Increase by $0.059V$

B. Decrease by $0.058V$

C. Increase by $0.41V$

D. Decrease by $0.41V$

Answer: D

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102. The tarnishing of silver ornaments in atmosphere is due to

A. Ag_2O, Ag_2S

B. $AgNO_3, Ag_2S$

C. $Ag(OH), Ag_2CO_3$

D. Ag

Answer: A

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103. For, $I_2 + 2e \rightarrow 2I^-$, standard reduction potential $= +0.54$ volt. For, $2Br^- \rightarrow Br_2 + 2e^-$ standard oxidation potential $= -1.09$ volt. For $Fe \rightarrow F^{2+} + 2e^-$, standard oxidation potential $= +0.44$ volt. Which of the follwoing reactions is non-spontaneous ?

A. $Br_2 + 2I^- \rightarrow 2Br^- + I_2$

B. $Fe + Br_2 \rightarrow Fe^{2+} + 2Br^-$

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

D. $I_2 + 2Br^- \rightarrow 2I^- + Br_2$

Answer: D

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104. The following facts are availabel :

$2A^{c-} + B_2 \rightarrow 2B^{-} + A_2,$

$2C^{c-} + B_2 \rightarrow Noreaction,$

$2D^{c-} + A_2 \rightarrow 2A^{c-} + D_2$

Which of the following statement is correct ?

A. $E^{\circ}_{C^{-}/C_2} > E^{\circ}_{B^{-}/B_2} > E^{\circ}_{A^{-}/A_2} > E^{\circ}_{D^{-}/D_2}$

B. $E^{\circ}_{C^{-}/C_2} < E^{\circ}_{B^{-}/B_2} < E^{\circ}_{A^{-}/A_2} < E^{\circ}_{D^{-}/D_2}$

C. $E^{\circ}_{C^{-}/C_2} < E^{\circ}_{B^{-}/B_2} > E^{\circ}_{A^{-}/A_2} > E^{\circ}_{D^{-}/D_2}$

D. $E^{\circ}_{C^{-}/C_2} > E^{\circ}_{B^{-}/B_2} < E^{\circ}_{A^{-}/A_2} < E^{\circ}_{D^{-}/D_2}$

Answer: B

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105. Given the $E^{\circ}_{Fe^{3+}\,/\,Fe}$ and $E^{\circ}_{Fe^{2+}\,/\,Fe}$ are $-0.36V$ and $0. \; - 439V$, respectively. The value of $E^{\circ}_{Fe^{3+}\,/\,Fe^{2+}}$ would be :

A. $(\,-0.36-0.439)V$

B. $[3(\,-0.36)+2(\,-0.439)]V$

C. $(0.36+0.439)V$

D. $[3(\,-0.36)-2(\,-0.439)]V$

Answer: D

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106. The time required to coat a metal surface of $80cm^2$ with $5\times10^{-3}cm$ 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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107. A hydrogen electrode placed in a solution containing sodium acetate and acetic acid in the ratio of $x : y$ and $y : x$ has an electrode potential value E_1 and E_2 volts, respectively, at $25^\circ C$. The pK_a value of acetic acid is

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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108. $Zn|Zn^{2+}(c_1)||Zn^{2+}(c_2)|Zn$. For this cell ΔG is negative if :

A. $C_1 = C_2$

B. $C_1 > C_2$

C. $C_2 > C_1$

D. None of these

Answer: C

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109. $Pt(H_2)(p_1)|H^{\oplus}(1M)|(H_2)(p_2), Pt$ cell reaction will be exergonic if

A. $P_1 > P_2$

B. $P_1 > P_2$

C. $P_2 > P_1$

D. $P_1 = 1$ atm

Answer: B

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110. $Cu^{+} + e \to Cu, E^{\circ} = X_1$ volt,

$Cu^{2+} + 2e \to Cu, E^{\circ} = X_2$X_(2) volt

For $Cu^{2+} + e \to Cu^{+}, E^{\circ}$ will be :

A. $X_1 - 2X_2$

B. $X_1 + 2X_2$

C. $X_1 - X_2$

D. $2X_2 - X_1$

Answer: D

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111. $100mL$ of buffer of $1MNH_3(aq)$ and $1MNH_4^{\oplus}(aq)$ are placed in two compartments of a voltaic cell separately. A current of $1.5A$ is passed through both cells for $20min$. If only electrolysis of water takes place, then

A. $L.~H.~S.$ will increase

B. $R.~H.~S.$ will increase

C. Both side will increase

D. Both side will decrease

Answer: B

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112. Passage of three faraday of charge through aqueous solution of $AgNO_3, CuSO_4, Al(NO_3)_3$ and $NaCl$ respectively will deposit themetals in the ratio (molar):

A. $1:2:3:1$

B. $6:3:2:6$

C. $6:3:0:0$

D. $3:2:1:6$

Answer: C

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113. For the cell reaction

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

of an electrochemical cell, the change in free energy (ΔG) of a given temperature is a function of

A. $\ln C_1$

B. $\ln C_2 / C_1$

C. $\ln(C_1 + C_2)$

D. $\ln C_2$

Answer: B

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114. Based on the data given below, the correct order of reducing power is:

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

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

$$Br_{2(aq.)} + 2e \rightarrow 2Br^-_{(aq.)}, E^\circ = +1.08V$$

A. $Br^- < Fe^{2+} < Al$

B. $Fe^{2+} < Al < Br^-$

C. $Al^{-} < Br^{-} < Fe^{2+}$

D. $Al^{-} < Fe^{2+} < Br^{-}$

Answer: A

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115. Use of lithium metal as an electrode in high energy density batteries is due to:

A. Lithium is highest element

B. Lithium has highest oxidation potential

C. Lithium is quite reactive

D. Lithium does not corrode readily

Answer: B

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

A. Provide cathodic protection

B. Protect oxidation of steel

C. Both (a) and (b) are correct

D. Neither (a) nor (b) is correct

Answer: C

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

A. $20kJ$

B. $11.5kJ$

C. $115kJ$

D. $0.115kJ$

Answer: B

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118. How much charge s requireed to produce H_2 fas at the rate of $1mL\sec^{-1}$ by the electrolysis of molten $NaCl$?

A. $8.6C$

B. $18.4C$

C. $4.3C$

D. $1.4C$

Answer: A

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119. The temperature coefficient of a cell whose operation is based on the reaction:

$Pb_s + HgCl_{2(aq.)} \rightarrow PbCl_{2(aq.)} + Hg_l$

os $-1.5 \times 10^{-4} VK^{-1}$. The heat of rection at $25^\circ C$ is (in $kJmol^{-1}$) (Given $E = 0.03V$):

A. 8.4

B. 16.4

C. 14.41

D. 4.5

Answer: C

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120. The e.mf. of an electrolytic cell depends mostly on :

A. The valency of the reacting meterials

B. The quantity of electrolytic solution

C. The size of the electrodes

D. The density of the electrolytic solution

Answer: A

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121. For which of the following compounds are the products of the electrolysis (using inert electrodes) of a fused metal salt and a concentrated aqueous solution most likely to be the same ?

A. Copper (II) chloride

B. Magneisum bromide

C. Potassium iodide

D. Sodium hydroxide

Answer: A

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122. A solution containing one mole per litre each of AX, BX_2, CX_2 and DX_2 is electrolysed using inert electrodes. The values of the standard potentials for reduction reactions of $A^+|A, B^{2+}|B, C^{2+} \mid C$ and $D^{2+} \mid D$ are $+.80, \ +.34, \ -0.76$ and -1.66 volts respectively. The correct sequence in which these metals will be deposited on the cathode is :

A. A, B, C, D

B. D, C, B, A

C. A, C, B, D

D. D, B, C, A

Answer: A

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123. Four Faraday of electricity were passed through aqueous solutions of $AgNO_3$, $NiSO_4$, $FeCl_3$ and $PbCl_4$ kept in four vessels using inert electrodes. The ratio moles of Ag, Ni, Fe and Pb depositeed will be :

A. $12:6:4:3$

B. $12:4:6:3$

C. $4:3:2:1$

D. $1:2:3:4$

Answer: A

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124. The standard reduction potential for half reactions for four different elements. A, B, C and D are:

(i) $A_2 + 2e^- \rightarrow 2A^-, E^\circ = +2.85V$

(ii) $B_2 + 2e^- \rightarrow 2B^-, E^\circ = +1.36V$

(iii) $C_2 + 2e^- \rightarrow 2C^-, E^\circ = +1.06V$

(iv) $D_2 + 2e^- \rightarrow 2D^-, E^\circ = +0.53V$

The strongest oxidising reducing agents smong these :

A. Would be A and D respectively

B. Would be D and A respectively

C. Would be B and C respectively

D. Cannot be ascertained from the given data as the species being subjected to ioxidation or reduction have not been indicated

Answer: A

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125. If $e^\circ_{Fe^{2+}/Fe} = -0.441V$. And $E^o_{Fe^{3+}/Fe^{2+}} = 0.771V$. The standard emf of the reaction $Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$ will be .

A. $1.212V$

B. $0.111V$

C. $0.330V$

D. $1.653V$

Answer: A

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126. A hypthetical electrochemical cell is given as $A^{\ominus}|A^{+}(xM)||B^{+}(yM)|B^{\ominus}$ The emf masured is $+0.20V$. The cell reaction is .

A. $A+B^{+}\to A^{+}+B$

B. $A^{+}+B\to A+B^{+}$

C. $A^{+}+e\to A, \ +B^{+}+e\to B$

D. cannot be predicted

Answer: A

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127. The correct order of mobility of alkali metal ions in aqueous solution is

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

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

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

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

Answer: B

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128. Efficiency of a cell reaction under standard conditions,

$A_{(s)} + B^+ \rightarrow A^+ + B_s, \Delta H^\circ = -300kJ$

is 70%. The standard electrode potential of cell is :

A. $2.176V$

B. $+2.876V$

C. $1.248V$

D. $+1.648V$

Answer: A

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129. In the reaction :

$XCrCl_3 + YH_2O_2 \rightarrow ZNaOH \rightarrow Na_2CrO_4 + NaCl + H_2O$

The values of X, Y and Z are respectively :

A. $2, 6, 5$

B. $2, 5, 6$

C. $2, 3, 10$

D. $2, 3, 8$

Answer: C

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130. The volume of $2M$ barium premanganate required to react completely, with $5mL$ of $3M$ lead oxalate soultion in acidic medium is :

A. $1mL$

B. $2mL$

C. $3mL$

D. $6mL$

Answer: C

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131. Equivalent weight of FeS_2 in the half reaction

$FeS \rightarrow Fe_2O_3 + SO_2$ is :

A. $M/10$

B. $M/11$

C. $M/8$

D. $M/7$

Answer: D

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132. An indicator electrode is :

A. Glass electrode

B. H-electrode

C. Quinhydrone electrode

D. Calomel electrode

Answer: C

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133. Standard electrode potential of an electrode is :

A. Intensive property

B. Extensive property

C. Isothermal property

D. Isobaric property

Answer: A

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134. Potassium chlorate is prepared by the electrolusis of KCl in basic medium as:

$Cl^{-} + 6OH^{-} \rightarrow ClO_3^{-} + 3H_2O + 6e$

If only 60% of current is utilised in the reaction, the time to produce $10g$ of $KClO_3$ using current of 2 ampere : $(mol.\ wt.$ of $KClO_3 = 122.5)$

A. $1.94hr$

B. $10.94hr$

C. $19.09hr$

D. $12.09hr$

Answer: B

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135. E° of two reactions are given below :

$Cr^{3+} + 3e \rightarrow Cr, E^\circ = -0.74V$

$OCl^- + H_2O + 2e \rightarrow Cl^- + 2OH^-, E^\circ = 0.94V$

What will be the E° for ?

$3OCl^- + 2Cr + 3H_2O \rightarrow 2Cr^{3+} + 3Cl^- + 6OH^-$

A. $-1.68V$

B. $1.68V$

C. $-0.20V$

D. $0.20V$

Answer: B

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136. E° for $F_\circ + 2e \Leftrightarrow 2F^-$ is $2.7V$

Thus, E° for $F^- \Leftrightarrow \frac{1}{2}Fe + e$ is :

A. $1.35V$

B. $-1.35V$

C. $-2.7V$

D. $2.7V$

Answer: C

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

A. $P_{H_2} = 1atm, \left[H^{+}\right] = 1M$

B. $P_{H_2} = 1atm, \left[H^{+}\right] = 2M$

C. $P_{H_2} = 2atm, \left[H^{+}\right] = 1M$

D. $P_{H_2} = 2atm, \left[H^{+}\right] = 2M$

Answer: C

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138. Salts of A (atomic weight 7), B (atomic weight 27) and C (atomic weight 48) were electolysed under idential condition using the same quanity of electricity. It was found that when $2.1g$ of A was deposited, the weights of B and C deposited were 2.7 and $7.2g$. The valencies A, B and Crespectively:

A. 3, 1 and 2

B. 1, 3 and 2

C. 3, 1 and 3

D. 2, 3 and 2

Answer: B

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139. A cell is to be constructed to show a redox change :

$Cr + 2Cr^{3+} \Leftrightarrow 3Cr^{2+}$. The number of cells with different E^{c-} an n but same value of ΔG^{c-} can be made (Given $E^{c-}{}_{\cdot Cr^{3+} | Cr^{2+}} = -0.40V$, $E^{c-}{}_{\cdot Cr^{3+} | Cr} = -0.74V$, adn $E^{c-}{}_{\cdot Cr^{2+} | Cr} = -0.91V$)

A. 1

B. 2

C. 3

D. 4

Answer: C

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140. For a given reaction:

$A^{x+n} + ne \rightarrow A^{x+}$,

The E°_{RP} is known along with concentration of A^{x+n} and A^{x+} ions.

Select the correct statement:

A. The value of n can be evaluated

B. The value of x can be evaluated

C. The value of $(x+n)$ can be evaluated

D. The value of n, x and $(x+n)$ can be evaluated

Answer: A

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141. Nernst equation is $E = E^{\circ} - \frac{RT}{nF}\ln Q$. If $Q = K_C$, then which one is one correct,

A. $E = E^{\circ}$

B. $\frac{RT}{nF}\ln Q = E^{\circ}$

C. $E = 0$

D. $K_C = e^{\frac{nE^\circ F}{RT}}$

Answer: A

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142. For the given cell,

$$\underset{P_1}{Pt, C1_2}\left|\underset{C_1}{HC1}\right|\left|\underset{C_2}{HC1}\right|\underset{P_2}{C1_2, Pt}$$

The emf will be positive when :

A. $C_1 > C_2$

B. $C_2 > C_1$

C. $C_1 = C_2$

D. None of these

Answer: A

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143. For the reaction,

$$2Cr_{(s)} + 3Cu^{2+}_{(aq.)} \Leftrightarrow 3Cr^{3+}_{(aq.)} + 3Cu_{(s)}$$

$E^{\circ} = 1.08V$, the equilibrium constant and standard free energy change at $300K$ for the redox change are :

A. $312.66kJ, 1.35 \times 10^{105}$

B. $312.66kJ, 1.37 \times 10^{109}$

C. $312.66kJ, 1.37 \times 10^{107}$

D. $625.32kJ, 7.27 \times 10^{108}$

Answer: D

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144. E° of two reactions are given below :

$Cr^{3+} + 3e \rightarrow Cr, E^{\circ} = -0.74V$

$OCl^{-} + H_2O + 2e \rightarrow Cl^{-} + 2OH^{-}, E^{\circ} = 0.94V$

What will be the E° for ?

$3OCl^{-} + 2Cr + 3H_2O \rightarrow 2Cr^{3+} + 3Cl^{-} + 6OH^{-}$

A. $1.68V$

B. $0.20V$

C. $-1.68V$

D. $-0.20V$

Answer: A

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145. E° for $F_{\circ} + 2e \Leftrightarrow 2F^{-}$ is $2.7V$

Thus, E° for $F^{-} \Leftrightarrow \frac{1}{2}Fe + e$ is :

A. $1.35V$

B. $-1.35V$

C. $-2.7V$

D. $2.7V$

Answer: C

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146. Chromium plating can involve the electrolysis of an electrolyte of an acidified mixture of chromic acid and chromium sulphate. If during electrolysis the article being plated increases in mass by $2.6g$ and $0.6dm^3$ of oxygen are evolved at an inert anode, the oxidation state of chromium ions being discharged must be : (assuming atomic weight of $Cr = 52$ and $1mole$ of gas at room temperature and pressure occupies a volume at $24dm^3$)

A. -1

B. -2

C. $+1$

D. $+2$

Answer: D

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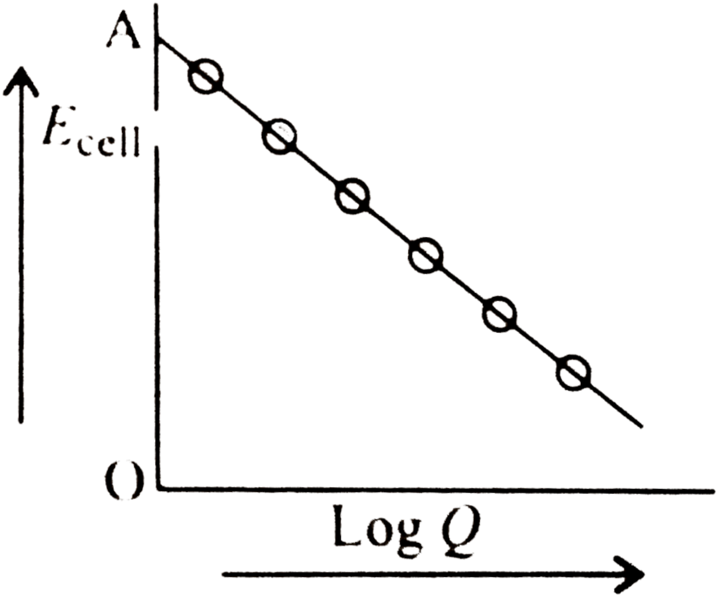
147. $Zn + Cu^{2+}(aq) \Leftrightarrow Cu + Zn^{2+}(aq)$.

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



A. 0.1

B. 0.01

C. 100

D. 1000

Answer: C

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148. If a cell reaction is spontaneous, then :

A. E°_{cell} in negative

B. E°_{cell} is positive

C. ΔG is negative

D. ΔG is positive

Answer: B::C

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149. Which of the following statement(s) is (are) incorrect?

A. Reduction occurs at the cathode in both galvanic and electrolytic cells

B. Oxidation takes place at the cathode in both galvanic and electrolytic cells

C. The anode is the negative terminal and the cathode is the positive terminal in a galvanic cell

D. The anode is the negative terminal and the cathode is the positive terminal for an electrolytic cell

Answer: B::D

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150. Faraday's laws of electrolysis are not related to the:

A. atomic number of the cation

B. atomic number of the anion

C. equivalent weight of the electrolyte

D. Speed of the cation

Answer: A::B::D

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151. The amount of ion dischargedf during electrolysis is directly proportional to :

A. Resistance

B. Time

C. Current

D. Chemical equivalent of the ion

Answer: B::C::D

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152. For the cell :

$$TI|TI^{\oplus}(10^{-3}M)||Cu^{2+}(10^{-1}M)|Cu$$

E_{cell} can be increased by

$a.$ Decreasing $\left[Cu^{2+}\right]$. $b.$ Decreasing $\left[TI^{\oplus}\right]$

$c.$ Increasing $\left[Cu^{2+}\right]$ $d.\ Increa\sin gby$[Tl^(o+)]`

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

B. by decreasing $\left[Tl^{2+}\right]$

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

D. by increasing $\left[Tl^{2+}\right]$

Answer: A::D

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153. Which of the following statement(s) is(are) correct about strong electrolyte ?

A. It conducts electric current in solution

B. It possesses ions even in the solid state

C. It dissociates into ions when dissolved in water because the force of repulsion increases

D. The conductivity of an electrolytic solution is directlu proportioonal to the number of ions in unit volume

Answer: A::B::C::D

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154. The measured reduction potential for the reaction, $Mg^{2+} + 2e^- \Leftrightarrow Mg(s)$ depends upon:

A. temperature

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

C. the purity of the magnesium plate

D. the area if cross-section of magnesium plate

Answer: A::B::C

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155. Which of the followinf statement(s) is(are) correct ?

A. Zn is precipitated by the addition of Cu powder to a $ZnSO_4$ solution

B. $AgNO_3$ solution cen be stored in a copper container

C. When Cl_2 is passed through $KBr(aq.)$, the solution becomes coloured

D. The addition of a crystal of I_2 turns a KBr solution violet

Answer: C::D

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156. Which of the following statements is (are) correct ?

A. A metal in its highest oxidation state acts as an oxidant

B. In the reaction, $F_2 + \frac{1}{2}O_2 \rightarrow OF_2$, oxygen is an oxidant

C. The oxidation number of Ni in $Ni(CO)_4$ is zero

D. Copper metal can be oxidised by Zn^{2+} ions

Answer: A::C

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157. Which of the following chages involves oxidation ?

A. The conversion of ferrous sulphate to ferric sulphate

B. The conversion of H_2S to S

C. The conversion of $ZnSO_4$ to Zn

D. The conversion of Zn to $ZnSO_4$

Answer: A::B::D

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158. Which of the following statement(s) is(are) correct ?

A. The electrolysis of molten $NaOH$ liberates O_2 at the anode

B. The electrolysis of molten $NaOH$ liberates O_2 at the cathode

C. Molten $NaCl$ conducts electricity due to the presence of Na^+ and Cl^- ions

D. The electrolysis of molten KCl produces Cl_2 at the cathode

Answer: A::C

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159. (a)iodine dissolves more in KI solution than in water. Why?

(b) Colour of KI solution containing starch turns deep blue when chlorine water is added. Explain.

A. The reduction potential of Cl_2 is more than that of I_2

B. The oxidation potential of Cl_2 is more than that of I_2

C. The product formed when Cl_2 combines with starch is blue in colour

D. The product formed when I_2 combines with starch is blue in colour

Answer: A::D

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160. On electrolusis, which of the following arragements will lead tio oxygen being evolved at the anode ?

A. Dilute H_2SO_4 with copper electrodes

B. Fused Na_2OH_4 with an iron cathode and a nickel anode

C. Aqueous $AgNO_3$ solution with platinum electrodes

D. Dilute H_2SO_4 with platinum electrodes

Answer: B::C::D

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161. On the electrolysis of a $10^{-6} MHCl$ solution:

A. O_2 gas is product at the anode

B. Cl_2 gas is producted at the anode

C. H_2 gas is produced at the cathode

D. O_2 gas is produced at the cathode

Answer: A::C

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162. Coulomb is the quantity of charge defined as:

A. One ampere of current passing for 1 sec1

B. The charge which deposits $0.001118g$ of Ag on cathode

C. The charge which deposits electrochemical equivalence of metal

D. $1/2$ ampere current for two second

Answer: A::B::C

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163. In which of the following salt bridge is not needed ?

A. $Pb|PbSO_{4(s)}|H_2SO_4|PbO_{2(s)}|Pb$

B. $Zn|ZnSO_4|CuSO_4 \mid Cu$

C. $Cd|CdO_s|KOH_{aq.}|NiO_{2(s)}|Ni$

D. $Fe_s|FeO_s|KOH_{aq.}|Ni_2O_{3(S)}|Ni$

Answer: A::C::D

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164. One faraday is the amount of charge:

A. that liberates $1g$ equivalent of a metal form its solution

B. 96515 coulomb

C. that liberates $31.78g$ of Cu

D. that liberates $1/2g$ atom of Cu

Answer: A::B::C::D

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165. Select the correct statements if $9.65A$ current is passed for 1 hour through the cell :

$Ag|Ag^{\oplus}(1M)||Cu^{2+}(1M)|Cu.$

A. Ag^{+} will reduce to Ag and new $[Ag^{+}] = 0.64M$

B. Ag will oxidise to Ag^{+} and new $[Ag^{+}] = 1.36M$

C. Cu will oxidise to Cu^{2+} and new $[Cu^{2+}] = 0.82M$

D. Cu^{2+} will reduce to Cu and new $[Cu^{2+}] = 0.82M$

Answer: B::D

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166. Which are true for a standard hydrogen electrode ?

A. The hydrogen ion concentration is $1M$

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

C. Pressure of hydrogen is 1 atm

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

Answer: A::B::C

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167. Which of the following rection(s) is (are) involved in the rustin of iron ?

A. $Fe_{(s)} \rightarrow Fe^{2+}_{(aq.)} + 2e$

B. $O_{2(g)} + 4H^{+}_{(aq.)} + 4e \rightarrow 2H_2O_l$

C. $2Fe_{(s)} + O_{2(g)} + 4H^{+}_{(aq.)} \rightarrow 2Fe^{2+}_{(aq.)} + 2H_2O_{(l)}$

D. $Fe^{2+} + 2e \rightarrow Fe_{(s)}$

Answer: A::B::C

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168. In which of the following redox pairs, the reduction potential very, with pH ?

A. MnO_4^- / Mn^{2+}

B. AmO_2^{2+} / AmO_2^+

C. AmO_2^{2+} / Am^{4+}

D. Zn^{2+} / Zn

Answer: A::C

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169. Select the correct relations :

A. $-\Delta S = \left(\frac{\partial E}{\partial T}\right)_P \times nF$

B. $\left(\frac{\partial E}{\partial T}\right)_P = \frac{\Delta G - \Delta H}{T}$

C. $\Delta S = \left(\frac{\partial E}{\partial tT}\right)_P \times nF$

D. $\left(\frac{\partial E}{\partial T}\right)_P = \left(\frac{\partial \Delta S}{\partial T}\right)_P$

Answer: B::C

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170. Select the correct statements:

A. Presence of CO_2 increase rate of rusting

B. Silver plating is done with the help of $K\left[Ag(CN)_2\right]$

C. In saline water, rate of rusting is retarded

D. Pure metals undergo corrosion faster than impure metlas.

Answer: A::B::D

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171. A 1.5 ampere current is passed for sometime through a solution of $AgNO_3$ to deposit $0.54g$ of Ag. Select the correct statements:

A. The time for the which current is passed in 321.67 minute

B. The charge passed is $482.5F$

C. The charge passed is $482.5F$

D. The time for which current passed is 321.67 sec.

Answer: C::D

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172. For the reduction of NO_3^{c-} ion in an aqueous solution, E^{c-} is $+0.96V$, the values of E^{c-} for some metal ions are given below :

$i. V^{2+}(aq) + 2e^- \rightarrow V, \qquad E^{c-} = -1.19V$

$ii. Fe^{3+}(aq) + 3e^- \rightarrow Fe, \qquad E^{c-} = -0.04V$

$iii. Au^{3+}(aq) + 3e^{-} \rightarrow Au, \qquad E^{c-} = +140V$

$iv. Hg^{2+}(aq) + 2e^{-} \rightarrow Hg, \qquad E^{c-} = +0.86V$

The pair(s) of metals that is $/$ are oxidized by NO_3^{c-} 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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173. Which of the following are correct about liquid junction potential?

A. The liquid juncation potential is due to different ionic mobility of ions.

B. The liquid junction potential can be measured directlty.

C. The magnitude of liquid juncation potential depends upon relative speed of ions.

D. The liquid junction potential always increases the $E.M.F.$ of cell.

Answer: A::C

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174. Select the correct statement(s) about the liquid juncation potential:

A. The sign and magnitude of liquid junction potential depdens upon transport number of anions and cations (t_a and t_c).

B. If $t_a = t_c, E_{IJP} = 0$

C. If $t_a > t_c, E_{IJP}$ increases the $E.\ M.\ F.$ of cell and if $t_a < t_c, E_{IJP}$ decreases the $E.\ M.\ F.$ of cell.

D. Only two vertical lines between two electrodes indicates the existance of liquid juncation potential.

Answer: A::B::C

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175. Among the following, the intersive property is (properties are) :

A. molar conductivity

B. electromotive force

C. resistance

D. heat capacity

Answer: A::B

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176. If Θ denotes standard reduction potentical, which is true:

A. $E_{cell}^{\circ} = \Phi_R - \Phi_L$

B. $E_{cell}^{\circ} = \Phi_L + \Phi_R$

C. $E_{cell}^{\circ} = \Phi_L - \Phi_R$

D. $E_{cell}^{\circ} = -(\Phi_L + \Phi_R)$

Answer: A

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177. Enf of a cell in terms of reduction potential of its left and right electrodes is :

A. $E = E_{\text{left}} - E_{right}$

B. $E = E_{\text{left}} + E_{right}$

C. $E = E_{right} - E_{\text{left}}$

D. $E = \ - \left[E_{right} + E_{\text{left})}\right.$

Answer: C

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178. Conductance (Siemens, S) is directly proportional to the area of the vessel and the concentration of solution in it and is inversely proprtional to the length of the vessel, then the unit of constant of proportionlity is :

A. $Smmol^{-1}$

B. Sm^2mol^{-1}

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

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

Answer: B

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179. The emf of given cell $Pt-\underset{P_1}{H_2}\left|H^+\right|\underset{P_2}{H_2}-Pt$ is :

A. $\frac{RT}{F}\log' \frac{P_1}{P_2}$

B. $\frac{RT}{2F}\frac{\log_e(P_1)}{P_2}$

C. $\frac{RT}{F}\frac{\log_e(P_2)}{P_1}$

D. None of these

Answer: B

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180. The $E_{M^{3+}/M^{2+}}{}^{\wedge}\circ$ values for Cr, Mn, Fe and Co are 0.41, $+1.57$, $+0.77$ and $+1,97V$ respectively. For which one of these metals the change ub oxidation state from $=2$ to 3 is easiest :

A. Co

B. Mn

C. Fe and Au

D. Cr

Answer: D

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181. Standared reduction electrode potenitals of three metals A, B and C are $= 0.5V, -3.0V$, and $-1.2V$ respectively. The reducing power of these metals are :

A. $B > C > A$

B. $A > B > C$

C. $C > B > A$

D. $A > C > B$

Answer: A

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182. 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

A. 1×10^{-10}

B. 29.5×10^{-2}

C. 10

D. 1×10^{10}

Answer: D

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183. When during electrolusis of a solution of $AgNO_3$, 9650 coulmbs of charge pass through the electroplationg bath, the mass of silver deposited on the cathode will be:

A. $1.08g$

B. $10.8g$

C. $21.6g$

D. $108g$

Answer: B

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184. For the redox change ,

$$Zn_s + \underset{0.1M}{F\ uCu^2} + \ \rightarrow \underset{Zn^{2+}}{1M} + Cu_{(s)},$$

Taking place in a cell E°_{cell} is 1.10 volt . E_{cell} for the cell would be :

A. $1.07V$

B. 0

C. $0.82V$

D. $2.14V$

Answer: A

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185. In a hydrogen-oxygen fuel cell, combustion of hydrogen occurs to :

A. remove adsorbed oxygen from electrode surfaces

B. create potential difference between the two electrodes

C. produce high purity water

D. generate heat

Answer: B

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186. Consider the following E° values . $E_{Fe^{3+}\ /\ Fe^{2+}\ \hat{}\ \circ\ =\ +0.77V}$,

$E^{\circ}_{Sn^{2+}\ /\ Sn} = -15.\ V$ The E°_{cell} for the reaction ,

`Sn (s) + 2Fe_(aq)^(3+) rarr 2 Fe_(aq.)^(2+) + Sn_(aq.)^(2+) is :

A. $0.63V$

B. $1.40V$

C. $0.91V$

D. $1.68V$

Answer: C

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187. The standard emf of a cell having one electron change is found to be $0.591V$ at $25^{\circ}C$, The equilibrium constant of the reaction is :

A. 1.0×10^{30}

B. 1.0×10^5

C. 1.0×10^{10}

D. 1.0×10^1

Answer: C

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188. In a cell that untillizes the reaction ,

$Zn_{(s)} + 2H^+_{(aq)} \rightarrow Zn^{2+}_{(aq.)} + H_{2(g)}$, adedition of H_2SO_4 to cathode compartment will :

A. Increase the E and shift equilibrium to the left

B. lower the E and shift equilibrium to the right

C. increase by E and shift equilibrium to the right

D. lower the E and shift equilibrium to the left

Answer: C

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

A. 302

B. 176

C. 278

D. 128

Answer: D

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

A. $0.1M$ acetic acid

B. $0.1M$ chloracetic acid

C. $0.1M$ fluoroacetic acid

D. $0.1M$ difluoroacetic acid

Answer: D

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

A. 517.2

B. 552.7

C. 390.7

D. 217.5

Answer: C

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192. Aluminium oxide may be electorlysed at $1000^{\circ} C$ to furnish aluminim metal (Atomic Mass $= 27$ amu, $1F = 96,500C$). The cathode reaction is

$Al^{3} + 3d^{-} \rightarrow Al^{\circ}$

To prepare $5.12kg$ of aluminium metal by this method would require .

A. 5.49×10^{7} coulomb

B. 1.83×10^{7} coulomb

C. 5.49×10^{4} coulomb

D. 5.49×10^{10} coulomb

Answer: A

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193. 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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194. The ionic mobility of alkali metal ions in aqueous solution is maximum for:

A. K^{+}

B. Rb^+

C. Li^+

D. Na^+

Answer: B

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

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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196. At $25^{\circ} C$, $\begin{array}{lll} Ag + I^{-} \rightarrow & AgI + e & E^{\circ} = 0.152V \\ Ag \rightarrow & Ag.^{+} + e & E^{\circ} = -0.80V \end{array}$

The $\log K_{sp}$ of AgI is: $\left(\frac{2.303RT}{F} = 0.059\right)$

A. -8.12

B. $+8.612$

C. -37.83

D. -16.13

Answer: D

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197. The equivalent conductances of two strong electrolytes at infinite dilution in H_2O (where ions move freely through a solution) at $25^\circ C$ are given below :

$\Lambda^\circ_{CH_3COONa} = 91.0 Scm^2 / \text{equi v.}$

$\Lambda^\circ_{HCl} = 426.2 Scm^2 / \text{equiv.}$ What additional information//quantity one need to calculate Λ° of an aqueous solution of acetic acid ?

A. Λ° of $NaCl$

B. Λ° of CH_3COOK

C. The limiting equivalent conductance of $H^+ (\lambda^\circ_{H^+})$

D. Λ° of chloroacetic acid $(ClCH_2COOH)$

Answer: A

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

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

A. antilog (24.08)

B. $3.7.3$

C. $10^{37.3}$

D. 9.65×10^{4}

Answer: C

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199. Oxidising power of chlorine in aqueous solution can be determined by the parameters indicated below

$$\frac{1}{2}CL_2(g)\xrightarrow{\frac{1}{2}\Delta_{diss}H^{\ominus}}Cl(g)\xrightarrow{\Delta H^{\ominus}_{Eg}}$$

$$Cl^-(g)\xrightarrow{\Delta_{hyd}H^{\ominus}}Cl^-(aq)$$

The energy involved in the conversion of $\frac{1}{2}Cl_2(g)$ to

$Cl^-(aq)$

(Using the data $\Delta_{diss}H^{\Theta}_{Cl_2} = 240KJmol^{-1}$)

$\Delta_{Eg}H^{\Theta}_{Cl} = -349KJmol^{-1}$,

$\Delta_{Eg}H^{\Theta}_{Cl} = -381KJmol^{-1}$) will be

A. $+152kJmol^{-1}$

B. $-610kJmol^{-1}$

C. $-850kJmol^{-1}$

D. $+120kJmol^{-1}$

Answer: B

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200. Given,
$$\begin{aligned} E^o_{Fe^{3+}/Fe} + 3eCrE^o &= -0.036V \\ E^o_{Fe^{3+}/Fe} &= -0.439V \end{aligned}$$

The value of standard electrode ptoential for the charge,

A. $-0.072V$

B. $0.385V$

C. $0.770V$

D. $-0.270V$

Answer: C

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

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

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

A. $4.5V$

B. $3.0V$

C. $2.5V$

D. $5.0V$

Answer: C

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202. The correct order of $E^{\circ}_{M^{2+}/M}$ Values with negative sign for the four successive elements Cr, Mn, Fe and Co is:

A. $Mn > Cr > Fe > Co$

B. $Cr > Fe > Mn > Co$

C. $Fe > Mn > Cr > Co$

D. $Cr > Mn > Fe > Co$

Answer: A

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

A. $P(H_2) = 1atm$ and $[H^+] = 2.0M$

B. $P(H_2) = 1atm$ and $[H^+] = 1.0M$

C. $P(H_2) = 2atm$ and $[H^+] = 1.0M$

D. $P(H_2) = 2atm$ and $[H^+] = 2.0M$

Answer: C

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

A. O_2, H_2

B. $S_2O_8^{2-}, Na$

C. O_2, Na

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

Answer: A

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205. A standard hydrogen electrode has zero electrode potential because :

A. hydrogen is easiest tio oxidise

B. this electrode potential is assumed to be zero

C. hydrogen atom has only one electron

D. hydrogen is the lightest element

Answer: B

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

A. $0.525V$

B. $0.827V$

C. $0.184V$

D. $0.490V$

Answer: A

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207. 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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208. The gas$X$ at $1atm$ is bubbled through a solution containing a mixture of $1MY^{c-}$ and $1MZ^{c-}$ at $25^{\circ}C$. If the order of reduction potential 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 X and Z

D. Y will reduce both X and Z

Answer: A

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209. For the electrochemicl cell, $M|M^{+}||X^{-}|X E^{\circ}_{(M^{+}/M)}=0.44V$ and $E^{\circ}_{(X/X^{-})}=0.33V$

From this data one can deduce that :

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

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

C. $E_{cell}=0.77V$

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

Answer: B

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210. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant K_c is:

A. $\Delta G^\circ = RT\ln K_c$

B. $-\Delta G = RTInK_c$

C. $\Delta G = Rt\ln K_c$

D. $-\Delta G = RT\ln K_c$

Answer: B

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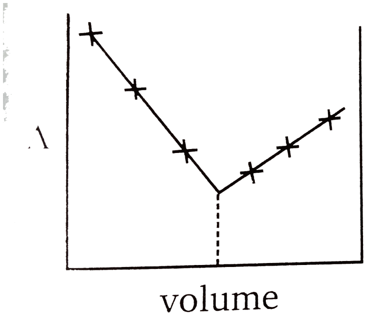
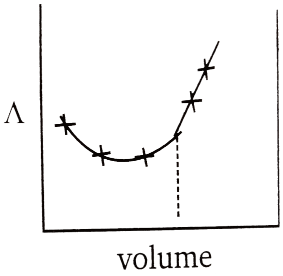
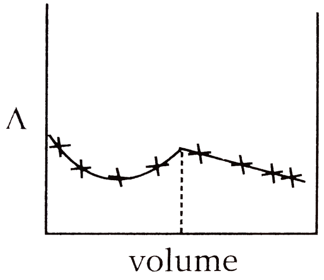
212. $AgNO_3(aq.)$ was added to an aqeous KCl solution gradually and the conductivity of the solution was measured. The plot of conductance (Λ) versus the volume of $AgNO_3$ is :



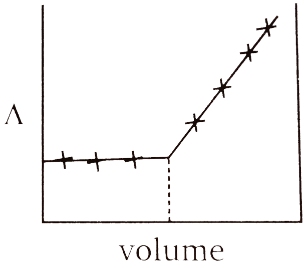
(P)



(Q)



(R)



(S)

A. (P)

B. (Q)

C. (R)

D. (S)

Answer: D

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213. 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. $X = Ni, Y = Zn$

B. $X = Fe, Y = Zn$

C. $X = Zn, Y = Ni$

D. $X = Ni, Y = Fe$

Answer: C

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214. How many kJ energy is expended during the passes of 1 ampere current for 90 sec under a potential of $100V$?

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

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216. Find the volume of Cl_2 at NTP produced during electrolysis of $MgCl_2$ which produces $6.6gMg.$ $(\text{At.wt. of } \ Mg = 24.3)$

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217. 3 ampere current was passed through an aqueous solution of an unknown salt of Pd for 1 hr. $2.977g$ of Pd^{n+} was deposited at cathode. Find the value of n.

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218. The standard oxidation potential of Ni/Ni^{2+} electrode is $0.236V$. If this is combined with a hydrogen electrode in acid solution, at what pH of this solution will be measured e.m.f. be zero at $25^{\circ}C$? Assume that $\left[Ni^{2+}\right] = 1M$ and $P_{H_2} = 1atm$.

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219. What is the quantity of charge needed for the reduction of 1 mole of MnO_4^- ion to Mn^{2+} ion ?

Watch Video Solution

220. A hydrogen electrode is dipped in a solution at $25^\circ C$. The potential of cell is $-0.177V$. Calcualte the pH of the solution.

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221. An oxide of metal $(\text{at. wt.} = 112)$ contain $12.5\% O_2$ by weight. The oxide was converted into chloride by treatment with HCl and electrolysed. Find the valency of metal.

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222. In above question no. 10, if a current of 0.862 ampere was passed for a period of 5 hr, calculate the amount of metal that would be deposited at cathode.

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223. 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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224. What current is to be passed for 0.25 sec for deposition of certain weight of metal which is equal to its electrochemical equivalent ?

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225. When water is electrolysed, hydrogen and oxgen gas are produced. If $1.008g$ of H_2 is liberated at cathode, calcualate the mass of O_2 is formed at anode.

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226. Electrolusis involves electronation and de-electronation at the redpective electrodes. Anode of electrolytic cell is the electrode at which de-electronation takes place whereas at cathode electronation is noticed. If two or more ions of same charge are to be electronated or de-electronated, the ion having lesser discharge potential is dischargeed. Discharge potential of an ion refers for E°_{OP} or E°_{RP} as the case may be. The products formed at either electrode is given in terms of Faraday's laws of electrolysis i.e., $w = \dfrac{Eit}{96500}$

A. During electrolysis of $CH_3COONa_{(aq.)}$ the mole ratio of gases formed at cathode and anode is :

A. $1:2$

B. $2:1$

C. $3:1$

D. $1:3$

Answer: D

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227. Electrolusis involves electronation and de-electronation at the redpective electrodes. Anode of electrolytic cell is the electrode at which de-electronation takes place whereas at cathode electronation is noticed. If two or more ions of same charge are to be electronated or de-electronated, the ion having lesser discharge potential is dischargeed. Discharge potential of an ion refers for E°_{OP} or E°_{RP} as the case may be. The products formed at either electrode is given in terms of Faraday's laws of electrolysis i.e., $w = \frac{Eit}{96500}$

B. During electrolysis of $HCOO\mathbb{N}a_{(aq.)}$, the gas liberated at andoe and cathode are respectively:

A. H_2, CO_2 and H_2

B. H_2, CO_2 and O_2

C. H_2 and O_2

D. O_2 and H_2

Answer: A

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228. Electrolusis involves electronation and de-electronation at the redpective electrodes. Anode of electrolytic cell is the electrode at which de-electronation takes place whereas at cathode electronation is noticed. If two or more ions of same charge are to be electronated or de-electronated, the ion having lesser discharge potential is dischargeed. Discharge potential of an ion refers for E°_{OP} or E°_{RP} as the case may be. The products formed at either electrode is given in terms of Faraday's laws of electrolysis i.e., $w = \frac{Eit}{96500}$

During electrolysis of $CuSO_{4(aq.)}$, the pH of solution becomes :

A. < 7

B. > 7

C. $= 7$

D. ≥ 7

Answer: A

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229. Electrolusis involves electronation and de-electronation at the redpective electrodes. Anode of electrolytic cell is the electrode at which de-electronation takes place whereas at cathode electronation is noticed. If two or more ions of same charge are to be electronated or de-electronated, the ion having lesser discharge potential is dischargeed. Discharge potential of an ion refers for E°_{OP} or E°_{RP} as the case may be. The products formed at either electrode is given in terms of Faraday's laws of electrolysis i.e., $w = \frac{Eit}{96500}$

D. 5 litre solution of $0.4MCuSO_{4(aq.)}$ is electrolysed using Cu electrode. A current of 482.5 amperer is passed for 4 minute. The concentration of $CuSO_4$ left in solution is :

A. $0.16M$

B. $0.32M$

C. $0.34M$

D. $0.40M$

Answer: D

Watch Video Solution

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230. Electrolusis involves electronation and de-electronation at the redpective electrodes. Anode of electrolytic cell is the electrode at which de-electronation takes place whereas at cathode electronation is noticed. If two or more ions of same charge are to be electronated or de-electronated, the ion having lesser discharge potential is dischargeed. Discharge potential of an ion refers for E_{OP}° or E_{RP}° as the case may be. The products formed at either electrode is given in terms of Faraday's laws of electrolysis i.e., $w = \dfrac{E.\,i.\,t}{96500}$

E. 5 litre solution of $0.4 M Ni(NO_3)_2$ is electrolysed using Pt electrodes with 2.4125 ampere current for 10 hour:

A. $0.31M$

B. $0.22M$

C. $0.26M$

D. $0.40M$

Answer: A

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231. Electrolusis involves electronation and de-electronation at the redpective electrodes. Anode of electrolytic cell is the electrode at which de-electronation takes place whereas at cathode electronation is noticed. If two or more ions of same charge are to be electronated or de-electronated, the ion having lesser discharge potential is dischargeed. Discharge potential of an ion refers for E°_{OP} or E°_{RP} as the case may be. The products formed at either electrode is given in terms of Faraday's laws of electrolysis i.e., $w = \dfrac{Eit}{96500}$

F. The volume of octane required to be used for its combustion by the oxygen liberated during electrolysis of an $NaNO_{3(aq.)}$ by passing 9.65 ampere current for 1 hr. is :

A. 322.56 mL

B. 32.256 mL

C. 3.22 mL

D. $1.612 \times 10^{2} mL$

Answer: D

Watch Video Solution

232. The E° values for the changes given below are measured againest NHE at $27^{\circ} C$.

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

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

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

The temperature coefficient of emf a cell designed as

$Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4 \times 10^{-4} V$ per degree. For a cell reaction in equilibrium $\Delta G = 0$ and $\Delta G^{\circ} = -2.303RT\log_{10} K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G = \Delta H - T\Delta S$.

The E° for $Cu \rightarrow Cu^{2+} + 2e$ is :

A. $0.325V$

B. $0.35V$

C. $-0.325V$

D. $-0.35V$

Answer: C

Watch Video Solution

233. The E° values for the changes given below are measured againest NHE at $27^{\circ}C$.

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

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

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

The temperature coefficient of emf a cell designed as $Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4 \times 10^{-4}V$ per degree. For a cell reaction in equilibrium $\Delta G = 0$ and $\Delta G^{\circ} = -2.303RT\log_{10}K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G = \Delta H - T\Delta S$.

The E° of $Zn|Zn^{2+}||Cu^{2+}|Cu$ cell is :

A. $1.085V$

B. $1.1V$

C. $1.126V$

D. $0.91V$

Answer: A

Watch Video Solution

234. Civen E° for $Cu^{2+} \rightarrow Cu^{+}$ is $+0.15V$ and $Cu^{+} \rightarrow Cu$ is $+0.05V$

Calculate E° for $Cu^{2+} \rightarrow Cu$.

A. $-0.325V$

B. $+0.325V$

C. $+0.65V$

D. $-0.65V$

Answer: B

Watch Video Solution

235. The E° values for the changes given below are measured againest NHE at $27^\circ C$.

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

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

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

The temperature coefficient of emf a cell designed as $Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4 \times 10^{-4}V$ per degree. For a cell reaction in equilibrium $\Delta G = 0$ and $\Delta G^{\circ} = -2.303RT\log_{10}K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G = \Delta H - T\Delta S$.

The E° for the reaction :

$2Cu^{+} \rightarrow Cu^{2+} + Cu$ is:

A. $+0.35V$

B. $-0.35V$

C. $+0.65V$

D. $-0.65V$

Answer: A

Watch Video Solution

236. The E° values for the changes given below are measured againest NHE at $27^\circ C$.

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

$Cu^{+} + e \to Cu, E^\circ = +0.50V,$

$Zn^{2+} + 2e \to Zn, E^\circ = -0.76V$

The temperature coefficient of emf a cell designed as $Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4 \times 10^{-4}V$ per degree. For a cell reaction in equilibrium $\Delta G = 0$ and $\Delta G^\circ = -2.303RT\log_{10}K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G = \Delta H - T\Delta S$.

The heat of reaction for the change

$Zn + \underset{0.1M}{Cu^{2+}} \Leftrightarrow \underset{1M}{Zn^{2+}} + Cu$ at $27^\circ C$ is :

A. $2.037 \times 10^5 J$

B. $2.116 \times 10^5 J$

C. $2.037 \times 10^6 J$

D. $2.116 \times 10^6 J$

Answer: A

Watch Video Solution

237. The E° values for the changes given below are measured againest NHE at $27^{\circ}C$.

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

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

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

The temperature coefficient of emf a cell designed as $Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4 \times 10^{-4}V$ per degree. For a cell reaction in equilibrium $\Delta G = 0$ and $\Delta G^{\circ} = -2.303RT\log_{10}K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G = \Delta H - T\Delta S$.

The E° of $Zn\big|Zn^{2+}\big|\big|Cu^{2+}\big|Cu$ cell is :

A. $1.076V$

B. $1.091V$

C. $1.117V$

D. $0.90V$

Answer: A

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238. The E° values for the changes given below are measured againest NHE at $27^\circ C$.

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

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

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

The temperature coefficient of emf a cell designed as $Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4 \times 10^{-4}V$ per degree. For a cell reaction in equilibrium $\Delta G = 0$ and $\Delta G^\circ = -2.303RT\log_{10}K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G = \Delta H - T\Delta S$.

The equilibrium constant for the reaction:

$Zn + Cu^{2+} \Leftrightarrow Zn^{2+} + Cu$ is:

A. 6.0×10^{36}

B. 1.94×10^{37}

C. 1.47×10^{38}

D. 7.0×10^{30}

Answer: A

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239. The E° values for the changes given below are measured againest NHE at $27^{\circ}C$.

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

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

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

The temperature coefficient of emf a cell designed as

$Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4 \times 10^{-4} V$ per degree. For a cell reaction in equilibrium $\Delta G = 0$ and $\Delta G^\circ = -2.303 RT \log_{10} K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G = \Delta H - T\Delta S$.

The heat of reaction for the change

$Zn + \underset{0.1M}{Cu^{2+}} \Leftrightarrow \underset{1M}{Zn^{2+}} + Cu$ at $27^\circ C$ is :

A. $-2118 \times 10^5 J$

B. $-2.197 \times 10^5 J$

C. $-2.237 \times 10^5 J$

D. $-1.818 \times 10^5 J$

Answer: A

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240. The E° values for the changes given below are measured againest NHE at $27^\circ C$.

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

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

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

The temperature coefficient of emf a cell designed as $Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4 \times 10^{-4}V$ per degree. For a cell reaction in equilibrium $\Delta G = 0$ and $\Delta G^{\circ} = -2.303RT\log_{10}K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G = \Delta H - T\Delta S$.

Change in entropy for the reaction :

$Zn + \underset{0.1M}{Cu^{2+}} \Leftrightarrow \underset{1M}{Zn^{2+}} + Cu$ at $27^{\circ}C$ is :

A. $14J$

B. $27J$

C. $-14J$

D. $-27J$

Answer: D

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241. The E° values for the changes given below are measured againest NHE at $27^{\circ}C$.

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

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

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

The temperature coefficient of emf a cell designed as $Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4\times10^{-4}V$ per degree. For a cell reaction in equilibrium $\Delta G=0$ and $\Delta G^{\circ} = -2.303RT\log_{10}K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G=\Delta H-T\Delta S$.

The equilibrium constant for the disproportionation of Cu^{+} is:

A. 8.5×10^{-5}

B. 8.5×10^{5}

C. 8.5×10^{-4}

D. 8.5×10^{6}

Answer: B

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242. The E° values for the changes given below are measured againest NHE at $27^{\circ}C$.

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

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

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

The temperature coefficient of emf a cell designed as $Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$ is $-1.4\times10^{-4}V$ per degree. For a cell reaction in equilibrium $\Delta G=0$ and $\Delta G^{\circ}=-2.303RT\log_{10}K_c$. The heat of reaction and entropy change during the reaction are are related by $\Delta G=\Delta H-T\Delta S$.

If 9.65 ampere current is passed through making Cu anode Zn cathode for 1000 sec in the cell $Zn|\underset{1M}{Zn^{2+}}||\underset{0.1M}{Cu^{2+}}|Cu$, the e.m.f. of cell after after passage of current would be :

A. 1.066

B. 1.076

C. 1.086

D. 1.056

Answer: A

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243. Tollen reagent is used for the detection of aldehydes. When a solution of $AgNO_3$ is added to glucose with NH_4OH, then gluconic acid is formed.

$$Ag^{\oplus} + e^{-} \rightarrow Ag, \qquad E^{c-}{\cdot}_{red} = 0.8V$$

$$C_6H_{12}O_6 \rightarrow \underset{Gluconicacid}{C_6H_{12}O_7} + 2H^{\oplus} + 2e^{-}, \qquad E^{c-}{\cdot}_{oxid} = -0.05V$$

$$\left[Ag(NH_3)_2\right]^{\oplus} + e^{-} \rightarrow Ag(s) + 2NH_3, \qquad E^{c-}{\cdot}_{red} = 0.337V$$

$$\left[Use 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 at 298K\right]$$

$2Ag^{\oplus}+C_6H^{12}O_6+H_2O\rightarrow 2Ag^s+C_6H_{12}O_7+2H^{\oplus}$ Find $\ln K$ of this reaction.

A. 12.7

B. 25.33

C. 28.30

D. 46.29

Answer: B

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244. Tollen reagent is used for the detection of aldehydes. When a solution of $AgNO_3$ is added to glucose with NH_4OH, then gluconic acid is formed.

$$Ag^{\oplus}+e^{-}\rightarrow Ag, \qquad E^{c-}\cdot_{red}=0.8V$$

$$C_6H_{12}O_6\rightarrow \underset{Gluconicacid}{C_6H_{12}O_7}+2H^{\oplus}+2e^{-}, \qquad E^{c-}\cdot_{oxid}=-0.05V$$

$$\left[Ag(NH_3)_2\right]^{\oplus}+e^{-}\rightarrow Ag(s)+2NH_3, \qquad E^{c-}\cdot_{red}=0.337V$$

$\left[Use 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 at 298K\right]$

When ammonia is added to the solution, pH is raised to 11. Which half cell reaction is affected by pH and by how much ?

A. E°_{oxd} glucose will increase by a factor of $0.463V$

B. E°_{oxd} glucose decrease by a factor of $0.463V$

C. $E^{\circ}_{red} Ag^{+}$ will increase by a factor of $0.463V$.

D. $E^{\circ}_{red} Ag^{+}$ will decrease by a factor of $0.463V$.

Answer: D

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245. Tollen reagent is used for the detection of aldehydes. When a solution of $AgNO_3$ is added to glucose with NH_4OH, then gluconic acid is formed.

$Ag^{\oplus} + e^{-} \rightarrow Ag, \qquad E^{c-}{}_{\cdot red} = 0.8V$

$C_6H_{12}O_6 \rightarrow \underset{Gluconic acid}{C_6H_{12}O_7} + 2H^{\oplus} + 2e^{-}, \qquad E^{c-}{}_{\cdot oxid} = -0.05V$

$\left[Ag(NH_3)_2\right]^{\oplus} + e^- \rightarrow Ag(s) + 2NH_3, \qquad E^{c-}{}_{\cdot red} = 0.337V$

$\left[Use 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 at 298K\right]$

Ammonia is always added in this reaction. Which of the followijng must be wrong ?

A. NH_3 combines with Ag^+ to form a complex

B. $\left[Ag(NH_3)_2\right]^+$ is a worker oxidising reagent than Ag^+

C. In absence of NH_3 silver salt of gluconic acid is fomed

D. NH_3 has affected tge standard reduction potential of glucose / glucose acid electrode

Answer: D

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246. Redox reactions play a pivotal role in chemistry and biology. The values standard redox potential (E^{c-}) 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.

$I_2 + 2e^- \rightarrow 2I^{c-}, \qquad E^{c-} = 0.54$

$Cl_2 + 2e^- \rightarrow 2Cl^{c-}, \qquad E^{c-} = 1.36$

$Mn^{3+} + e^- \rightarrow Mn^{2+}, \qquad E^{c-} = 1.50$

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

$O_2 + 4H^{\oplus} + 4e^- \rightarrow 2H_2O, \qquad E^{c-} = 1.23$

Among the following, identify the correct statement.

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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247. 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. O_2 oxidises Mn^{2+} to Mn^{3+}

B. O_2 oxidises both Mn^{2+} to Mn^{3+} and Fe^{2+} to Fe^{3+}

C. Fe^{3+} oxidises H_2O to O_2

D. Mn^{3+} oxidises H_2O to O_2

Answer: D

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248. The concentration of potassium ions inside a biological cell is at least twenty times higher than the outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simple mode for such a concentration cell involving a metal M is :

$$M_{(s)}\left|M^{\circ}_{(aq.)}\,0.05\text{molar}\right|\left|M^{\circ}_{(aq.)}\,1\text{molar}\right|M_{(s)}$$

For the above electrolytic cell the magnitude of the cell potential $|E_{cell}| = 70mV$

For the above cell :

A. $E_{cell} < 0, \Delta G > 0$

B. $E_{cell} > 0, \Delta G < 0$

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

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

Answer: B

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249. The electrochemical cell shown below is a concentration cell

M / M^{2+} (saturated solution of a sparingly soluble salt, $MX_2) \mid \left|M^{2+}\left(0.001 moldm^{-3}\right)\right| M$

The emf of the cell depends on the difference in concentrations of Mn^{2+} ions at the two electrodes. The emf of the cell at $298K$ is $0.059V$.

The value of $\Delta G\left(kJ\text{mol}^{-1}\right)$ for the given cell is : (take $1F = 96500C\text{mol}^{-1}$)

A. -5.7

B. 5.7

C. 11.4

D. -11.4

Answer: D

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250. Statement : Electrolysis involves electronaltion or de-electronation as a result of passage of current.

Explanation : The species undergoes electronation at anode and show show de-electronation at cathode.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: A

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251. Statement : Very pure form of iron does not show rusting.

Explanation : Rusting is catalysed by impurities present in iron and H^+ ions.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: D

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252. Statement : The cathode of electrolytic cell during electrolysis of $NaCl_{(aq.)}$ on additon of little litmus shows a blue colour.

Explanation : At cathode : $2H^{+}+2e \rightarrow H_2$. The reaction at cathode give rise to an increase in pH ranging in alkaline medium and litmus shows blue colour.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: C

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253. Statement : In concentration cell neither electronation occurs at cathode nor e-electronation at anode.

Explanation : The electrical energy is produced due to decrease in frree energy during the transfer of concentration from high to low region.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: B

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254. Statement : In case of H^{+} and Na^{+} present in a solution discharge of H^{+} is preferred at cathode.

Explanation :The higher is discharge potential of ion, lesser is its tendency to get discharged.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: C

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255. Statement : Milli-equivalent of a metla discharged at cathode during electrolysis $= \dfrac{i.T}{96.5}$

Explanation : This is Faraday's I law of electrolysis.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: C

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256. Statement : $Pt_{H_2} \mid HCl$ at $25^\circ CE_H = 0.$

Explanation : For primary reference electrode $E^\circ_{H/H^+} = 0$

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: B

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257. Statement : $\left(\frac{\delta E}{\delta T}\right)_P$ is called temperature coefficient of emf.

Explanation : $\left(\frac{\delta E}{\delta T}\right)_P$ may be $+ve, \ -ve$ and depends upon heat of reaction.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: D

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258. Statement : Liquid juncation potential can be eliminated by putting a salt bridge of KCl.

Explanation : The funcation of salt bridge is to remove liquid junction potential because the salt used has same speed of cathions and anions.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: C

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259. Statement : Dry cells-Leclanche cells are corroded and lose their current producing nature after sometime and do not posses infinite life.

Explanation : NH_3 formed at cathode in dry cell as a result of reduction reacts with Zn container

$MnO_2 + NH_4^+ + e \rightarrow MnO(OH) + NH_3$

to form $Zn(NH_3)_4^{2+}$

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: D

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260. 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. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: D

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261. Statement : At the end of electrolysis using platinum electrodes, an aqueous solution of copper sulphate turn colourless.

Explanation : Copper in copper sulphate is converted to copper hydroxide during the electrolysis.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: A

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262. Statement : Poggendroff compensation method is used for the measurement of emf of voltaic cells.

Explanation : This method has the advantage of giving the emf of an open circuit when it produces no current and thus determines emf of cells under reversible condition.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: C

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263. Assertion (A): The mobility of $Na^{\oplus}$ is lower than that of $K^{\oplus}$ ion.

Reason (R): The ionic mobility depends upon the effective radius of the ion.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: C

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264. Statement : E°_{cell} is an intensive property.

Explanation : $\Delta G^{\circ} / n$ is also intensive property.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: C

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265. Statement : Passes of charge through $CuSO_4(aq)$ solution in presence of Pt electode increase it pH.

Explanation : Concentration of $[OH^-]$ in solution decreases.

A. S is correct but E is wrong

B. S is wrong but E is correct.

C. Both S and E are correct and E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: C

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266. Statement : If two half reaction with electrode potential E_1° and E_2° gives a third reaction then,

$\Delta G_3^\circ = \Delta G_1^\circ + \Delta G_2^\circ$

Explanation : $E_3^\circ = E_1^\circ + E_2^\circ$

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267. Find the volume of gases evolved by passing 0.9655. A current for 1 hr through an aqueous solution of CH_3COONa at $25^\circ C$ and $1atm$.

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268. Calculate the mass of benzene that would be required to produce a current of one ampere (assume current efficiency 50%) for three hours from the following data :

$C_6H_6 + \frac{15}{2}O_2 \rightarrow 6CO_2 + 3H_2O$

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269. The half cell potentials of a halfcell $A^{(x+n)+}, A^{x+} \mid pt$ were found to be as follows :

%of reduced form	24.4	48.8
Half cell potential (V)	0.101	0.115

Determinwe the value of n.

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

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

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

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271. e.m.f. diagram for some ions is given as :

$$FeO_4^{2-} \xrightarrow{E^\circ = +2.20V} Fe^{3+} \xrightarrow{E^\circ = +0.77V} Fe^{2+} \xrightarrow{E^\circ = -0.445V} Fe^0$$

Datermine the value of $E^\circ_{FeO_4^{2-} / Fe^{2+}}$.

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272. The reduction potential diagram for Cu in acid solution is :

$$\begin{tikzcd} Cu^{2+} \arrow[r, "+\ 0.15\text{ volt}"] \arrow[rr, bend right, "E^{\circ}=X\text{ volt}"'] & Cu^{+} \arrow[r, "+\ 0.50\text{ volt}"] & Cu \end{tikzcd}$$

Calculate X. Does Cu^{+} disproportionate in solution ?

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273. At $25^{\circ}C$, the free energy of formation of $H_2O(l)$ is $-56,700Calmol^{-1}$. The free energy of ionization of water to $H^{\oplus}$ and $\overset{c-}{O}H$ is $19050calmol^{-1}$. What is the reversible EMF of the following cell at $25^{\circ}C$:

$$H_2(g)(1atm)|H^{\oplus}||\overset{c-}{O}H, O_2(g), 1atm$$

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274. Peroxodisulphate salts, $(e.g., Na_2S_2O_8)$ are strong oxidizing agents used be bleaching agents for fats, oils, ets.

Given :

$O_2(g) + 4H^{\oplus}(aq) + 4e^- \rightarrow 2H_2O(l) \qquad E^{c-} = 1.23V$

$S_2O_8^{2-}(aq) + 2e^- \rightarrow 2SO_4^{2-}(aq) \qquad E^{C-} = 2.01V$

Which of the following statement is (are) correct ?

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275. Dissociation constant for $Ag(NH_3)_2^+$ into Ag^+ and NH_3 is 6×10^{-14}. Calculate E° for the half reaction.

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

Given, $Ag^+ + e \rightarrow Ag$ has $E^\circ = 0.799V$

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

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

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278. A certain electrode has a standard reduction potential of $0.140V$ when measure against a saturaed calomel electrode

$(E^{\circ}_{RP} = +0.244V)$. Calculate its standard reduction potential against a standard H-electrods.

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(A) ELECTROLYSIS

1. A metal wire carries a current of 4 ampere. How many electrons pass through a point in the wire in one second?

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2. A current of 0.2 ampere is passed for 600 sec. through $100mL$ of $0.1MNaCl$. If hydrogen and chlroine gas is produced at the cathode and anode respectively, calculate

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(B) ELECTRODE POTENTIAL AND EMF

1. Write the nernst equation and $e.m.f.$ of the following cells at $298K$:

$Mg_{(s)}|Mg^{2+}(0.001M)||Cu^{2+}(0.0001M)|Cu_{(s)}$

(b) $Fe_{(s)}|Fe^{2+}(0.001M)||H^{+}(1M)|H_{2(g)}(1\text{bar}) \mid Pt_{(s)}$

(c) $Sn_{(s)}|Sn^{2+}(0.050M)||H^{+}(0.020M)|H_{2(g)}(1\text{bar}) \mid Pt_{(s)}$

(d) $Pt_{(s)}|Br_{2(l)}|Br^{-}(0.010M)||H^{+}(0.030M)|H_{2(g)}(1\text{bar})|Pt_{(s)}$

Given : $E^{\circ}_{OP}Mg = 2.36V$, $E^{\circ}_{OP}Cu = -0.34V$, $E^{\circ}_{OP}Fe = 0.44V$, $E^{\circ}_{OP}Sn = 0.14V$ and $E^{\circ}_{OP}Br_2 = -1.09V$ respectively.

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(D) ELECTROCHEMICAL SERIES

1. E° of some oxidants are given as :

$I_2 + 2e \rightarrow 2I^{-} \quad E^{\circ} = +0.54V$

$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O \quad E^\circ = +1.52V$

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

$Sn^{4+} + 2e \rightarrow Sn^{2+} \quad E^\circ = +0.1V$

(a) Select the strongest reductant and oxidant in these.

(b) Select the weakest reductant and oxidant in these.

(c) Select the spontaneous reaction from the changes given below :

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

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

(iii) $Sn^{4+} + 2I^- \rightarrow Sn^{2+} + I_2$

(iv) $Sn^{2+} + I_2 \rightarrow Sn^{4+} + 2I^-$

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Exercise 2 PREVIOUS YEARS NUMERICAL PROBLEMS

1. The following electrochemical cell has been set up.

$Pt_{(I)} \left| Fe^{3+}, Fe^{2+}(a=1) \right|\left| Ce^{4+}, CE^{3+}(a=1) \right| Pt_{(II)}$

If an ammeteris connected between the two platinum electrode, predict the direaction of flow of current. Will the current increases or decrease with time?

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2. Find the equilibrium constant for the reaction,

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

Given: $E^\circ_{Cu^{2+}\,/\,Cu^{+}} = 0.15V$, $E^\circ_{In^{3+}\,/\,In^{+}} = -0.42V$

and $E^\circ_{In^{2+}\,/\,In^{+}} = -0.40V$

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3. For the reaction,

$Ag^{+}_{(aq.)} + Cl^{-}_{(aq.)} \Leftrightarrow AgCl_{(s)}$

the Δg° Values for $Ag^\circ_{aq.}, Cl_{aq.}$ and $AgCl_s$ are $+77, -129$ and $-109 kjmol^{-1}$, Write the cell representation of above reaction and calculate E° at $298K$, also calculate the $\log_{10} K_{sp}$ of $AgCl$ at $298K$.

(b) If $6.539 \times 10^{-2} g$ of metallic zinc is added to $100mL$ saturated solution of $AgCl$, find the value of $\log_{10}.\frac{[Zn^{2+}]}{[Ag^+]^2}$. How many moles of Ag will be precipitated in this reaction ?

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

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Exercise (3A) OBJECTIVE PROBLEMS: (Only One Option is Correct)

1. Which of the following expressions is no correct ?

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

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

C. $\lambda^{\infty}_{\text{cation}} = u^{\infty}_{\text{cation}} \times \text{faraday}$

D. $\lambda^{\infty}_{anion} = u^{\infty}_{anion} \times faraday$

Answer: D

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2. A student made the following observations in the laboratory:

(i) Clean copper metal did not react with 1 molar $Pb(NO_3)_2$ solution

(ii) Clean lead metal dissolved in a 1 molar $AgNO_3$ solution and crystals of Ag metal appeared

(iii) Clean silver metal did not react with 1 molar $Cu(NO_3)_2$ solutions.

A. Cu, Pb, Ag

B. Cu, Ag, Pb

C. Pb, Cu, Ag

D. Pb, Ag, Cu

Answer: C

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3. In an aqueous solution, hydrogen (H_2) will not reduce:

A. Fe^{3+}

B. Cu^{2+}

C. Zn^{2+}

D. Ag^{+}

Answer: C

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4. Which represents disproportionation?

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

B. $3I_2 \rightarrow 5I^{-} + I^{5+}$

C. $H_2O + Cl_2 \rightarrow Cl^{-} + ClO^{-} + 2H^{+}$

D. All of these

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Exercise (3B) OBJECTIVE PROBLEMS: (More than One OptIons are Correct)

1. The passage of current through the solution of a dcertain electrolyte results in the liberation of H_2 at the cathode and chlorine at the anode. The solution in the container could be:

A. $NaCl(aq.)$

B. $CuCl_2(aq.)$

C. $Kcl(aq.)$

D. $MgCl_2(aq.)$

Answer: A::C::D

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Exercise (4) OBJECTIVE PROBLEMS: (Competitive Examination)

1. Given $E^{\circ}_{Cr^{3+}/Cr} = -0.72V, E^{\circ}_{Fe^{2+}/Fe} = -0.439V$. The value of standard electrode potential for the change,

$Fe^{3+}_{aq.} + e^{-} \rightarrow Fe^{2+}_{aq.}$ will be:

A. $-0.072V$

B. $0.385V$

C. $0.770V$

D. $-0.270V$

Answer: A

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2. Saturated solution of KNO_3 is used to make salt bridge because:

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

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

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

D. KNO_3 is higly soluble in water

Answer: C

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3. Standard electrode potenital data are useful for understanding the suitablity of an oxidant in a redox titration. Some half cell reactions and their standard potential are given below:

$MnO^-_{4(aq)} + 8H^+_{(aq.)} + 5e \rightarrow Mn^{2+}_{(aq.)} + 4H_2O_l, E^\circ = 1.51V$

$Cr_2O^{2-}_{7(aq.)} + 14H^+_{(aq.)} + 6e \rightarrow 2Cr^{3+}_{(aq.)} + 7H_2O_l, E^\circ = 1.38V$

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

$Cl_{2(g)} + 2e^- \rightarrow 2Cl^-_{(aq.)}, E^\circ = 1.40V$

Identify the only incorrect statement regarding the 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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4. In the electrolytic cell, flow of electrons is from:

A. cathode to anode in solution

B. cathode to anode through external supply

C. cathode to anode through internal supply

D. anode to cathode through internal supply

Answer: C

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5. The emf of the cell $Zn\left|\underset{(0.01M)}{Zn^{2+}}\right|\left|\underset{(0.001M)}{Fe^{2+}}\right|Fe$ at $298K$ is 0.2905, 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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6. The rusting of iron takes place as follows:

$2H^{+}+2e+1/2O(2)\rightarrow H_2O_{(l)}, E^{\circ}=+1.23V$

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

The ΔG° for the net process is :

A. $-322kJmol^{-1}$

B. $161kJmol^{-1}$

C. $-152kJmol^{-1}$

D. $-76kJmol^{-1}$

Answer: A

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7. Electrolysis of dilute aqueous $NaCl$ solution was carried out by passing 10 milli-ampere current. The time required to liberate 0.01 mole of H_2 gas at the cathode is :

(1 faraday $= 96500Cmol^{-1}$)

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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8. Consider the following cell reaction :

$2Fe_s + O_{2(g)} + 4H^+_{(aq.)} \rightarrow 2Fe^{2+}_{(aq.)} + 2H_2O_{(l)}, E^\circ = 1.67V$

$At[Fe^{2+}] = 10^{-3}M, P(O_2) = 0.1atm$ and $pH = 3$, the cell potential at $25^\circ C$ is:

A. $1.47V$

B. $1.77V$

C. $1.87V$

D. $1.57V$

Answer: D

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Exercise (6) INTEGER ANSWER TYPE PROBLEAMS

1. $10800C$ of electricity through the electrolyte deposited $2.977g$ of metal with atomic mass $106.4gmol^{-1}$. Find the charge on the metal cations.

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2. A current of 2 ampere passing for 5 hr through a molten tin salt deposits $22.2g$ of t tin. Find the oxidation number of tin in the salt.

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Exercise (7) COMPREHENSION BASED OBJECTIVE PROBLEMS

1. Redox reactions play a pivotyal role in chemistry and biology. The values of standard redox potential (E°) of two half-cell reactions decide which way the reaciton is expected to proced. A simple exampler is a Daniel cell in which zinc goes into solution and copper gerts deposited. Given below are a set of half-cell reactions (acidic medium) along with their E° $(V$ with respect to normal hydrofgen electrode) values. Using this data :

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

$CI_2 + 2e^- \rightarrow 2CI^- \qquad E^\circ = 1.36,$

$. Mn^{3+} + e^- \rightarrow Mn^{2+} \qquad E^\circ = 1.50,$

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

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

Soldium fusion extract, obtained from aniline, on treatment with iron (II) sulphatge and H_2SO_4 in presence of air gives a Prussion bule precipitate. The blue colour is due to the formation of :

A. $Fe_4\left[Fe(CN)_6\right]_3$

B. $Fe_3\left[Fe(CN)_6\right]_2$

C. $Fe_4\left[Fe(CN)_6\right]_2$

D. $Fe_3\left[Fe(CN)_6\right]_3$

Answer: A

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2. The concentration of potassium ions inside a biological cell is at least twenty times higher than the outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simple mode for such a concentration cell involving a metal M is :

$M_{(s)}\left|M^{\circ}_{(aq.)}0.05\text{molar}\right|\left|M^{\circ}_{(aq.)}1\text{molar}\right|M_{(s)}$

For the above electrolytic cell the magnitude of the cell potential $|E_{cell}| = 70mV$

If the 0.05 molar solution of M^+ is replaced by 0.0025 molar M^+ solution, then the magnitude of the cell potential would be :

A. $35mV$

B. $70mV$

C. $140mV$

D. $700mV$

Answer: C

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3. The electrochemical cell shown below is a concentration cell

M/M^{2+} (saturated solution of a sparingly soluble salt, $MX_2) \mid \left|M^{2+}(0.001moldm^{-3})\right|M$

The emf of the cell depends on the difference in concentrations of Mn^{2+} ions at the two electrodes. The emf of the cell at $298K$ is $0.059V$.

The solublity product $\left(K_{SP}, \text{mol}^3\text{dm}^{-9}\right)$ of MX_2 at $298K$ based on the information available for the given concentration cell is :

(take $2.303 \times R \times 298/F = 0.059V$)

A. 1×10^{-15}

B. 4×10^{-15}

C. 1×10^{-12}

D. 4×10^{-12}

Answer: B

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Exercise (9) ADVANCED NUMERICAL PROBLEMS

1. A current of $0.5A$ is passed through acidulated water for 30 minute. Calculate weight of H_2 and O_2 evolved. Also calculate the volume of O_2 produced at $25^\circ C$ and 760 mm of Hg, if the gas is :

(a) dry

(b) saturated with water vapour (aqueous tension is 23.0 mm at $25^\circ C$).

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2. A copper cell containing 5% solution of $CuSO_4.5H_2O$ and a silver cell contaning a 2% solution of $AgNO_3$ by weight are connectged in series. A current of 0.01 ampere was passed through the cells for 30 minute. What was the ratio of mass of Cu and Ag deposited at the cathode of cell? $At. wt.$ of Cu and Ag arte 63.6 and 108 respectively.

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3. Some quantity of electricity being used to liberate iodine (at anode) and a metal x (at cathode). The mass of x liberated at cathode is $0.617g$ and the liberated iodine completely reduced by $46.3mL$ of $0.124M$ sodium thio-sulphate solution. what is equivalent weight of metal ?

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4. A test for complete romovel of Cu^{2+} ions form a solution of $Cu^{2+}_{(aq.)}$ is to add $NH_{3(aq.)}$. A buke colour signifies the fomaltionn of complex $\left[Cu(NH_3)_4\right]^{2+}$ having $K_f = 1.1 \times 10^{13}$ and thus confirms the presence of Cu^{2+} in solution. $250mL$ of $0.1MCuSO_{4(aq.)}$ is electrolysed by passing a current of 3.512 ampere for 1368 second. After passage of this passage of this charge sufficient quantity of $NH_{3(aq.)}$ is added to electrolysed solution maintaining $[NH_3] = 0.10M$. If $\left[Cu(NH_3)_4\right]^{2+}$ is detectable up to its concentration as low as 1×10^{-5}, would a blue colour be shown by the electrolysed solution on addition of NH_3.

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5. A Zn rod weighing $25g$ was kept in $100mL$ of $1MCuSO_4$ solution. After a certain time the molarity of Cu^{2+} in solution was 0.8. What was molartiyof SO_4^{2-} ? What was the weight of Zn rod after cleaning ? $(\text{At. Weight of } Zn = 65.4.)$

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6. Assume that impure copper contains only Fe, Au and Ag as impurities. After passage of 140 ampere for 482.5 sec, the mass of anode decreased by $22.260g$ and the cathode increased in mass by $22.011g$. Calculate the percentage of iron and percentage of copper originally present.

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7. $50mL$ of $0.1MCuSO_4$ solution is electrolysed using Pt electrodes with a current of 0.965 ampere for a period of 1 minute. Assuming that volume of solution does not change during electrolysis, calculate $[Cu^{2+}], [H^+]$ and $[SO_4^{2-}]$ after electrolusis. What will be the concentration of each species if current is passed using Cu electrodes ?

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8. An oxide of metal $(\text{at. wt.} = 112)$ contain $12.5\% O_2$ by weight. The oxide was converted into chloride by treatment with HCl and electrolsed. Calculate the amount of metal that would be deposited at cathode if a current of 0.965 ampere was passed for a period of 5 hr. What is valency of metal ?

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9. $19g$ fused $SnCl_2$ was electrolysed using inert electrodes. $0.119gSn$ was deposited at cathode. If nothing was given out during electrolysis, calculate the ratio of weight of $SnCl_2$ and $SnCl_4$ in fused state after electrolysis. $(\text{At. Wt. } Sn = 119)$

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10. A lead storage cell is discharged which causes the H_2SO_4 electrolyte to change from a concentration of 34.6% by weight (density $1.261 gmL^{-1}$ at $25^{\circ} C$) to one of 27% by weight. The original volume of electrolyte is one litre. How many faraday have left the anode of battry ? Note the water is produced by the cell reaction as H_2SO_4 is used up. Over all reaction is :

$$Pb_s + PbO_2 + 2H_2SO_{4(l)} \rightarrow 2PbSO_{4(s)} + 2H_2O$$

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11. Two litre solution of a buffer mixture containing $1.0 M NaH_2PO_4$ and $1.0 M Na_2HPO_4$ is placed in two compartments (one litre ineach) of an electrolytic cell. The platinum electrodes are inserted in each compartments and 1.25 ampere current is passed for 212 minute. Assuming electrolysis of water onlu at each compartment. What will be pH in each compartment after passage of above charge ? (pK_a for $H_2PO_4^{-} = 2.15$.)

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12. A current of 40 microampere is passed through a solution of $AgNO_3$ for 32 minute using Pt electrodes. An uniform single atom thick layer of Ag is deposited covering 43% cathode surface. What is the total surface area of cathode if each Ag atom covers $5.4 \times 10^{-16} cm^2$?

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13. Suppose a fully charged battery containes 1.50 litre of $5.0 M H_2SO_4$. What will be the concentration of H_2SO_4 left in battery after 2.50 ampere current is drawn from the battery for 6.0 hour? Assume volume of solution ramains constant.

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14. In an analytical determination of aresenic , a solution containing aresenious acid, (H_3AsO_3). KI and a small amount of starch is electrolysed. The electrolysis produes free I_2 from I^- ion and the I_2 immediately oxidises the arsenious acid to hydrogen arsenate ion, $(HAsO_4^{2-})$.

$$I_{2(aq.)} + H_3AsO_{3(aq.)} + H_2O_{(l)} \rightarrow 2I^-_{(aq.)} + HAsO^{2-}_{4(aq.)} + 4H^+_{(aq.)}$$

When the oxidation of arsenic is complete, the free iodine combines with the starch to give a deep blue colour. If during a particular run, it takes $65.3s$ for a current of $10.5mA$ to give an end point (indicated by the blue colour), how many grams of arsenic and H_3AsO_3 are present in the solution? $(\text{At. wt. of } As = 75)$

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15. Assuming that a constant current is delivered, how many kW-h of electricity can be produced by the reacation of 1.0 mole Zn with Cu^{2+} ion in a Daniel cell in which all the concentration remains $1.00M$?

$$\left(E^\circ_{Zn/Zn^{2+}} = 0.76V, E^\circ_{Cu/Cu^{2+}} = -0.34V\right)$$

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16. Find the e.m.f. of the following cell at $18^\circ C$ taking the degree of dissocution of $0.2NAgNO_3$ and $0.05AgNO_3$ solution as 0.75 and 0.95 respectively.

$$Ag|0.2NAgNO_3||0.05AgNO_3|Ag$$

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17. If it is disreed to construct the following voltaic cell to have $E_{cell} = 0.0860V$, what $\left[Cl^-\right]$ must be present in the cathodic half cell to achieve the desired e.m.f.? Given K_{SP} of $AgCl$ and Agl are 1.8×10^{-10} and 8.5×10^{-17} respectively.

$$Ag_{(s)}\left|Ag^+\left[Sat.\ Agl_{(aq.)}\right]\right|\ |\ Ag^+\left[Sat.\ AgCl.\ xMCl^-\ |\ Ag_{(s)}\right]$$

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18. The e.m.f. of the obtained by combining Zn and Cu electrodes of Daniel cell with N calomel electrode are $1.083V$ and $-0.0180V$

respectively at $25^\circ C$. If the potential of N calomel electrode is $-0.28V$, Find e.m.f. of Daniel cell.

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19. Calcualte the potential of an indicator electrode versus the standard hydrogen electode, which originally contained $0.1 M MnO_4^-$ and $0.8 M H^+$ and which was treated with Fe^{2+} necessary to reduce 90% of MnO_4^- to Mn^{2+}. $\left(E^\circ_{MnO_4^- / Mn^{2+}} = 1.51V\right)$

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20. An electrode is prepared by dipping a silver strip into a solution saturateed with $AgACN$ and containining $0.10 M SCN^-$. The e.m.f. of voltaic cell constructed by connecting this, as the cathode, to the standard hydrogen half-cell as anode was found to be $0.45V$. What is the solubility product of $AgSCN$.

(Given $E^\circ_{Ag^+ / Ag} = 0.80V$)

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21. Calculate the minimum weight of $NaOH$ required to be added in R.H.S. to consume all the H^{+} present in R.H.S of cell of e.m.f. $+0.701V$ at $25^{\circ}C$ before its use. Also report the $e.m.f.$ of cell after addition of $NaOH$.

$$Zn\left|\begin{array}{c}Zn^{2+}\\ 0.1M\end{array}\right|\left|\begin{array}{c}HCl\\ 1\text{litre}\end{array}\right|\begin{array}{c}Pt_{H_{2(g)}}\\ 1\text{atm}\end{array}, E^{\circ}_{Zn/Zn^{2+}} = +0.760V$$

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22. Consider the cell $Ag|AgBr_{(s)}, Br^{-}||AgCl_{(s)}, Cl^{-}|Ag$ at $25^{\circ}C$. The solubility product and $AgCl$ and $AgBr$ are 1×10^{-10} and 5×10^{-13} respectively. For what ratio of the concentrations of Br^{-} and Cl^{-} ions would the $e.m.f.$ of the cell be zero ?

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23. Calculate the half cell potential of a reaction $Ag_2S+2e \rightarrow 2Ag+S^{2-}$ in a solution beffered at $pH=3$ and also saturated with $0.1MH_2S$. K_1 and K_2 for H_2S are 10^{-8} and 1.1×10^{-8} and 1.1×10^{-13} respectively.

$\left(K_{SP_{Ag_2S}}=2 \times 10^{-49}, E^{\circ}_{Ag^{+}/Ag}=0.8V\right)$

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24. The standard electrode potential are for the following reactions :

$Fe_{(s)} \rightarrow Fe^{2+}_{(aq.)}+2e, E^{\circ}=0.48V$

$Cr^{3+}+e \rightarrow Cr^{2+}_{(aq.)}, E^{\circ}=-0.41V$

If excess of Fe_s is added to a solution in which $\left[Cr^{3+}\right]=1M$, what will be maximum value of $\left[Fe^{2+}\right]$ when equilibrium is attained at $298K$?

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25. The pK_{SP} of Agl is 16.07. If the E° value for Ag^{+} / Ag is $0.7991V$, find the E° for hlaf cell reaction :

$AgI_{(s)} + e \rightarrow Ag + I^{-}$

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26. The e.m.f. of cell $Zn|ZnSO_4||CuSO_4|Cu$ at $25^{\circ}C$ lis $0.03V$ and the temperature coefficient of $e.m.f$ is $-1.4 \times 10^{-4}V$ per degree. Calculate heat of reaction for the change taking place inside the cell.

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27. For the cell $Mg_{(s)}\left|Mg^{2+}_{(aq.)}\right|\left|Ag^{+}_{(aq.)}\right|Ag_{(s)}$, calculate the equilibrium constant at $25^{\circ}C$ and the maximum work that can be obtained during operation of cell. (Given, $E^{\circ}_{Mg/Mg^{2+}} = +2.37V$ and $E^{\circ}_{Ag^{+}/Ag} = +0.80V, R = 8.314J\big)$

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28. The standard reduction potential of $E^{\circ}_{Bi^{3+}\,/\,Bi}$ and $E^{\circ}_{Cu^{2+}\,/\,Cu}$ are $0.226V$ and $0.344V$ respectively. A mixture of salts of Bi and Cu unit concentration each is electrolysed at $25^{\circ}C$. To what value can $\left[Cu^{2+}\right]$ be brought down before bismuth starts to deposit during electrolysis ?

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29. Show that the potentials are additive for the process in which half reaction are added to yield an overall reaction bu they are not additive when added to yield a third half reaction.

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30. An alloy weighing $1.05g$ of $Pb-Ag$ was dissolved in desired amount of HNO_3 and the volume was made $350mL$. An Ag electrode was dipped in solution and E_{cell} of the cell $\underset{1atm}{PtH_2}|\underset{1M}{H^+}||Ag^+|Ag$ was

$0.503V$ at $298K$. calculate the percentage of lead in alloy. $\left(\text{given}, E^{\circ}_{Ag^{+}\,/\,Ag} = 080V\right)$

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31. The following galvanic cell was

$$Zn\left|\begin{array}{l} Zn(NO_3)_{2\,(aq.)} \\ 100mL, 1M \end{array}\right|\left|\begin{array}{l} Cu(NO_3)_{2\,(aq.)} \\ 100mL, 1M \end{array}\right|Cu$$

operated as ann electrolytic cell using Cu as anode Zn as cathode. A current of 0.48 ampere was passed for 10 hour and then the cell was allowed to funcation as galvanic cell. What would be the $e.m.f.$ of the cell at $25^{\circ}C$? Assume that the only electrode reactions occuring were those involving Cu/Cu^{2+} and Zn/Zn^{2+}.

(Given $E^{\circ}_{Cu^{3+}\,/\,Cu} = +0.34V$ and $E^{\circ}_{Zn^{2+}\,/\,Zn} = -0.76V$)

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32. When silver chloride is dissolved in a large excess of ammonia, practically all silver ion can be assumed to exist in form of a sigle ionic species $\left[Ag_x[NH_3)_y\right]^{x+}$. Computer the values of x and y using the following two cells.

(a)

$Ag\left|0.4 \times 10^{-3} MAgCl, 1MNH_3\right|\left|40 \times 10^{-3}, MAgCl, 1MNH_3\right|Ag$

$E_{cell} = 0.1185V$ at $298K$

(b)

$Ag\left|3 \times 10^{-3} MAgCl, 1MNH_3\right|\left|3.0 \times 10^{-3} M, AgCl, 0.001MNH_3\right|Ag$

$E_{cell} = 0.1263V$ at $298K$.

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33. Estimate the cell potential of a Daniel cell having $1.0MZn^{2+}$ and originally having $1.0MCu^{2+}$ after sufficient ammonia has been added to the cathode compartment to make the NH_3 concentration $2.0M$. Given, $E^{\circ}_{Zn/Zn^{2+}}$ and $E^{\circ}_{Cu/Cu^{2+}}$ are 0.76 and $-0.34V$ respectively. Also equilirbrium constant for the $\left[Cu(NH_3)_4\right]^{2+}$ formation is 1×10^{12}.

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34. Calculate the $e.m.f.$ of cell

$$\begin{array}{l|l||l|l} Pt_{H_2} & CH_3COOH & NH_4OH & Pt_{H_2} \\ 1atm & 0.1M & 0.01M & 1atm \end{array}$$

(K_a for $CH_3COOH = 1.8 \times 10^{-5}$,

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

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35. Calculate the degree of hydrolysis and hydrolysis constant of $M/32$ solution of aniline hydrochloride from the following cell data.

$$Pt\left|\begin{array}{l} H_2 \\ 1atm \end{array}\right|\begin{array}{l} H^+ \\ 1M \end{array}\left|\left|\frac{M}{32}C_6H_5NH_3^+Cl^-_{(aq.)}\right|\begin{array}{l} H_2 \\ 1atm \end{array}\right|Pt,$$

$$E_{cell} = -0.188V$$

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36. Design the cell having one of the half reaction $CuS + 2e \rightarrow Cu + S^{2-}$ and cell reaction

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

Also calculate $E^{\circ}_{Cu\,/\,CuS}$ if K_{SP} of $Cu = 8.5 \times 10^{-36}$. Calculate the standard free energy change, E°_{cell} for the cell reaction.

(Also given $E^{\circ}_{Cu\,/\,Cu^{2+}} \;=\; -0.34V$)

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