doubtnut
India's Number 1 Education App

CHEMISTRY

PHYSICAL, INORGANIC, AND ORGANIC CHEMISTRY

ELECTROCHEMISRY

Examples

1. Write short hand notation for the following reaction $Sn^{2+}(aq) + 2Ag^{+}(aq) \rightarrow Sn^{4+}(aq) + 2Ag(s)$.

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2. Write the electrode reaction and the net cell reaction for the following cells, which electrode would be the positive terminal in each cell?

(a) $Zn|Zn^{2+}||Br^{-}, Br_2|Pt$

(b). $Cr\left|Cr^{3+}\right|\left|I^{-}, I_2\right|Pt.$

(c). $Pt\left|H_2, H^{+}\right|\left|Cu^{2+}\right|Cu$

(d). $Cd\left|Cd^{2+}\right|\left|Cl^{-}, AgCl\right|Ag$

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3. Calculate E^0_{cell} of (at 298K)

$Zn(s)\,/\,ZnSO_4(aq)\;|\;\;|\;CuSO_4(aq)\,/\,Cu(s)$

given that $E^0_{Zn\,/\,Zn^{2+}\,(aq)} = 0.76V$

$E^0_{Cu\,(s)\,/\,Cu^{2+}\,(aq)} = -0.34V$

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4. Given the cell Ag $AgCl(s)|NaCl(0.05M)||AgNO_3(0.30)|Ag$

(a) write half reaction occurring at the anode. (b). Write half reaction occurring at the cathode.

(c). Write the net ionic equation of te reaction. (d). Calculate E^0_{cell} at $25^\circ C$

(e). Does the cell reaction go spontaneous as written? (given $E^{\circ}_{AgCl,Cl} = +0.22\text{volt}$), $E^{0}_{Ag^{+}/Ag} = +0.80\text{volt}$)

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5. An aqueous solution containing Na^{+}, Sn^{2+}, Cl^{-} & SO_4^{2-} ions, all at unit concentration is electrolysed between a silver anode and a platium cathode. What changes occur at the electrodes when curret is passed through the cell? Given $E^{0}_{Ag^{+}|Ag} = 0.799V$,

$E^{0}_{Sn^{2+}|Cn} = -0.14V$, $E^{0}_{Cl_2|Cr^{-}} = 1.36V$, $E_{S_2O_8^{2-}|SO_4^{2-}} = 2V$, $E^{0}_{Sn^{4+}|Sn^{2+}} =$

(A). Sn^{2+} is reduced and Cl^{-} is oxidized

(B). Ag is oxidized and Sn^{2+} is reduced

(C). Sn^{2+} is reduced and Sn^{2+} is oxidized

(D). H^{+} is reduced and Sn^{2+} is oxidised

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6. Given that $E^{0}_{Cu^{2+}/Cu} = 0.337$ and $E^{0}_{Cu^{+}/Cu^{2+}} = -0.153V$. then calculate $E^{0}_{Cu^{+}/Cu}$

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7. $E^0_{Mn^{2+}/MnO_4^-} = -1.51V$

$E^0_{MnO_2/Mn^{+2}} = +1.23V$

$E_{MnO_4^-/MnO_2=?}$ (All in acidic medium)

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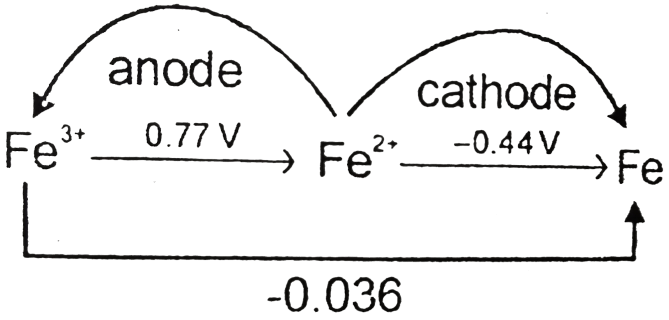

8.

Will Fe^{2+} disproportionate or not

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9. Calculate R.P. of hydrogen electrode at 298 K which is prepared with the help of aq. Solution of acetic acid with 0.1 M conc at 1 atm pressure $Ka = 1.8 \times 10^{-5}$

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10. Which is stronger oxidizing agent

(i). $K_2Cr_2O_7$ in solution in which

$[Cr_2O_7^{2-}] = 0.1M, [Cr^{3+}] = 10^{-2}M$ and $[H^+] = 10^{-1}M$

(ii). $KMnO_4$ in a solution in which

$[MnO_4^-] = 10^{-1}M, [Mn^{2+}] = 10^{-2}M, [H^+] = 10^{-2}M$

$E^0_{Cr_2O_7^{2-}/Cr^{+3}} = 1.33V, E^0_{MnO_4^-/Mn^{+2}} = 1.51V$

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11. Calculate E_{cell} of

$$Pt(s)\left|\begin{matrix} cl_2(g) \\ 0.1atm \end{matrix}\right|\begin{matrix} Cl^-(aq) \\ 10^{-2}M \end{matrix}\Bigg|\left|\begin{matrix} Cr_2O_7^{2-} & Cr^{+3}(\text{in}H_2SO_4) = 0.05M \\ 0.01M & 0.1M \end{matrix}\right|$$

given that $E^0_{Cr_2O_7^{2-}/Cr^{+3}} = 1.33V$

$E^0 Cl^- \mid Cl_2 = -1.36V$

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12. The E^0_{cell} for the reaction $Fe + Zn^{2+} \Leftrightarrow Zn + Fe^{3+}$ is -0.32 volt at $25^\circ C$. What will be the equilibrium concentration of Fe^{2+}, when a piece of iron is placed in a $1M Zn^{2+}$ solution?

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

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

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14. Calculate K_{sp} if $(PbSO_4)E_{cell}$ at 298 K of this electrode is 0.236 V

$$Pb(s)|PbSO_4(s)|\underset{0.01M}{Na_2SO_4(aq)}\ ||\ \underset{0.1M}{Pb(NO_3)}\ |\ Pb(s)$$

$$E_{cell} = E^{\circ}_{cell} - \frac{0.059}{2}\log[\frac{0.01}{0.1}]$$

$$0.236 = E^{\circ}_{cell} + \frac{0.059}{2}$$

$$E^{\circ}_{cell} = 0.236 - 0.03 = 0.206 - 0.059\log[K_{sp}]$$

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15. Calculate volume of the gases liberated at STP if 1 L of 0.2 molar solution of $CuSO_4$ is electrolysed by 5.79 A current for 10000 seconds.

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16. The electrochemical equivalent of copper is 0.0003296 g coulomb^{-1}. Calculate the amount of copper deposited by a current of 0.5 ampere following through copper sulphate solution for 50 minutes.

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17. An electric current is passed through three cells connected in series containing $ZnSO_4$, acidulated water and $CuSO_4$ respectively. What amount of Zn and H_2 are liberated when 6.25 g of Cu is deposited? Eq. wt. of Cu and Zn are 31.70 and 32.6 respectively.

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18. The cell consists of three compartments separated by porous barriers. The first contains a cobalt electrode in 5.00 L of 0.100 M cobalt (II) nitrate, the second contains 5.00 L of 0.100M $AgNO_3$. Assuming that the current within the cell is carried equally by the positive and negative ions, tabulate the concentrations of ions of each type in each compartment of the cell after the passage of 0.100 mole electrons.

given $Co^{2+} + 2e^- \rightarrow Co \qquad E^0 = -0.28V$

$Ag^+ + e^- \rightarrow Ag \qquad E^0 = 0.80V$

Spontaneous reaction is: $2Ag^+ + \cot oCo^{2+} + 2Ag \qquad 1.08V$

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19. If resistivity of $0.8M$ KCl solution is $2.5 \times 10^3 \Omega$ cm calculate λ_m of the solution

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20. $\lambda_m^0 Na^+ = 150\Omega^{-1}cm^2\text{mole}^{-1}$: $\lambda_{eq}^0 Ba^{2+} = 100\Omega^{-1}cm^2aq^{-1}$

$\lambda_{eq}^0 SO_4^{2-} = 125\Omega^{-1}cm^2eq^{-1}$:

lamda_(m)^(0)Al^(3+)=300Omega^(-1)cm^(2)"mole"^(-1)

lamda_(m)^(0)NH_(4)^(+)=200Omega^(-1)cm^(2)"mole"^(-1) :

lamda_(m)^(0),Cl^(-)=150Omega^(-1)cm^(2)"mole"^(-1)$thencalcate(a)$.

lamda_(eq)^(0),Al^(3+)(b). lamda_(eq)^(0)Al_(2)(SO_(4))^(3)(c).

lamda_(m)^(0)(NH_(4))NaCl(d). lamda_(0)^(0)NaCl,BaCl_(2).6H_(2)O(e).

lamda_(m)^(0),(NH_(4))_(2)SO_(4)Al_(2)(SO_(4))_(3).24H_(2)O $< br.$ (f).

lamda_(eq)^(0)NaCl`

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21. To calculate λ_m^0 or λ_{eq}^0 of weak electrolyte

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22. Calculate λ_m^0 of oxalic acid, given that

$\lambda_{eq}^0 Na_2C_2O_4 = 400\Omega^{-1}cm^2aq^{-1}$

$\lambda_m^0 H_2SO_4 = 700\Omega^{-1}cm^2\text{mole}^{-1}$

$\lambda_{eq}^0 Na_2SO_4 = 450\Omega^{-1}cm^2eq^{-1}$

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23. If conductivity of water used to make saturated of AgCl is found to be

$3.1 \times 10^{-5}\Omega^{-1}$

cm^{-1} and conductance of the solution of $AgCl = 4.5 \times 10^{-5}\Omega^{-1}cm^{-1}$

if $\lambda_M^0 AgNO_3 = 200\Omega^{-1}cm^2\text{ mole}^{-1}$

$\lambda_M^0 NaNO_3 = 310\Omega^{-1}cm^2\text{ mole}^{-1}$

calculate K_{SP} of $AgCl$

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24. to calculate K_W of water

$H_2O(l) + H_2O_l \rightarrow H_2O^+(aq) + OH^-(aq)$

$\lambda_m = \lambda^0_{M\,.\,H_2O} = \lambda^0_M H^+ + \lambda^0_M OH^-$

$= \dfrac{K \times 1000}{\text{molarity}} -$ concentration of water molecules $100\,\%$ dissociated ask

Molarity $= [H^+] = [OH^-] = \dfrac{K \times 100}{\lambda^\infty_M}$

$K_W = [H^+][OH^-] = [\dfrac{K \times 1000}{\lambda^0_M}]K_a$ or $K_b = \dfrac{[H^+][OH^-]}{H_2O}$

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25. During the discharge of a lead storage battery the density of H_2SO_4 talls from $\rho_1 g/$ to $\rho_2 g/C$, H_2SO_4 of density of $\rho_1 g/C$. C is $X\,\%$ by weight and tat of density fo $\rho_2 gc$. c is $Y\,\%$ by weight. The battery holds V litre of acid before discharging. Calculate te total charge released at anode of the battery. The reactions occurring during discharging are ltbr.

At anode: $Pb + SO_4^{2-} \rightarrow PbSO_4 + 2e^-$

At cathode: $PbO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightarrow PbSO_4 + 2H_2O$

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26. 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. Calculate the total charge released at anode of the battery. Note that the water is produced by the cell reaction as H_2SO_4 is used up. over all reaction is.

$Pb(s) + PbO_2(s) + 2H_2SO_4(l) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

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Miscellaneous Solved Problems

1. Na-amalgam is prepared by electrolysis of $NaCl$ solution using liquid Hg as cathode. How long should the current of 10 amp. Is passed to produce $10\,\%$ Na-Hg on a cathode of 10 gm Hg. (atomic mass of $Na = 23$).

(A). 7.77 min

(B). 9.44 min.

(C). 5.24 min.

(D). 11.39 min

A. (A). 90 gm Hg has 10 gm Na

$$\therefore \ 10\text{gm Hg} = \frac{10}{90} \times 10 = \frac{10}{9} gmNa$$

$$\therefore \ \text{weight } Na = \frac{M}{n} \times \frac{i \times t}{96500}$$

$$\frac{10}{9} = \frac{23}{1} \times \frac{10 \times t}{96500}$$

$$[\ \therefore Na^{+} + e \rightarrow Na]$$

$$\therefore t = \frac{10 \times 96500}{9 \times 10 \times 23} = 7.77 \text{ min}$$

B.

C.

D.

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2. We have taken a saturated solution of $AgBr$. K_{sp} of $AgBr$ is 12×10^{-14}. If 10^{-7} mole of $AgNO_3$ are added to 1 mitre of this solutio then the conductivity of this solution in terms of $10^{-7} Sm^{-1}$ units will be [given

$\lambda((Ag^+))^\circ = 4 \times 10^{-3} Sm^2 mol^{-1} \lambda^\circ_{(Br^-)} = 6 \times 10^{-3} Sm^2 mol^{-1}$. $\lambda^\circ_{(NO_3^-)}$

(A). 39

(B). 55

(C). 15

(D). 41

A. (A). The solubility of AgBr in presence of 10^{-7} molar $AgNO_3$ is

$3 \times 10^{-7} M$

Therefore $[Br^-] = 3 \times 10^{-4} m^3, [Ag^+] = 4 \times 10^{-4} m^3$ and

$[NO_3^-] = 10^{-4} m^3$

therefore $K_{\text{total}} = K_{Br^-} + K_{Ag^+} + K_{NO_3^-} = 39 Sm^{-1}$

B.

C.

D.

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3. A hydrogen electrode X was placed in a buffer solution of sodium acetate ad acetic acid in the ratio $a : b$ and another hydrogen electrode Y was placed in a buffer solution of sodium acetate ad acetic in the ratio $b : a$ if reduction potential values for two cells are found to be E_1 and E_2 respectively w.r.t. standard hydrogen electrode, the pK_a value of the acid can be given as

(A) $\frac{E_1 - E_2}{0.118}$

(B). $-\frac{E_1 + E_2}{0.118}$

(C). $\frac{E_1}{E_2} \times 0.118$

(D). $\frac{E_2 - E_1}{0.118}$

A. (B). $H^+ + e^- \Rightarrow \frac{1}{2} H_2(g)$

$E_1 = 0 - .0591 \log(\frac{1}{(H^+)_1}$

$E_1 = + 0.0591 \log[H^+]_1$

$= - 0.0591\, pH_1$

$E_2 = - 0.0591 pH_2$

$pH_1 = pk_a + \log(\frac{\text{salt}}{\text{acid}})$

$pH_1 = pk_a + \log(\frac{a}{b})$ ..(1)

$pH_2 = pk_a + \log(\frac{b}{a})$

$pH_2 = pk_a - \log(\frac{a}{b})$ ...(2)

Add (1) & (2)

$pH_1 + pH_2 = 2pk_a$

$2pk_a = - \frac{E_1}{0.0591} - \frac{E_2}{0.0591} \Rightarrow pk_a = - [\frac{E_1 + E_2}{0.118}]$

B.

C.

D.

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4. At what $\frac{[Br^-]}{\sqrt{[CO_3^{2-}]}}$ does the following cell have its reaction at equilibrium?

$Ag(s)|Ag_2CO_3(S)|Na_2CO_3(aq)||KBr(aq)|AgBr(s)|Ag(S)$

$K_{SP} = 8 \times 10^{-12}$ for Ag_2CO_3 and $K_{SP} = 4 \times 10^{-13}$ for AgBr.

(A). $\sqrt{1} \times 10^{-7}$

(B). $\sqrt{2} \times 10^{-7}$

(C). $\sqrt{3} \times 10^{-7}$

(D). $\sqrt{4} \times 10^{-7}$

A. (B). Anode: $Ag(s) \rightarrow Ag^+(aq) + 1e^-$

cathode: $\underline{Ag^+(aq) + 1e^- \rightarrow Ag}$

net: $Ag^+_{(AgBr)} \xrightarrow{1e^-} Ag^+_{(Ag_2CO_3)}$

$$0 = 0 + \frac{0.059}{1}\log\left(\frac{\frac{K_{SP}AgBr}{[Br^-]}}{\sqrt{\frac{K_{SP}Ag_2CO_3}{[CO_3^{2-}]}}}\right) \Rightarrow \frac{K_{SP}AgBr}{[Br^-]} = \sqrt{\frac{K_{SP}Ag_2CO_3}{[CO_3^{2-}]}}$$

$$\Rightarrow \frac{4 \times 10^{-13}}{\sqrt{8 \times 10^{-12}}}$$

([Br^(-)])/(sqrt([CO_(3)^(2-)]))implies([Br^(-)])/(sqrt([CO_(3)^(2-)]))=sqrt(2)

B.

C.

D.

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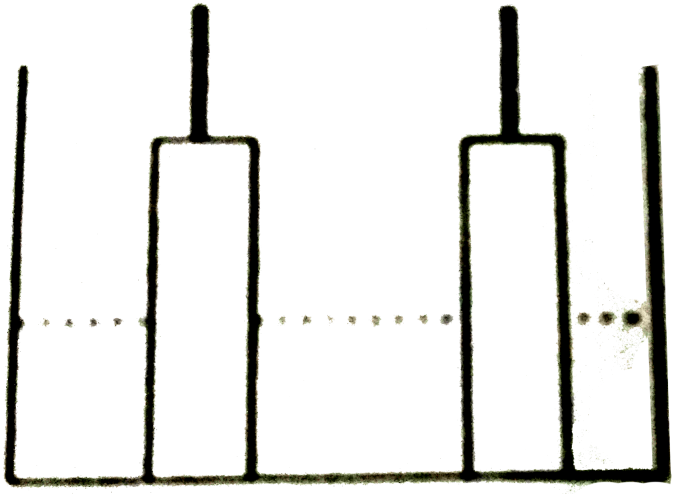

5.

A resistane of 50Ω is registered when two electrodes are suspended into beaker containing a dilute solution of a strong electrolyte such that exactly half of the them are submerged into solution. If the solution is diluted by addig pure water (negligible conductivity) so as to just completely submerge the electrodes. the new resistance offered by te solutio would be .

(A). 50Ω

(B). 100Ω

(C). 25Ω

(D). 200Ω

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

The k is halved while the A is doubled Hence R remains 50Ω.

B.

C.

D.

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6. Calculate the cell EMF in mV for

$Pt|H_2(1atm)|HCl(0.01M)\ ||\ |AgCl(s)|Ag(s)$ at 298 K

if $\triangle\ G_1^{\circ}$ values are at $25^{\circ}C$

$-109.56\frac{kJ}{mol}$ for $AgCl(s)$ and

$-130.79\frac{kJ}{mol}$ for $(H^+ + Cl^-)(ag)$

(A). 456 mV

(B). 654 mV

(C). 546 mV

(D). None of these

A. (A). $\triangle G^0_{\text{cell reaction}} = 2(-130.79) - 2(-109.56)$

$= -42.46 kJ/\text{mole}$

(for $H_2 + 2AgC < o2Ag + 2H^+ + 2Cl^-$)

$\therefore E^0_{cell} = \frac{-42460}{-2 \times 96500} = +0.220V$

Now $E_{cell} = +0.220 + \frac{0.059}{2}\log(\frac{1}{(0.01)^4} = 0.456V = 456mV.$

B.

C.

D.

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7. Consider the cell $Ag(s)|AgBr(s)|Br^-(aq)||AgCl(s)|Cl^-(aq)|Ag(s)$ at $25^\circ C$. The solubility product constants of $AgBr$ & $AgCl$ are respectively 5×10^{-13}&1×10^{-10} for what ratio of the concentrations of Br^- & Cl^- ionns would the emf of the cell be zero?

(A). $1:200$

(B). $1:100$

(C). $1:500$

(D). $200:1$

A. (A).

$$E^0_{Br^-/AgBr/Ag} = E^0_{Ag^+/Ag} + \frac{0.059}{1}\log K_{SP}AgBr = E^0_{Ag^+/Ag} - 0.72$$

and

$$E^0_{Cl^-/AgCl/Ag} = E^0_{Ag^+/Ag} + \frac{0.059}{1}\log K_{SP}AgCl = E^0_{Ag^+/Ag} = -0.$$

Now cell reaction is

$$Ag + Br^- \rightarrow AgBr + 1e^-$$

$$\underline{AgCl + 1e^- \rightarrow Ag + Cl^-}$$

$$Br^- + AgCl \xrightarrow{1e^-} Cl^- + AgBr$$

$$0 = (0.7257 - 0.59) + \frac{0.59}{1}\frac{\log([Br^-])}{[Cl^-]} \Rightarrow \frac{[Br^-]}{[Cl^-]} = 0.005$$

B.

C.

D.

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8. The coductivity of a solution may be take to the directly proportional to the total concentration of the charge carriers (ions) present in it in many cases. Using the above fid the percent decrease in conductivity (k) of a solution of a weak monoacidic base BOH when its 0.1 M solution is diluted to double its original volume ($K_b = 10^{-5}$ for BOH) (take $\sqrt{50} = 7.07$) (mark the answer to nearest integer)

A. initially $[OH^-] = \sqrt{10^{-5} \times 0.1} = 10^{-3}$

$therf \text{ or } e[\text{ions}]_{\text{total}} = 2\sqrt{50} \times 10^{-4} M$

$therf \text{ or } e\,\%$ change on

$[\text{ions}]_{\text{total}} = \dfrac{2\sqrt{50} - 20}{20} \times 100 = -29.29\,\%$

B.

C.

D.

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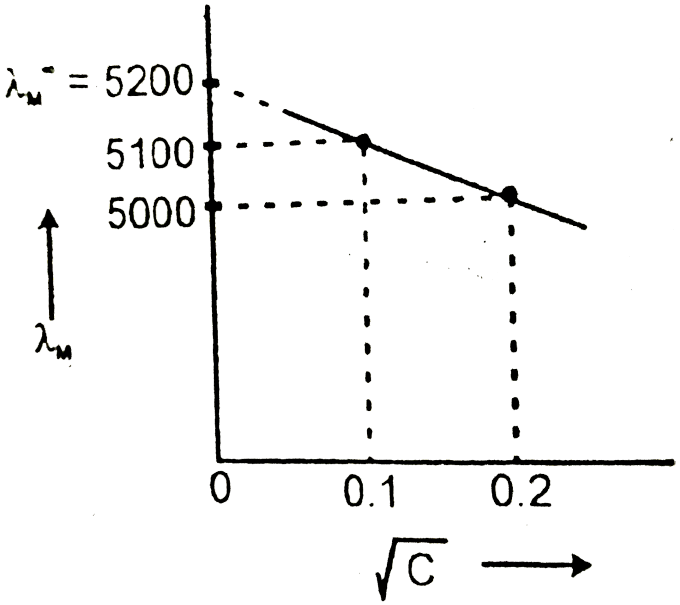
9.



At 0.04 M concentration the molar conductivity of a solution of a electrolyte is $5000\Omega^{-1}cm^2mol^{-1}$ while at 0.01 M concentration the value is $5100\Omega^{-1}cm^2mol^{-1}$ making necessary assumption (taking it as strong electrolyte) find the molar conductivity at infinite dilution and also determine the degree of dissociation of strong electrolyte at 0.04M.

A. From the graph we can see te λ_M^∞ value of $5200\Omega^{-1}cm^2mol^{-1}$

hence

$$\alpha = \frac{5000}{5200} = 0.9615 \cong 0.96$$

B.

C.

D.

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Board Level Exercise

1. Write the equation showing the relationship between standard free energy and standard cell potential.

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2. Rusting of iron is quicker in salline water than in ordinary water. Why is it so?

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3. define specific conductance (conductivity)

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4. What does the negative value of E°_{cell} indicate?

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5. Why is it impossible to obtain the electrode potential for a single electrode?

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6. What are primary cells?

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

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8. What mass of zinc (II) ion will be reduced by 1 mole of electrons.

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9. How many faradays of charge are required to convert:

(a). 1 mole of MnO_4^- to Mn^{2+} ion,

(b). 1 mole of $Cr_2O_7^{2-}$ to Cr^{2+} ion

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10. (a). What is standard hydrogen electrode?

(b). Give the reactions that occurs at this electrode wen it acts as positive in an electrochemical cell.

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

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12. The same quantity of electrical charge deposited $0.583g$ of Ag when passed through $AgNO_3$, $AuCl_3$ solution calculate the weight of gold formed. (At weighht of $Au = 197gmol$)

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

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14. Consider a cell composed of two cells:

(i). $Cu(s)Cu^{2+}(aq)$ and (ii). $Ag(s) \mid Ag^{+}(aq)$

(b). The cell potential when $[Cu^{2+}] = 2M$ and $\left|Ag^{+}\right| = 0.05M$

[Given: $C^{\circ}_{Cu^{2+}/Cu} = +0.344V$, $E^{\circ}_{Ag^{+}/Ag} = +0.80V$]

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15. Consider the cell:

$Mg(s)\left|Mg^{2+}(0.13M)\right|\left|Ag^{+}(1.0 \times 10^{-4})M\right|Ag(s)$

its e.m.f. is $2.96V$. calculate E°_{cell}

$(R = 8.314JK^{-1}, 1F = 96500Cmol^{-1})$

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16. For a cell $Ag(s)|AgNO_3(0.01M)||AgNO_3(1.0M)|Ag(s)$

(i). Calculate the e.m.f. of the cell at $25^{\circ}C$

(ii). Write the net cell reaction.

(iii). Will the cell generate e.m.f when two concentrations become equal?

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17. What is corroison? What are the factors which affect corrosion? CO_2 is always present in natural water. Explain its effect (increases stops or no effect) on rusting of Fe.

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18. Explain the term electrolysis. Write the reactions at cathode ad anode when following substances are electrolysed: (i) molten NaCl (ii) aqueous solution of NaCl (iii). Molten lead bromide (iv) Aq. H_2SO_4

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19. How long a current of 3 ampere has to be passed through a soulution of silver nitrate to coat a metal. Surface of $80cm^2$ with a 0.005 mm thick layer? Density of Ag is $10.5gcm^{-3}$. At wt. $Ag = 108.0u$

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20. (a). The resistance of a decinormal solution of an electrolyte in a conductivity cell was found to be 245 ohms. Calculate the equilvalet conductivity of the solution if the electrodes in the cell were 2 cm apart and each has an area of 3.5 sq. cm.

(b). The conductivity of 0.001028M acetic acid is $4.95 \times 10^{-5} Scm^{-1}$. Calculate its dissociation constant if $\wedge_m^\circ$ for acetic acid is $390.5 Scm^{2_m ol^{-1}}$

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Exercise

1. In the galvanic cell $Cu|Cu^{2+}| \ | \ Ag^{+}|Ag$, the electrons flow from Cu-electrode at Ag- electrode. Answer the following questions regarding this cell:

(a). Which is the anode?

(b). Which is the cathode?

(c). What happends at anode-reduction or oxidation?

(d). What happens at cathode-oxidation or reduction?

(e). Which electrode loses mass?

(f). Which electrode gais mass?

(g). white the electrode reaction.

(h). Write the cell reaction.

(i). Which metal has greater tendency to loss electron-Cu or Ag?

(J) Which is the more reactive metal Cu or Ag?

(k). What is the function of salt bridge represented by the symbol||?

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2. The reduction potential velues are given below

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

$I_2/I^- = +0.53\text{volt}$. Which one is the best reducing agent?

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3. The standard reduction potential value of the three metallic cations X, Y and Z are 0.52, -3.03 and $-1.18V$ respectively. Write the decreasing order of reducing power of the corresponding metals.

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4. (i). Which of the following oxides is reduced by hydrogen?

MgO, CuO and Na_2O

(ii). Which of the following oxides will decompose on heating ?

ZnO, CuO, MgO, and Ag_2O

(iii). The value of E°_{OX} for electrode reaction.

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

are 0.444, -0.337 and 0763 volt respectively. State which of these metals can replace the orther two from the solution of their salts?

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5. Determine range of E° values for this reaction $X_{aq}^{2+} + 2e^- \rightarrow X(s)$ for given conditions:

(a). If the metal X dissolve in HNO_3 but not in HCl it can displace Ag^+ ion but not Cu^{2+} ion.

(b). If te metal X is HCl acid producing $H_2(g)$ but does not displace either Zn^{2+} or Fe^{2+}

Given $E^0_{Ag^+/Ag} = 0.8V$ $E^0_{Fe^{2+}/Fe} = -0.44$

$E^0_{Cu^{2+}/Cu} = 0.34V$ $E^0_{NO_3^-/NO} = 0.96V$ $E^0_{zn^{2+}/Zn} = -0.76V$

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6. If $E^\circ_{fe^{2+}/Fe}$ is $x_1, E^\circ_{Fe^{3+}/Fe}, isx\_(2)thenwûvillbe$ E_(Fe^(3+)//Fe^(2+))^(@)`

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7. The standard reduction potential of TiO^{2+} and Ti^{3+} are given by

$TiO_{2+} + 2H^+ + e^- \rightarrow Ti^{3+} + H_2O$ $E^\circ = 0.10V$

$Ti^{3+} + 3e^- \rightarrow Ti \qquad E^\circ = -1.21V$

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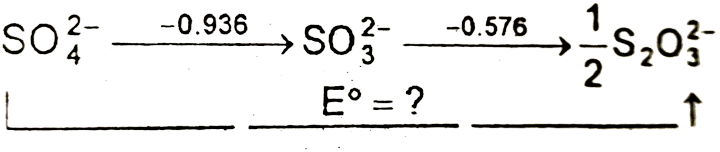
8.



consider the standard reduction potentials (in volts) as shown in figure

Find E°

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9. The standard oxidation potentials for Mn^{3+} ion acid solution are $Mn^{2+} \xrightarrow{-1.5V} Mn^{3+} \xrightarrow{-1.0V} MnO_2$. Is the reaction $2Mn^{3+} + 2H_2O \rightarrow Mn^{2+} + MnO_2 + 4H^+$ spontaneous under conditions of unit activity? What is the change in free energy?

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10. Using the $\triangle G^0$ for the reaction

$C + O_2 \rightarrow CO_2 \triangle G^0 = -395kJ/\text{mole}$

$2A(l) + 3/2O_2 \rightarrow Al_2O_3(s) \triangle G^0 = -1269kJ/\text{mole}$

$Al_2O_3(\text{melt}) + 3C \rightarrow 4Al(l) + 3CO_2(g)$

Calculate the EMF for thhe cell reaction

$2Al_2O_3(\text{melt}) + 3C \rightarrow 4Al(l) + 3CO_2(g)$

the number of electrons involved in the reaction is 12.

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11. Make complete cell diagrams of the following cell reactions

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

(b). $2Ag^+(aq) + H_2(g) \rightarrow 2H^+(aq) + 2Ag(s)$

(c). $Hg_2Cl_2(s) + Cu(s) \rightarrow Cu^{2+}(aq) + 2Cl^-(aq) + 2Hg(l)$

(d).

$Cu_2O_7^{2-}(aq) + 14H^+(aq) + 6Fe^{2+}(aq) \rightarrow 6Fe^{3+}(aq) + 2Cr^{3+}(aq) + 7I$

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12. Write cell reaction of the following cells:

(a). $Pt|Fe^{2+}, Fe^{3+}||MnO_4^-, Mn^{2+}, H^+|Pt$

(b). $Pt, Cl_2|Cl^-(aq)||Ag^+(aq)|Ag$

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13. Calculat ethe oxidation potential of a hydrogen electrode at $pH = 1(T = 298K)$

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14. The standard oxidation potential for the half-cell

$NO_2^-(g) + H_2O \to NO_3^-(aq) + 2H^+(aq) + 2e$ is $-0.78V$.

Calculate the reduction in 9 molar H^+ assuming all other species at unit concentration. What will be the reduction potential in neutral medium?

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15. Calculate the electrode potential at $25^\circ C$ of Cr^{3+}, $Cr_2O_7^{2-}$ electrode at $pOH = 11$ in solution of 0.01 M both in Cr^{3+} and $Cr_2O_7^{2-}$

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

$E^0 = 1.33V.$

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16. The standard reduction potential for Cu^{2+}/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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17. The EMF of the cell $M \mid M^{n+}$ (0.02 M) | H^(+) (1 M) | H_(2)(g) (1 atm), Pt at 25°C is 0.81 V. Calculate the valency of the metal if the standard oxidation potential of the metal is 0.76 V

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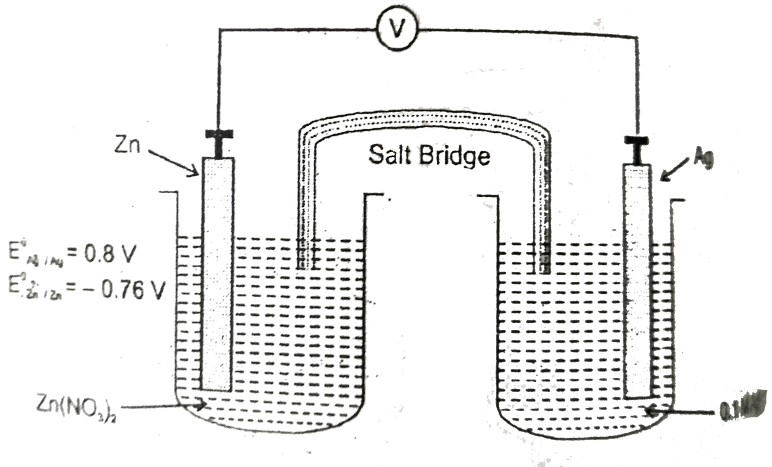

18.

Consider the following electrochemical cell.

(a). Write a balanced net ionic equation for the spontaneous reaction that take place in the cell.

(b). Calculate the standard cell potential E^0 for the cell reaction.

(c). If the cell emf is $1.6V$ what is the concentration of Zn^{2+}?

(d). How will the cell potential be affected if Kl is added to Ag^+ half-cell?

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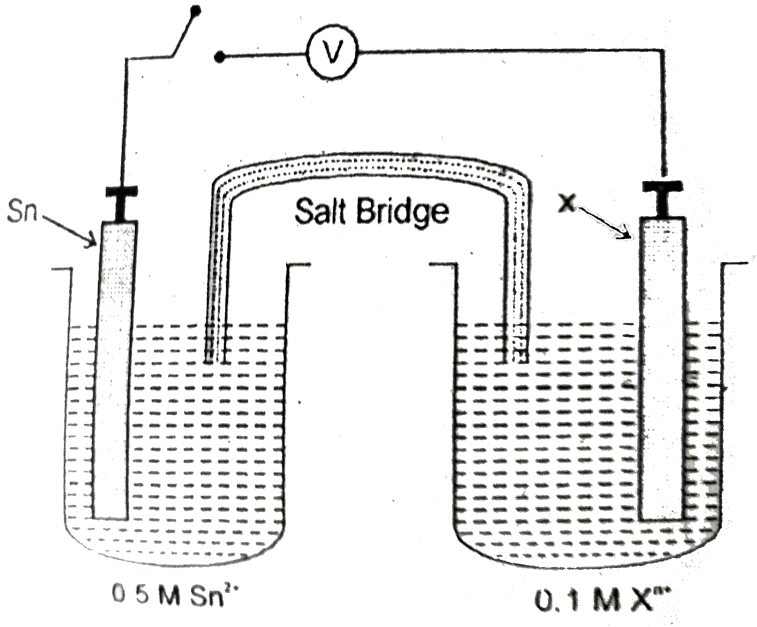

19.

An electrochemical cell is constructed with an open switch as shown below. When the switch is closed, mass of tin-electrode increase. If $E^{\circ}(Sn^{2+}/Sn) = -0.14V$ and for $E^{\circ}(X^{n+}/X) = -0.78V$ and initial emf of the cell is 0.65 V, determine n and indicate ad direction of electron flow in the external circuit.

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20. Equinormal solutions of two weak acids $HA(pK_a = 3)$ and $HB(pK_a = 5)$ are each placed in contact with standard hydrogen electrode at $25^\circ C(T = 298K)$ when a cell is constructed by interconnecting them through a salt bridge find the e.m.f. of the cell.

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21. In two vessels each containing 500 ml water, 0.5m mol of aniline ($K_b = 10^{-9}$) and 25 m mol of HCl are added separately. Two hydrogen electrodes are constructed using these solutions. Calculate the emf of cell made by connecting them appropriately.

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22. $NO_3^- \rightarrow NO_2$ (acid medium) $E^0 = 0.790V$

$NO_3^- \rightarrow NH_3OH^+$ (acid medium) $E^0 = 0.731V$.

At what pH, the above two will have same E value ? Assume the concentration of all other species NH_3OH^+ except $[H^+]$ to be unity.

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23. The standard oxidation potential of Zn referred to SHE is 0.76 V and that of Cu is $-0.34V$ at $25^\circ C$ when excess of Zn is added to $CuSO_4$, Zn displaces Cu^{2+} till equilibrium is reached. What is the approx ratio of Zn^{2+} to Cu^{2+} ios at equilibrium?

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24. The emf of the cell $Ag|AgI|CI(0.05M)\ ||\ AgNO_3(0.05M)|Ag$ is 0.79 V. Calculate the solubility product of AgI.

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25. The cell Pt, $H_2(1atm)|H^+(pH=x)||$ normal calomel electrode has an EMF of 0.67 V at $25^\circ C$ Calculate the pH of the solution. The oxidation potential of the calomel electrode on hydrogen scale is $-0.28V$

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26. The EMF of the standard weston cadmium cell

$Cd(12.5\,\%)$ in $Hg \mid 3CdSO_4, 8H_2O$ (solid) $\mid$ satd. Soln of $CdSO_4 \mid\mid Hg_2SO_4(s)|Hg$ is

1.0180 volts at $25^\circ C$ and the temperature coefficient of the cell, $\left(\frac{\partial E}{\partial T}\right)_P = -4.0 \times 10^{-5}/\text{degree}$, calculate $\triangle G$ $\triangle H$ and $\triangle S$ for the reactionn in the cell when $n = 2$

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27. $\triangle H$ for the reactio $Ag(s) + \frac{1}{2}Hg_2Cl_2(s) \to AgCo(s) + Hg(l)$ is $+1280$ cal at $25^\circ C$ this reaction can be conducted in a cell for which the emf $= 0.0455$ volt at this temperature. Calculate the temperature coefficient of the emf.

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28. The standard electromitive force of the cell

$Fe\left|Fe^{2+}(aq)\right|\left|Cd^{2+}\right|Cd$ is 0.0372 V

The temperature coefficient of e.m.f. is $-0.125VK^{-1}$. Calculate the quantities $\triangle G$, $\triangle H^{\circ}$ and $\triangle S^{\circ}$ at $25^{\circ}C$

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29. The voltage of a certain cell has standard potential at $25^{\circ}C$ and $20^{\circ}C$ are 0.3525 V and 0.3533 V respectively. If the number of electrons involved in te overall reactions are two, calculate $\triangle G^{\circ}$, $\triangle S^{\circ}$ and $\triangle H^{\circ}$ at $25^{\circ}C$.

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30. Find the number of electrons involved in the electro-deposition of 63.5 g of copper from a solution of copper sulphate is:

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31. A current 0.5 ampere when passed through $AgNO_3$ solution for 193 sec. Deposited 0.108 g of Ag. Find the equivalent weight of Ag.

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32. A certain metal salt solution is electrolysed in series with a silver coulometer. The weights of silver ad the metal deposited are 0.5094 g and 0.2653 g. Calculate the valency of the metal if its atomic weight is nearly that of silver.

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33. 3 Amp current was passed through an aquesous solution salt of unknown salt of Pd for 1hr. 2.977 g of Pd^{+n} was deposited at cathode. Find n (Given Atomic mass of Pd = 106.4)

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34. How long a current of 2 A has to be passed through a solution of $AgNO_3$ to coat a metal surface of $80cm^2$ with $5\mu m$ thick layer? Density of water $= 10.8g/cm^3$

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35. 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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36. A certain electricity deposited $0.54g$ of Ag from $AgNO_3$ solution what volume of hydrogen will the same quantity of electricity liberate at $27^\circ C$ and $728mmMg$ pressure?

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37. A current of $3.6A$ is a passed for 6 hrs between Pt electrodes in $0.5L$ of $2M$ solution of $Ni(NO_3)_2$. What will be the molarity of solution at the end of electrolysis?

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38. 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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39. Cadmium amalgam is prepared by electrolysis of a solution of $CdCl_2$ using a mercury cathode. Find how long a current of 5 ampere should be passed in order to prepare 12% Cd-Hg amalgam on a cathode of 2 g mercury. At mass of Cd=112.40.

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40. Electrolysis of a solution of HSO_4^{-1} ions produces $S_2O_8^{2-}$. Assuming $75\,\%$ current efficiency, what current should be employed to achieve a production rate of 1 "mole" of $S_2O_8^{2-}$ per hour?

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41. One of the methods of preparation of per disulphuric acid, $H_2S_2O_8$, involve electrolytic oxidation of H_2SO_4 at anode ($2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^+ + 2e^-$) with oxygen ad hydrogen as by-products in such an electrolysis, 9.722 L of H_2 and $2.35L$ of O_2 were generated at STP. What is the weighht of $H_2S_2O_8$ formed?

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42. The Standard reduction potential values, $E^\circ(Bi^{3+}/Bi)$ and $E^\circ(Cu^{2+}/Cu)$ are 0.226 V and 0.344 V respectively. A mxiture of salt of bismut and copper at unit concentration each is electrolysed at $25^\circ C$ to

what value can $[Cu^{2+}]$ be brought down before bismuth starts to deposit, in electrolysis.

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43. A fuell cell uses $CH_4(g)$ and forms CO_3^{2-} at the anode. It is used to power a car with 80 amp, for 0.96 hr. how many litres of $CH_4(g)$ (at 1 atm, 273 K) would be required? (V_(m) = 22.4 L/mol) (F = 96500). Assume $100\ \%$ efficiency.

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44. The resistance of a $N/10KCI$ solution is 245 ohms. Calculate the specific conductance and the equivalent conductance of the solution if the electrodes in the cell are 4 cm apart and each having an area of 7.0 sq cm.

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

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46. In a conductivity cell, the two platinum electrodes, each of area 10sq. Cm are fixed 1.5 cm apart. The cell contained 0.05 N solution of a salt. If the two electrodes are just half dipped into the solution which has a resistance of 50 ohms, find equivalent conductance of the salt solution in $\Omega^{-1}cm^2eq^{-1}$.

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47. The equivalent conductance of $0.10N$ solution of $MgCI_2$ is 97.1 mho cm^2eq^{-1}. A cell electrodes that are $1.50cm^2$ in surface are and 0.50 cm

apart is filled with $0.1NMgCI_2$ solution. How much current will flow when the potential difference between the electrodes is 5 volts?

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48. The specific conductance of a $N/10KCI$ solution at $18^\circ C$ is $1.12 \times 10^{-2} mhocm^{-1}$. The resistance of the solution contained in the cell is found to be 65 ohms. Calculate the cell constant.

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49. The equivalent conductance of an infinitely dilute solution of NH_4Cl is 150 and te ionic conductance of OH^- ad Cl^- ions are 198 and 76 respectively. What will be the equivalent conductance of the solution of NH_4OH at infinite dilution. if the equivalent conductance of a 0.01 N solution NH_4OH is 9.6, what will be its degree of dissociation?

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50. Given the equivalent conductance of sodium butyrate sodium chloride and hydrogen chloride as 83,127 and 426 mho cm^2 at $25^\circ C$ respectively the equivalent conductance of butyric acid at infinite dilution.

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51. Calculate the dissociation canstant of water at $25^\circ C$ from te followig data specific conductance of $H_2O = 5.8 \times 10^{-8} mhocm^{-1}$, $\lambda^\infty_{H^+} = 350.0$ and $\lambda^\infty_{OH} = 198.0 mhocm^2 mol^{-1}$

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52. Calculate K_a of acetic acid it its $0.05N$ solution has equivalent conductances of $7.36 mhocm^2$ at $25^\circ C (\lambda^\infty_{CH_3COOH} = 390.70)$

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53. The sp. Cond. Of a saturated solution of $AgCl$ at $25^\circ C$ after subtracting the sp. Conductance of conductivity of water is $2.28 \times 10^{-6} mhocm^{-1}$. Fid te solubility product of AgCl at $25^\circ C$ $(\lambda^\infty_{AbCl} = 138.3 mhocm^2)$

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54. In a galvanic cell

A. chemical reaction rpoduces electrical energy

B. electrical energy produces chemical reaction

C. reduction occurs at anode

D. oxidation occurs at cathode

Answer: A

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55. Which of the following statements is wrong about galvanic cells?

A. Cathode is the positive electrode

B. cathode is the negative electrode

C. electrons flow from cathode to anode in the external circuit

D. reduction occurs at cathode

Answer: B::C

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56. Which of the following is/are function(s) of salt-bridge?

A. it completes the electrical circuit with electrons flowing from one electrode to the other through external wires ad a flow of ions betwee the two compartments through salt-bridge.

B. it minimises the liquid-liquid junction potential

C. both correct

D. none of these

Answer: C

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57. Salt bridge contains

A. calomel

B. corrosive sublimate

C. H_2O

D. agar-agar paste

Answer: D

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58. E^0 for $F_2 + 2e \rightarrow 2F^-$ is $2.8V$, E^0 for $\frac{1}{2}F_2 \rightarrow F^-$ is

A. 2.8 V

B. 1.4 V

C. $-2.8V$

D. $-1.4V$

Answer: A

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59. Consider the cell potentials $E^0_{Mg^{2+}|Mg} = -2.37V$ and $E^0_{Fe^{3+}|Fe} = -0.04V$

The best reducing agent would be

A. Mg^{2+}

B. Fe^{3+}

C. Mg

D. Fe

Answer: C

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

A. Cu will precipitate out

B. iron will precipitate

C. Cu and Fe will precipitate

D. no reaction will take place

Answer: D

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

A. The spoon will get coated with aluminium

B. an alloy of aluminium and copper is formed

C. The solution becomes blue

D. there is no reaction

Answer: D

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62. Given :

$E^{c-}_{\cdot Ag^{\oplus}|Ag} = 0.80V, E^{c-}_{\cdot Mg^{2+}|Mg} = -2.37V,$

$E^{c-}_{\cdot Cu^{2+}|Cu} = 0.34V, E^{c-}_{\cdot Hg^{2+}|Hg} = 0.79V$

Which of the following statements is / are incorrect ?

A. $AgNO_3$ can be stored in copper vessel

B. $Mg(NO_3)_2$ can be stored in copper vessel

C. $CuCl_2$ can be stored in silver vessel

D. $HgCl_2$ can be stored in copper vessel

Answer: B::C

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63. For $Zn^{2+}/Zn, E^\circ = -0.76V$, for $Ag^+/AfE^\circ = 0.799V$. The correct statement is .

A. The reaction Zn getting reduced Ag getting oxidized is spontaneous

B. Z undergoes reduction and Ag is oxidized

C. Zn undergoes oxidation Ag^+ gets reduced

D. No suitable answer

Answer: C

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64. Electrode potential data are given below:

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

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

$Br_2(aq) + 2e^- \rightarrow 2Br^-(aq) : E^\circ = +1.08V,$

Based on the data, the reducing power of Fe^{2+} Al and Br^- will increase in the order

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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65. The electrode potential becomes equal to standard electrode potential when reactants and products concentration ratio is:

A. equal to 1

B. greater than 1

C. less than 1

D. none of the above

Answer: A

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66. Given standard electrode potentials:

$Fe^{3+} + 3e^- \rightarrow Fe, E^\circ = -0.036vo <$

$Fe^{2+} + 2e^- \rightarrow Fe, E^\circ = -0.440\text{volt}$

the standard electron potential E° for $Fe^{3+} + e^- \rightarrow Fe^{2+}$

A. -0.476volt

B. -0.404volt

C. 0.440volt

D. 0.772volt

Answer: D

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67. $Cu^{+} + e^{-} \rightarrow Cu, E^{\circ} = x_1 vo <$,

$Cu^{2+} + 2e^{-} \rightarrow Cu, E^{\circ} = x_2$ volt, then for

$Cu^{2+} + e^{-} \rightarrow Cu^{+}, E^{\circ}$ (volt) 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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68. Any redox reaction would occur spontaneously, if:

A. the free energy change $(\triangle G)$ is negative

B. The $\triangle G^{\circ}$ is positive

C. The cell e.m.f. (E°) is negative

D. the cell e.m.f is positive

Answer: A::D

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69. KCl can be used in salt bridge as electrolyte in which of the following cells?

A. $Zn|ZnCl_2||AgNO_3|Ag$

B. $Pb|Pb(NO_3)_2||Cu(NO_3)_2|Cu$

C. $Cu|CuSO_4||AuCl_3|Au$

D. $Fe|FeSO_4||Pb(NO_3)_2|Pb$

Answer: C

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70. The reaction

$$\frac{1}{2}H_2(g) + AgCl(s) \Leftrightarrow H^+(aq) + Cl^-(aq) + Ag(s)$$

occurs in the galvanic cell

A. $Ag\,/\,AgCl(s)KCl(sol)\ ||\ AgNO_3(sol)|Ag$

B. $Pt\,/\,H_2(g)|HCl(sol)||AgNO_3(sol)|Ag$

C. $Pt\,/\,H_2(g)|HCl(sol)||Cl^-|AgCl(sol)\ |\ Ag$

D. $Pt??H_2(g)|KCl(sol)||AgCl(sol)|Ag$

Answer: C

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71. Which of the followig statements about the spontaneous reaction occurring in a galvanic cell is always true?

A. $E_{cell}^{\circ} < 0, \ \triangle G^{\circ} 0$ and $Q < K$

B. $E_{cell}^{\circ} > 0, \ \triangle G^{\circ} < 0$, and $Q > K$

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

D. $E_{cell} > 0, \ \triangle G < 0$ and $Q < K$

Answer: D

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

A. $-0.25 + 0.80 = 0.55$Volt

B. $-0.25 - (+0.80) = -1.05$volt

C. $0 + 0.80 - (- 0.25) = + 1.05$ volt

D. $- 0.80 - (- 0.25) = - 0.55$volt

Answer: C

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

A. 1.10 volt

B. 0.110 volt

C. $- 1.10$ volt

D. $- 0.110$ volt

Answer: A

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

A. $C_1 = C_2$

B. $C_1 > C_2$

C. $C_2 > C_1$

D. none

Answer: C

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75. $Pt\left|\underset{(p_1)}{H_2}\right|\underset{(1M)}{H^+}\left|\left|\underset{(1M)}{H^+}\right|\underset{(p_2)}{H_2}\right|Pt$ (where p_1 and p_2 are pressure) cell reaction cell reaction will be spontaneous if:

A. $p_1 = p_2$

B. $p_1 > p_2$

C. $p_2 > p_1$

D. $p_1 = 1atm$

Answer: B

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76. $Pt|H_2|pH = 1 \mid |pH = 2|(H_2)Pt$

1 atm 1 atm

The cell reaction for the given cell is:

A. Spontaneous

B. non-spontaneous

C. Equilibrium

D. none of these

Answer: B

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77. The cell $Pt(H_2)(1atm) \mid H^+(pH = ?)T^-(a = 1)AgI(s), Ag$ has emf, $E_{298KK} = 0$. The electrode potaneial for the reaction $AgI + e^- \rightarrow Ag + I^{\Theta}$ is -0.151 volt. Calculate the pH value:-

A. 3.37

B. 5.26

C. 2.56

D. 4.62

Answer: C

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78. Using the information in the preceding problem, calculate the solubility product of AgI in water at $25^\circ C$ $[E^\circ_{(Ag^+, Ag)} = +0.799\text{volt}]$

A. 1.97×10^{-17}

B. 8.43×10^{-17}

C. 1.79×10^{-17}

D. 9.17×10^{-17}

Answer: B

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79. The solubiltiy product of silver iodide is 8.3×10^{-17} and the standard potential (reduction) of Ag, Ag^{+} electrode is $+0.800$ volts at $25^{\circ}C$. The standard potential of $Ag, AgI / I^{-}$ electrode (reduction) from these data is

A. $-0.30V$

B. $+0.15V$

C. $+0.10V$

D. $-0.15V$

Answer: D

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80. Consider the cell $H_2(Pt)|${:(H_(3)O^(+)(aq)),(pH= 5.03):}||{:(Ag^(+),),("xM"):}|Ag. $The measured EMF of the cell is 1.0V. W\hat{i}s the value of x?$

[E_(Ag^(+),Ag)^(@) = +0.8V][T = 25^(@)C]`

A. $2 \times 10^{-2} M$

B. $2 \times 10^{-3} M$

C. $1.5 \times 10^{-3} M$

D. $1.5 \times 10^{-2} M$

Answer: A

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81. The standard potential of the reaction

$H_2O + e^- \rightarrow (\frac{1}{2})H_2 + OH^-$ at 298 K by using $k_w(H_2O) = 10^{-14}$, is:

A. $-0.828V$

B. $0.828V$

C. $0V$

D. $-0.5V$

Answer: A

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82. Given :

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

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

A. 3.13×10^{-3}

B. 3.13×10^{-4}

C. 6.26×10^{-3}

D. 6.26×10^{-4}

Answer: C

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83. The EMF of concentration cell consisting of two zinc electrodes, one dipping into $M/4$ solution of $ZnSO_4$ and the other into $M/16$ solution of the same salt at $25^\circ C$ is

A. 0.0125 V

B. 0.0250 V

C. 0.0178 V

D. 0.0356 V

Answer: C

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84. The efficiency of a hypothetical cell is about $84\,\%$ which involves the following reactions:

$A(s) + B^{2+}(aq) \rightarrow A^{2+}(aq)_B(s)\ \Delta H = -285kJ$

Then, the standard electrode potential of the cell will be: (Asume `DeltaS = 0)

A. 1.2

B. 2.40 V

C. 1.10 V

D. 1.24 V

Answer: D

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85. $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H - (2)O,$

If H^+ concentration is decreased from 1 M to 10^{-4} M at $25^\circ C$, whereas

concentration of Mn^{2+} and MnO_4^- remains 1M, then:

A. The potential decreases by 0.38 V with decrease in oxidising power

B. The potential increases by 0.38 V with increase in oxidising power

C. The potential decreases by 0.25 V with decrease inn oxidising power

D. the potential decreases by 0.38 V without affecting oxidising power

Answer: A

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86. At equimolar concentration of Fe^{2+} and Fe^{3+}, what must $[Ag^+]$ be so that the voltage of the galvanic cell made from the $(Ag^+|Ag)$ and $(Fe^{3+} \mid Fe^{2+}$ electrodes equals zero?

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

$E^\circ_{Ag^+, Ag}$ = 0.7991, $E^\circ_{Fe^{3+}/Fe^{2+}} = 0.771$

A. 0.34

B. 0.44

C. 0.47

D. 0.61

Answer: A

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87. Fe is reacted with $1.0MHCI$. E° for $Fe/Fe^{2+} = +0.34$ volt. The correct observation (s) regarding this reaction is/are:

A. Fe will be oxidised to Fe^{2+}

B. Fe^{2+} will be reduced to Fe

C. since e.m.f > 0, the reaction shall occur

D. since e.m.f > 0 the reaction shall not occur.

Answer: A::B

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88. The temperature coefficient of the emf i.e. $\frac{dE}{dT} = 0.00065\text{volt}.\, deg^{-1}$ for the cell $Cd|CdCl_2(1M)|\,|\,AgCl(s)$ $|Ag$ at $25^\circ C$ calculate the entropy changes $\triangle S_{298K}$ for the cell reaction, $Cd + 2AgC < oCd^{++} + 2Cl^- + 2Ag$

A. $-105.5JK^{-1}$

B. $-150.2JK^{-1}$

C. $-75.7JK^{-1}$

D. $-125.5JK^{-1}$

Answer: D

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89. The standard emf of the cell, $Cd(s)|CdCI_2(aq)(0.1M)||AgCI(s)|Ag(s)$ in which the cell reaction is $Cd(s) + 2AgCI(s) \rightarrow 2Ag(s) + Cd^{2+}(aq)$ is $0.6915V$ at $0^\circ C$ and $0.6753V$ at $25^\circ C$. The ΔH of the reaction at $25^\circ C$ is,-

A. $-176kJ$

B. $-234.7kJ$

C. $+123.5kJ$

D. $-167.26kJ$

Answer: D

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90. The potential of the Daniel cell, $Zn|(ZnSO_4)|\ |\ (CuSO_4\ |\ Cu$ was reported by Buckbee, Surdzial and Metz as $E^\circ = 1.1028 - 0.641 \times 10^{-3}T + 0.72 \times 10^{-5}T^2$, where T is the temperature in degree celcius, Calcualte $\Delta S^{\circ 0}$ for the cell reaction at $25^\circ C$.

A. $-45.32EU$

B. $-34.52EU$

C. $-25.43EU$

D. $-54.23EU$

Answer: D

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91. Using the date in the preceding problem, calculate the equilibrium constant of the reaction at $25^\circ C$

$$Zn + Cu^{++} \Leftrightarrow Zn^{++} + Cu, K\frac{[Zn^{2+}]}{[Cu^{2+}]}$$

A. 8.314×10^{24}

B. 4.831×10^{31}

C. 8.314×10^{36}

D. 4.831×10^{44}

Answer: C

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92. $\Delta G = \Delta H - T\Delta S$ and $\Delta G + T[\frac{d(\Delta G)}{dT}]_p$ then $((d\frac{E_{cell}}{dT})$ is:

A. $(t\rangle S\frac{)}{nF}$

B. $\frac{nE}{\triangle\ S}$

C. $-nFE^{cell}$

D. $+nEF_{cell}$

Answer: A

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93. How many faraday are required to reduce one mol of MnO_4^- to Mn^{2+}:

A. 1

B. 2

C. 3

D. 5

Answer: D

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

A. 56 g

B. 84 g

C. 112 g

D. 168 g

Answer: B

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

A. $1:2:3$

B. $\frac{1}{1}:\frac{1}{2}:\frac{1}{3}$

C. $3:2:1$

D. $6:3:2$

Answer: B::D

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96. One g equivalent of Na metal is formed from electrolyis of fused NaCl. No of "mole" of Al from the fused Na_3AlF_6 with the same current passed is:

A. 1

B. 3

C. $1/3$

D. 2

Answer: C

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97. A current of 2 A was passed for $1h$ through a solution of $CuSO_4$. $0.237g$ of Cu^{2+} ions was discharged at cathode . The current efficiency is .

A. $42.2\ \%$

B. $26.1\ \%$

C. $10\ \%$

D. $40.01\ \%$

Answer: C

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98. A current of 9.65 ampere is passed through the aqueous solution $NaCI$ using suitable electrodes for $1000s$. The amount of $NaOH$ formed during electrolysis is

A. 2.0 g

B. 4.0 g

C. 6.0 g

D. 8.0 g

Answer: B

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99. In a electrolytic cell of $Ag / AgNO_3 / Ag$, when current is passed, the concentration of $AgNO_3$

A. increases

B. decreases

C. remains same

D. none of these

Answer: C

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100. If 0.224 L of H_2 gas is formed at the cathode, the volume of O_2 gas formed at the anode under identical conditions, is:

A. 0.224 L

B. 0.448 L

C. 0.112 L

D. 1.12L

Answer: C

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101. On electrolysis in which of the following, O_2 would be liberated at the anode?

A. dilute H_2SO_4 with Pt electrodes

B. aqueous $AgNO_3$ solution with Pt electrodes

C. dilute H_2SO_4 with Cu electrodes

D. aqueous NaOH with a Fe cathode & a Pt anode

Answer: A::B::D

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

A. increasing

B. decreasing

C. remains unchanged

D. initially increases but decreases subsequently.

Answer: B

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103. In $H_2 - O_2$ fuel cell the reaction occuring at cathode is:

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

B. $2H_2 + O_2 \rightarrow 2H_2O(l)$

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

D. $H^+ + e^- \rightarrow \frac{1}{2}H_2.$

Answer: A

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104. When a lead storage battery is discharged

A. $PbSO_4$ is formed

B. Pb is formed

C. SO_2 is consumed

D. H_2SO_4 is consumed

Answer: A::D

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

A. 250

B. 196

C. 392

D. 384

Answer: C

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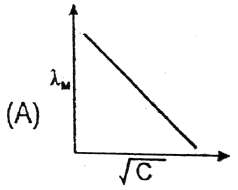
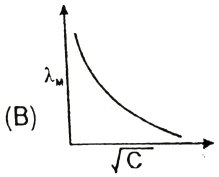
106. Which of the following curve represents the variation of λ_M with $\sqrt{C}$ for $AgNO_3$?

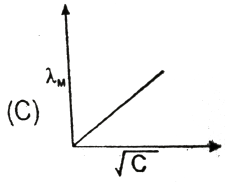
A.



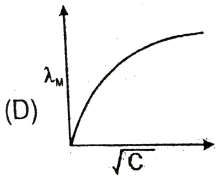
B.



C.



D.



Answer: A

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107. Which has the maximum conductivity ?

A. $[Cr(NH_3)_3Cl_3]$

B. $[Cr(NH_3)_4Cl_2]Cl$

C. $[Cr(NH_3)_5Cl]Cl_2$

D. $[Cr(NH_3)_5]Cl_3$

Answer: D

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108. Molar conductances 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 is :

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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109. The specific conductivity of a saturated solution of AgCl is $3.40 \times 10^{-6} ohm^{-1} cm^{-1}$ at $25^\circ C$. If $\lambda_{Ag^+ = 62.3 ohm^{-1} cm^2 \text{mol}^{-1}}$ and $\lambda_{Cl^-} = 67.7 ohm^{-1} cm^2 \text{mol}^{-1}$, the solubility of AgC at $25^\circ C$ is:

A. $2.6 \times 10^{-5} M$

B. $4.5 \times 10^{-3} M$

C. $3.6 \times 10^{-5} M$

D. $3.6 \times 10^{-3} M$

Answer: A

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110. The conductivity of saturated solution of $BaSO_4$ is $3.06 \times 10^{-6} ohm^{-1} cm^{-1}$ and its equivalent conductance is 1.53 $ohm^{-1} cm^2 \text{equiv}^{-1}$. The K_{sp} for $BaSO_4$ will be:

A. 4×10^{-12}

B. 2.5×10^{-13}

C. 25×10^{-9}

D. 10^{-6}

Answer: D

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111. Molar conductance of $0.1M$ acetic acid is $7ohm^{-1}cm^2\text{mol}^{-1}$. If the molar conductance to acetic acid at dinfintie dilution is $380.8\text{ohm}^{-1}cm^2\text{mol}^{-1}$, the value of dissociation constant will be :

A. $226 \times 10^{-5} moldm^{-3}$

B. $1.66 \times 10^{-3} moldm^{-1}$

C. $1.66 \times 10^{-2} moldm^{-3}$

D. $3.442 \times 10^{-5} moldm^{-3}$

Answer: D

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112. The conductivity of a solution of AgCl at 298 K is found to be $1.382 \times 10^{-6}\Omega^{-1}cm^{-1}$ the ionic conductance of Ag^+ and Cl^- at

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

A. $1.4 \times 10^{-5}molL^{-1}$

B. $1 \times 10^{-2}molL^{-1}$

C. $1 \times 10^{-5}molL^{-1}$

D. $1.9 \times 10^{-5}molL^{-1}$

Answer: C

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Assertion Reasoning

1. Statement-1: The electrode potential of SHE is zero only at $25^\circ C$ And not on other temperature

Statement-2: SHE is standard reference electrodes.

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2. Statement-2: Absolute value of E^0_{red} of an electrode cannote be determined.

Statement-2: Neither oxidation nor reduction can take place alone.

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3. Statement-1: $E^0_{cell} = 0$ for a chloride ion concentration cell.

Statement-2 : For this concentration cell where $E_{cell} = \frac{RT}{nF}\frac{\ln([Cl^-]_{LHS})}{[Cl^-]_{RHS}}$

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4. Statement-1: if $(\frac{dE_{cell}}{dT})_p > 0$ for a cell reaction then $\triangle S$ is positive.

Statement-2: $\triangle S = nFT(\frac{dE}{dT})_p$

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5. Statement-1: if an aqueous solution of $NaCl$ is electroysed, the product obtained at the cathode is H_2 gas and not Na.

Statement-2: Gases are liberated faster than the metals during the electrlysis of electrolyte.

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6. Statement-1: When 2 faraday of electricity is passed through 0.1 $MH_2SO_4(aq)$, 11.2 litre O_2 evolved at STP.

Statement-2: Molecular weight of oxygen is 32.

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7. Statement-1: Gold chloride $(AuCl_3)$ solution cannot be stored in a vessel made of copper, iron, nickel, chromium, zinc or tin.

Statement-2 Gold is a very precious metal.

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8. Statement-1: Copper is dissolved at anode and deposited at cathode when Cu electrodes are used and electrolyte is 1M $CuSO_4(aq)$ solution.

Statement-2: SOP of Cu is less than SOP of water and SRP of Cu is greater than SRP of water.

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9. Statement-I: Molar conductivity of a weak electrolyte at infinite dilution cannot be determined experimenttally.

Because Statement-II: Kohlrausch law help to find the moar conductivity of a weak electrolyte at infinite dilution.

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10. Statement-1: Molar conductivity increases with decrease in concentration for weak electrolytes.

Statement-2: No. of ions per unit volume decreases due to dilution.

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11. STATEMENT-1: Conductivity decreases with the decreases is concentration both the weak and strong electolytes.

STATEMENT-2: No. of ions per unit volume linearly decreases in both electrolytes.

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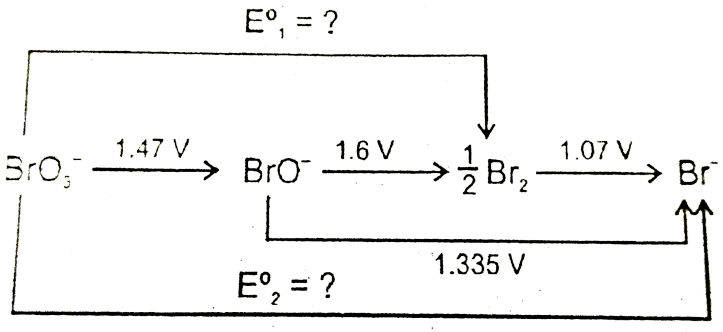
Subjective Questions

1.



From the standard potentials shown in the fillowing figure, calculate the potentials E_1° and E_2°.

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2. Consider the following redox reaction:

$2lrCl_6^{3-} + 3HCOOH \rightarrow 2lr + 3CO_2 + 12Cl^- + 6H^+$

Given: $CO_2 + 2H_3O^+ + 2e \rightarrow HCOOH + 2H_2O \qquad E^\circ = -0.20V$

$lrCl_6^{3-} + 3e \rightarrow lr + 6Cl^- \qquad E^\circ = 0.77V$

(a). Determine standard state emf of cell.

(b). Is this reaction thermodynamically spontaneous as written? Briefly explain.

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3. The overall formaion constant for the reaction of 6 mole of CN^- with cobalt (II) is 1×10^{19} the standard reduction potential constant of $[Co(CN)_6]^{3-} + e^- \rightarrow Co(CN)_6^{4-}$ is $-0.83V$

Calcualte the formation constant of $[Co(CN)_6]^{3-}$. Given $Co^{3+} + e^- \rightarrow Co^{2+}, E^\circ = 1.82V$

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4. Estimate the cell potential of a Daniel cell having $1.0Zn^{++}$ and originally having $1.0MCu^{++}$ after sufficient NH_3 has been added to the cathode compartment to make NH_3 concentration $2.0M$. Given K_f for $[Cu(NH_4)_4]^{2+} = 1 \times 10^{12}$, E° for the reaction, $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ is $1.1V$

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5. Consider the cell $Ag|AgBr(s)|Cr^-||Cl^-|AgCl(s)|Ag$ at $25^\circ C$ the solubility product constants of $AgBr$ & $AgCl$ are respectively 5×10^{-13}&1×10^{-10}. For what ratio of the concentrations of Br^- & Cl^- ions would the e.m.f. of the cell be zero?

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6. Calculate the first dissociation constant of H_3PO_4 if the e.m.f. of the cell,

$Hg|Hg_2Cl_2(s)|KCl(\text{salt})(conc.\ = 4N)||H_3PO_4(0.1M)|H_2(1atm)|Pt,\ -$

of $SCE = 0.2412V.\ (10^{-212} = 131.82)$

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7. Calculate the potential of an indicator electrode versus the standard hydrogen electrode, which originally contained $0.1MMnO_4^-$ and $0.8MH^+$ and which was treated with Fe^{2+} necessary to reduce $90\ \%$ of the MnO_4 to Mn^{2+}

$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + H_2O,\ E^\circ = 1.51V$

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8. Calculate the emf of the cell in mV (atleast first two digits must match with correct answer)

$Ag(s),\ AgIO_3(s)|Ag^+(xM),\ HIO_3(1M)||Zn^{+2}(1M)|Zn(s)$

if $K_{sp} = 3 \times 10^{-8}$ for $AgIO_3$ and $K_a = \frac{1}{6}$ for HIO_3 and E^0_{cell} for

$2Ag + Zn^{+2} \rightarrow 2Ag^{+} + Zn$ is $-1.56V$.

$\log 3 = 0.48) Take \frac{PT}{F} = 0.059$) (giving your answer in magnitude only)

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9. Calculate the voltage E of the cell at $25^{\circ} C$

$Mn(s)|Mn(OH_2)(s)|Mn^{2+}(x, M)OH^{-}(1.00 \times 10^{-4} M) \mid |Cu^{2+}(0.675M$

given that $K_{sp} = 1.9 \times 1 -^{-13}$ for

$Mn(OH)_2(s) E^{\circ}(Mn^{2+}/Mn) = -1.18V, E^{\circ}(Cu^{+2}/C) = +0.34V$

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10. $100mL CuSO_4(aq)$ was electrolyzed using inert electrodes by passing $0.965A$till the pH of the resulting solution was 1. The solution after electrollysis was neutralized, treated with excess KI and titrated with $0.04M Na_2S_2O_3$. Volume of $Na_2S_2O_3$ required was $35mL$. Assuming no volume change during electrolysis, calculate:

(a) duration of electrolysis if current efficiency is $80\ \%$

(b) initial concentration (M) of $CuSO_4$.

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11. 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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12. A silver coulometer is in series with a cell electrolyzing water. In a time of 1 minute at a constant current 1.08 g silver get deposited on the cathode of the coulometer. What total volume (in mL at 1atm, 273K) of

the gases would have produced in other cell. In this cell that the anodic and cathodic efficiencies were 90% and 80% respectively. Assume the gases collected are dry. (Ag = 108) (molar volume of any ideal gas at 1atm and 273K = 22.4L)

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13. An external current source giving a current of $5.0A$ was joined with Daniel cell arrangement opposing the normal current flow and was removed after 10 hrs. Before passing the current the LHE and RHE contained 1L each of $1MZn^{2+}$ and Cu^{2+} respectively. Find the EMF supplied by the Daniel cell after removal of teh external curretn source, E° of Zn^{2+}/Zn and Cu^{2+}/Cu at $25^{\circ}C$ is -0.76 and $+0.34V$ respectively.

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14. A big irrengular shaped vessel contained waer the sp conductance of which was $2.56\times10^{-5}mhocm^{-1}500g$ of $NaCI$ was then added to the

water and the specific conductance after the addition of $NaCI$ was found to be $3.10 \times 10^{-5} mhocm^{-1}$. find the capacity of the vessel if it is fulfilled with water $(\lambda_{\infty} NaCI = 149.9)$

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Objective Questions

1. Given : $E^{\circ}(Cu^{2+/Cu}$ = 0.337V and E^(@) (Sn^(2+//Sn) = -0.136V`. Which of the following statements is correct?

A. Cu^{2+} ions can be reduced by $H_2(g)$

B. Cu can be oxidized by H^{+}

C. Sn^{2+} ions can be reduced by $H_2(g)$

D. Cu can reduce Sn^{2+}

Answer: A

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2. Red hot carbon will remove oxygen from the oxide AO and BO but not from MO, while B will remove oxygen from AO. The activity of metals A, B and M in decreasing order is

A. $A > B > M$

B. $B > A > M$

C. $M > B > A$

D. $M > A > B$

Answer: C

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3. what is the emf at $25^\circ C$ for the cell,

$$Ag\left|\begin{matrix} AgBr(s) & Br^- \\ \alpha = 0.34 & \end{matrix}\right|\left|\left|\begin{matrix} Fe^{3+} & Fe^{2+} \\ \alpha = 0.1 & \alpha = 0.02 \end{matrix}\right|Pt$$

The standard reduction potentials for the half-reactions $AgBr + e^- \rightarrow Ag + Br^-$ and $Fe^{3+} + e^- \rightarrow Fe^{2+}$ are +0.0713V and +0.770V respectively.

A. 0.474 volt

B. 0.529 volt

C. 0.356 volt

D. 0.713 volt

Answer: D

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4. The standard reduction potential E° of the following systems are:-

$System$	$E^{\circ}(\text{volts})$
$(i) MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$	1.51
$(ii) Sn^{4+} + 2e^- \rightarrow Sn^{2+}$	0.15
$(iii) Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$	1.33
$(iv) Ce^{4+} + e^- \rightarrow Ce^{3+}$	1.61

The oxidising power of teh various species decreases in the order

A. $Ce^{4+} > Cr_2O_7^{2-} > Sn^{4+} > MnO_4^-$

B. $Ce^{4+} > MnO_4^- > Cr_2O_7^{2-} > Sn^{4+}$

C. $MnO_4^- > Ce^{4+} Sn^{4+} > Cr_2O_7^{2-}$

D.

Answer: B

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

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

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

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

A. 0.54 volt

B. 0.35 volt

C. 0.24 volt

D. -0.29volt

Answer: B

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6. $2Ce^{4+} + Co \rightarrow 2Ce^{3+} + Co^{2+}, E^{\circ}_{cell} = 1.89V$

$E^{\circ}_{Co^{2+}/Co} = -0.277V$. Hence $E^{\circ}_{Ce^{4+}/Ce^{3+}}$ is

A. 0.805 V

B. 1.62 V

C. $-0.805V$

D. $-1.61V$

Answer: B

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7. $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O, E^{\circ} = 1.51V$

$MnO_2 + 4H^+ + 2e^- rig \leftrightarrow ow Mn^{2+} + 2H_2O\ E^{\circ} = 1.23V$

$E_{MnO_4^-|MnO_2}$

A. 1.70 V

B. 0.91 V

C. 1.37 V

D. 0.548 V

Answer: A

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8. A hydrogen electrode placed in a buffer solution of CH_3COONa and CH_3COOH in the ratios of $x:y$ and $y:x$ has electrode potential values E_1 volts and E_2 volts, respectively at $25^\circ C$ The pK_a values of acetic acid is (E_1 and E_2 are oxidation potential)

A. $\frac{E_1+E_2}{0.118}$

B. $\frac{E_2-E_1}{0.118}$

C. $-\frac{E_1+E_2}{0.118}$

D. $\frac{E_1-E_1}{0.118}$

Answer: A

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9. The electrode potential of electrode $M(s) \rightarrow M^{n+}(aq)(2M) + \neq^{-}$ at 298 K is E_(1). When temperature is doubled and concentration is made half, then the electrode potential becomes E_2. Which of the following represents the correct relationship between E_1 and E_2?

A. $E_1 > E_2$

B. $E_1 < E_2$

C. $E_1 = E_2$

D. Can't be predicted.

Answer: B

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10. 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.

A. 0.21 V

B. 0.059 V

C. 0.018 V

D. 0.021 V

Answer: B

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11. ΔG is the available energy (energy produced) during the electochemical reaction in galvanic cell which can be converted into useful work. In the light of second law of thermodynamics, in the cell, the change in electrode potential with temperature will be equal to:

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

B. $\frac{nF}{\triangle S}$

C. $-2.303RT\log K_C$

D. $\frac{-2.303}{nF}$

Answer: A

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12. Electrolysis of a solution of $MnSO_4$ in aqueous sulphuric acid is a method for the preparation of MnO_2. Passig a curret of 27 A for 24 hours gives 1 kg of MnO_2. The current efficiency in this process is:

A. $100\ \%$

B. $95.185\ \%$

C. $80\ \%$

D. $82.951\ \%$

Answer: B

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13. During thhe preparation of $H_2S_2O_8$ (per disulphuric acid) O_2 gas also releases at anode as byproduct. When 9.72 of H_2 releases at cathode and 2.35L O_2 at anode at STP, the weight of $H_2S_2O_8$ produced in gram is

A. 87.12

B. 43.56

C. 83.42

D. 51.74

Answer: B

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14. 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. $6 \times 67 \times 10^{-4} cm^2 \sec^{-1} \text{volt}^{-1}$

B. $5.01 \times 10^{-3} cm^2 \sec^{-1} \text{volt}^{-1}$

C. $3.22 \times 10^{-4} cm^2 \sec^{-1} \text{volt}^{-1}$

D. $2.00 \times 10^{-4} cm^2 \sec^{-1} \text{volt}^{-1}$

Answer: A

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

A. pure zinc as cathode and pure copper as anode

B. impure sample as cathode and pure copper as anode

C. Impure zinc as cathode and impure sample as anode

D. pure copper as cathode and impure sample as anode.

Answer: D

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16. The reduction potential of hydrogen electrode when placed in a buffer solution is found to be $-0.413V$. The pH of the buffer is

A. 10

B. 4

C. 7

D. 12

Answer: C

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17. A galvanic cell is compsed of two hydrogen electrodes, one of which is a standard one. In which of the following solutions should the other electrode be immersed to get maximum emf?

$K_a(CH_3COOH) = 2 \times 10^{-5}$,$K_a(H_3PO_4) = 10^{-3}$.

A. 0.1 M HCl

B. 0.1 M CH_3COOH

C. $0.1M\ H_2PO_4$

D. $0.1MH_2SO_4$

Answer: B

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18. A gas Cl_2 at 1 atm is bubble through a solution containing a mixture of 1 M Br^{-1} and 1 M F^{-1} at $25^\circ C$ if the reduction potential is $F > Cl > Br$, then:

A. Cl will oxidise Br and not F

B. Cl will oxidise F and not Br

C. Cl will oxidise both Br and F

D. Cl will reduce both Br and F.

Answer: A

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19. The oxidation ptentials of Zn, Cu, Ag, H_2 and Ni are $0.76, -34, -0.80. 0. 00, 0. 25$ volt, respectively. Which of the following reactions will provide maximum voltage ?

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

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

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

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

Answer: B

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20. The reduction potential of a half-cell consisting of a Pt electrode immersed in $1.5MFe^{2+}$ and $0.015MFe^{3+}$ solutin at $25^{\circ}C$ is $(E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.770V)$ is .

A. 0.652 V

B. 0.88 V

C. 0.710 V

D. 0.850 V

Answer: A

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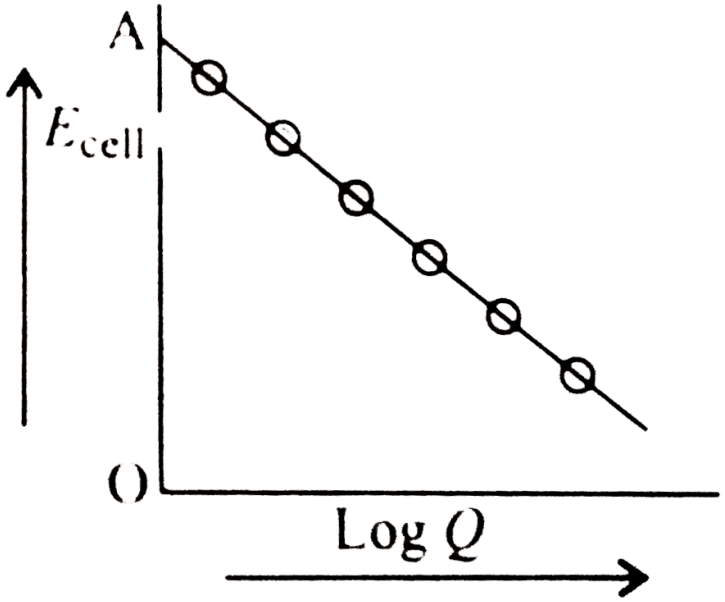
21. $Zn + Cu^{2+}(aq) \Leftrightarrow Cu + Zn^{2+}(aq)$.

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. $[Cu^{2+}]/[Zn^{2+}] = 0.01$

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

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

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

Answer: B

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22. Pure water is saturated with pure solid $AgCl$, a silver electrode is placed in the solution and the potential is measured against normal calomel electrode at $25^{\circ}C$. This experiment is then repeated with a saturated solution of Agl. If the difference in potential in the two cases is $0.177V$. What is the ratio of solubility product (solubility) of $AgCl$ and Agl at the temperature of the experiment?

A. 10^3

B. 10^6

C. 10^2

D. 10^2

Answer: A

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23. The two aqueous solutions, $A(AgNO_3)$ and $B(LiCI)$, were electrolysed using Pt electrodes. The pH of the resulting solutions will.

A. increase in A and decrease B

B. decreases in both

C. increase in both

D. decreases in A and increase B.

Answer: D

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24. When iron is rusted, it is

A. reducted

B. oxidised

C. evaporated

D. decomposed

Answer: B

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25. Which statement is correct?

A. In SHE, the pressure of dihydrogen gas should be low and pH of solution should be zero.

B. in the reaction $H_2O_2 + O_3 \rightarrow 2H_2O + 2O_2$, H_2O_2 is oxidised to H_2O.

C. The absolute value of electrode potential cannot be determined.

D. According to IUPAC conventions, the standard electrode potential pertains to oxidation reactions only.

Answer: C

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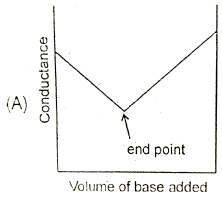
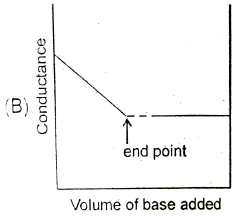
26. Conductance measurements and be used to detect the end point of acid-base titrations. Which of the following plots correctly represents the

end point of the titration of strong acid and a strong base?

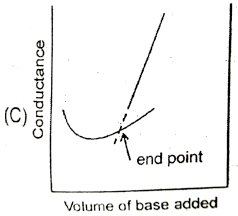
A.



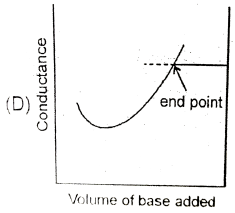
B.



C.



D.



Answer: A

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27. Using the standard electrode potential values given below, decide which of the statements, I, II, III and IV are correct. Choose the right answer from $(1)(2)$ and (4)

$Fe^{2+} + 2e^- \Leftrightarrow Fe \quad , \quad E^0 = -0.44V$

$Cu^{2+} + 2e^- \Leftrightarrow Cu \quad , \quad E^0 = +0.34V$

$Ag^+ + e^- \Leftrightarrow Fe \quad , \quad E^0 = +0.80V$

I. Copper can displace iron from $FeSO_4$ solution.

II. Iron can displace copper from $CuSO_4$ solution

III. Silver can displace copper from $CuSO_4$ solution

IV. Iron can displace silver from $AgNO_3$ solution.

A. I and II

B. II and III

C. II and IV

D. I and IV

Answer: C

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

A. The positive and negative ions will move towarsd anode.

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

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

D. the positive and negative ions will start moving randomly.

Answer: D

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

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

A. increase in the size of silver rod

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

C. increase in the concentration of Ag^+ ions

D. none of the above.

Answer: C

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30. In $H_2 - O_2$ fuel cell, $6.72L$ of hydrogen at NTP reacts in 15 minutes, the averge current produced in ampres is .

A. 64.3 amp

B. 643.3 amp

C. 6.43 amp

D. 0.643 amp

Answer: A

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

A. 22.4

B. 44.8

C. 67.2

D. 89.4

Answer: C

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32. the standard reduction potenital of a silver chloride electrode is 0.2 V and that of a silver electrode is 0.79 V. The maximum amount of AgCl that can dissolve in 10^6L of a 0.1 M $AgNO_3$ solution is:

A. 0.5 mmol

B. 1.0 mmol

C. 2.0 mmol

D. 2.5 mmol

Answer: B

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33. A cell $Cu|Cu^{++}||Ag^{+}|Ag$ initially contains $2MAg^{+}$ and $2MCu^{++}$ ions in 1 L electrolyte. The change in cell potential after the passage of 10 amp. Curret for 4825 sec is:

A. $-0.00738V$

B. $-1.00738V$

C. $-0.0038V$

D. none

Answer: A

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34. With t taken in seconds and I taken in amp, the variation of I follows the equation $t^2 + I^2 = 25$

What amount of Ag will be electrodeposited with this current flowing in the interval 0-5 second? (Ag=108)

A. 22 mg

B. 66 mg

C. 77 mg

D. 88 mg

Answer: A

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35. When a cleaned strip of zinc metal is placed in a solution of $CuSO_4$, a spontaneous reaction occurs, which of the following observation(s) is/are made?

A. The mass of zinc metal decreases gradually

B. The copper metal start depositing on either zinc plate or settles down the vessel

C. The solution remains electrically neutral

D. The temperature of the solution decreases as it is an endothermic reaction.

Answer: A::B::C

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36. During electrolysis of aqueous $CuBr_2$ using Pt electrode,

A. Br_2 gas is evolved at the anode

B. $Cu(s)$ is deposited at the cathode

C. Br_2 gas is evolved at anode and H_2 gas at cathode

D. H_2 gas is evolved at anode.

Answer: A::B

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

Which of the following statements is / are correct ?

A. increase in mass of cathode $= 3.174g$

B. decrease in mass of anode $= 3.174g$

C. no change in masses of electrodes

D. the ratio between the change of masses of cathode and anode is $1:2$

Answer: A::B

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38. Mark out the correct statement(s).

A. Copper metal cannot reduce iron (II) ions in acidic solution.

B. sodium can be obtained by the electrolysis of aqueous solution of NaCl using Pt electrodes.

C. the current carrying ions in an electrolytic cell are not necessarily discharged at the electrodes.

D. Cations having more negative oxidation potential than $-0.828V$ are reduced in preference to water.

Answer: A::C::D

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39. Mark out the correct statement(s) regarding electrolytic molar conductivity.

A. it increase as temperature increases.

B. It experiences resistance due to vibration of ion at the mean position.

C. Increase in concentration decreases the electrolytic molar conductivity of both the strong as well as the weak electrolyte.

D.

Answer: A::C::D

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40. If same quantity of electricity is passed through three electrolytic cells containing $FeSO_4$, $Fe_2(SO_4)_3$, and $Fe(NO_3)_3$, then

A. The amount of iron deposited in $FeSO_4$ and $Fe_2(SO_4)_3$ are equal

B. The amount of iron deposited in $FeSO_4$ is 1.5 times of the amount of iron deposited in $Fe(NO_3)_3$.

C. the amount of rion deposited in $Fe_2(SO_4)_3$ and $Fe(NO_3)_3$ are equal

D. The same amount of gas is evolved in all three cases at the anode.

Answer: B::C::D

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41. Which of the following statements is/are correct?

A. The conductance of one cm^3 (or $1unit^3$) of a solution is called conductivity.

B. Specific conductance increases while molar conductivity decreases on progressive dilution.

C. The limiting equivalent conductivity of weak electrolyte cannote bee determine exactly by extraplotation of the plot of $\wedge_{eq}$ against $\sqrt{c}$.

D. The condcutance of metals is due to the movement of free electrons.

Answer: A::C::D

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Comprehension

1. If an element can exist in several oxidation states, it is convernient to display the reduction potentials correspondingg to the various half reactions in diagrammatic form, know as latimer diagram the latimer diagram for chlorine in acid solutio is

$ClO_4^- \xrightarrow{+1.20V} ClO_3^- \xrightarrow{+1.18V} HClO_2 \xrightarrow{+1.60V} HClO \xrightarrow{1.67V} Cl_2 \xrightarrow{1.36V} Cl^-$

in basic solution.

$ClO_4^- \xrightarrow{0.37V} ClO_3^- \xrightarrow{0.30V} ClO_2^- \xrightarrow{0.68V} ClO^- \xrightarrow{0.42V} Cl_2 \xrightarrow{1.36V} Cl^-$ The standard potentials for two nonadjacent species can also be calculateed by using the concept that $\triangle G^\circ$ as an additive property but potential is not an additive property and $\triangle G^\circ = -nFx^0$. if a given oxidation stateis a stronger oxidising agent than the next higher oxidation state, disproportionation can occur. The reverse of disproportionation is called comproportionation. The relative stabilities of the oxidation state can also be understood by drawing a graph of $\triangle G^\circ / F$ against oxidation state, known as frost diagram, choosing the stability of zero oxidation state arbitrarily as zero. The most stable oxidation state of a species lies lowest in the diagram, disproportionation is spontaneous if the species lies above a straight line joining its two product species.

Q. Which of the following couple have same value of potential at $pH = 0$ and $pH = 14$?

A. $\frac{ClO_4^-}{ClO_3^-}$

B. $\frac{ClO_2^-}{Cl_2}$

C. $\frac{ClO_2^-}{Cl_2}$

D. $\frac{Cl_2}{Cl^-}$

Answer: D

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2. If an element can exist in several oxidation states, it is convernient to display the reduction potentials correspondingg to the various half reactions in diagrammatic form, know as latimer diagram the latimer diagram for chlorine in acid solutio is

$$ClO_4^- \xrightarrow{+1.20V} CiO_3^- \xrightarrow{+1.18V} HClO_2 \xrightarrow{+1.60V} HClO \xrightarrow{1.67V} Cl_2 \xrightarrow{1.36V} Cl^-$$

in basic solution.

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Q. What is the potential couple $\frac{ClO^{-}}{Cl^{-}}$ at $pH = 14$?

A. $1.78V$

B. $-0.94V$

C. $0.89V$

D. $-0.89V$

Answer: C

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3. If an element can exist in several oxidation states, it is convernient to display the reduction potentials correspondingg to the various half

reactions in diagrammatic form, know as latimer diagram the latimer diagram for chlorine in acid solutio is

$$CIO_4^- \xrightarrow{+1.20V} CiO_3^- \xrightarrow{+1.18V} HClO_2 \xrightarrow{+1.60V} HClO \xrightarrow{1.67V} Cl_2 \xrightarrow{1.36V} Cl^-$$

in basic solution.

$$ClO_4^- \xrightarrow{0.37V} ClO_3^- \xrightarrow{0.30V} ClO_2^- \xrightarrow{0.68V} ClO^- \xrightarrow{0.42V} Cl_2 \xrightarrow{1.36V} Cl^-$$ The standard potentials for two nonadjacent species can also be calculateed by using the concept that $\triangle G^\circ$ as an additive property but potential is not an additive property and $\triangle G^\circ = -nFx^0$. if a given oxidation stateis a stronger oxidising agent than the next higher oxidation state, disproportionation can occur. The reverse of disproportionation is called comproportionation. The relative stabilities of the oxidation state can also be understood by drawing a graph of $\triangle G^\circ / F$ against oxidation state, known as frost diagram, choosing the stability of zero oxidation state arbitrarily as zero. The most stable oxidation state of a species lies lowest in the diagram, disproportionation is spontaneous if the species lies above a straight line joining its two product species.

Q. Which of the following statement is correct?

A. Cl_2 undergoes disproportionation into Cl^- and ClO^- both at $pH = 0$ and $pH = 14$.

B. Cl_2 undergoes disproportionation into Cl^- at $pH = 14$ but not at $pH = 0$

C. Cl_2 undergoes disproportionation into Cl^- and ClO^- at $pH = 0$ but not at $pH = 14$

D. none of these

Answer: B

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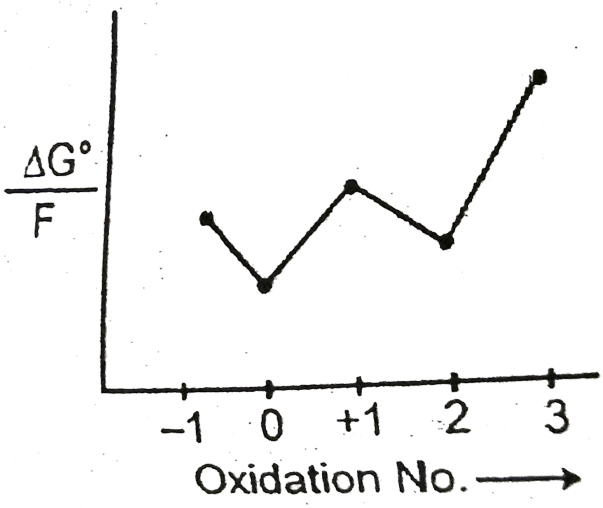
4. If an element can exist in several oxidation states, it is convernient to display the reduction potentials correspondingg to the various half reactions in diagrammatic form, know as latimer diagram the latimer diagram for chlorine in acid solutio is

$$ClO_4^- \xrightarrow{+1.20V} ClO_3^- \xrightarrow{+1.18V} HClO_2 \xrightarrow{+1.60V} HClO \xrightarrow{1.67V} Cl_2 \xrightarrow{1.36V} Cl^-$$

in basic solution.

$ClO_4^- \xrightarrow{0.37V} ClO_3^- \xrightarrow{0.30V} ClO_2^- \xrightarrow{0.68V} ClO^- \xrightarrow{0.42V} Cl_2 \xrightarrow{1.36V} Cl^-$ The standard potentials for two nonadjacent species can also be calculateed by using the concept that $\triangle G^\circ$ as an additive property but potential is not an additive property and $\triangle G^\circ = -nFx^0$. if a given oxidation stateis a stronger oxidising agent than the next higher oxidation state, disproportionation can occur. The reverse of disproportionation is called comproportionation. The relative stabilities of the oxidation state can also be understood by drawing a graph of $\triangle G^\circ / F$ against oxidation state, known as frost diagram, choosing the stability of zero oxidation state arbitrarily as zero. The most stable oxidation state of a species lies lowest in the diagram, disproportionation is spontaneous if the species lies above a straight line joining its two product species.

Q.



For a hypothetical element, the frost diagram is shown in figure.? which of the following oxidation state is least stable?

A. -1

B. 0

C. $+2$

D. $+3$

Answer: D

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5. If an element can exist in several oxidation states, it is convernient to display the reduction potentials correspondingg to the various half reactions in diagrammatic form, know as latimer diagram the latimer diagram for chlorine in acid solutio is

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Q. Which of the following statement is correct?

A. A^{+1} undergoes disproportionation into A and A^{2+}

B. A^{2+} undergoes disproportionation in A and A^{3+}

C. A undergoes comporportionation in A^{+1} and A^{-1}

D. All of the above.

Answer: A

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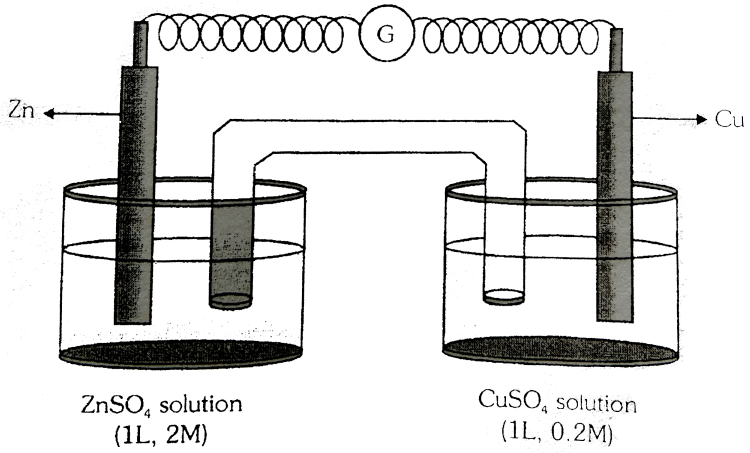

6.

Given:

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

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

$K_f[Cu(NH_3)_4]^{2+} = 4 \times 10^{11}$

$\frac{2.303R}{F} = 2 \times 10^{-4}$

Find emf at cell of $200K$ if E° values are independent of temperature

$[\log 2 = 0.3]$

A. 1.7 V

B. 1.08 V

C. 1.09 V

D. 1.10 V

Answer: B

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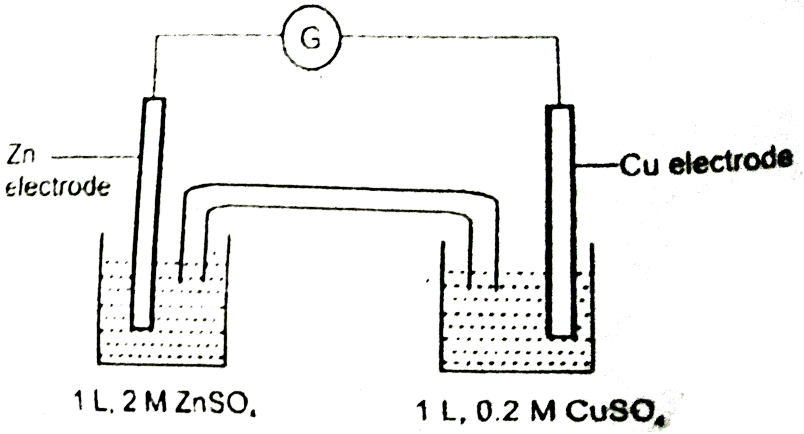
7.



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

$K_f[Cu(NH_3)_4]^{+2} = 4 \times 10^{11}$

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

Answer the following.

Q. When 1 mole NH_3 added to cathode compartment than emf of cell is (at 298 K)

A. 0.81 V

B. 1.91 V

C. 1.1 V

D. 0.72 V

Answer: A

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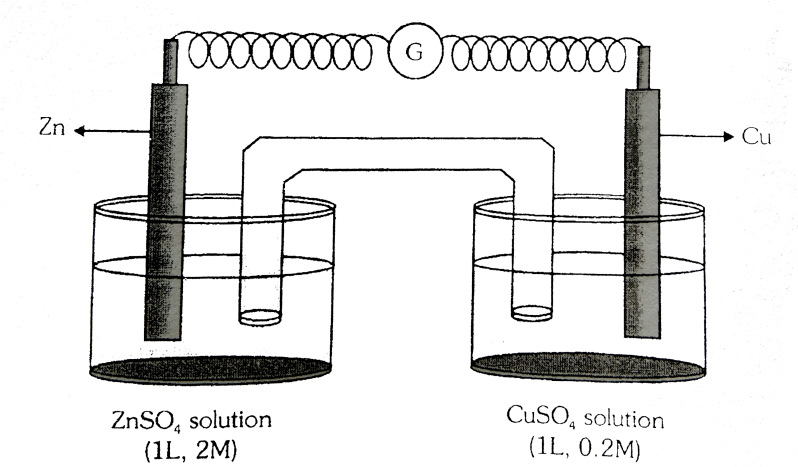

8.

Given:

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

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

$$K_f[Cu(NH_3)_4]^{2+} = 4 \times 10^{11}$$

$$\frac{2.303R}{F} = 2 \times 10^{-4}$$

At what concentration of Cu^{+2} emf of the cell will be zero (at 298K) and concentration of Zn^{+2} is remains same:

A. 1.19×10^{-37}

B. 1.19×10^{-20}

C. 3.78×10^{-4}

D. 0.0068

Answer: A

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9. The molar conductance of NaCl varies with the concentration as shown in the following table and all values follows the equation.

$\lambda_m^c = \lambda_m^\infty - b\sqrt{C}$ where λ_m^c= molar specific conductance λ_m^∞ = molar specific conductance at infinite dilution C=molar concentration

Molar Concentration of NaCl	Molar Conductivity in $ohm^{-1}\ cm^2\ mole^{-1}$
4×10^{-4}	107
9×10^{-4}	97
16×10^{-4}	87

When a certain conductivity cell (C) was filled with $25 \times 10^{-4}(M)NaCl$

solution, the resistance of the cell was found to be 1000 ohm. At infinite dilution, conductance of Cl^- and SO_4^{2-} are $80 ohm^{-1} cm^2 \text{mole}^{-1}$ and $160 ohm^{-1} cm^2 \text{mole}^{-1}$ respectively.

What is the molar conductance of NaCl at infinite dilution?

A. $147 ohm^{-1} cm^2 \text{mole}^{-1}$

B. $107 ohm^{-1} cm^2 s\text{mole}^{-1}$

C. $127 ohm^{-1} cm^2 \text{mole}^{-1}$

D. $157 ohm^{-1} cm^2 \text{mole}^{-1}$

Answer: C

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10. The molar conductance of NaCl varies with the concentration as shown in the following table and all values follows the equation.

$\lambda_m^c = \lambda_m^\infty - b\sqrt{C}$ where λ_m^c= molar specific conductance λ_m^∞ = molar specific conductance at infinite dilution C=molar concentration

Molar Concentration of NaCl	Molar Conductivity in $ohm^{-1}\ cm^2\ mole^{-1}$
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What is the cell constant of the conductivity cell (C)?

A. $0.385 cm^{-1}$

B. $3.86 cm^{-1}$

C. $38.5 cm^{-1}$

D. $0.1925 cm^{-1}$

Answer: D

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11.

Molar Concentration of NaCl	Molar Conductance in $ohm^{-1}\ cm^2\ mole^{-1}$
4×10^{-4}	107
9×10^{-4}	97
16×10^{-4}	87

The molar conductance of NzCl varies with the concentration as shown in the following table and all values follows the equation

$\lambda_m^C = \lambda_m^\infty - b\sqrt{C}$

where $\lambda_m^C =$ molar specific conductance

$\lambda_m^\infty =$ molar specific conductance at infinite dilution

$C =$ molar concentration When a cenrtain conductivity cell (C) was filled with $25 \times 10^{-4}(M)$ NaCl solution. The resistance of the cell was found to be 1000 ohm At infinite dilution, Conductance of Cl^- and SO_4^{-2} are $80 ohm^{-1} cm^2 \text{mole}^{-1}$ and $160 ohm^{-1} cm^2 \text{mole}^{-1}$ respectively.

Q. If the cell (C) is filled with $5 \times 10^{-3}(N) Na_2SO_4$ the observed resistance was 400 ohm. what is the molar conductance of Na_2SO_4

A. $19.25 ohm^{-1} cm^2 \text{mole}^{-1}$

B. $96.25 ohm^{-1} cm^2 \text{mole}^{-1}$

C. $385 ohm^{-1} cm^2 \text{mole}^{-1}$

D. $192.5 ohm^{-1} cm^2 \text{mole}^{-1}$

Answer: D

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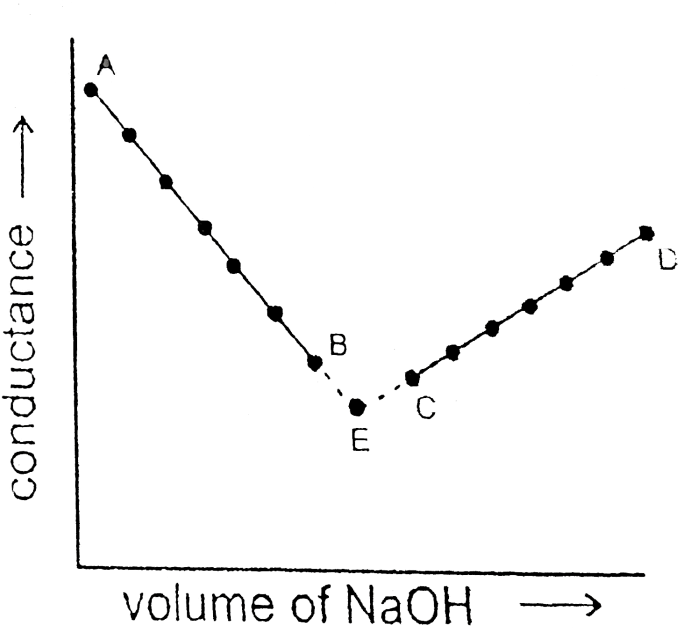

12.

Strong acid versus strong base:

The principle of conductometric titrations is based on the fact that during the titration, one of the ions is replaced by the other and invariable these two ions differ in the ionic conductivity with the result

that thhe conductivity of the solution varies during the course of the titration. take, for example, the titration between a strong acid, say HCl, and a string base, say NaOH before NaOH is added, the conductance of HCl solution has a high value due to the presence of highly mobile hydrogen ions. As NaOH is added, H^+ ions are replaced by relatively slower moving Na^+ ions. consequently the conductance of the solution decreases and this continues right upto the equivalence point where the solution contains only NaCl. Beyond the equivalence point, if more of NaOH is added, then the solution contains a excess of the fast moving OH^- ions with the result that its conductance is increased ad it condinues to increase as more and more of NaOH is added. If we plot the conductance value versus the amount of NaOH added, we get a curve of the type shown in Fig. The descending portion AB represents the conductances before the equivalence point (solution contains a mixture of acid HCl and the salt NaCl) and the ascending portion CD represents the conductances after the equivalence point (solution contains the salt NaCl and the excess of NaOH). The point E which represent the minium conductance is due to the solution containing only NaCl with no free acid or alkali and thus represents the equivalence point. this point can,

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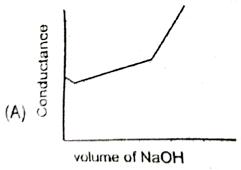
method.

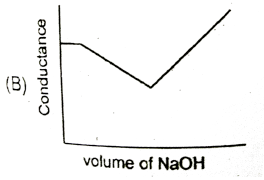
In all these graphs it has been assumed that the volume change due addition of solution from burrette is negnigible, hence volume change of the solution in beaker the conductance of which is measured is almost constant throughout the measurement.

Q. The nature of curve obtained for the titration between weak acid versus strong base as described in the above passage will be:

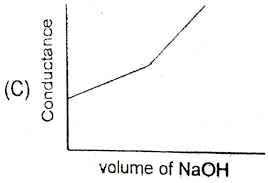
A.



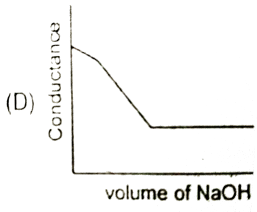
B.



C.



D.



Answer: A

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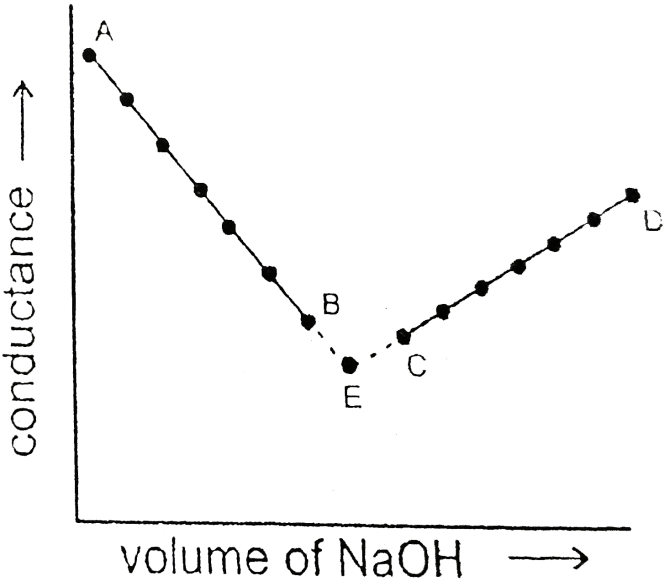

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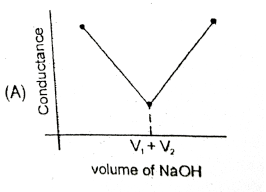
In all these graphs it has been assumed that the volume change due

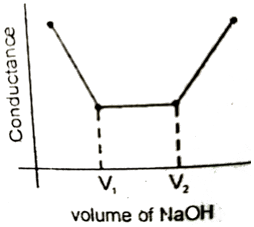
addition of solution from burrette is negnigible, hence volume change of the solution in beaker the conductance of which is measured is almost constant throughout the measurement.

Q. The most appropriate titration curve obtained when a mixture of a strong acid (say HCl) and a weak acid (say CH_3COOH) is titrated with a strong base (say NaOH) will be

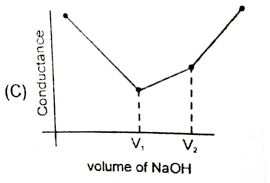
A.



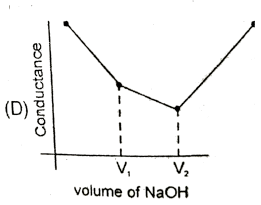
B.



C.



D.



Answer: C

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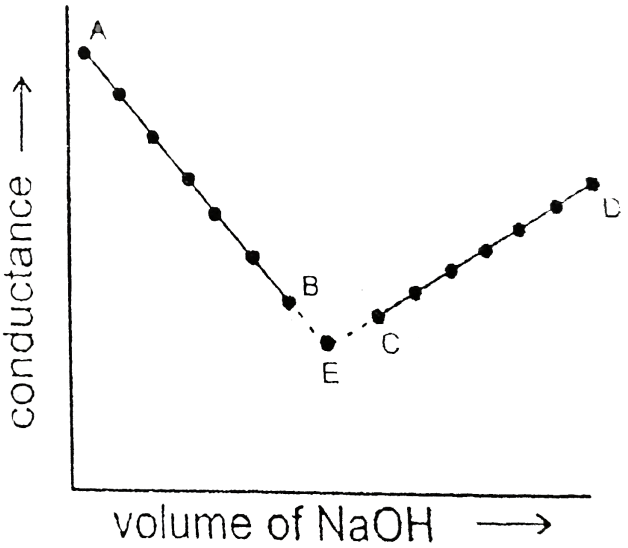

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In all these graphs it has been assumed that the volume change due

addition of solution from burrette is negnigible, hence volume change of the solution in beaker the conductance of which is measured is almost constant throughout the measurement.

Q. If a 100 mL solution of 0.1 M HBr is titrated using a very concentrated solution of $NaOH$, then the conductivity (specific conductance) of this solution at the equivalence point will be (assume volume change is negligible due to addition of NaoH) report your answer after multipling it with 10 in Sm^{-1}

[Given $\lambda^{\circ}_{(Na^{+})} = 8 \times 10^{-3} Sm^{2} mol^{-1}$, $\lambda^{\circ}_{(Br^{-})} = 4 \times 10^{-3} Sm^{2} mol^{-1}$]

A. 6

B. 12

C. 15

D. 24

Answer: B

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

$Ag^+ \rightarrow e^- \rightarrow Ag, E^\circ_{red} = 0.8V$

$C_6H_{12}O_6 + H_2O \rightarrow C_6H_{12}O_7$ (Gluconic acid)

$+2H^+ + 2e^-, E^\circ_{\otimes d} = -0.05V$

$Ag(NH_3)_2^+ + e^- \rightarrow Ag(s) + 2NH_3, E^\circ = -0.337V$

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

Now answer the following three questions:

Q. $2Ag^+ + C_6H_{12}O_6 + H_2O \rightarrow 2Ag(s) + C_6H_{12}O_7 + 2H^+$

Find in K of this reaction:

A. 66.13

B. 58.38

C. 28.3

D. 46.29

Answer: B

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$Ag(NH_3)_2^+ + e^- \rightarrow Ag(s) + 2NH_3, E^\circ = -0.337V$

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

Now answer the following three questions:

Q. 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. $E_{\otimes d}$ will increase by a factor of 0.65 for $E^\circ_{\otimes d}$

B. $E_{\otimes d}$ will decrease by a factor of 0.65 for $E^\circ_{\otimes d}$

C. E_{red} will increase by a factor of 0.65 for E°_{red}

D. E_{red} will decrease by a factor of 0.65 for E°_{red}

Answer: A

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$Ag(NH_3)_2^+ + e^- \rightarrow Ag(s) + 2NH_3, E^\circ = -0.337V$

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

Now answer the following three questions:

Q. Ammonia is always is added inn this reaction. Which of the following must be INCORRECT:

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

B. $Ag(NH_3)_2^+$ is a weaker oxidising reagent than Ag^+

C. In absence of NH_3, silver salt of gluconic aacid is formed.

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

Answer: D

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

Now answer the following three questions:

Q. We have take a saturated solution of $AgBr$. K_{sp} of $AgBr$ is

12×10^{-14} if 10^{-7} mole of $AgNO_3$ are added to 1 litre of this solution, find conductivity (specific conductance) of this solution in terms of $10^{-7} Sm^{-1}$

Given

$\lambda^{\circ}_{(Ag^+)} = 6 \times 10^{-3} Sm^2 mol^{-1}, \lambda^{\circ}_{(Br^-)} = 8 \times 10^{-3} Sm^2 mol^{-1}, \lambda^{\circ}_{(NO_3^-)} =$

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19. Chemical reaction involve interaction of atoms and molecules. A large number of atoms/molecules (approximately 6.022×10^{23})are present in a few grams of any chemical compound varying with their atomic/molrcular mass. To handle such a large numbers conveniently, the mole concept was introduced. This concept has implications in diverse areas such as analytical in diverse areas such as analytical chemistry, biochemistry, electrochemistry and radiochemistry. The following example illustrates a typical case, involving chemical/ electrochemical reaction, which requires a clear understanding of the mole concept.

A 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one

of teh electrodes (atomic mass: Na=23, Hg=200, 1F=96500 coulombs)

The total number of moles of chlorine gas evolved is

A. 0.5

B. 1

C. 2

D. 3

Answer: B

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If cathode is a Hg electrode, the maximum weight(g) of amalgam formed from the solution is

A. 200

B. 225

C. 400

D. 446

Answer: D

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The total charge in couloms required to complete the electrolysis

A. 24125

B. 48250

C. 96500

D. 19300

Answer: D

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22. 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. Iodine ion is oxidised by chlorine

D. Mn^{2+} is oxidised by chlorine

Answer: C

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

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

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^{2+} oxidises H_2O to O_2

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

Answer: D

Watch Video Solution

24. Redox reactins play a pivoted role in chemistry and biology. The values of standard redox potential (E°) of two half-cell reactions decide which way the reaction is expected to proceed. A simple example is a Daniel cell in which zinc goes into solution and copper gets deposited. Given below is a set of half-cell reactions (acidic medium) along with their E° values with respect to normal hydrogen electrode. Using this data, obtained the correct explanations to questions $15 - 16$

$I_2 + 2e^- \rightarrow 2I^-, E^\circ = 1.36V$

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

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

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

Q. Electrolysis of dilute aqueous $NaCl$ solution was carried out by passing 10 milliampere current. The time required to liberate 0.01 mole of H_2 gas at the cathode is: (1 faraday $= 96500C$)

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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25. For the reduction of NO_3^- ion in an aqueous solution E° is $+0.96V$. Values of E° for some metal ions are given below

$V^{2+}(aq) + 2e^- \Leftrightarrow V, E^\circ = -1.19Vtt$

$Fe^{3+}(aq) + 3e^- \rightarrow Fe : E^\circ = -0.04V$

$Au^{3+}(aq) + 3e^- \rightarrow Au, E^\circ = +1.40V$

$Hg^{2+}(aq) + 3e^- \rightarrow Hg, E^\circ = +0.86V$

The pari(s) of metals that is/are oxidised by NO_3^- in aqueous solution is (are)

A. V and Hg

B. Hg and Fe

C. Fe and Au

D. Fe and V

Answer: A::D

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26. The concentration of potassium ions inside a biological cell is at least 20 times higher than outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simplel model for a concentration cell involving a metal M is

$M(s) \mid M^{\oplus}(aq, 0.05 \text{ molar}) \mid \mid M^{\oplus}(aq, 1 \text{ molar}) \mid M(s)$

For the abov electrolytic cell, the magnitude of the cell potential is $|E_{cell}| = 70mV$.

For the above cell

A. $E_{Cell} < 0 \triangle G \geq 0$

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

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

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

Answer: B

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For the abov electrolytic cell, the magnitude of the cell potential is $|E_{cell}| = 70mV$.

If the 0.05 moolar solution of $M^{\oplus}$ is replaced by a 0.0025 molar $M^{\oplus}$ solution, then the magnitude of the cell potential would be

A. $35mV$

B. $70mV$

C. $140mV$

D. $700mV$

Answer: C

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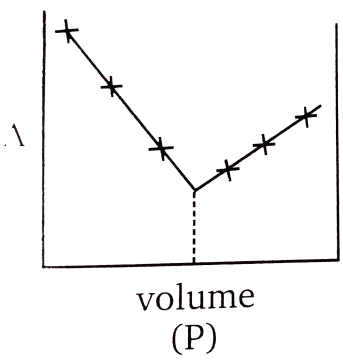
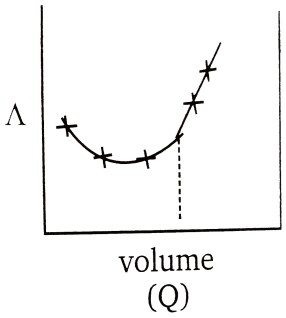
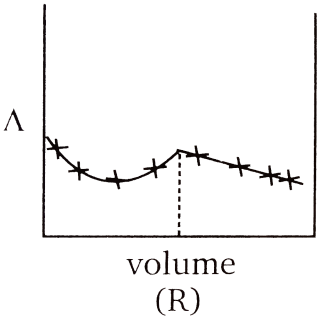
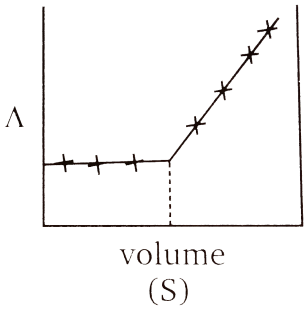
28. $AgNO_3(aq.)$ was added to an aqeous KCl solution gradually and the conductivity of the solution was measured. The plot of conductance (Λ) versus the volume of $AgNO_3$ is :









A. (P)

B. (Q)

C. (R)

D. (S)

Answer: D

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29. Consider the following cell reaction.

$2Fe(s) + O_2(g) + 4H^+(aq) \rightarrow 2Fe^{2+}(aq) + 2H_2O(l),$

$E^\circ = 1.67V$

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

A. `1.47 V

B. 1.77 V

C. 1.87 V

D. 1.57 V

Answer: D

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30. The electrochemical cell shown below is a concentration cell.

$$M\left|M^{2+}\left(\begin{array}{c}\text{Saturated solution}\\ \text{of sparingly soluble}\\ \text{salt, } MX_2\end{array}\right)\right|\left|M^{2+}(0.001 \text{ mol dm}^{-3})\right|M$$

The emf of the cell depends on the difference in concentrations of M^{2+}

ions at the two electrodes. The emf of the cell at 298 K is 0.059 V.

The solubility product ($K_{sp}, mol^3 dm^{-9}$) of MX_2 at 298 K based on the information available for the given concentration cell is $(\text{take } 2.303 \times R \times 298/F = 0.059V)$:

A. $1 \times x10^{-15}$

B. 4×10^{-15}

C. 1×10^{-12}

D. 4×10^{-12}

Answer: B

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31. The electrochemical cell shown below is a concentration cell M/M^{2+} (saturated solution of a sparingly soluble salt, MX_2) $||$ $\left|M^{2+}(0.001 mol dm^{-3})\right|M$

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 value of $\Delta G(kJ\text{mol}^{-1})$ 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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Exercise 3

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

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

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

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

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

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

A. MnO_4^- can be used in aqueous HCl

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

C. MnO_4^- can be used in aqueous H_2SO_4

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

Answer: A

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2. In an electrolytic cell, the flow of electrons is form

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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3. 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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4. The emf of the cell,

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

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

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

B. $10^{\frac{0.32}{0.0295}}$

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

D. $10^{\frac{0.32}{0.059}}$

Answer: B

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5. Find the equilibrium constant for the reaction :

$Cu^{2+} + In^{2+} \Leftrightarrow Cu^{\oplus} + In^{3+}$

Given that $E^{c-}{}_{.Cu^{2+}|Cu^{\oplus}} = 0.15V$, $E^{c-}{}_{\ln^{2+}|\ln^{\oplus}} = -0.4V$,

$E^{c-}{}_{\ln^{3+}|\ln^{\oplus}} = -0.42V$

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

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

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

ΔG° (in KJ) for the reaction is

A. -76

B. -322

C. -122

D. -176

Answer: B

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7. (a). Calculate $\triangle G_f^\circ$ of the following raection:

$Ag^+(aq) + Cl^- \rightarrow AgCl(s)$

given

$\triangle G_f^\circ(AgCl) = -109kJ/\text{mole}, \triangle G_f^\circ(Cl^-) = -129kJ/\text{mole}, \triangle G_f^\circ$

Represent the above reaction in form of a cell.

Calculate E° of the cell. find $\log_{10} K_{sp}$ of $AgCl$ at $25^\circ C$

(b). $6.539 \times 10^{-2} g$ of metallic Zn (atomic mass $= 65.39a\mu$) was added to

100 mL of saturated solution of AgCl.

Calculate $\frac{\log_1([Zn^{2+}])}{[Ag^+]^2}$ at equilibrium at $25^\circ C$ given that

$Ag^+ + e^- \rightarrow Ag \qquad E^\circ = 0.80V$

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

Also find how many moles of Ag will be formed (take $\frac{114}{193} = 0.59, \frac{1.56}{0.059} = 26.44$)

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Part 2

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

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

A. $\frac{RT}{F}\frac{\log_e(p_1)}{p_2}$

B. $\frac{RT}{2F}\frac{\log_e(p_1)}{p_2}$

C. $\frac{RT}{F}\frac{\log_e(p_2)}{p_1}$

D. $\frac{RT}{2F}\frac{\log_e^{p_2}}{p_1}$

Answer: B

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2. Which reaction is possible at anode?

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

B. $F_2 \rightarrow 2F^-$

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

D. displacement reaction

Answer: A

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3. For a cell given below:

$Ag|Ag^+||Cu^{2+} \mid Cu$

$Ag^+ + e^- \rightarrow Ag, E^\circ = x$

$Cu^{2+} + 2e^- \rightarrow Cu, , E^\circ = y$ ltbr. The value of E°_{cell} is

A. $x + 2y$

B. $2x + y$

C. $y - x$

D. $y - 2x$

Answer: C

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

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

Answer: B

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

A. 1×10^{-10}

B. 29.5×10^{-2}

C. 10

D. 1×10^{10}

Answer: D

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6. Stadard reduction electrode potentials of three metals A,B and C are respectively $+0.5V,\ -3.0V$ and $-1.2V$. The reducing powers 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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7. Consider the following E_0 values,

$E^0_{Fe^{3+}/F^{2+}} = +0.77V, E^0_{Sn^{2+}/Sn} = -0.14V$, the E^0_{cell} for the reaction, $Sn_{(s)} + 2Fe^{3+}_{(aq.)} \rightarrow 2F^{2+}_{(aq.)} + Sn^{2+}_{(aq.)}$ is:

A. 1.68 V

B. 1.40 V

C. 0.91 V

D. 0.63 V

Answer: C

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

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

B. $176 Scm^2 mol^{-1}$

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

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

Answer: A

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9. 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. lower the E and shift equilibrium to the left.

B. lower the E and shift the equilibrium to the right

C. increase the E and shift the equilibrium to the right.

D. increase the E and shift the equilibrium to the left.

Answer: C

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10. The $E_{M^{3+}/M^{2+}\hat{}\circ}$ 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. Cr

B. Mn

C. Fe

D. Co

Answer: A

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

A. 0.1 M acetic acid

B. 0.1 M chloroacetic acid

C. 0.1 M fluoroacetic acid

D. 0.1 M difluoroacetic acid.

Answer: D

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

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

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

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

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

Answer: A

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13. 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 $\Lambda^{2}_{HOAc,}$ the additional value required is:

A. $\wedge_{H_2O}^0$

B. $\wedge_{KCl}^0$

C. $\wedge_{NaOH}^0$

D. $\wedge_{NaCl}^0$

Answer: D

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

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

A. -8.12

B. $+8.612$

C. -37.83

D. -16.13

Answer: D

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

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

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

C. $1.24 Sm^2 mol^{-1}$

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

Answer: D

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

$A^\circ_{CH_3COONa} = 91.0 Scm^2/\text{equiv}$

$A^\circ_{HCl} = 426.25 cm^2/\text{equiv}$

What additional information/quantity one needs to calculate A° of an aqueous solution of acetic acid?

A. The limiting equivalent conductance of $H^+ (\lambda^\circ H^+)$

B. $(\wedge)^\circ$ of chloroacetic acdi $(CICH_2COOH)$

C. $(\wedge)^\circ$ of NaCl

D. $(\wedge)^\circ$ of CH_3COOK

Answer: C

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

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

A. $10^{37.3}$

B. 9.65×10^{4}

C. antilog (24.08)

D. 37.3

Answer: A

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18. Given: $E^{\circ}_{Cr^{3+}/Cr}$ = -0.72V, E_(Fe^(2+)//Fe)^(@) $= -0.42VThepotentialf$ or $thecell$Cr||Cr^(3+)(0.1M) || Fe^(2+)(0.01 M)|| Fe), is:

A. 0.339 V

B. $-0.339V$

C. $-0.26V$

D. 0.26 V

Answer: D

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19. Given, $E^o_{Fe^{3+}/Fe} + 3eCrE^o = -0.036V$
$E^o_{Fe^{3+}/Fe} = -0.439V$

The value of standard electrode ptoential for the charge,

A. 0.385 V

B. 0.770 V

C. $-0.270V$

D. -0.072

Answer: B

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

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

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

A. 4.5 V

B. 3.0 V

C. 2.5 V

D. 5.0 V

Answer: C

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

Answer: C

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

A. $X = Ni, Y = Fe$

B. $X = Ni, Y = Zn$

C. $X = Fe, Y = Zn$

D. $Z = Zn, Y = Ni$

Answer: D

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

Among the following, the strongest reducing agent is

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

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

Based on the data given above strongest oxidising agent will be

A. Cl

B. Cr^{3+}

C. Mn^{2+}

D. MnO_4^-

Answer: D

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CBSE Problems

1. Write Nernst equation for the electrode reaction :

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

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2. How much electricity is requried in coulomb for the oxidation of 1 mol of H_2O to O_2

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3. Write Nernst equation for the electrode reaction :

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

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

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

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

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

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6. The E° value in respect of the electrodes $(Z=24)$, manganese $(Z=25)$ and iron $(Z=26)$ are :

$Cr^{3+}/Cr^{2+}=-0.4V, Mn^{3+}/Mn^{2+}=+1.5V,$

$Fe^{3+}/Fe^{2}=+0.8V.$

On the basic of the above information compare the feasibilities of further oxidation of their $+2$ oxidation states.

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7. What is corrosion? Describe the electrochemical phenomenon of rusting of iron

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8. How much charge is required for the reduction of 1 mole of Cu^{2+} to Cu.

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

Fe^{II} to Fe^{III}. Given.

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

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

Calculate its molar conductivity.

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

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

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

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

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

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

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

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

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

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

(i). Cell constant

(ii). conductivity of 0.01 M Y solution

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

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

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16. Corrosion is essentially an electrochemical phenomenon. Explain the reactions occurring during corrosion of iron kept in an open atmosphere.

(b) Calculate the equilibrium constant for the equilibrium reaction

$$Fe_{(s)} + Cd^{2+}_{(aq)} \Leftrightarrow Fe^{2+}_{(aq)} + Cd_{(s)}$$

(Given : $E^{\circ}_{Cd^{2+}|Cd} = -0.40V$, $E^{\circ}_{Fe^{2+}|Fe} = -0.44V$).

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17. Calculate the cell emf and $\triangle_r G^{\circ}$ for the cell reactin at $25^{\circ}C$

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

(given $E^{\circ}_{Zn^{2+}/Zn} = -0.763V$, $E^{\circ}_{Cd^{2+}/Cd} = -0.403V$

$1F = 96500Cmol^{-1}$, $R = 8.314JK^{-1}mol^{-1}$]

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18. What is meant by limiting molar conductivity?

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

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

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

.

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

Or

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

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

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

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

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20. Express the relation among cell constant , resistance of the solution in the cell and conductivity of the solution . How is molar conductivity of a solution related to its conductivity ?

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

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

$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^-, E^\circ = +0.51V$ Construct the redox equation from the two half cell reactions and predict if theis reaction favours formation of reaction or product shown in the equation.

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

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

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

cell.

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

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

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25. The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactio:rs occurring during the corrosion of iron in the atmosphere.

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

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

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

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27. What type of a battery is lead storage battery? Write the anode and cathode reactions and the overall cell reaction occurring in the operation of a lead storage battery.

(b) Calucluate the potential for half-cell containing.

0.10 M $K_2Cr_2O_7(aq)$, $0.20MCr^{3+}(aq)$ and $1.0 \times 10^{-4}MH^+(aq)$

The half -cell reaction is

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

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

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28. (a) How many mole of mercury will be produced by electrolysing 1.0 M Hg $(NO_3)_2$ solution with a current of 2.00 A for 3 hours? [Hg $(NO_3)_2 = 200.6gmol^{-1}$].

(b) A voltaic cell is set up at $25^{\circ}C$ with the following half-cells Al^{3+} (0.001M) and Ni^{2+} (0.50M). Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.

(Given : $E^{2}_{Ni^{2+}/Ni} = -0.25V, E^{\circ}_{Al^{3+}/Al} = -1.66V$)

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

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30. The electrical resistance of a column of $0.05\ \text{mol}\ L^{-1}$ NaOH solution of diameter 1 cm and length 50 cm is $5.55 \times 10^{3}\ \text{ohm}$ .Calculate its resistivity,conductivity and molar conductivity.

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

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

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

Determine E° and ΔG° for the reaction.

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

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

(b) The resistance of conductivity cell containing $0.001MKCl$ solution at $298K$ is 1500ω.

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

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

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34. Calculate the emf of the following cell at $298K: Fe(s)\left|Fe^{2+}(0.001M)\right|\left|H^{+}(1M)\right|H_2(g)(1\text{bar}), Pt(s)(\text{Given}E^{\circ}_{\text{Cell}} =$

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Advanced Level Problems

1. 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 $0.059V$

C. increase by 0.41 V

D. decrease by 0.41 V

Answer: D

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2. The standard electrode potentials (reduction) of Pt/Fe^{3+}, Fe^{+2} and Pt/Sn^{4+}, Sn^{+2} are $+0.77V$ and $0.15V$ respectively at $25^{\circ}C$. The standard EMF of the reaction $Sn^{4+} + 2Fe^{2+} \rightarrow Sn^{2+} + 2Fe^{3+}$ is

A. $-0.62V$

B. $-0.92V$

C. $+0.31V$

D. $0.85V$

Answer: A

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3. An acidic solution of copper (II) sulphate containing some contaiminations of zinc and iron (II) ions was electrolysed till all the copper is deposited. If electrolysis is further continued for sometime, the product liberated at cathode is

A. Fe

B. Zn

C. H_2

D. Alloy of Zn and Fe.

Answer: C

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4. Acetic acid is titrated with NaOH solution. Which of the following statement is correct for this titration?

A. Conductance increases upto equivalence point, then it decreases

B. Conductance increases upto equivalence point, then it increases

C. first conductance increases slowly upto equivalence point and then increases rapidly

D. first conductance increases slowly upto equivalence point ad then drops rapidly.

Answer: C

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5. Which statement is correct?

A. A solution of copper (II) sulphate can be stored in iron vessel.

B. An oxide layer on zinc vessel can be easily removed by washing with dilute HCl.

C. Molten $PbBr_2$ is good conductor of electricity because it contains free ions.

D. in the reaction $Li + \frac{1}{2}H_2 \rightarrow LiH$, hydrogen is a reducing agent.

Answer: C

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6. During the electrolysis of 0.1 M $CuSO_4$ solution using coppepr electrodes, a depletion of $[Cu^{2+}]$ occurs near the cathode with a corresponding excess near the anode, owing to inefficient stirring of the solution. If the local concentration of $[Cu^{2+}]$ near the anode and cathode are respectively 0.12 M and 0.08 M, calcualte the back emf developed. Temperature = 298 K.

A. 22 mV

B. 5.2 mV

C. 29 mV

D. 59 mV

Answer: B

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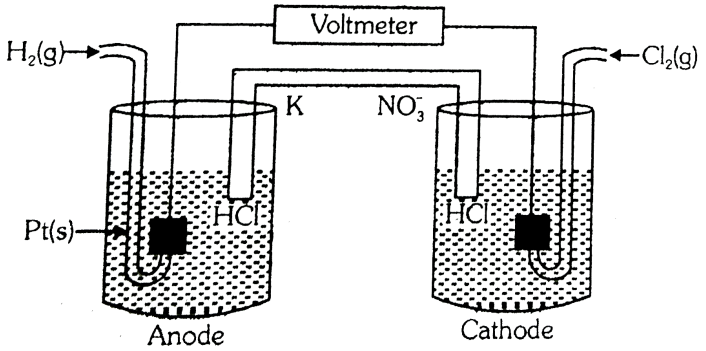
7. Consider the following Galvanic cell:-



By what value the cell voltage when concentration of ions in anodic and cathodic compartments both increased by factor of 10 at 298K:

A. $+0591$

B. -0.0591

C. -0.1182

D. 0

Answer: C

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8. $Pt|Cl_2(P_1 atm)|HCl(0.1M)|Cl_2(P_2 atm)|Pt$, cell reaction will be spontaneous if

A. $p_1 = p_2$

B. $p_1 > p_2$

C. $p_2 > p_1$

D. $P_1 = P_2 = 1 atm$

Answer: C

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9. $Pt\left|\begin{matrix}(H_2)\\1atm\end{matrix}\right.:\left|pH=2:|:|:pH=3\right|:\left.\begin{matrix}(H_2)Pt\\1atm\end{matrix}\right|:$. The cell reaction for the given cell is:-

A. spontaneous

B. non-spontaneous

C. Equilibrium

D. none of these

Answer: B

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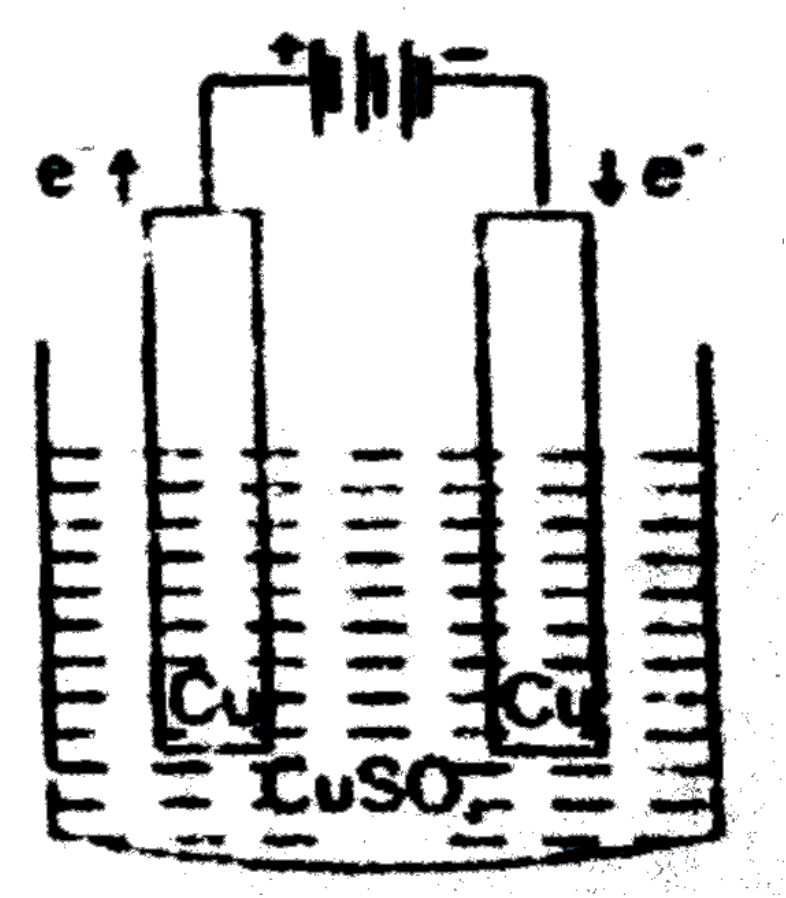
10. In the given figure the electrolytic cell contains $1L$ of an aqueous $1M$ Copper (II) sulphate solution. If 0.4 mole of electrons passed through of

cell, the concentration of copper ion after passage of the charge will be



A. 0.4 M

B. 0.8 M

C. 1.0 M

D. 1.2 M

Answer: C

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11. By how much will the potential of half-cell $Cu^{2+} \mid Cu$ change if the solution is diluted to 100 times at 298K?

A. increases b 59 mV

B. decreases by 59 mV

C. increases by 29.5 mV

D. decreases by 29.5 mV

Answer: B

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12. Which of the following facts is not truegt

A. If $E^{\circ}(M^{n+}/M)$ is negative, H^{+} will be reduced to H_2 by the metal M

B. If $E^{\circ}(M^{n+}/M)$ is positive Mn^{2+} will e reduced to M by H_2

C. In a cell M^{n+}/M electrode is attached to hydrogen-half cell. To produce spontaneous cell reaction, metal M will act as negative electrode.

D. Compounds of active metals (Zn, Na, Mg) are reducible by H_2 whereas those of noble metals (Cu, Ag, Au) are not reducible.

Answer: D

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13. Equivalent conductance of 1M CH_3COOH is $10 ohm^{-1}cm^2\text{equiv}^{-1}$ and that at inifinite dilution is 200 $ohm^{-1}cm^2\text{equiv}^{-1}$. Hence, % ionisation of CH_3COOJ is:

A. 5%

B. 2%

C. 4%

D. 1%

Answer: A

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14. Adding powdered Pb and Fe to a solution containing 1.0 M each of Pb^{2+} and Fe^{2+} ions would result into the formation of:

A. More of Pb and Fe^{2+} ions

B. More of Fe and Pb^{2+} ions

C. More of Fe and Pb

D. More of Fe^{2+} and Pb^{2+} ions

Answer: A

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

A. 2X

B. 4X

C. 16X

D. 32X

Answer: A

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16. The reaction :

$Zn(s) + 2AgCl(g) \rightarrow ZnCl_2(aq) + 2Ag(s)$

occurs in the cell $Zn \mid ZnCl_2$ (1M solution), AgCl(s) | Ag. The number of Faradays required from the external source for this reaction to occur in the cell is:

A. 2

B. 3

C. 1

D. zero

Answer: D

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17. If the pressure of hydrogen gas is increased from 1 atm. To 100 atm, keeping the hydrogen ion concentration constant at 1 M, the reduction potential of the hydrogen half cell is at $25^\circ C$ will be

A. 0.059 V

B. $-0.059V$

C. $0.295V$

D. $0.118V$

Answer: B

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18. The equilibrium $Cu^{+2}(aq) + Cu(s) \Leftrightarrow 2Cu^{+}$ established at $20^{\circ}C$ corresponds to $\frac{[Cu^{+2}]}{[Cu^{+}]} = 2.02 \times 10^{4+}$. The standard potential . $E^{0}_{Cu^{+2}.Cu} = 0.33$ volt at this temperature . What is the standard potential $E^{0}_{Cu\,/\,Cu^{+}}$?

A. -0.457

B. $-0.125V$

C. $-0.66V$

D. $-0.250V$

Answer: A

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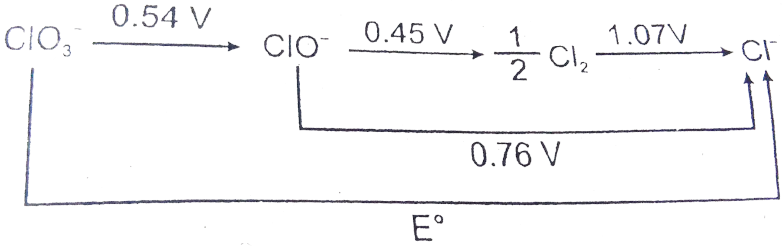

19.

The E° in the given figure is

A. 0.5

B. 0.6

C. 0.7

D. 0.8

Answer: B

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20. What is the cell entropy change (in JK^{-1}) of the following cell :

$$Pt(s)\left|H_2(g)\right|_{p=1atm}\left|CH_2COOH, HCl\right|_{0.1M}\left|KCl(aq)\right|_{0.1M}\left|Hg_2Cl_2(s)\mid Hg\right.$$

The EMF of the cell is found to be $0.045V$ at $298K$ and temperature coefficient if $3.4 \times x10^{-4}VK^{-1}$

(Given : $K_{a(CH_3COOH)} = 10^{-5}M$)

A. 60

B. 65.2

C. 69.2

D. 63.5

Answer: B

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21. $Na-$ amalgam is prepared by electrolysis of $NaCl$ solution using liquid Hg as cathode . How long should the current of $10amp.$ Is passed to produce $10\,\%\, Na-Hg$ on a cathode of $10gmHg.$ (atomic mass of $Na = 23$).

A. 7.77 min

B. 9.44 min

C. 5.24 min

D. 11.39 min

Answer: A

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22. Zn amalgam is prepared by electrolysis of aqueous $ZnCl_2$ using Hg cathode (9gm) How much current is to be passed through $ZnCl_2$ solution for 1000 seconds to prepare a Zn amalgam with $25\ \%$ Zn by wt. $(Zn = 65.4)$

A. 5.6 amp

B. 7.2 amp

C. 8.85 amp

D. 11.2 amp

Answer: C

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23. A solution containing one mole per litre each of $Cu(NO_3)_2$, $AgNO_3$, $Hg(NO_3)_2$ and $Mg(NO_3)_2$ is being electrolysed by using inerty electrodes. The values of the standard oxidation potentials in vlts are $Ag/Ag^+ = -0.8V$, $Ag/Hg^{2+} = -79V$, $Cu/Cu^{2+} = -0.34V$, $Mg/$

. The order in which metals will be formed at cathode will be-

A. Ag, Cu, Ag, Mg

B. Ag, Hg, Cu, Mg

C. Ag, Hg, Cu

D. Cu, Hg, Ag

Answer: C

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24. At 298 K the standard free energy of formation of $H_2O(l)$ is $-237.20k\frac{J}{\text{mole}}$ while that of its ionisation into H^+ ions and hydroxyl ions is $80k\frac{J}{\text{mole}}$, then the emf of the following cell at 298 K will be :

[Take 1F = 96500 C]

$H_2O(g, 1^-)|H^+(1M)||OH^-(1M)|O_2)(g, 1^-)$

A. 0.40 V

B. 0.81 V

C. 1.23 V

D. $-0.40V$

Answer: A

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25. Wlhich of the following cell can produce more electrical work?

A. $Pt, H_2|0.1NH_4Cl||0.1MCH_3COOH|H_2, Pt$

B. $Pt, H_2|0.1MHCl||0.1MNaOH|H_2, Pt$

C. $Pt, H_2|0.1MHCl||0.1MCH_3COOK|H_2, Pt$

D. $Pt, H_2|0.1MCH_3COOK||0.1MHCl|H_2, Pt$

Answer: D

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26. A hydrogen electrode is immersed in a solution with pH = 0 (HCl). By how much will the potential (reduction) change if an equivalent amount of NaOH is added to this solution?

(Take $p_{H_2=1atm}$ T=298K

A. increase by 0.41 V

B. increase by 59 mV

C. decrease by 0.41 V

D. decrease by 59 mV

Answer: C

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27. A current of 1.0 A was passed for 2 hr through a solution of cuprocyanide and 0.3745 g of copper was deposited on the cathode. Calculate the current efficiency for the copper deposition. $(Cu - 63.5)$

A. $79\ \%$

B. $39.5\ \%$

C. $63.25\ \%$

D. $63.5\ \%$

Answer: A

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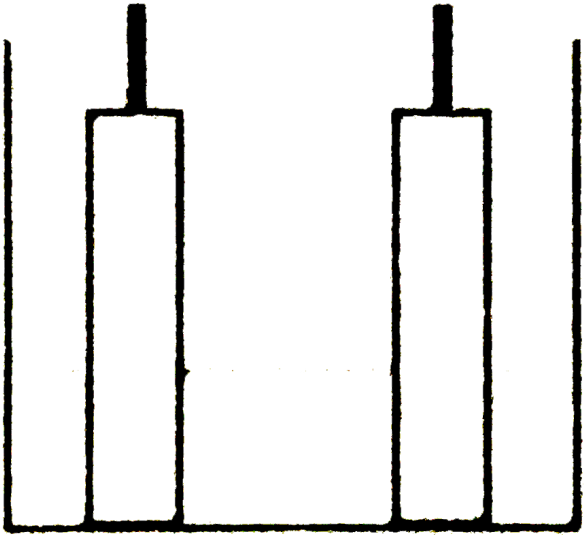
28. A resistance of 50Ω is registered when two electrodes are suspended into a beaker containing a dilute solution of a strong electrolyte such that exactly half of them are submerged into solution as shown in figure. If the solution is diluted by adding pure water (negligible conductivity) so as to just completely submerge the electrodes, the new ressitance offered by the solution would be: ltbegt



A. 50Ω

B. 100Ω

C. 25Ω

D. 200Ω

Answer: A

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29. Calcualte the cell EMP in mV for

$Pt|H_2(1atm)|HCl(0.01M)\ ||\ |AgCl(s)|Ag(s)$ at 298 K

If ΔG_f° values are at $25^\circ C$,

$-109.56\frac{kJ}{mol}f$ or $AgCl(s)$ and

$-130.79\frac{kJ}{mol}$ for $(H^+ + Cl^-(aq)$, Take 1F = 96500 C

A. $456mV$

B. $654mV$

C. $546mV$

D. none of these

Answer: A

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30. Calculate the value of Λ_m^{∞} for $SrCl_2$ in water at $25^{\circ}C$ from the following data :

$Conc.\ (mol/lt)$	0.25	1
$\Lambda_m(\Omega^{-1}cm^2mol^{-1})$	260	250

A. 270

B. 260

C. 250

D. 255

Answer: A

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

A. $1:1$

B. $1:2$

C. $2:1$

D. none of above

Answer: A

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32. Which of the following is not true about emf of a cell?

A. work calculated from it is not the maximum work obtainable from the cell

B. it is maximum voltage obtainable from the cell

C. it is the potential difference between two electrodes when no current is flowing in ciruict

D. it is responsible for the flow of steady current in the cell.

Answer: A

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

A. 3.74×10^{20}

B. 6.0×10^{23}

C. 7.48×10^{21}

D. 6.0×10^{20}

Answer: A

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34. By the electrolysis of aqueous solution of $CuSO_4$, the products obtained at both the inert electrodess are:

A. O_2 at anode and H_2 at cathode

B. H_2 at anode and Cu at cathode

C. O_2 at anode and Cu at cathode

D. $H_2S_2O_8$ at anode and O_2 at cathode.

Answer: C

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35. How many gm of silver will be displaced from a solution of $AgNO_3$ by 4gm of magnesium?

A. 18 gm

B. 4 gm

C. 4 gm

D. 2 gm

Answer: C

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36. The "mole"s of electrons required to deposit 1 gm equivalent aluminium (at wt. =27) from a solution of aluminium chloride will be:

A. 3

B. 1

C. 4

D. 2

Answer: A

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37. How many electrons flow when a current of 5 amperes is passed through a conductor for 200 seconds?

A. 6.214×10^{21}

B. 6.0241×10^{21}

C. 6.241×10^{22}

D. 6.0241×10^{22}

Answer: A

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38. A current of 9.95 amp following for 10 minutes, deposits 3 gm of a metal. Equivalent weight of the metal is:

A. 12.5

B. 18.5

C. 21.5

D. 48.5

Answer: D

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39. Which of the following has been universally accepted as a reference electrode at all temperature and has been assigned a value of zero volt?

A. platinum electrode

B. copper electrode

C. graphite electrode

D. standard hydrogen electrode.

Answer: D

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

A. 31.8 g

B. 16.0 g

C. 12.7 g

D. 63.5 g

Answer: C

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41. The specific conductance of a N/10 KCl at $25^\circ C$ is 0.0112 $ohm^{-1}cm^{-1}$. The resistance of cell contaiing solution at the same temperature was found to be 55 ohms. The cell contant will be:

A. $6.16cm^{-1}$

B. $0.616cm^{-1}$

C. $0.0616cm^{-1}$

D. $616cm^{-1}$

Answer: C

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42. Which of the following statements is true for an electrochemical cell of Cu-H_2?

A. H_2 is anode and Cu is cathode

B. H_2 is cathode and Cu is anode

C. reduction occurs at H_2 electrode

D. oxidation occurs Cu electrode.

Answer: A

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

A. $9.81g$

B. 1.32g

C. $4.56g$

D. $12.6g$

Answer: B

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44. A spoon to be electroplated with gold should be placed at:

A. cathode

B. anode

C. electrolyte

D. none of these

Answer: A

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45. Time required to deposit one milli"mole" of aluminium metal by the passage of 9.65 amp through aqueous solution of aluminium ion is:

A. 30 s

B. 10 s

C. 30,000s

D. 10,000s

Answer: B

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46. Which of the following statement is true for the electrochemical Daniell cell ?

A. electrons flows from copper electrode to zinc electrode.

B. Current flows from zinc electrode to copper electrode.

C. Cations moves towards copper electrodes.

D. cations moves towards zinc electrode.

Answer: C

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47. The chemical reaction

$2AgCl_{(\text{fused})} + H_{2(g)} \rightarrow 2HCl_{(aq)} + 2Ag_{(s)}$

taking place in a galvanic cell is represented by the notation

A. $Pt(s)|H_2(g), 1bar|1MKCl(aq)|AgCl(s)|Ag(s)$

B. $Pt(s)|H_2(g), 1bar|1MKCl(aq)|2MAg^+(aq)|Ag(s)$

C. $Pt(s)|H_2(g), 1bar|1MKCl(aq)|AgCl(s)|Ag(s)$

D. $Pt(s)|H_2(g), 1bar|1MKCl(aq)|Ag(s)|AgCl(s)$

Answer: B

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48. For the cell (at 298K)

$Ag(s)|AgCl(s)|Cl^-(aq) \mid |AgNO_3(aq)|Ag(s)$

Which of the following is correct?

A. The cell emf will be zero when $[Ag^+]_a = [Ag^+]_c$ ($[Ag^+]$ in anodic compartment $= [Ag^+]$ in cathode compartment)

B. The amount of $AgCl(s)$ precipitate in anodic compartment will decrease with the working of the cell.

C. The concentration of $[Ag^+] =$ constant, in anodic compartment during work of cell.

D. $E_{cell} = E^0_{Ag^+|Ag} - E^0_{Cl^-|AgCl|Ag} - \frac{0.059}{1}\log(\frac{1}{|Cl^-|_a})$

Answer: A

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49. During an electrolysis of conc. H_2SO_4 perdisulphuric acid $(H_2S_2O_6)$ and O_2 form in equimolar amount. The amount of H_2 than will form simultaneously at other electrode will be $(2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^+ + 2e^-)$

A. thrice that of O_2 in moles

B. twice that of O_2 in moles

C. equal to that of O_2 in moles

D. half of the of O_2 in moles

Answer: A

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50. The electric charge required for electrode deposition of one gram-equivalent of a substance is :

A. one amp/sec

B. 96500C/sec

C. one amp/hour

D. 96500C

Answer: D

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

A. H_2, O_2

B. O_2, H_2

C. O_2, Na

D. O_2, SO_2

Answer: A

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52. The standard oxidation potential E° for the half cell reactions are

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

$Fe \rightarrow Fe^{2+} + 2e^- E^\circ = +0.41V$

EMF of the cell reaction

$Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ will be

A. $-0.35V$

B. $+0.35V$

C. $+1.17V$

D. $-1.17V$

Answer: B

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53. The reaction

$$\frac{1}{2}H_2(g) + AgCl(s) \Leftrightarrow H^+(aq) + Cl^-(aq) + Ag(s)$$

occurs in the galvanic cell

A. $Ag|AgCl(s)|KCl(so\ln)AgNO_3(so\ln) \mid Ag$

B. $Pt|H_2(g)|HCl(so\ln)|AgNO_3(so\ln)|Ag$

C. $Pt|H_2(g)|HCl(so\ln)|AgCl(s)|Ag$

D. $Pt|H_2(g)|KCl(so\ln)|AgCl(s)|Ag$

Answer: C::D

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54. Choose the correct statement(s)

A. At the anode, the species havig minimum reduction potential is formed from the oxidation of correcsponding oxidizable species.

B. In highly alkaline medium, the anodic process during the electrolytic process is

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

C. The standard potential of $Cl^- | AgCl | Ag$ half-cell is related to that of $Ag^+ Ag$ through the expression

$$E^\circ_{Ag^+ | Ag} = E^\circ_{Cl^- | AgCl | Ag} + \frac{RT}{F} \ln K_{sp}(AgCl)$$

D. Compounds of active metals (Zn, Na, Mg) are reducible by H_2 whereas those of noble metals (Cu, Ag, Au) are not reducible.

Answer: A::B

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

Choose the correct statement(s).

A. $E_{M | M^{n+}}$ decrease with increase in $[M^{n+}]$

B. $E_{M^{n+}|M}$ increases on increasing temeperature.

C. $E_{M^{n+}|M}$ increases on increasing $[M^{n+}]$

D. $E_{M|M^{n+}}$ increases on increasing temperature.

Answer: A::B::C

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56. During the working of a galvanic cell and with the passage of time.

A. spontaneity of the cell reaction decreases, E_{Cell} decreases

B. reaction quotient Q decreases, E_{cell} increases

C. reaction quotient Q increases, E_{cell} decreases

D. at equilibrium $Q = K_c, E_{cell} = 0$

Answer: A::C::D

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57. Standard electrode potential are $E^{\circ}_{Fe^{2+}|Fe} = -0.44V$, $E^{\circ}_{Fe^{3+}|Fe^{2+}} = 0.77V$. If Fe, Fe^{2+} and Fe^{3+} are kept together, then

A. Fe^{3+} increases

B. Fe^{3+} decreases

C. Fe^{2+} increases

D. Fe^{2+} decreases

Answer: B::C

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58. In which of the following cell(s): $E_{\text{cell}} = E^{\circ}_{\text{cell}}$?

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

B. $Pt(H_2)pH = 1 \mid \left|Zn^{2+}(0.01M)\right|Zn(s)$

C. $Pt(H_2)|pH = 1\left|\left|Zn^{2+}(1M)\right|Zn(s)\right.$

D. $Pt(H_2)|H^+ = 0.1M||Zn^{2+}(0.01M)|Zn(s)$

Answer: A::B::D

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59. Which is/are correct among the following? Given the half cell EMFs

$E^{\circ}_{Cu^{2+}/Cu} = 0.337V$, $E^{\circ}_{Cu^{+}|Cu} = 0.521V$

A. Cu^{+1} disproportionates

B. Cu and Cu^{2+} comproportionates.

C. $E^0_{Cu|Cu^{+2}} + E^0_{Cu^{+1}|Cu}$ is positive

D. all of these

Answer: A::C

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60. When a solution of conductanes $1.342 mhom^{-1}$ was placed in a conductivity cell with parallel electrodes the resistance was found to be 170.5 ohm. The area of the electrode is 1.86×10^{-4} sq meter. Calculate the distance between the two electrodes in meter.

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61. The pK_{sp} of AgI is 16.07 if the E° value for Ag^{+}/Ag is $0.7991V$, find the E° for the half cell reaction $AgI(s) + e^{-} \rightarrow Ag + I^{-}$

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62. Voltage of the cell $Pt, H_2(1atm)|HOCN(1.3 \times 10^{-3}M)||Ag^{+}(0.8M)|Ag(s)$ is $0.982V$. Calculate the K_a for $HOCN$, neglect $[H^{+}]$ because of oxidation of $H_2(g)$

$Ag^{+} + e^{-} \rightarrow Ag(s) = 0.8V$

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63. K_d for dissociation of $[Ag(NH_3)_2]^+$ into Ag^+ and NH_3 is 6×10^{-8}. Calculae E° for the following half reaction.

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

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

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64. The resistance of an aqueous solution containing $0.624g$ of $CuSO_4.5H_2O$ per $100cm^3$ of the solution in a conductance cell of cell constant 153.7 per meter iss 520 ohms at 298K. Calculate the moalr conductivity. $(CuSO_4.5H_2O = 249.5)$

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65. Calculate the e.m.f. of the cell

$Pt|H_2(1.0atm)|CH_3COOH(0.1M)||NH_3(aq, 0.01M)|H_2(1.0atm)|Pt$

$K_a(CH_3COOH) = 1.8 \times 10^{-5}, K_b, (NH_3) = 1.8 \times 10^{-5}$

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66. Calculate the equilibrium concentration of all ions in an ideal solution prepared by mixing $25.00mL$ of $0.100MTI^+$ with $25.00mL$ of $0.200MCo^{3+}$

$E^\circ(TI^+/TI^{3+}) = -1.25V, E^\circ(Co^{3+}/Co^{2+}) = 1.84V$

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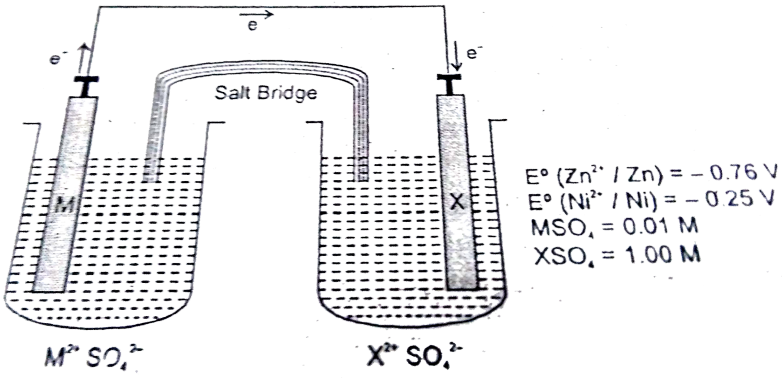
67.



The expermental setup for a typical $Zn - Ni$ galvanic cell as shown below in figure:

(a). Identify M and X and determine cell potential at $25^{\circ}C$

(b). If concentration of M^{2+} ion changes to 1.0 M during its usage, what would be the new cell voltage?

(c). Describe, what would happen to cell voltage if salt bridge was removed.

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

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69. 10g fairly concentrated solution of $CuSO_4$ is electrolyzed using $0.01F$ of electricity. Calculate:

(a) The weight of resulting solution

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

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70. An electric current is passed through electrolytic cells in series one containing $Ag(NO_3)$(eq) and other H_2SO_4 (aq). What volume of O_2 measured at $25^\circ C$ and 750mm Hg pressure would be liberated form H_2SO_4 if

(a) one mole of Ag^+ is deposited from $AgNO_3$ solution

(b) 8×10^{22} ions of Ag^+ are deposited from $AgNO_3$ solution.

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71. After electrolytes of NaCl solution with inert electrodes for a certain period of time 600 mL of the solution was left which was found to be 1N in NaOH. During the same time, 31.75 g of Cu deposited in the copper voltmeter in seris with the electrolytic cell. Calcualte the percentage yield of NaOH obtained.

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72. 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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73. The resistance of two electrolytes X and Y ere found to be 45 and 100 respectively when equal volumes of both the solutions were taken in the same cell in two different experiments. If equal volumes of these solutions are mixed in the same cell, what will be the conductance of the mixture?

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74. For $0.0128N$ solution fo acetic at $25^\circ C$ equivalent conductance of the solution is 1.4 mho cm^3eq^{-1} and $\lambda^\infty = 391$ mho cm^2eq^{-1}. Calculate dissociation constant (K_a) of acetic acid.

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75. Specific conductance of pure water at $25^\circ C$ is 0.58×10^{-7} mho cm^{-1}. Calculate ionic product of wter (K_w) if ionic conductances of H^+ and OH^- ions at infinite are 350 and 198 mho cm^2 respectively at $25^\circ C$

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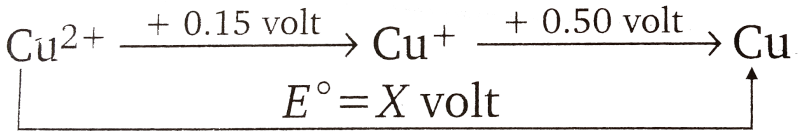
76. The reduction potential diagram for Cu in acid solution is :



Calculate X. Does Cu^+ disproportionate in solution ?

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77. For the cells in opposition,

Zn(s) | ZnCl_(2)(sol).|AgCl(s)|Ag|AgCl(s)|

$C-(1)=0.02M$, $ZnCl_2(sol)|$ Zn(s)

$C_2=0.5M$

Find out the emf (in millivolt) of the resultant cell. (take log 2 $=0.3$, $\frac{RT}{F}$ at 298 K = 0.060)

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78. At $Tl^+ \mid Tl$ couple was prepared by saturating 0.1 M KBr with TlBr and allowing the Tl^+ from the relatively insoluble bromide to equilibrate. This couple was observed to have a potential of -0443V with respect to $Pb6(2+) \mid Pb$ couple in which $Pb6(2+)$ was 0.1 M. What is K_{sp} of TlBr?

(Report answer in multiplication of 10^{-8})

$(E^{\circ}_{Pb^{2+}/Pb}=-0.126, (E^{\circ}_{Tl^+/Tl}=-0.336V)$

(Take antilog(0.5509) = 3.55, (2.303RT)/(F) = 0.059)

[Hint: Take Pb as anode]

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79. The following two cells with initial concentration as given are connected in parallel with each other ltbr (1). $Fe(s)|Fe(NO_3)_2(aq.)(1M)||SnCl_2(aq.)(1M)|Sn(s)$

(2). $Zn(s)ZnSO_4(aq.)(1M)\ ||\ |Fe(NO_3)_2(aq.)(1M)|Fe(s)$

After sufficient time equilibrium is estabilised in the circuit. What will be the concentrations (in mmoles/L) of Fe^{2+} ions in first and second cells respectively.

[Take

$E^0_{Sn^{2+}/Sn} = -0.14V, E^0_{Zn^{2+}/Zn} = -0.76V, E^0_{Fe^{2+}/Fe} = -0.44V, 2.3 \times$

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80. For the cell (at 1bar H_2 pressure) Pt|H_2(g) HX(m_(1), NaX(m_(2), NaCl(m_(3)|AgCl|Ag|Pt is found that the value of $E - E^\circ + RTF^{-1}$ in

$[\frac{m_{HX}.mCl^-}{m_{X^-}}]$ approaches 0.2814 in the limit of zero concentration. Calcualte K_a for the acid HX at $25^\circ C$ expressing your answer as 10^7K_(a)`

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81. A positive potential implies that the species under study has _____reduction tendency than that of _____into $H_2(g)$.

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82. In a galvanic cell, the half-cell having more standard potential serves as ___terminal and that having less standard potential serves as ___terminal.

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83. At 300 K specific conductivity of ethanol is $4 \times 10^{-10} mhocm^{-1}$. The ionic conductances of H^+, $C_2H_5O^-$ at his temperature is 300 and 100

$mhocm^2$ equivalent^{-1} respectively. Then the negative logarithm of ionic product of alcohol will be 18.

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84. Metallic sodium cannot be prepared from electrolysis of an aqueous solution of NaCl because the $SRPH_2O < SRPNa^+$

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85. The process of $AgCN + KCN \rightarrow K[Ag(CN)_2]$ involves the oxidation of Ag.

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86. Cations move towards cathode and anions towards anode in both galvanic and electrolytic cells.

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87. A positive half-cell potential implies that the element can lose its electrons more readily than hydrogen.

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88. Metallic anodes smore reactive than platinum tend to pass into the solution instead of O_2 being produced.

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