CHEMISTRY

BOOKS - CENGAGE CHEMISTRY (HINGLISH)

ELECTROCHEMISTRY

Illustration

1. Consider the following cell reaction

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

Given that

$E^{c-}\cdot_{Zn^{2+}(aq)Zn(s)} = -0.76V$

$E^{c-}\cdot_{Ag^{\oplus}(aq)Ag(s)} = 0.80V$

$a.$ Calculate the standard EMF fo the cell.

$b.$ Which ion is more powerful oxidizing agent ?

$c.$ Which metal is more powerful reducing agent ?

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2. Can a solution of $CuSO_4$ be stored in (a) zinc (Zn) pot, (b) silver (Ag) pot ?

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3. Construct a cell using given electrodes at $298K$ and also calculate its standart EMF.

Given : $E^{c-}\cdot_{Zn \mid Zn^{2+}} = 0.76V$

$E^{c-}\cdot_{Cu^{2+} \mid Cu} = 0.34V$

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4. If $E^{c-}\cdot\left(Ag \mid Ag^{\oplus}\right) = -0.8V$ and $E^{c-}\cdot\left(H_2 \mid 2H^{\oplus}\right) = 0V$, in a cell arrangement using these two electrodes, find $E^{c-}\cdot_{cell}$ and find out which electrode acts as anode and which acts as cathode.

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5. Calculate E^{C-} for each cell and write the equation for each cell precess.

Explaing the significance of any negative. E^{c-} value.

a. $Cd(s)\left|Cd^{2+}(1.0M)\right|\left|AgNO_3(1.0m)\right|Ag(s)$

b. $Fe(s)\left|FeSO_4(1.0M)\right|\left|ZnSO_4(1.0m)\right|Zn(s)$

c. $Pt, Cl_2(g)(1atm)|NaCl(1.0M)|Hg_2Cl_2(s) \mid Hg(s)$

Given $E^{c-}._{Cd} = -0.40V, E^{c-}._{(Fe)} = -0.41V, E^{c-}._{(Zn)} = -0.76V$

$E^{c-}._{(Ag)} = +0.80V, E^{c-}.\left(2Cl^{c-} \mid Cl\right) = -1.36V.$

$E^{c-}.\left(Hg \mid Hg_2Cl_2\right)$=-0.27V.`

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

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

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

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

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

The pair(s) of metals that is / are oxidized by NO_3^{c-} in aqueous solution is / are

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7. The following electrochemical cell is represented as :

$Pt(1)\left|Hg^{2+}, Hg_2^{2+}(a=1)\right|\left|Ce^{4+}, Ce^{3+}(a=1)\right|Pt(2)$

$a.$ If an ammeter is connected between two platinum electrodes, predict the direction of flow of current.

$b.$ Will the current decrease or increase with time?

Given : $E^{c-}\cdot_{2Hg^{2+} \mid Hg_2^{2+}} = 0.92V, E^{c-}\cdot_{Ce^{4+}/Ce^{3+}} = 1.61V$

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8. The following reaction : occurs in the dry cell, called flash light battery, which is used to power radios, clocks, and flashlights :

$2MnO_2(s) + 8\overset{\oplus}{NH_4} + Zn(s) \rightarrow 2Mn^{3+} + 8NH_3 + An^{2+} + 4H_2O$

$a.$ Write the anode and cathode reactions.

b. Calculate $E^{c-}\cdot_{cell}$ of the dry cell if the electrode potential of cathode $\left(E^{c-}\cdot_{reduction}\right)$ varies between $0.49V$ and $0.74V$ and that of anode $E^{c-}\cdot_{reduction}$ is $-0.76V$.

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9. Represent the cell in which following reaction takes place :

$Mg(s) + 2Ag^{\oplus}(0.0001M) \rightarrow Mg^{2+}(0.130M) + 2Ag(s)$ calculate its E_{cell} if $E^{c-}\cdot_{cell} = 3.17V$.

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10. Calculate the reduction potential of the following electrodes :

$a.\ Pt, H_2(4atm) \mid H_2SO_4(0.01M)$

$b.\ Pt, H_2(1atm) \mid HCl(0.2M)$

c. Calculate the potential of hydrogen electrode in contact with a solution whose

$ipH = 5 \quad ii. pOH = 4$

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11. Calculate the equilibrium constant of the reaction :

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

$E^{c-}{}_{\cdot cell} = 0.46V$

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12. The standard electrode potential for Deniell cell is $1.1V$. Calculate the standart Gibbs energy for the reaction.

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

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13. For the cell :

$Zn(s)\Big|Zn^{2+}(aM)\Big|\Big|Ag^{\oplus}(bM)\Big|Ag(s).$

$a.$ Write Nernst equation to show how E_{cell} vary with concentration of Zn^{2+} and $Ag^{\oplus}$ ions. Given

$E^{c-} \cdot \left(Zn^{2+} \mid Zn\right) = 0.76V, E^{-} \cdot \left(Ag^{\oplus} \mid Ag\right) = 0.80V.$

b. Find E_{cell} for $\left[Zn^{2+}\right] = 0.01M$ and $\left[Ag^{c-}\right] = 0.02M.$

c. For what values of Q will the cell EMF be

$i. 0.0V \quad ii. 0.97V$

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14. Calculate the potential of the following half - cells | cells :

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

Given : $E^{c-} \cdot_{Cr^{3+} \mid Cr} = -0.74V E^{c-} \cdot_{Fe^{2+} \mid Fe} = -0.44V$

$b.\ 6e^{c-} + BrO_3^{c-}(aq) + 3H_2O \rightarrow Br^{c-}(aq) + 6OH(aq)$

Given : $E^{c-} \cdot \left(BrO_3^{c-} \mid Br^{c-}\right) = 0.61V,$

$\left[BrO_3^{c-}\right] = 2.5 \times 10^{-3}M, \left[Br^{c-}\right] = 5.0 \times 10^{-3}M, pH = 9.0$

$c.\ Ag\left|Ag^{\oplus}(0.1M)\right|\left|Cl^{c-}(0.02M)\right|Cl_2(g)(0.5atm) \mid Pt$

Given $E\left(Ag^{\oplus} \mid Ag\right) = 0.80V, E^{c-}\left(\left(Cl_2 \mid 2Cl^{c-}\right) = 1.36V\right.$

$d.\ NO_3^{c-}(aq) + 2H^{\oplus}(aq) + e^{-} \rightarrow NO_2 + H_2O$

Given : $E^{c-} \cdot_{NO_3^{c-} \mid NO_2} = 0.78V$

What will be the reductino potential of the half cell in neutral solution ?

Assuming all the other species to be at unit concentration.

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15. The solution of $CuSO_4$ in which Cu ord is dipped is diluted to 10 times, the reduction electrode potential will :

$a.$ Decrease by $0.03V$ $b.$ Decrease by $0.059V$

$c.$ Increase by $0.03V$ $d.$ Increase by $-.059V$

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16. For the cell :

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

E_{cell} can be increased by

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

$c.$ Increasing $[Cu^{2+}]$ $d.$ $Increasingby$[TI^(o+)]`

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17. A zinc electrode is placed in $0.1M$ solution of $ZnSO_4$ at $25^{\circ}C$. Assuming salt is dissociated to the extent of 20% at this dilution. The potential of this electrode at this temperature is :

$\left(E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V\right)$

$a.\ 0.79V$ $.\ b.\ -0.79V$ $c.\ -0.81V.$ $d.\ 0.81V$

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18. If excess ofZn is added to $1.0M$ solution of $CuSO_4$, find the concentration of Cu^{2+} ions at equilibrium.

Given : $E^{c-}.\left(Zn^{2+} \mid Zn\right) = -0.76V$

$E^{c-}._{cell} = \left(E^{c-}.\left(Cu^{2+} \mid Cu\right) = 0.34V\right.$

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19. Find the reduction potential of $AsO_4^{3-} \mid AsO_2^{c-}$ in a solution when $18mL$ of $0.1N$ solution of NaI is added to $20mL$ of $0.1NNa_3AsO_4$ solution at $pH = 5$. The standard reduction potential of $AsO_4^{3-} \mid AsO_2^{c-} = -0.70V$.

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20. Calculate the potential of the following cell :

$$Pt(s)\left|\begin{matrix} Ce^{3+} & (2M) \\ Ce^{4+} & (1M) \end{matrix}\right|\left|\begin{matrix} Cr^{3+}(2M) & \\ Cr_2O_7^{2-}(1M) & H^{\oplus}(1M) \end{matrix}\right|Pt(s)$$

Given : $E^{c-}{}_{\cdot Ce^{3+} \mid Ce^{4+}} = -1.7, E^{c-}{}_{\cdot Cr_2O_7^{2-} \mid Cr^{3+}} = 1.3V$

(Take$0.059 \approx 0.06$)

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21. Explain the construction and working of Westron standard cell.

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22. The EMF of Westron standard cell is 1.0153 at $20\,^{\circ}C$ and 1.01807 at $25\,^{\circ}C$. CalculateΔG, ΔH, and ΔS for the cell reaction at $25\,^{\circ}C$.

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23. The EMF of the cell :

$Cd \mid CdCl_2($ solution $)(1atm)|AgCl(s)|Ag$ is 0.675 at $25^\circ C$. The temperature coefficient of the cell is -6.5×10^{-4} $degree^{-1}$. Find the change in heat content and entropy for the electrochemical reaction that occurs when $1F$ of electricity is drawn for it.

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

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

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25. Find K_c for the complex:

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

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

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26. The standard free energy of formation of $AgCl(s)$ at $25^{\circ}C$ is $-109.7kJmol^{-1}$ and $\left[H^{\oplus} + Cl^{c-}\right](aq)$ is $-131.2kJmol^{-1}$. Find E^{c-} of a cell up cells, with standard hydrogen electrode, and $Cl^{c-}|Ag|AgCl(s)$.

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27. The EMF of the following cellis $1.05V$ at $25^{\circ}C$:

$Pt, H_2(g)(1.0atm)|NaOH(0.1m), NaCl(0.1M)|AgCl(s), Ag(s)$

$a.$ Write the cell reaction,

$b.$ Calculate pK_w of water.

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

Given :

$E^{c-}\cdot\left(MnO_4^{c-} \mid Mn^{2+}\right) = 1.51V$

$E^{c-}\cdot\left(CO_2 \mid C_2O_4^{2-}\right) - 0.49V$

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29. Find the standard electrode potential of $MnO_4^{c-} \mid MnO_2$. The standard electrode potential of $MnO_4^{c-} \mid Mn^{2+} = 1.51V$ and $MnO_2 \left| MnO_2 \right| Mn^{2+} = 1.23V$.

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30. Find the EMF of the concentration cell represented as given below:

$$\underbrace{Pt, H_2(2\ atm)\,|\,H_2SO_4(0.01\,M)}_{Anode}\,||\,\underbrace{HCl(0.1\,M)\,|\,H_2(1\ atm), Pt}_{Cathode}$$

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31. Calculate the EMF of the following concentration cells a $30\,^{\circ}C$ and predict whether the cells are exergonic or endergonic. [Assume Kw does not chage at $30\,^{\circ}C$]

a. $Pt\left|H_2(g)(1atm)\right|H^{\oplus}\left(10^{-6}M\right)\left|\right|H^{\oplus}\left(10^{-4}M\right)\left|H_2(g)(1atm)\right|Pt$

b. $Pt\left|\right|Hg_2(1atm)\left|NaOH\left(10^{-4}M\right)\right|\left|H^{\oplus}\left(10^{-5}M\right)\right|H_2(g), (1atm)\ |\ Pt$

c. $Pt\left|H_2(g)(1atm)\right|H_2SO_4(0.05M)\left|\right|KOH\left(10^{-3}M\right)\left|H_2(g)(1atm)\right|Pt$

d. $Pt\left|H_2(g)(1atm)\right|CH_2COOH\left(10^{-2}M\right)\left|\right|CsOH\left(10^{-3}M\right)\left|H_2(g)(1atm)\right|Pt\left(pK_a ofC\right.$

e. $Pt|H_2(g)(1atm)|H_2O||HCl(10^{-3}M)|H_2(g)(1atm)|Pt$

f. $Pt|H_2(g)(1atm)||NH_4OH\ (10^{-2}M),\ pK_b = 4.74||RbOH\ (10^{-3}M)|H_2(g)(1atm)|Pt$

g. $Pt|H_2(g)(1atm)|CH_3COONa\ (10^{-1}M) + CH_3COOH\ (10^{-2}M),\ pK_a\ \text{of}\ CH_3COOH = 4.74||NH_4Cl(0.4M) + NH_4OH\ (0.2M),\ pK_b\ \text{of}\ NH_4OH = 4.74|H_2(g)(1atm)|Pt$

`f.

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32. Calculate the EMF of the following concentration cells at $30^\circ C$ and predict whether the cells are exergonic or endergonic.

a. $Pt \mid \underset{(1\,atm)}{H_2(g)} \mid \underset{\substack{(10^{-2}M) \\ pK_a \text{ of } CH_3COOH = 4.74}}{CH_3COONa} \mid \underset{\substack{pK_b \text{ of } NH_4OH \\ = 4.74}}{NH_4NO_3(0.2\,M)} \mid \underset{(1\,atm)}{H_2(g)} \mid Pt$

b. $Pt \mid \underset{(1\,atm)}{H_2(g)} \mid \underset{\substack{pK_a CH_3COOH = \\ pK_b \text{ of } NH_4OH = 4.74}}{CH_3COONH_4} \mid \underset{(10^{-3}M)}{CH_3COONa} \mid \underset{(1\,atm)}{H_2(g)} \mid Pt$

c. $Pt \mid \underset{(1\,atm)}{H_2(g)} \mid \underset{\substack{(0.1\,M) \\ pK_a = 4.74}}{CH_3COOH} \mid \underset{pK_b = 4.74}{NH_4OH(10^{-2}M)} \mid \underset{(1\,atm)}{H_2(g),} \mid Pt$

d. $Ag(s) \mid Ag^{\oplus}(0.1\,M) \parallel Ag^{\oplus}(1\,M) \mid Ag(s)$

e. $Pt \mid \underset{(1\,atm)}{Cl_2(g)} \mid Cl^{\ominus}(10^{-3}M) \parallel Cl^{\ominus}(10^{-2}M) \mid \underset{(1\,atm)}{Cl_2(g)} \mid Pt$

f. $Pt \mid \underset{2\,atm}{Cl_2(g)} \mid Cl^{\ominus}(10^{-3}M) \parallel Cl^{\ominus}(10^{-2}M) \mid \underset{(1\,atm)}{Cl_2(g)} \mid Pt$

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33. The *EMF* of the following cell is $0.180V$ at $30^{\circ}C$.

$$Pt(s) \mid \underset{(1\,atm)}{H_2(g)} \mid \underset{(100\,mL, 0.1\,M)}{HA} \parallel \underset{(0.05\,M)}{H_2SO_4} \mid \underset{(1\,atm)}{H_2(g)} \mid Pt(s)$$

Find EMF_{cell} when

$a.\ 40 mL of 0.2 M NaOH$ is added to the negative terminal of the battery .

$b.$ $50 mL$ of $0.2 M NaOH$ is added to the negative terminal of the battery .

$c.$ $50 mL$ OF $0.2 M NaOH$ is added to $100 mL$ of H_2SO_4 at the positive terminal of the battery.

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34. A hydrogen electrode placed in a solution containing CH_3COOK and CH_3COOH in the ration $a:b$ and $b:a$ has electrode potential values of -1.59 and $+1.0V,$ respectively. Calculate pK_a of $CH_3COOH.$

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35. Two buffer solutions A and B each made with benzoic acid and sodium benzoate differ in their pH by two units. A has salt: acid$a:b.$ B has salt: acid $= b:a.$ If $a > b$, then the value of $a:b$ is

$a.\ 3.17 \quad b.10.0 \quad c.3.0 \quad d.\ 6.0$

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36. Calculate the charge on mercurous ion and its magnetic moment. EMF of the cell given below is $0.0295V$ at $25^\circ C$.

$$Pt, Hg(l)\left|\begin{array}{l}0.01M mercurous\\ nitrate solution\\ in 0.1MHNO_3\end{array}\right|\left|\begin{array}{l}0.1M mercurous\\ nitrate solution in\\ 0.1MHNO_3\end{array}\right|Hg(l), Pt$$

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37. The quinhydrone electrode $\left(Q, H^{\oplus} \mid H^2Q\right)$ is used in conjunction with a saturated calomel electrode, as represented below:

$EMF_{cell} = 0.264V$ at $30^\circ C$. Calculate the pH of unknown solution at this temperature.

Given : $E_{calomel} = 0.24V$ and $E^{c-}._{2H^{\oplus}, Q \mid H_2Q} = 0.7V$

$$Hg(l), Hg_2Cl_2(s)\left|\begin{array}{l}\text{KCl (saturated}\\ \text{solution)}\end{array}\right|\left|\begin{array}{l}H^{\oplus}\\ \text{(Unknown)}\end{array}\right|Q, H_2Q, Pt$$

Calculate the pH of unknown

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38. Glass electrode || Buffer solution pH = ? | Standard calomel electrode

If the EMF of the above cell is $0.03V, E_{SCE} = 0.24V, E^{c^-}\cdot_{glass} = 0.51V,$ then calculate the pH of buffer solution at $30\,^{\circ}C$.

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39. For galvanic cell,

$Ag|AgCl(s), CsCl(0.1M)|\,\Big|CsBr\left(10^{-3}M\right), AgBr(s)\Big|Ag.$

Calculate the EMF generated and assign correct polarity to each electrode for spontaneous or exergonic process at $25\,^{\circ}C$.

Given $\therefore K_{sp}$ of $AgCl = 3.0 \times 10^{-10}, K_{sp}$ of $AgBr = 4.0 \times 10^{-13}$.

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40. EMF of the cell

$|Ag|AgNO_3(0.1M)\ |\ |KBr(1N), AgBr(s)|Agis - 0.6V$ at $298K$

$AgNO_3$ is $80\ \%$ and KBr is $60\ \%$ dissociated.

Calculate a. Solubility and

b. K_{sp} of $AgBr$ at $298K$.

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41. Estimate the E^{c-} reduction for $Cu\ |\ CuS$ electrode.

Given : K_{sp} of $CuS = 8.0 \times 10^{-36}, E^{c-}.\left(Cu \mid Cu^{2+}\right) = -0.34V$

A. -0.71V

B. 0.71V

C. -1.42V

D. 1.42V

Answer: A

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42. $1F$ of electricity is passed through $10L$ of a solution of aqueous solution of $NaCl$. Calculate the pH of the solution.

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43. A current strength of $96.5A$ is passed for $10s$ through $1L$ of a solution of $0.1M$ aqueous $CuSO_4$. Calculate the pH of the solution.

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

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45. In the electrolysis of $7.2L$ aqueous solution of $CuSO_4$, a current of $9.65A$ passed for 2 hours.

$a.$ Calculate the weight of Cu deposited at cathode.

$b.$ Calculate the volume of O_2 produced at anode at $27^\circ C$ and $1atm$ pressure.

$c.$ Calculate the pH of the solution after electrolysis.

[Atomic mass of $Cu = 63g$]

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46. How many grams of $Cl_2(g)$ can be produced by the electrolysis molten $NaCl$ with a current of $5.5A$ for $25min$? [Atomic weight of $Cl = 35.5amu$]

A. 3.017g

B. 3.017g

C.

D.

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47. What is the volume of O_{20} liberated at anode at STP in the electrolysis of $CdSO_4$ solution when a current of $2A$ is passed for $8min$?

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48. What weight of Ni is plated out in an electrolysis of aqueous $NiSO_4$ solution that it takes place to deposit $2G$ OF Ag in a silver coulometer that is arranged in series with $NiSO_4$ electrolytic cell. [Atomic weight of $Ag = 107.8amu$, atomic weight of $Ni = 58.7amu$]

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49. What is the amount of Al deposited on the electrolysis of molten Al_2O_3 when a current of $9.65A$ is passed for $10.0s$.

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50. Calculate the number of Faradays required to electrolyze $6.35g$ of $Cu^{\oplus}(aq)$ ions from an aqueous solution.

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51. $100mL$ of $0.3MFe^{3+}(aq)$ ions were electrolyzed by a charge of $0.072F$. In electrolysis, metal was deposited and $O_2(g)$ was evolved. At the end of electrolysis, it is desired to oxidize the un - electrolyzed metal ion.

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

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

The moles of Fe^{2+} ions left un - electrolyzed in the solution is

$a.\ 0.009 \quad b.0.021 \quad c.0.072 \quad d.0.042$

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52. Marshall's acid $\left(H_2S_2O_8\right)$ or peroxodisulphuric acid is prepared by the electrolytic oxidation of mmolH_2SO_4 as :

$2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^{\oplus} + 2e^-$

$O_2(g)$ and $H_2(g)$ are obtained as byproducts. In such electrolysis $4.48L$ of $H_2(g)$ and $1.12L$ or $O_2(g)$ were produced at STP. The weight of $H_2S_2O_8$ formed is

$a.\ 9.7g \quad b.19.4g \quad c.14.5g \quad d.29.1g$

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53. What volume of $0.2MFeSO_4$ can be oxidized by a current of 0.965 ampere hour?

A. 0.07 L

B. 0.08 L

C. 0.09L

D. 0.1 L

Answer: C

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54. $100 mL$of $1M$ solution of $CuBr_2$ was electrolyzed with a current of 0.965 ampere hour. What is the normality of the remaining $CuBr_2$ solution ?

a. 1.64 b.3.28 c.0.82 d.4.92

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55. In a $500 mL$ of $0.5 M CuSO_4$ solution, during electrolysis 1.5×10^{23} electron were passed using copper electrodes. Assume the volume of solution remains unchanged during electrolysis. Which of the following statements is/ are correect?

a. At the end of electrolysis, the concentration of the solution is $0.5M$.

b. $7.9 g$ of Cu is deposited on the cathode.

c. $4 g$ of Cu is dissolved from the anode.

d. $7.9 g$ of Cu ions are discharged.

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56. A Zn rod weighing $1.0g$ is taken in $100mL$ of $1MCuSO_4$ solution . After some time, $\left[Cu^{2+}\right]$ in solution $= 0.9M$(atomic weight of $Zn = 65.5g$). Which of the following statements is / are correct ?

a. $0.655g$ of Zn was lost during the reaction.

b. $0.327g$of Zn was lost during the reaction .

c. There is no change in the molarity of SO_4^{2-} ion.

d. There is a change in the molarity of SO_4^{2-} ion.

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57. A sodium salt of ternary acid of molybdenum (atomic mass $= 96$) has the formula Na_2MoO_n. When an acidified solution of Na_2MoO_n is electrolyzed, O_2 gas is liberated corresponding to a volume of $0.112L$ at STP and $0.32g$ of Mo is deposited. Find the formula of salt. .

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58. Calculate the quantity of electricity required to reduct $24.6g$ of nitrobenzene to aniline if the current efficiency is 75%. If the potential drop across the cell is $4.0V$, how much energy is consumed $(Mw$ of $C_6H_5NO_2 = 123gmol^{-1})$

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59. Find the volume of gases evolved by passing $0.1A$ of current for $965s$, through an aqueous solution of sodium succinate at $27^\circ C$ and $1atm$.

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60. A current strength of $1.0A$ is passed for $96.5s$ through $200mL$ of a solution of $0.05MKCl$. Find

$a.$ The amoudn of gases produced

$b.$ The concentration of final solution $w.r.t. \overset{c-}{OH}$ ions

$c.$ pH of the solution.

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61. $100mLCuSO_4(aq)$ 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 $0.04MNa_2S_2O_3$. 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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62. A current of $5.0A$ is passed through a $100L$ aqueous solution of sodium soccinate for $4.0h$. The gases produced at anode are collected separately at $25^\circ C$ and $1.0atm$ pressure. Find the volume of gases. Also find the pH of solution at the end of electrylysis . (Assume that at the start of electrolysis, pH of solution is 7.0 at $25^\circ C\big)$

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63. A lead storage cell is discharged which causes H_2SO_4 electrolyte to change from a concentration of 40% by weight (density $1.25gmL^{-1}C$ to one of 30% by weight. The original volume of electrolyte is $1L$. How many Faradays have left the anode of battery. Overall reaction of lead storage cell is : ltbr. $Pb(s) + PbO_2 + 2H_2SO_4(l) \rightarrow 2PbSO_4(s) + 2H_2O$

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64. The density of copper is $8.95gmL^{-1}$. Find out the number of coulombs needed to plate an area of $100cm^2$ to a thickness of $10^{-2}cm$ using $CuSO_4$ solution as electrolyte. (Atomic weight of $Cu = 63.5g$)

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65. What is the (i) volume of gases evolved at STP and $(ii)pH$ of solution on the electrolysis of $10L$ of the following solutions when $1F$ of electricity is passed :

$a.$ Aqueous solution of Na_2SO_4

$b.$ Aqueous solution of CH_3COONa

$c.$ Aqueous solution of $HCOOK$

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66. $18.97g$ fused $SnCl_{20}$ was electrolyzed using inert electrodes. $1.187gSn$ was deposited at cathode. If nothing is obtained during electrolysis, calculate the ration of weight of $SnCl_2$ and $SnCl_4$ in fused state after electrolysis.

Given :

Atomic weight of $Sn = 118.7$, $Mw$of $SnCl_2 = 189.7$, Mw of $SnCl_4 = 260.7$

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

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68. The electrical resistance of a column of $0.05 MNaOH$ solution of diameter $1cm$ and length $50cm$ is $5.55 \times 10^3 ohm$. Calculate its resistivity , conductivity, and molar conductivity.

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69. The resistance of $0.01N$ solution of an electrolysis is 210Ω at $298K$ with a cell constant of $0.88cm^{-1}$. Calculate the conductivity and equivalent conducitivty of the solution.

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70. The resistance and conductivity of $0.02MKCl$ solution are $82.4ohm$ and $0.002768Sch^{-1}$ respectively . When filled with $0.005NK_2SO_4$, the solution had a resistance of $324ohm$. Calculate :

a. Cell constant

b. Conductance of K_2SO_4 solution

c. Conductivity of K_2SO_4 solution

d. Equivalent conductivity of K_2SO_4 solution

e. Molar conductivity of K_{20SO_4} solution.

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71. The resistance of decinormal solution of a salt occupying a volume between two platinum electrodes $1.80cm$ apart and $5.4cm^2$ area was found to be $32ohm$. Calculate k and $\wedge_{eq}$.

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72. $\wedge_{eq}$ of $0.10N$ solution of CaI_2 is $100.0Scm^2eq^{-1}$ at $298K$. G^* of the cell $= 0.25cm^{-1}$. How much current will flow potential difference between the electrode is $5V$?

A. 0.4

B. 0.6

C. 0.2

D. 0.8

Answer: B

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

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74. Arrange the following compounds in the order of increasing conductance : $HCl, LiCl, NaCl, KCl$.

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75. Arrange the following compounds in the order of decreasing molar conductivity in aqueous solution.

$i. a. K\left[Co\left(NH_3\right)_2\left(NO_2\right)_4\right]$

$b. \left[Cr\left(NH_3\right)_3\left(NO_2\right)_3\right]$

$c. \quad \left[Cr\left(NH_3\right)_5\left(NO_2\right)\right]_3\left[Co\left(NO_2\right)_6\right]_2$

$d. \quad \left[Mg\left(Cr\left(NH_3\left(NO_2\right)_5\right]\right.\right.$

$ii. a. Li\left[Co\left(NH_3\right)_2\left(NO_2\right)_4\right] \quad b. \quad Na\left[Co\left(NH_3\right)_2\left(NO_2\right)_4\right]$

$c. K\left[Co\left(NH_3\right)_2\left(NO_2\right)_4\right] \quad d. \quad Cs\left[Co\left(NH_3\right)_2\left(NO_2\right)_4\right]$

$iii. a. Pt\left(NH_3\right)_6Cl_4 b. \quad Cr\left(NH_3\right)_6Cl_3$

$c. \quad Co\left(NH_3\right)_4Cl_3 \quad d. K_2PtCl_6$

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76. The molar conductivity of KCl solution at different concentrations at $298K$ is given below :

c or $M\left(molL^{-1}\right)$	$\wedge_m\left(Scm^2mol^{-1}\right)$
0.000198	148.61
0.000309	148.29
0.000521	147.81
0.000989	147.09

Show that a plot between $\wedge_m$ and $\sqrt{c}$ is a straight line. Determine the value of $\wedge_m^{\circ}$ and A for KCl.

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77. The conductivity (k) of a saturated solution of $AgBr$ at $298K$ is $8.5 \times 10^{-7} Scm^{-1}$. If $\lambda^{\circ}{}_{\cdot Ag^{\oplus}}$ and $\lambda^{\circ}{}_{\cdot Br^{c-}}$ are 62 and $78 Scm^2mol^{-1}$, respectively, then calculate the solubility and K_{sp} of $AgBr$.

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

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

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

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

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

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

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81. The molar conductivity of acetic at infinite dilution is 390.7 and for $0.01M$ acetic acid is $3.9.7 Scm^2 mol^{-1}$. Calculate $(a)\alpha$ and $(b)pH$ of solution.

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82. The ionic equivalent conductivities of $C_2O_4^{2-}, K^{\oplus}$, and $Na^{\oplus}$ ions are x, y, and $zScm^2Eq^{-1}$ respectively. Calculate $\wedge_{eq}^{\circ}$ of $(NaOOC - COOK)$.

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83. The ionic molar conductivities of $C_2O_4^{2-}, K^{\oplus}$, and $Na^{\oplus}$ ions are x', y', and $z' Scm^2mol^{-1}$, respectively. Calculate $\wedge_m^{\circ}$ and $\wedge_{eq}^{\circ}$ of $(NaOOC - COO)$

.

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84. The ionic equivalent conductivities of $K^{\oplus}, Al^{3+}$, and SO_4^{2-} ions are x, y, and $zScm^2Eq^{-1}$, respectively. Calculate $\wedge_m^{\circ}$ and $\wedge_{eq}^{\circ}$ for $\left(K_2SO_4.Al_2\left(SO_4\right)_3.24H_2O\right)$(Potash alum).

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85. From the following molar conductivities at infinite dilution :

$\wedge_m^\circ$ for $Ba(OH)_2 = 457.6\Omega^1 cm^2 mol^{-1}$

$\wedge_m^\circ$ for $BaCl_2 = 240.6\Omega^{-1} cm^2 mol^{-1}$

$\wedge_m^\circ$ for $NH_4Cl = 129.8\Omega^{-1} cm^2 mol^{-1}$

Calculate $\wedge_m^\circ$ for NH_4OH.

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Solved Examples (Electrochemical Cell)

1. Calculate EMF of the following half cells :

$a. Pt, H_2(2atm) \mid HCl(0.02M) \quad E^{c-} = 0V$

$b. Pt, Cl_2(10atm) \mid HCl(0.1M) \quad E^{-c} = 1.36V$

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2. Calculate pH of the half cell :

$Pt, H_2(1atm) \mid H_2SO_4 \quad E^0 = -0.3V$

A. 2

B. 5

C. 10

D. 1

Answer: B

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

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

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4. Given :

$NO_3^{c-} \rightarrow NO_2($ acidic medium $)$, $E^{c-} = 0.8V$

$NO_3^{c-} \rightarrow NO_3OH($ acidic medium $)$ $E^{c-} = 0.74V$

At what pH the above two half reactions will have same EMF values ? Assume the concentration of all the species to be unity. (Take $0.059 \approx 0.06)$

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5. The standard potential of a cell using the reaction

$$2Ni(s) + O_2 + 2H_2O \rightleftharpoons 2Ni(OH)_2$$

is 1.12. The heat of the reaction is $-504.2kJmol^{-1}$ at $25^{\circ}C$. Calculate the entropy change.

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6. The standard potential of a cell using the reaction

$2MnO_4^{\ominus}(aq) + 3Hg(l) + H_2O \rightleftharpoons 2MnO_2(s)$

$+3HgO(s) + 2\left(\overset{c-}{OH}\right)(aq)$ is $0.489V$ at $25^{\circ}C$. What is the equilibrium constant of the reaction ?

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7. The EMF of the cell :

$Ag|AgCl, 0.1MKCl\|0.1MAgNO_3|Ag$ is $0.45V$. $0.1MKCl$is 85% dissociated and $0.1MAgNO_3$ is 82% dissociated. Calculate the solubility product of $AgCl$ at $25^{\circ}C$.

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8. Calculate the potential corresponding to the following cell. Given

$Pt|Co^{2+}(2.0M), Co^{3+}(0.01M)\|Cr^{3+}(0.5M), Cr_2O_7^{2-}(4.0M), H^{\oplus}(1.5M)|Pt$

$E^{c-}\cdot_{Co^{2+} \mid Co^{3+}} = -1.82V$

$E^{c-}\cdot_{Cr_2O_7^{2-} \mid Cr^{3+}} = +1.33V$

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9. Estimate the standard reduction potential for the copper / copper sulphide electrode. For $CuS, K_{sp} = 8.5 \times 10^{-36}, E^{c-}\cdot_{Cu \mid Cu^{2+}} = -0.34V.$

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10. Knowing that K_{sp} for $AgCl$ is 1.0×10^{-10}, calculate E for a silver / silver chloride electrode immersed in $1.00MKCl$ at $25^{\circ} C. E^{c-}\cdot_{Ag^{\oplus} \mid Ag} = 0.799V.$

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11. Consider the following half reactions :

$PbO_2(s) + 4H^{\oplus}(aq) + SO_4^{2-} + 2e^- \rightarrow PbSO_49s\big) + 2H_2O \quad E^{c-} = +1.70V$

$PbSO_4(s) + 2e^- \rightarrow Pb(s) + SO_4^{2-}(aq) \quad E^{c-} = -0.31V$

a. Calculate the value of E^{c-} for the cell.

b. Calculate the voltage generated by the cell if $\left[H^{\oplus}\right] = 0.10M$ and $\left[SO_4^{2-}\right] = 2.0M$

c. What voltage is generated by the cell when it is at chemical equilibrium ?

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12. The EMF of the cell

$Ag\left|0.1(N)AgNO_3\right||1(N)KBr, AgBr(s)|Ag$ was found to be $-0.64V$ at $298K$. $0.1NAgNO_3$ is 81.3% dissociated and $1NKBr$ is 75.5% dissociated.

Calculate :

a. Solubility

b. Solubility product of $AgBr$ at $298K$

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13. For the cell $Zn\left|ZnCl_2(m)\right|AgCl, E$ is $1.24V$ at $25\,^{\circ}C$ and $1.260V$ at $35\,^{\circ}C$ of $m = 10^{-3}$. Write down the cell reaction and calculate $\Delta G, \Delta H,$ and ΔS at $25\,^{\circ}C$.

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14. A saturated calomel electrode is coupled through a salt bridge with a quinhydrone electrode dipping in $0.1MNH_4Cl$. The observed EMF at $25\,^{\circ}C$ is $0.152V$. Find the dissociated constant of NH_4OH. The oxidation potential of saturated calomel electrode $= -0.699V$ at $25\,^{\circ}C$.

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15. 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 $\left(1atm \text{ and } 25\,^{\circ}C\right)$ and are interconnected through a salt bridge. Find the EMF of the cell.

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16. Find the solubility of $AgCl$ in $0.1 MCaCl_2$. $E^{c-}{}_{Ag^{\oplus} | Ag} = 0.799V$ and that of $AgCl \mid Ag = 0.222V$.

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17. The EMF of the cell :

$Ag \left| Ag_2CrO_4(s), K_2CrO_4(0.1M) \right|\left| AgNO_3(0.1M) \right| \mid Ag$ is $206.5mV$. Calculate the solubility of Ag_2CrO_4 in $1MNa_2CrO_4$ soluion.

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18. The EMF of a galvanic cell $Pt \left| H_2(1atm) \right| HCl(1M) \left| Cl_2(g) \right| Pt$ is $1.29V$. Calculate the partial pressure of$Cl_2(g)$. $E^{c-}{}_{Cl_2 | Cl^{c-}} = 1.36V$.

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19. Calculate the potential of silver electrode in a saturated solution of $AgBr\left(K_{sp} = 6 \times 10^{-13}\right)$ containing $0.1 M KBr$. $E^{c-}{}_{Ag^{\oplus} \mid Ag} = 0.80V$.

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20. A solution of Fe^{2+} is titrated potentiaometrically using Ce^{4+} solution . Calculate the EMF of the redox electrode thus formed when

a. 50% of Fe^{2+} is titrated

b. 90% of Fe^{2+} is titrated

c. 110% titration is done

Given : $E^{c-}{}_{Fe^{2+} \mid Fe^{3+}} = -0.77V$ and $Fe^{2+}Ce^{4+} \rightarrow Fe^{3+} + Ce^{3+}, K = 10^{14}$

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21. Find the EMF of the cell at $25^{\circ}C$.

Decinormal calomel electrode | Buffer pH = 3.5 | Quinhydrone electrode

$E^{c-}{}_{red}$ (quinhydrone electrode) $= 0.699V$

$E^{c-}{}_{red}$ (calomel electrode) $= +0.268V$

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22. The EMF of the following cell is found to be $-0.46V$:

$$\text{Pt, H}_2 \left| \begin{matrix} \text{NaHSO}_4 \\ (0.4\text{ M}) \end{matrix} \right| \begin{matrix} \text{Na}_2\text{SO}_4 \\ (6.44 \times 10^{-3}\text{ M}) \end{matrix} \left\| \begin{matrix} \text{Zn}^{+2} \\ (0.3\text{ M}) \end{matrix} \right| \text{Zn}$$

If the standard electrode potential of Zince Is $-0.763V$, find the value of K_2

for H_2SO_4, where $K_2 = \dfrac{\left[H^{\oplus}\right]\left[SO_4^{2-}\right]}{\left[HSO_4^{c-}\right]}$

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23. The EMF of the following cell is observed to be $0.118V$ at $25^{\circ}C$:

$$\begin{matrix} \text{Pt, H}_2 \\ (1\text{ atm}) \end{matrix} \left| \begin{matrix} \text{HA} \\ (100\text{ mL of }0.1\text{ M}) \end{matrix} \right| \begin{matrix} \text{H}^{\oplus} \\ (0.1\text{ M}) \end{matrix} \left| \begin{matrix} \text{H}_2\text{,Pt} \\ (1\text{ atm}) \end{matrix} \right.$$

If $30mL$ of $0.2MNaOH$ is added to the negative terminal of the battery, find the EMF of the cell.

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24. Find the standard electrode potential of $I_2 \mid 2I^{c-}$ if the equilibrium constant for the reaction $I_2 + I^{c-} \rightarrow {}_3^{c-}$ is 703. The standard electrode potential of $I_3^{c-} \mid 3I^{c-}$ is $0.5355V$. Also give the electrode reaction.

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25. A silver electrode dipping in $AgNO_3$ solution $(0.1M)$ is combined salt bridge with a hydrogen electrode dipping in a solution of $pH = 3\left(at25^{\circ}C\right)$. If the standard reduction potential of the silver electrode is $0.799V$, what is the EMF of the cell ?

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26. The EMF of a galvanic cell composed of two hydrogen electrodes is $177mV$. If the solution at one of the electrode has $\left[H^{\oplus}\right] = 10^{-3}$, find the $\left[H^{\oplus}\right]$ at the other electrode.

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27. The EMF of the cell :

$Pt\left|Ce^{4+}(90\%), Ce^{3+}(10\%)\right|$ Normal calomel electrode is $1.464V$ at $25^{\circ}C$. Find the value of equilibrium constant of the reaction :

$2Ce^{3+} + 2H^{\oplus} \rightarrow 2Ce^{4+} + H_2$

The electrode potential of the normal calomel electrode is $+0.28V$.

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28. A hydrogen electrode placed in a buffer solution of sodium cyanide and HCN in the ration of $x:y$ and $Y:x$ has electrode potential value a and

b volts, respectively, at $25\,^{\circ}C$. If the difference $a - b = 35.52mV$, what is the ratio of $y : x$.

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

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

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

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

Given : $E^{c-}.\left(Ag^{\oplus} \mid Ag\right) = 0.799$

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

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

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30. Predict whether or not Cl_2 would disproportionate in cold alkaline medium. The standard reduction potentials of$Cl_2 \mid Cl^{c-}$ and $ClO^{c-} \mid Cl_2$ are $1.36V$ and $0.40V$, respectively.

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31. What would be the electrode potential of a silver electrode dipped in a saturated solution of $AgCl$ in contact with $0.1 MKCl$ solution at $25\,^{\circ}C$?

$E^{c-}\cdot_{Ag^{\oplus} \mid Ag} = 0.799V$

K_{sp} of $AgCl = 1 \times 10^{-10}$

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32. E^{c-} of some elements are given as :

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

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

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

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

$a.$ Select the stronges reductant and weakes oxidant among these elements.

$b.$ Select the weakest reductant and strongest oxidant among these elements.

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33. Select the spontaneous rreactions from the changes given below

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

$b. 2Fe^{2+} = I_2 \rightarrow 2Fe^{3+} + 2I^{c-}$

$c. Sn^{4+} + 2I^{c-} \rightarrow Sn^{2+} + I_2$

$d. Sn^{2+} + I_2 \rightarrow Sn^{4+} + 2I^{c-}$

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34. Two metals M_1 and M_2 have $E^{c-}._{red} = -0.76V$ and $0.80V$, respectively. Which will liberate $H_2(g)$ from H_2SO_4 ?

Given :

$M_1^{n+} + ne^- \rightarrow M_1 \qquad E^{c-}._{red} = -0.76V$

$M_2^{n+} + ne^- \rightarrow M_2 \qquad E^{c-}._{red} = 0.80V$

$2H^{\oplus} + 2e^- \rightarrow H_2(g) \qquad E^{c-}._{red} = 0.0V$

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35. Determine whether $O_2(g)$ can oxidize sulphate $\left(SO_4^{2-}\right)$ ion to peroxodisulphate $\left(S_2O_8^{2-}\right)$ ion or not in an acidic solution with $O_2(g)$ being reduced to water.

Given : $E^{C-}{\cdot}_{O_2 \mid H_2O} = 1.20V$ and $E^{C-}{\cdot}_{S_2O_8^{2-} \mid 2SO_4^{2-}} = 2.0V$

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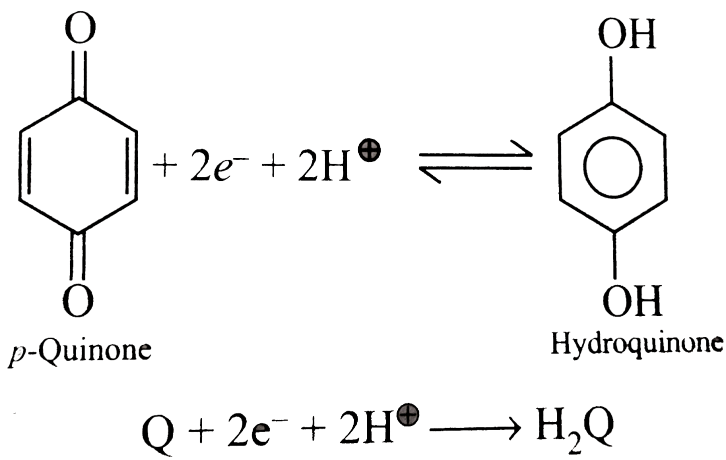
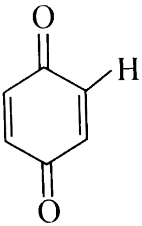
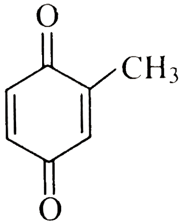
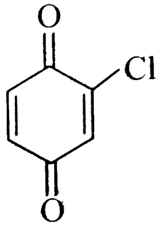
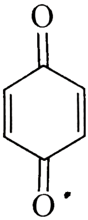
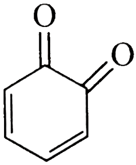
36. Quinones are good electron acceptors, party because reduction restores aromaticity.

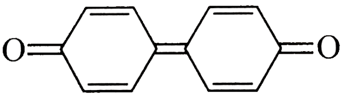


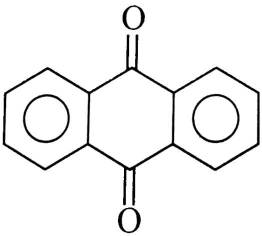
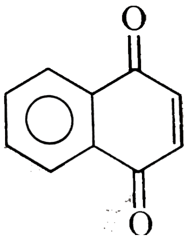
$Q + 2e^- + 2H^{\oplus} \rightarrow H_2Q$

Give the decreasing order of $E^{c-}{}_{\cdot reduction}$ of the following quinones :

a. I.  II.  III. 

b. I.  II. 

III. 

c. I.  II. 

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Solved Examples(Electrolysis And Electrolytic Cells)

1. Express each of the following combinations of electrical units as a single unit :

a. Volt - ampere

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2. A resistance heater was wound around a $5.0g$ metallic cylinder. A current of $0.84A$ was passed through the heater for $20s$ while the drop in voltage across the heater was $50V$. The temperature change of the cylinder was from $25\,^{\circ}C$ before the heating period and $35\,^{\circ}C$ at the end. If the heat loss is neglected, what is the specific heat of the cylinder metal in $calg^{-1}K^{-1}$.

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3. In a zinc manganese dioxide dry cell, the anode is madeup of $Zn1$ and cathode of carbon rod surrounded by a mixture of MnO_2, carbon, NH_4Cl, and $ZnCl_2$ in aqueous base. The cathodic reaction is :

$ZnMnO_2(s) + Zn^{2+} + 2e^- \rightarrow ZnMn_2O_4(s)$

$8.7g$ of MnO_2 is taken in the cathodic compartment. How many days will the dry cell continue to give a current of $9.65 \times 10^{-3}A$? (Atomic weight of $Mn = 55)(Mw$ of $MnO_2 = 87gmol^{-1}\Big)$

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

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

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

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5. A constant current was flowen for $1min$ through a solution of Kl . At the end of experiment, liberated I_2 consumed $150mL$ of $0.01M$ solution of $Na_2S_2O_3$ following the reaction :

$$I_2 + 2S_2O_3^{2-} \rightarrow 2I^{c-} + S_4O_6^{2-}$$

What was the average rate of current flow in ampere ?

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6. Aqueous solution of m - dinitroso benzene was electrolyzed for 2 hors passing current of $2A$ with efficiency of 90% . Calculate the amound of 3 - aminoaniline.

$$\left(Mw = 108gmol^{-1}\right)$$

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7. A 35% solution of $LiCl$ was electrolyzed by using a $2.5A$ current for $0.8h$. Assuming the current efficiency of 90% , find the mass of $LiOH$ produced at the end of electrolysis. (Atomic mass of $Li = 7$)

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8. A current of $10A$ is employed to plate nickel in $NiSO_4$ bath. The current efficiency with respect to Ni plating is 60%.

$a.$ How many grams of Ni is plated on the cathode per hour ?

$b.$ What is the thickness of the plating if the cathode consists of a sheet of metal $4.0cm^2$ which is coated on both faces ?

$c.$ What is the volume of $H_2(STP)$ evolved during above electrolysis ?

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9. A certain amount of charge is passed through acidulated water. A total of $504mL$ of hydrogen and oxygen were collected at STP. Find the magnitude of charge that is passed during electrolysis in coulombs.

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10. During the electrolysis of water, a total volume of $33.6mL$ of hydrogen and oxygen gas was collected at STP. Find the amound of electricity that passed during electrolysis.

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11. During an electrolysis of conc H_2SO_4, perdisulphuric acid $\left(H_2S_2 \_ (8)\right)$ and O_2 are formed in equimolar amount. The moles of H_2 that will be formed simultaneously will be

A. Thrice that of O_2

B. Twice that of O_2

C. Equal to that of O_2

D. Half of that of O_2

Answer: A

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12. A current of $1.0A$ is passed for $96.5s$ trhough a $200mL$ solution of $0.05MLiCl$ solution. Find

a. The volume of gases produced at STP

b. The pH of solution at the end of electrolysis

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Ex 3.1 (Objective)

1. If the temperature coefficient of EMFif $-0.125VK^{-1}$, ΔS for the given cell at $25^\circ C$ is :

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

A. $-26.125kJK^{-1}$

B. $-24.125kJK^{-1}$

C. $-22.125kJK^{-1}$

D. $-20.125kJK^{-1}$

Answer: b

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2. Which of the following is (are) function (s) of salt bridge ?

A. It completes the electrical circuit with electrons flowing from one electrode to other through wires and flow of ions between the two compartments through salt bridge.

B. It prevents the accumulation of the ions.

C. Both (a) and (b)

D. None of the above.

Answer: C

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3. $Cu^{2+} + 2e^{-} \rightarrow Cu$. On increasing $\left[Cu^{2+}\right]$, electrode potential

A. Increases

B. Decreases

C. No change

D. First increases, then decreases

Answer: a

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4. Consider the following E° values . $E_{Fe^{3+}/Fe^{2+}}{}^{\wedge}\circ = +0.77V$'

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

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

A. $-0.58V$

B. $-0.30V$

C. $+0.30V$

D. $+0.58V$

Answer: c

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5. E^{c-} of some elements are given as :

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

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

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

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

$a.$ Select the stronges reductant and weakes oxidant among these elements.

$b.$ Select the weakest reductant and strongest oxidant among these elements.

A. Zn

B. Cr

C. H_2

D. Fe

Answer: a

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6. For hydrogen oxygen fuel cell with reaction

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

$\Delta G_f^{c-}\left(H_2O\right) = -237.2 kJmol^{-1}$. Hence, EMF of the fuel cell is

A. $+2.46V$

B. $-2.46V$

C. $+1.23V$

D. $-1.23V$

Answer: c

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7. A metal - insoluble salt electrode consists of

A. A piece of metal placed in a solution containing a sparingly soluble salt.

B. Crystals of an insoluble salt coated with a metal.

C. A piece of metal coated with one of its insoluble salts.

D. A metal fixed with an insoluble salt at high temperature.

Answer: c

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8. Which of the following is the most powerful reducing agent ?

A. F^{c-}

B. Cl^{c-}

C. Br^{c-}

D. I^{c-}

Answer: d

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9. If all species are in their standard states, which of the following is the strongest oxidizing agent ?

A. Br^{c-}

B. Zn^{2+}

C. CO^{3+}

D. Fe^{2+}

Answer: c

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10. The standard EMF of a galvanic cell involving cell reaction with $n = 2$ is found to be $0.295V$ at $25\ ^\circ C$. The equilibrium constant of the reaction would be

A. 4.0×10^{12}

B. 1.0×10^{2}

C. 1.0×10^{10}

D. 2.0×10^{11}

Answer: c

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11. The correct order of reactivity of K, Mg, Zn and Cu with water according to the electrochemical series is

A. $K > Mg > Zn > Cu$

B. $Mg > Zn > Cu > K$

C. $K > Zn > Mg > Cu$

D. $Cu > Zn > Mg > K$

Answer: a

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12. For $Pt(H_2) \mid H_2O$, reduction potential at $298K$ and $1atm$ is :

A. $-0.23V$

B. $-0.41V$

C. $0.41V$

D. $0.00V$

Answer: b

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13. Consider the cell :

$$Pt\left|H_2(p_1atm)\right|H^{\oplus}(x_1M) \mid \left|H^{\oplus}(x_2M)\right|H_2(p_2atm)Pt.$$

The cell reaction 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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14. If $E^{c-}{}_{\cdot Fe^{3+} | Fe}$ and $E^{c-}{}_{\cdot Fe^{2+} | Fe}$ are $= -0.36V$ and $-0.439V$, respectively, then the value of $E^{c-}{}_{\cdot Fe^{3+} | Fe^{2+}}$

A. $3x_2 - 2x_1$

B. $x_2 - x_1$

C. $x_2 + x_1$

D. $2x_2 + 3x_2$

Answer: a

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15. $Pt\left(Cl_2\right)\left(p_1\right)|HCl(0.1M)|\left(Cl_2\right)\left(p_2\right), Pt$ cell reaction will be endergonic if

A. $p_1 = p_2$

B. $p_1 > p_2$

C. $p_2 > p_1$

D. $p_1 = 1atm$

Answer: c

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16. Consider the following cell with hydrogen electrodes at difference pressure p_1 and p_2.

$$\text{Pt}, H_2(p_1) \,\Big|\, \underset{1\,M}{H^{\oplus}(aq)} \,\Big|\, H_2(p_2), \text{Pt}$$

The EMF of the cell is given by

A. $\frac{RT}{F}\ln.\frac{p_1}{p_2}$

B. $\frac{RT}{2F}\ln.\frac{p_1}{p_2}$

C. $\frac{RT}{F}\ln.\frac{p_2}{p_1}$

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

Answer: b

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17. Consider the following cell reaction

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

Given that

$E^{c-} \cdot_{Zn^{2+}(aq)Zn(s)} = -0.76V$

$E^{c-}{}_{\cdot Ag^{\oplus}(aq)Ag(s)} = 0.80V$

$a.$ Calculate the standard EMF fo the cell.

$b.$ Which ion is more powerful oxidizing agent ?

$c.$ Which metal is more powerful reducing agent ?

A. $x + 2y$

B. $2x + y$

C. $y - x$

D. $y - 2x$

Answer: c

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18. The standard reduction potentials of three metals $A, B,$ and C are $+0.5V, -3.0V,$ and $-1.2V$, respectively. The order of reducing power of these metals is

A. $B > C > A$

B. $A > B > C$

C. $C > B > A$

D. $A > C > B$

Answer: a

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19. Calculate the maximum work that can be obtained from the decimolar Daniell cell at $25^{\circ} C$.

Given $E^{c-}.\left(Zn^{2+} \mid Zn\right) = -0.76V$ and $E^{c-}.\left(Cu^{2+} \mid Cu\right) = 0.34V$

A. $193.0kJ$

B. $212.3kJ$

C. $81.06kJ$

D. $40.53kJ$

Answer: B

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20. Stronger the oxidizing agent, greater is the

A. Standard reduction potential

B. Standard oxidation potential

C. Ionic nature

D. None

Answer: a

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21. Consider the cell $Ag(s)\left|AgBr(s)Br^{c-}(aq)\right|\left|AgCl(s), Cl^{c-}(aq)\right|Ag(s)$ at 298K. The K_{sp} of $AgBr$ and $AgCl$, respectively are 5×10^{-13} and 1×10^{-10}. At what ratio of $\left[Br^{c-}\right]$ and $\left[Cl^{c-}\right]$ ions, EMF_{cell} would be zero ?

A. $200:1$

B. $1:200$

C. $1:100$

D. $1:500$

Answer: a

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22. The pH of LHE in the following cell is :

$Pt, H_2(1atm)\Big|H^{\oplus}(xM)\Big|\Big|H^{\oplus}(0.1M)\Big|H_2(0.1atm)Pt$ E_(cell)=0.295V`.

A. 6.5

B. 6.0

C. 5.5

D. 4.0

Answer: c

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23. At what concentration of $\left[\overset{c-}{OH}\right]$ does the following half reaction has a potential of $0V$ when other species are at $1M$?

$$NO_3^{c-} + H_2O + 2e^- \rightarrow NO_2^{c-} + 2\overset{c-}{OH}, E^{c-}._{cell} = -0.06V$$

A. $2.0M$

B. $1.0M$

C. $0.1M$

D. $0.01M$

Answer: c

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24. If hydrogen electrodes dipped in two solutions of $pH = 3$ and $pH = 6$ are connected by a salt bridge, the EMF_{cell} is

A. $0.052V$

B. $0.104V$

C. $0.177V$

D. $0.3V$

Answer: C

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25. Consider the cell reaction :

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

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

A. $2.03V$

B. $-2.03V$

C. $-2.17V$

D. $2.71V$

Answer: d

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26. $E^{c-}{}_{red}$ of different half cell are given as :

$E^{c-}{}_{Cu^{2+} | Cu} = 0.34V, E^{c-}{}_{Zn^{2+} | Zn} = -0.76V.$

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

In which cell ΔG^{c-} is most negative ?

A. $Zn \mid Zn^{2+}(1M) \| Mg^{2+}(1M) \mid Mg$

B. $Zn \mid Zn^{2+}(1M) \| Ag^{\oplus}(1M) \mid Ag$

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

D. $Ag \mid Ag^{\oplus}(1M) \| Mg^{2+}(1M) \mid Mg$

Answer: b

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27. For the reaction :

$A + 2B^{3+} \rightarrow 2B^{2+} + A^{2+}$

E^0 of the given redox reaction is :

$A^{2+} + 2e^- \rightarrow A\ E^0 = xV$

$B^{3+} + e^- \rightarrow B^{2+}\ E^0 = yV$

A. $x - 2y$

B. $x + y/2$

C. $x - y$

D. $y - x$

Answer: D

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28. Excess of solid $AgCl$ is added to a $0.1M$ solution of Br^{c-} ions. E^{c-} for half cell is :

$AgBr + e^- \rightarrow Ag + Br^{c-}, E^{c-} = 0.095V$

$AgCl + e^{-} \rightarrow Ag + Cl^{c-}, E^{c-} = 0.222V$

The value of $\left[Br^{c-}\right]$ ion at equilibrium is :

[Given : $Anti\log(2.152) = 142$]

A. $0.0317M$

B. $0.013M$

C. $0.99M$

D. $0.099M$

Answer: d

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Ex 3.2 (Objective)

1. During the electrolysis of acidified water, O_2 gas is formed at the anode. To produce O_2 gas at the anode at the rate of $0.224Ml$ per second at STP, the current passed is

A. $0.224A$

B. $2.24A$

C. $9.64A$

D. $3.86A$

Answer: d

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2. Number of electrons lost dring electrolysis of $0.355g$ of Cl^{c-} is $\left(N_A = \right.$ Avogadro's number)

A. 0.01

B. $0.01N_A$

C. $0.02N_A$

D. $\frac{0.01}{2N_A}$

Answer: b

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3. How many faradays are required to reduce 1 mol of MnO_4^- to Mn^{2+}?

A. 1

B. 5

C. 3

D. 2

Answer: B

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4. Copper containing zinc as impurity is refined by electrolysis. The cathode and anode used are

A. $\begin{matrix} Cathode & Anode \\ Purecopper & Purezinc \end{matrix}$

B. $\begin{matrix} Cathode & Anode \\ Purezinc & Purecopper \end{matrix}$

C. $\begin{matrix} Cathode & Anode \\ Purecopper & Impurecopper \end{matrix}$

D. $\begin{matrix} Cathode & Anode \\ Purezinc & Impurezinc \end{matrix}$

Answer: c

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5. Which of the following reactions is / are possible at the anode ?

A. $F_2 + 2e^- \rightarrow 2F^{c-}$

B. $2H^{\oplus} + \frac{1}{2}O(2) + 2e^- \rightarrow H_2O$

C. .2 C r 3 + + 7 H 2 O → C r 2 O 2 − 7 + 14 H ⊕ + 6 e − `

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

Answer: c,d

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6. The number of moles of Zn^{2+} ions deposited when a current of $1.5A$ is passed for 4 hours through a molten solution of a zince salt. (Assume current efficiency to be 90%)

A. 6.35

B. 0.1

C. 0.4

D. None of these

Answer: b

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7. Molten $NaCl$ is electrolyzed in a cell called

A. Downs cell

B. Castner cell

C. Kellner cell

D. Hall cell

Answer: a., b,c., d.

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8. A dilute aqueous solution of sodium fluoride is electrolyzed, the products at the and cathode are

A. O_2 and K

B. O_2 and F_2

C. H_2 and F_2

D. O_2 and H_2

Answer: D

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9. If $0.224L$ of $H_2(g)$ is formed at the cathode of one cell at STP, how much of Mg is formed at the cathode of the other electrolytic cell arranged in series ?

A. $0.24g$

B. $2.4g$

C. $0.48g$

D. $4.8g$

Answer: a

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10. A certain amount of charge is passed through acidulated water. A total of $504mL$ of hydrogen and oxygen were collected at STP. Find the magnitude of charge that is passed during electrolysis in coulombs.

A. $1930C$

B. $965C$

C. $482.5C$

D. $241.2C$

Answer: b

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11. $1L$ of $1MCuSO_4$ solution is electrolyzed using Pt cathode and Cu anode. After passing $2F$ of electricity, the $\left[Cu^{2+}\right]$ will be

A. 0

B. M

C. $M/2$

D. $M/4$

Answer: b

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12. In a Ni - Cd battery (more than one correct)

A. All the reactants and products in the overall reaction are in the solid state.

B. The voltage of the cell changes rapidly.

C. The elctrolyte used is an alkali solution.

D. All of the above are true.

Answer: a,c

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13. Rusting of iron is

A. A decomposition process

B. A photochemical process

C. An electrochemical

D. A reduction process

Answer: c

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14. In H_2 - O_2 fuel cell, the reaction occurring at cathode is

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

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

C. $CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$

D. $C(s) + O_2(g) \rightarrow CO_2(g)$

Answer: b

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15. The cathode reaction during the charging of a lead - acid battery leads to the

A. Formation of $PbSO_4$

B. Reduction of Pb^{2+} to Pb

C. Formation of PbO_2

D. Deposition of Pb at the anode.

Answer: b

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16. Which of the following cells is rechargeable ?

A. Lead storage cell

B. Ni - Cd cell

C. Edison cell (Iron - nickel cell)

D. All of these

Answer: d

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17. During discharging of alead storage battery

A. Pb is oxidized to $PbSO_4$ at the anode

B. PbO_2 is reduced to $PbSO_4$ at the cathode

C. Both electrodes are immersed in the same aqueous solution of H_2SO_4

D. All of the above are true.

Answer: d

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

A. $Fe^{2+} \mid Fe$

B. $O_2 \mid H_2O$

C. $Fe^{3+} \mid F^{2+}$

D. $Fe \mid Fe^{3+}$

Answer: b

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19. How many Faradays are required to reduce $1 mol of BrO_3^{c-}$ to Br^{c-} in basic medium ?

A. 6

B. 5

C. 4

D. 3

Answer: a

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20. Which of the following aqueous solutions remains neutral after electrolysis ?

A. K_2SO_4

B. $NaCl$

C. $AgNO_3$

D. $CuSO_4$

Answer: a

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21. Same quantity of current is passed through molten $NaCl$ and molten cryolite containing Al_2O_3. If $4.6g$ of Na was liberated in one cell, the mass of Al liberated in the other cell is

A. $0.9g$

B. $1.8g$

C. $2.7g$

D. $3.6g$

Answer: b

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22. In the electrolysis of a $40LCuSO_4$ solution, there are two possible reactions at anode :

$i. Cu \rightarrow Cu^{2+} + 2e^-$

$ii. 2H_2O \rightarrow 4H^{\oplus} + 4e^- + O_2$

A current of $1.07A$ is passed for 2 hours. The loss in the mass of Cu at anode was $1.27g$.

(Atomic weight of $Cu = 63.5gmol^1\big)$.

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

A. $0.08mol$ of electrons are passed through the solution during entire electrolysis

B. $224mL$ of $O_2(g)$ is liberated at STP at anode.

C. Fraction of current in the production of Cu^{2+} ions $= 0.5$.

D. pH drops to 3

Answer: a,b,c,d

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23. Two platinum electrodes were immersed in a solution of $CuSO_4$ and electric current was passed through the solution. After some time, it was fournd that the colour of $CuSO_4$ disappeared with the evolution of $O_2(g)$ at the electrode.

Which statement is true regarding the resultant solution having $pH = X$?

A. $\left[Cu^{2+}\right] > \left[SO_4^{2-}\right]$

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

C. $\left[\overset{c-}{OH}\right] > \left[H^{\oplus}\right]$

D. $7 > X$

Answer: d

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

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

To prepare $5.12kg$ of aluminimu metal by this method woold require .

A. $5.49 \times 10^{10}C$

B. 1.83×10^7C

C. 5.49×10^4C

D. 5.49×10^7C

Answer: d

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25. The density of copper is $8.95 gmL^{-1}$. Find out the number of coulombs needed to plate an area of $100 cm^2$ to a thickness of $10^{-2} cm$ using $CuSO_4$ solution as electrolyte. (Atomic weight of $Cu = 63.5 g$)

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26. a. In the following reactions, what weight of substance would be liberated if $1F$ of electricity were passed through the cell :

$i. Cu^{2+} + 2e^{-} \rightarrow Cu$ $ii. Al^{3+} + 3e^{-} \rightarrow Al$

$iii. 2Cl^{c-} \rightarrow Cl_2 + 2e^{-}$ $iv. Ag^{\oplus} + e^{-} \rightarrow Ag$

b. In the series of cathodes / anodes given above, how many coulombs are needed to produce $1g$ of each of

A. Cu

B. Al

C. Cl_2

D. Ag

Answer: $a.\ i.\ 31.75g \quad ii.\ 9g \quad iii.\ 35.5g \quad iv.\ 108g$
$b.\ \ i.\ 3039C \quad ii.\ 10722.2C \quad iii.\ 2718.3C \quad iv.\ 893.5C$

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Ex 3.3 (Objective)

1. Arrange the following compounds in the order of increasing conductance : $HCl, LiCl, NaCl, KCl.$

A. $LiCl > NaCl > KCl$

B. $KCl > NaCl > LiCl$

C. $NaCl > KCl > LiCl$

D. $LiCl > KCl > NaCl$

Answer: B

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2. Which of the following alkali metal ions has the lowest ionic mobility in aqueous solutions?

A. $Li^{\oplus}$

B. $Na^{\oplus}$

C. $K^{\oplus}$

D. $Rb^{\oplus}$

Answer: A

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3. For a $0.01 M CH_2COOH$ solution, $\wedge_m = 7.8 \Omega^{-1} cm^2 mol^{-1}$ if $\wedge_m^{\circ} = 390 \Omega^{-1} cm^2 mol^{-1}$. What is the degree of the dissociation (α) of acetic acid ?

A. 0.20

B. 0.48

C. 0.02

D. 0.05

Answer: C

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

A. 46.0

B. 9.2

C. 18.4

D. 2.3

Answer: A

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5. The equivalent conductance of Ba^{2+} and Cl^{c-} are $63.5ohm^{-1}cm^2eq^{-1}$ and $76ohm^{-1}cm^2eq^{-1}$, respectively, at infinite dilution . The equivalent conductance (in $oh^{-1}cm^2\Big)$ of $BaCl_2$ at infinite dilution will be

A. 139.5

B. 203.0

C. 279.0

D. 101.15

Answer: A

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6. The quivalnet conductance of any electrolyte MA at infinite dilution $\wedge^{\circ}._{(MA)}$ is equal (more than one correct answer)

A. $\wedge^{\circ}{}_{(MA)} = \wedge^{c-}{}_{(MCl)} + \wedge^{\circ}{}_{(NaA)} + \wedge^{\circ}{}_{(NaCl)}$

B. $\wedge^{\circ}{}_{(MA)} = \wedge^{c-}{}_{(MCl)} + \wedge^{\circ}{}_{(NaA)} - \wedge^{\circ}{}_{(NaCl)}$

C. $\wedge^{\circ}{}_{(MA)} = \lambda^{\circ}{}_{\left(M^{\oplus}\right)} + \lambda^{\circ}{}_{\left(A^{c-}\right)}$

D. $\wedge^{\circ}{}_{(MA)} = \wedge^{c-}{}_{(MCl)} + \wedge^{\circ}{}_{(NaA)} - \wedge^{\circ}{}_{(NaCl)}$

Answer: B,C

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7. Which of the following alkali metal ions has the lowest ionic mobility in aqueous solutions?

A. $Na^{\oplus}$

B. F^{c-}

C. SO_4^{2-}

D. $\overset{c-}{OH}$

Answer: D

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8. $\wedge^{\circ}{}_{aq}$ of $BaCl_2, H_2SO_4$, and $HCl(aq)$ solutions are $x_1, x_2,$ and x_3, respectviley . $\wedge^{\circ}{}_{m}\left(BaSO_4\right)$ is :

A. $x_1 + x_2 - x_3$

B. $x_1 - x_2 - x_3$

C. $x_1 + x_2 - 2x_3$

D. $x_1 - 2x_2 + x_3$

Answer: A

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9. $\wedge^{\circ}{}_{m}$ of $BaCl_2, H_2SO_4$, and $HCl(aq)$ solutions are $x_1, x_2,$ and x_3 respectively. $\wedge_{m}\left(BaSO_4\right)$ is :

A. $x_1 + x_2 - x_3$

B. $x_1 - x_2 - x_3$

C. $x_1 + x_2 - 2x_3$

D. $x_1 - 2x_2 + x_3$

Answer: C

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10. Which of the following statemetn is / are correct ?

I. Van't Hoff factor for $10^{-3} MCH_3COOH$ is $39/35\left(\wedge^{\circ}{}_m = 350 Scm^2 mol^{-1}\right.$ and $\left.k = 4 \times 10^{-5} Scm^{-1}\right)$.

II. If $\wedge^{\circ}{}_m$ of $KCl, LiCl,$ and KNO_3 are $150, 115,$ and $145 Scm^2 mol^{-1}$, then that of $LiNO_3$ will be $110 Scm^2 mo^{-1}$.

III. In general, with increase in concentration, the specific conductance increases and reaches a maximum and then decreases with further increase in concentration.

A. $I, II,$ and III

B. I and II

C. Only I

D. Only II

Answer: A

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Exercise(Linked Comprehension)

1. An aqueous solution containing $0.1MFe^{3+}$ and $0.01MFe^{2+}$ was titrated with a concentrated solution of $NaOH$ at $30^{\circ}C$, so that changes in volumes were negligible. Assuming that the new species formed during titration are $Fe(OH)_3$ and $Fe(OH)_2$ only.

Given $E^{c-}._{Fe^{3+} \mid Fe^{2+}} = 0.80V$,

$K_{spFe(OH)_3} = 10^{-37}$, and $K_{spFe(OH)_2} = 10^{-19}$

The redox potential of $Fe^{3+} \mid Fe^{2+}$ electrode at $pH = 6$ is

A. $0.8V$

B. $0.5V$

C. $0.2V$

D. $0.1V$

Answer: a

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2. An aqueous solution containing $0.1 M Fe^{3+}$ and $0.01 M Fe^{2+}$ was titrated with a concentrated solution of $NaOH$ at $30^{\circ} C$, so that changes in volumes were negligible. Assuming that the new species formed during titration are $Fe(OH)_3$ and $Fe(OH)_2$ only.

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A. $0.8V$

B. $0.5V$

C. $0.2V$

D. $0.1V$

Answer: C

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3. An aqueous solution containing $0.1MFe^{3+}$ and $0.01MFe^{2+}$ was titrated with a concentrated solution of $NaOH$ at $30^{\circ}C$, so that changes in volumes were negligible. Assuming that the new species formed during titration are $Fe(OH)_3$ and $Fe(OH)_2$ only.

Given $E^{c-}\cdot_{Fe^{3+}|Fe^{2+}} = 0.80V$,

$K_{spFe(OH)_3} = 10^{-37}$, and $K_{spFe(OH)_2} = 10^{-19}$

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A. $0.8V$

B. $0.5V$

C. $0.2V$

D. $0.1V$

Answer: c

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4. Calculate $\Delta_r G^{c-}$ of the reaction :

$Ag^{\oplus}(aq) + Cl^{c-}(aq) \rightarrow AgCl(s)$

Given : $\Delta_f G^{c-}{}_{\cdot AgCl} = -109 kJmol^{-1}$

$\Delta_f G^{c-} \_ \left(\left(Cl^{c-}\right)\right) = -129 kJmol^{-1}$

$\Delta_f G^{c-} \cdot \left({}_{Ag^{\oplus}}\right) = -77 kJmol^{-1}$

A. $-97 kJmol^{-1}$

B. $-57 kJmol^{-1}$

C. $57 kJmol^{-1}$

D. $97 kJmol^{-1}$

Answer: b

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5. $E^{c-}._{cell}$ of the reaction above in Question is

A. $0.59V$

B. $-0.59V$

C. $0.295V$

D. $-0.295V$

Answer: a

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6. K_{sp} of $AgCl$ is

A. 10^{-13}

B. 10^{-12}

C. 10^{-11}

D. 10^{-10}

Answer: d

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7. $6.537 \times 10^{-2} f$ of metallic Zn was added to $100 mL$ of saturated solution of $AgCl$. Calculate $\log . \frac{[Zn^{2+}]}{[Ag^{\oplus}]}$.

Given : $E^{c-} \cdot_{Ag^{\oplus} | Ag} = 0.80V, E^{c-} \cdot_{Zn^{2+} | Zn} = -0.763V.$

K_{sp} of $AgCl \approx 10^{-10}$, atomic weight of $Zn = 65.37$

A. 26.5

B. 13.24

C. 53

D. 106

Answer: c

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8. Calculate the number of moless of Ag formed above in Question.

A. 10^{-4}

B. 10^{-5}

C. 10^{-6}

D. 10^{-7}

Answer: c

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9. The magnitude (but not the sign) of the standard reduction potentials of two metals X and Y are :

$Y^2 + 2e^- \rightarrow Y \left| E_1^{c-} \right| = 0.34V$

$X^2 + 2e^- \rightarrow X \left| E_2^{c-} \right| = 0.25V$

When the two half cells of X and $Y$are connected to construct a cell, eletrons flow from X to Y. When X is connected to a standard hydrogen electrode (SHE),electrons flow from X to SHE.

If a half call $X \mid X^2(0.1M)$ is connected to another half cell $Y \mid Y^{2+}(1.0M)$ by means of a salt bridge and an external circuit at $25^{\circ} C$, the cell voltage would be

A. $0.06V$

B. $0.12V$

C. $0.62V$

D. $0.72V$

Answer: c

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10. The magnitude (but not the sign) of the standard reduction potentials of two metals X and Y are :

$Y^2 + 2e^- \rightarrow Y \left|E_1^{c-}\right| = 0.34V$

$X^2 + 2e^- \rightarrow X \left|E_2^{c-}\right| = 0.25V$

When the two half cells of X and $Y$are connected to construct a cell, eletrons flow from X to Y. When X is connected to a standard hydrogen electrode (SHE),electrons flow from X to SHE.

If standard emf $\left(E^{c-}\right)$ of a half cell $Y^2 \mid Y^{\oplus}$ is $0.15V$, the standard emf of the half cell $Y^{\oplus} \mid Y$ will be

A. $0.19V$

B. $0.53V$

C. $0.49V$

D. $0.64V$

Answer: b

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11. The magnitude (but not the sign) of the standard reduction potentials of two metals X and Y are :

$Y^2 + 2e^- \rightarrow Y\left|E_1^{c-}\right| = 0.34V$

$X^2 + 2e^- \rightarrow X\left|E_2^{c-}\right| = 0.25V$

When the two half cells of X and $Y$are connected to construct a cell, eletrons flow from X to Y. When X is connected to a standard hydrogen electrode (SHE),electrons flow from X to SHE.

Given the following half cell : $YI + e^- \rightarrow Y - I^{c-}: \quad E^{c-} = -0.27V$

Solubility product of the iodide salt YI is

A. 2×10^{-3}

B. 2×10^{-12}

C. 2×10^{-14}

D. 6.8×10^{-16}

Answer: c

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12. A volataic cell consists of an electode of solide silver immerse in a $0.10 MAgNO_3$ solution and an electrode of unknown metal $'X'$ immersed in a $0.10M$ solution $X\left(NO_3\right)_2$. A porous barrier separates the two half of the cell. Also given :

$E^{c-}\cdot\left(Ag^{\oplus} \mid Ag\right) = 0.80V$ and $E^{c-}\cdot_{cell} = 1.05V$ at $25\,^{\circ}C$

$X(s)\left|X^{2+}(1.0M)\right|\left|Ag^{\oplus}(0.1M)\right|Ag(s)$

Which of the following statements regarding the cell and X is incorrect?

A. Standard $EMF\left(E^{c-}\right)$ of $X^{2+} \mid X$ is $-0.25V$ at $25\,^{\circ}C$.

B. X is the stronger reducing agent than $H_2(g)$.

C. As the cell operates , the concentration of both X^2 and $Ag^{\oplus}$ increase in their respective half cells.

D. As the cell operates, the concentration of X^{2+} increases in the anode chamber while the concentration of $Ag^{\oplus}$ decreases in the cathode chamber.

Answer: c

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13. A volataic cell consists of an electode of solide silver immerse in a $0.10 M AgNO_3$ solution and an electrode of unknown metal $'X'$ immersed in a $0.10 M$ solution $X\left(NO_3\right)_2$. A porous barrier separates the two half of the cell. Also given :

$E^{c-}\cdot\left(Ag^{\oplus} \mid Ag\right) = 0.80 V$ and $E^{c-}\cdot_{cell} = 1.05 V$ at $25^{\circ} C$

$X(s)\left|X^{2+}(1.0M)\right|\left|Ag^{\oplus}(0.1M)\right|Ag(s)$

If $Ag^{\oplus} \mid Ag$ half cell in the above voltaic cell is replaced by $Zn^{2+} \mid Zn$ half cell $\left(E^{c-}\cdot_{Zn^{2+} \mid Zn} = -0.76 V\right)$

A. The direction of current flow will remain same.

B. Polarity of the electrodes will be reversed.

C. Cell will stop working.

D. EMF of the cell will increase.

Answer: b

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14. Fuel cells : Fuel cells are galvanic cells in which the chemical energy of fuel cell is directly converted into electrical energy. A type of fuel cell is a hydrogen - oxygen fuel cell. It consists of two electrodes made up of two porous graphite impregnated with a catalyst (platinum, silver, or metal oxide). The electrodes are placed in aqueous solution of $NaOH$. Oxygen and hydrogen are continuously fed into the cell. Hydrogen gets oxidized to $H^{\oplus}$ which is neutralized by $\overset{c-}{OH}$, $i.e.$, anodic reaction.

$$H_2 \rightleftharpoons 2H^{\oplus} + 2e^-$$

$$2H^{\oplus} + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O$$

$$H_2 + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O + 2e^-$$

At cathode, O_2 gets reduced to $\overset{\ominus}{O}H$

i.e., $O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$

Hence, the net reaction is $2H_2 + O_2 \rightleftharpoons 2H_2O$

At cathode, O_2 gets reduced to $\overset{c-}{OH}$

$O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$ has $E^{\ominus} = 0.40$ V,

then $E^{\ominus}$ for $2H_2O + 2e^- \rightleftharpoons H_2 + 2\overset{\ominus}{O}H$ will be

a. 0.41 V **b.** 0.83 V **c.** – 0.41 V **d.** – 0.83 V

Hence, the net reaction is

The overall reaction has

$\Delta H = -285.6 kJmol^{-1}$ and $\Delta G = -237.4 kJmol^{-1}$ at $25^{\circ} C$

If the cell voltage is $1.23V$ for the $H_2 - O_2$ fuel cell and for the half cell :

A. $0.41V$

B. $0.83V$

C. $-0.41V$

D. $0.83V$

Answer: d

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15. Fuel cells : Fuel cells are galvanic cells in which the chemical energy of fuel cell is directly converted into electrical energy. A type of fuel cell is a hydrogen - oxygen fuel cell. It consists of two electrodes made up of two porous graphite impregnated with a catalyst (platinum, silver, or metal oxide). The electrodes are placed in aqueous solution of $NaOH$. Oxygen and hydrogen are continuously fed into the cell. Hydrogen gets oxidized to $H^{\oplus}$ which is neutralized by $\overset{c-}{OH}$, $i.e.$, anodic reaction.

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Hence, the net reaction is $2H_2 + O_2 \rightleftharpoons 2H_2O$

At cathode, O_2 gets reduced to $\overset{c-}{OH}$

Hence, the net reaction is

The overall reaction has

$\Delta H = -285.6kJmol^{-1}$ and $\Delta G = -237.4kJmol^{-1}$ at $25^{\circ}C$

What is the value of ΔS^{c-} for the fuel cell at $25^{\circ}C$?

A. $-1600JK^{-1}$

B. $-160JK^{-1}$

C. $160JK^{-1}$

D. $1600JK^{-1}$

Answer: b

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16. Fuel cells : Fuel cells are galvanic cells in which the chemical energy of fuel cell is directly converted into electrical energy. A type of fuel cell is a hydrogen - oxygen fuel cell. It consists of two electrodes made up of two porous graphite impregnated with a catalyst (platinum, silver, or metal oxide). The electrodes are placed in aqueous solution of $NaOH$. Oxygen and hydrogen are continuously fed into the cell. Hydrogen gets oxidized to $H^{\oplus}$ which is neutralized by $\overset{c-}{OH}$, $i.e.$, anodic reaction.

$$H_2 \rightleftharpoons 2H^{\oplus} + 2e^-$$

$$2H^{\oplus} + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O$$

$$H_2 + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O + 2e^-$$

At cathode, O_2 gets reduced to $\overset{\ominus}{O}H$

i.e., $O_2 + 2H_2O + 4e^- \rightleftharpoons 4\overset{\ominus}{O}H$

Hence, the net reaction is $2H_2 + O_2 \rightleftharpoons 2H_2O$

At cathode, O_2 gets reduced to $\overset{c-}{OH}$

Hence, the net reaction is

The overall reaction has

$\Delta H = -285.6 kJmol^{-1}$ and $\Delta G = -237.4 kJmol^{-1}$ at $25\,^{\circ}C$

Suppose the concentration of hydroxide ioin in the cell is doubled, then the cell voltage will be

A. Reduced by half

B. Increased by a factor of 2

C. Increased by a factor of 4

D. Unchanged

Answer: d

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17. Fuel cells : Fuel cells are galvanic cells in which the chemical energy of fuel cell is directly converted into electrical energy. A type of fuel cell is a hydrogen - oxygen fuel cell. It consists of two electrodes made up of two porous graphite impregnated with a catalyst (platinum, silver, or metal oxide). The electrodes are placed in aqueous solution of $NaOH$. Oxygen and hydrogen are continuously fed into the cell. Hydrogen gets oxidized to $H^{\oplus}$ which is neutralized by $\overset{c-}{O}H, i.e.,$ anodic reaction.

$$H_2 \rightleftharpoons 2H^{\oplus} + 2e^-$$

$$2H^{\oplus} + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O$$

$$H_2 + 2\overset{\ominus}{O}H \rightleftharpoons 2H_2O + 2e^-$$

At cathode, O_2 gets reduced to $\overset{\ominus}{O}H$

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Hence, the net reaction is $2H_2 + O_2 \rightleftharpoons 2H_2O$

At cathode, O_2 gets reduced to $\overset{c-}{OH}$

Hence, the net reaction is

The overall reaction has

$\Delta H = -285.6kJmol^{-1}$ and $\Delta G = -237.4kJmol^{-1}$ at $25\,°C$

A fuel cell is

$I.$ A voltaic cell in which continuous supply of fuels are sent at anode to

perform oxidation.

$II.$ A voltaci cell in which fuels such as : $CH_4, H_2,$ and CO are used up at

anode.

$III.$ One which involves the reaction of $H_2 - O_2$ fuel cell such as :

Anode : $2H_2O + 4\overset{c-}{OH} \rightarrow 4H_2O(l) + 4e^{c-}$

Cathode : $O_2 + 2H_2O(l) = 4e^- \rightarrow 4\overset{c-}{OH}$

$IV.$ The efficiency of $H_2 - O_{20}$ fuel cell is 70 to 75 %

A. I, III

B. I, III, IV

C. I, II, III, IV

D. I, II, III

Answer: c

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18. A conductivity cell is used to measure the conductance of electrolyte . It makes use of conductivity of water which does not contain any ions. The cell constant of conductivity cell is determined.

If the cell constant is $0.40 cm^{-1}$, the conductivity of $0.051 M NaCl$ solution having $R = 1850 ohm$ is equal to

A. $1.08 \times 10^{-4} Scm^{-1}$

B. $4.32 \times 10^{-4} Scm^{-1}$

C. $2.16 \times 10^{-4} Scm^{-1}$

D. $5.04 \times 10^{-5} Scm^{-1}$

Answer: c

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19. A conductivity cell is used to measure the conductance of electrolyte . It makes use of conductivity of water which does not contain any ions. The cell constant of conductivity cell is determined.

Calculate α of CH_3COOH if $\Delta^{\infty}{}_{\cdot m}$ for $HCl, NaCl, CH_3COOHNa$ are $426, 126, 91 Scm^2 mol^{-1}$, respectively, and $\wedge_m = 14.4 Scm^2 mol^{-1}$ at $0.015M$ concentration.

A. 0.037

B. 0.018

C. 0.37

D. 0.18

Answer: a

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20. Breathalyzer is used to detect the alcohol content in the suspected drunk drivers. The ethanol in the exhaled breath is oxidized to ethanoic acid with an acidic solution of $K_2Cr_2O_7$ as follows :

$3CH_3CH_2OH(aq)Ehanol + 2Cr_2O_7^{2-}(aq) + 16H^{\oplus}(aq) \rightarrow 3CH_3COH(aq)Ethanoicaci$

The breathalyzer measures the colour change and produces a metre reading calibrated in the terms of blood alcohol content.

If $E^{c-}._{CH_3COOH \mid C_2H_5OH} = 0.06V$ and $E^{c-}._{Cr_2O_7^{2-} \mid Cr^{3+}} = 1.33V$,

then $E^{c-}._{cell}$ of the reaction taking place in alcohol metre is

A. $1.39V$

B. $1.27V$

C. $-1.39V$

D. $-1.51V$

Answer: b

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21. Breathalyzer is used to detect the alcohol content in the suspected drunk drivers. The ethanol in the exhaled breath is oxidized to ethanoic acid with an acidic solution of $K_2Cr_2O_7$ as follows :

$3CH_3CH_2OH(aq)Ehanol + 2Cr_2O_7^{2-}(aq) + 16H^{\oplus}(aq) \rightarrow 3CH_3COH(aq)Ethanoicaci$

The breathalyzer measures the colour change and produces a metre reading calibrated in the terms of blood alcohol content.

Colour of the testing solution changes from

A. Orange to green

B. Colourless to green

C. Orange to green

D. Yellow to blue

Answer: c

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22. Breathalyzer is used to detect the alcohol content in the suspected drunk drivers. The ethanol in the exhaled breath is oxidized to ethanoic acid with an acidic solution of $K_2Cr_2O_7$ as follows :

$3CH_3CH_2OH(aq)Ehanol + 2Cr_2O_7^{2-}(aq) + 16H^{\oplus}(aq) \rightarrow 3CH_3COH(aq)Ethanoicaci$

The breathalyzer measures the colour change and produces a metre reading calibrated in the terms of blood alcohol content.

The EMF of the reaction when the concentration of all the species are $1.0M$ and pH is 4.0 is

A. 1.64

B. 0.31

C. $-1.01V$

D. $0.95V$

Answer: d

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23. Breathalyzer is used to detect the alcohol content in the suspected drunk drivers. The ethanol in the exhaled breath is oxidized to ethanoic acid with an acidic solution of $K_2Cr_2O_7$ as follows :

$3CH_3CH_2OH(aq)Ehanol + 2Cr_2O_7^{2-}(aq) + 16H^{\oplus}(aq) \rightarrow 3CH_3COH(aq)Ethanoicaci$

The breathalyzer measures the colour change and produces a metre reading calibrated in the terms of blood alcohol content.

What is the ethanol ethanoic acid ratio if the breathalyzer records $1.33V$ and other species are at $1M$?

A. 10^4

B. 10^{-4}

C. 10^{12}

D. 10^{-12}

Answer: a

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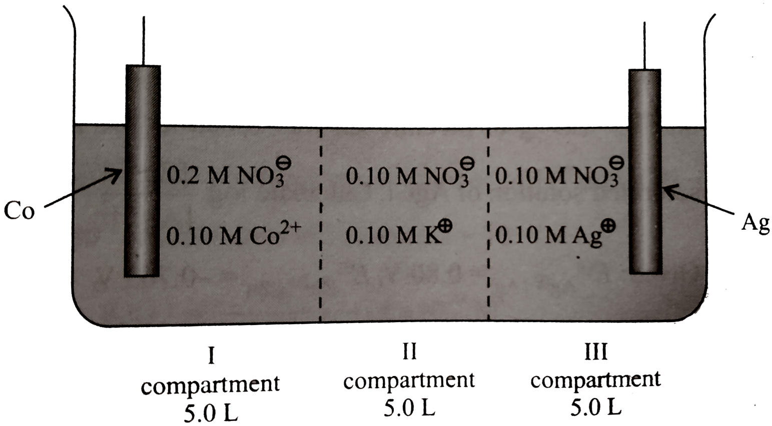
24. A cell, as shown below, consists of there compartments separated by porous pots. The first contains a cobalt eletrode in $5.0L$ of $0.10MCo\left(NO_3\right)$, the second contains $5.0L$ of $0.10MKNO_3$, the third contains an Ag electrode in $5.0L$ of $0.10MAgNO_3$. Assuming that current with in the cell iis carried equally by the negative and positive ions by passign $0.1F$ of electricity.



Given : $Co^{2+} + 2e^{-} \rightarrow Co \quad E^{c-} = -0.28V$

Ag^(o+)+e^(-) rarr Ag" "E^(c-)=0.80V2Ag^(o+)+Corarr Co^(2+)+2Ag" "E^(c-)._(cell)=1.08V$F \in ally, the$I$compartmentconta \in s$I. Co^(2+)" "II. NO_(3)^(c-)" "III.K^(o+)" "IV.Ag^(o+)`

A. I

B. I, II

C. I, II, III

D. II, III, IV

Answer: b

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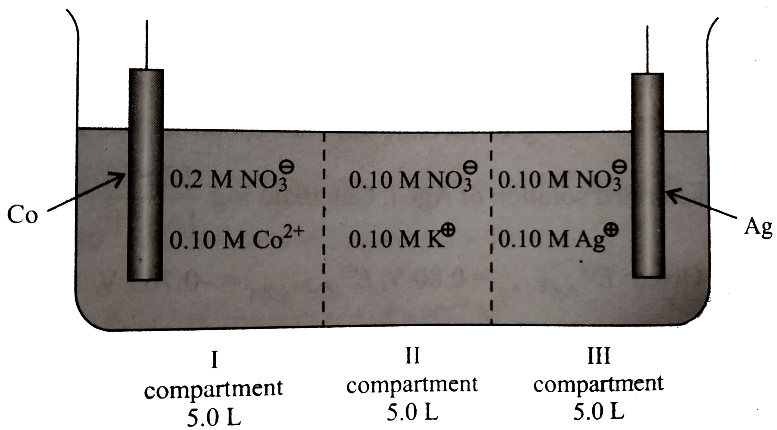
25. A cell, as shown below, consists of there compartments separated by porous pots. The first contains a cobalt eletrode in $5.0L$ of $0.10MCo(NO_3)$, the second contains $5.0L$ of $0.10MKNO_3$, the third contains an Ag electrode in $5.0L$ of $0.10MAgNO_3$. Assuming that current with in the cell iis carried equally by the negative and positive ions by passign $0.1F$ of electricity.



Given : $Co^{2+} + 2e^{-} \rightarrow Co \quad E^{c-} = -0.28V$

Ag^(o+)+e^(-) rarr Ag" "E^(c-)=0.80V2Ag^(o+)+Corarr Co^(2+)+2Ag"

"E^(c-)._(cell)=1.08V$F \in ally, the$II` compartment contains

A. I

B. $I, II,$

C. I, II, III

D. II, III, IV

Answer: c

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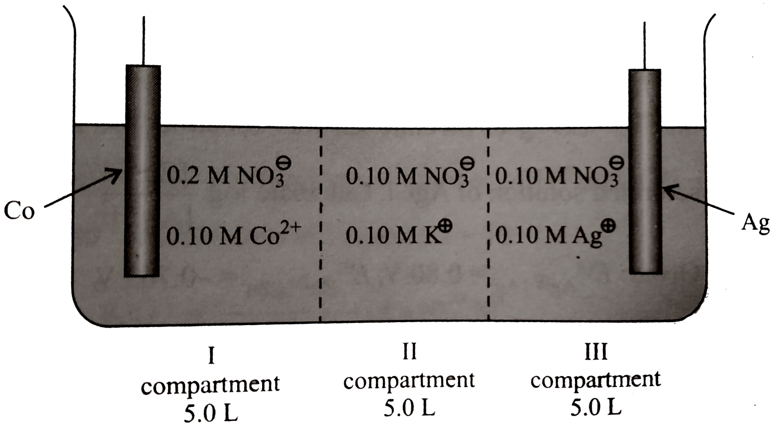
26. A cell, as shown below, consists of there compartments separated by porous pots. The first contains a cobalt eletrode in $5.0L$ of $0.10MCo\left(NO_3\right)$, the second contains $5.0L$ of $0.10MKNO_3$, the third contains an Ag electrode in $5.0L$ of $0.10MAgNO_3$. Assuming that current with in the cell iis carried equally by the negative and positive ions by passign $0.1F$ of electricity.



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Ag^(o+)+e^(-) rarr Ag" "E^(c-)=0.80V2Ag^(o+)+Corarr Co^(2+)+2Ag"

"E^(c-)._(cell)=1.08V$F \in allythe$II` compartment contains

A. I

B. $I, II,$

C. I, II, III

D. II, III, IV

Answer: d

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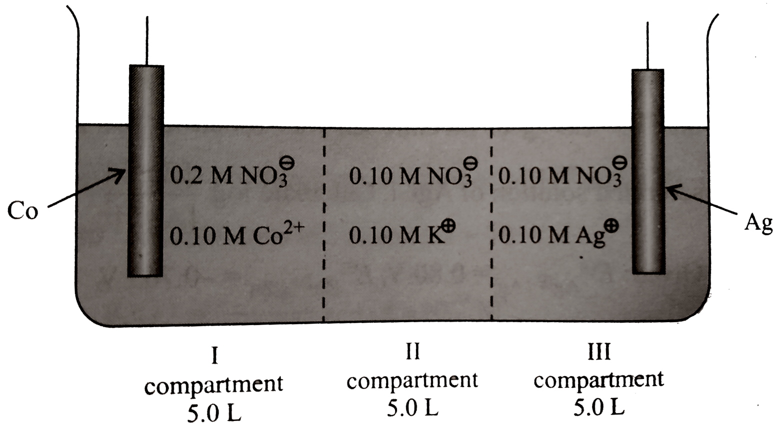
27. A cell, as shown below, consists of there compartments separated by porous pots. The first contains a cobalt eletrode in $5.0L$ of $0.10MCo\left(NO_3\right)$, the second contains $5.0L$ of $0.10MKNO_3$, the third contains an Ag electrode in $5.0L$ of $0.10MAgNO_3$. Assuming that current with in the cell iis carried equally by the negative and positive ions by passign $0.1F$ of electricity.



Given : $Co^{2+} + 2e^{-} \rightarrow Co \quad E^{c-} = -0.28V$

Ag^(o+)+e^(-) rarr Ag" "E^(c-)=0.80V2Ag^(o+)+Corarr Co^(2+)+2Ag"

"E^(c-)._(cell)=1.08V*Thef* ∈ *alconcentrationof*Co^(2+) ∈ I, II, and III`

compartment is

A. $0.105, 0.005, 0.0M$

B. $0.005, 0.105, 0.0M$

C. $0.105, 0.0, 0.005M$

D. 0.0,0.005,0.105M`

Answer: a

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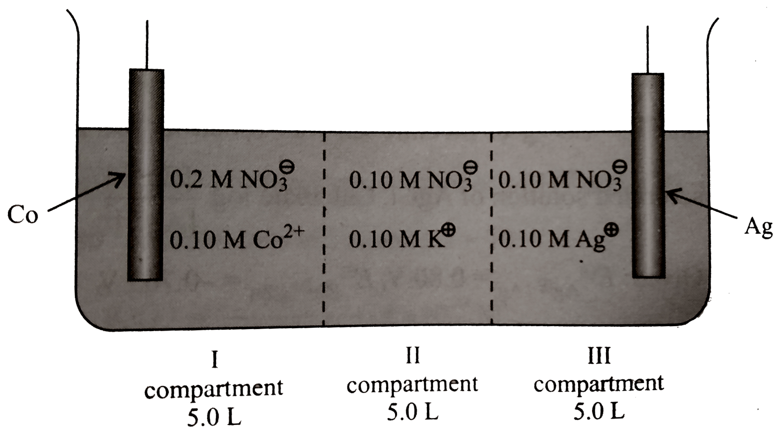
28. A cell, as shown below, consists of there compartments separated by porous pots. The first contains a cobalt eletrode in $5.0L$ of $0.10MCo(NO_3)$, the second contains $5.0L$ of $0.10MKNO_3$, the third contains an Ag electrode in $5.0L$ of $0.10MAgNO_3$. Assuming that current with in the cell iis carried equally by the negative and positive ions by passign $0.1F$ of electricity.



Given : $Co^{2+} + 2e^{-} \rightarrow Co \quad E^{c-} = -0.28V$

Ag^(o+)+e^(-) rarr Ag" "E^(c-)=0.80V2Ag^(o+)+Corarr Co^(2+)+2Ag"

"E^(c-)._(cell)=1.08V$Thef \in alconcentrationof$NO_(3)^(c-) ∈ I,II, and III`

compartment is

A. $0.100, 0. .210, 0.0900M$

B. $0.210, 0.100, 0.0900M$

C. $0.0900, 0.210, 0.100M$

D. $0.900, 0.100, 0.210M$

Answer: b

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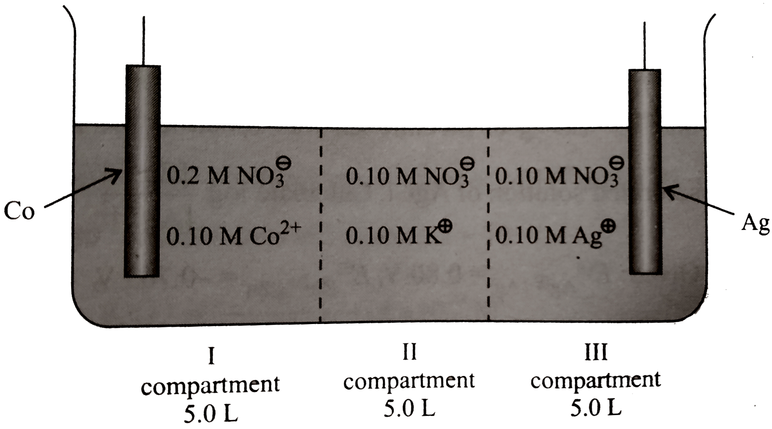
29. A cell, as shown below, consists of there compartments separated by porous pots. The first contains a cobalt eletrode in $5.0L$ of $0.10MCo(NO_3)$, the second contains $5.0L$ of $0.10MKNO_3$, the third contains an Ag electrode in $5.0L$ of $0.10MAgNO_3$. Assuming that current with in the cell iis carried equally by the negative and positive ions by passign $0.1F$ of electricity.



Given : $Co^{2+} + 2e^{-} \rightarrow Co \quad E^{c-} = -0.28V$

Ag^(o+)+e^(-) rarr Ag" "E^(c-)=0.80V2Ag^(o+)+Corarr Co^(2+)+2Ag"

"E^(c-)._(cell)=1.08V*Thef* ∈ *alconcentrationof*K^(o+) ∈ I,II, and III`

compartment is

A. $0.090, 0.0, 0.0100M$

B. $0.0, 0.0100, 0.090M$

C. $0.0, 0.090, 0.0100M$

D. $0.100, 0.90, 0.0M$

Answer: c

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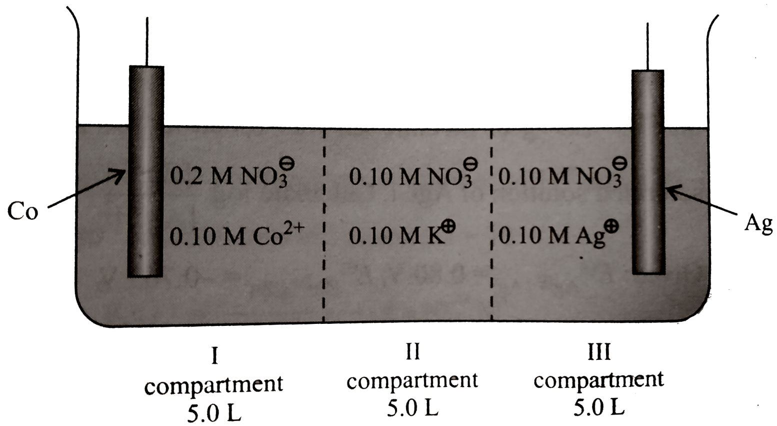
30. A cell, as shown below, consists of there compartments separated by porous pots. The first contains a cobalt eletrode in $5.0L$ of $0.10MCo(NO_3)$, the second contains $5.0L$ of $0.10MKNO_3$, the third contains an Ag electrode in $5.0L$ of $0.10MAgNO_3$. Assuming that current with in the cell iis carried equally by the negative and positive ions by passign $0.1F$ of electricity.



Given : $Co^{2+} + 2e^{-} \rightarrow Co \quad E^{c-} = -0.28V$

Ag^(o+)+e^(-) rarr Ag" "E^(c-)=0.80V2Ag^(o+)+Corarr Co^(2+)+2Ag"

"E^(c-)._(cell)=1.08V$Thef \in alconcentrationof$Ag^(o+) $\in$ I,II, and III`

compartment is

A. $0.0, 0.0, 0.08M$

B. $0.0, 0.08, 0.0M$

C. $0.08, 0.0, 0.0M$

D. $0.0M$ in all compartments

Answer: a

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Exercisemultiple Correct Ansers

1. Consider the following concentration cell :

$Zn(s)\left|Zn^{2+}(0.024M)\right|\left|Zn^{2+}(0.480M)\right|Zn(s)$

which of the following statements is / are correct?

A. The EMF of the cell at $25^{\circ}C$ is nearly $+0.039V$.

B. The EMF of the cell at $25^{\circ}C$ is nearly $-0.039V$.

C. If water is added in LHE, so that the $\left[Zn^{2+}\right]$ is reduced to $0.012M$, the cell voltage increases.

D. If water is added in LH , so that the $\left[Zn^{2+}\right]$ is reduced to $0.012M$, the cell voltage decreases.

Answer: a,c

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2. Given :

Oxidation$H_2O_2 \rightarrow O_2 + 2H^{\oplus} + 2e^{-} \quad E^{c-} = -0.69V,$

$2F^{c-} \rightarrow F_2 + 2e^{-} \quad E^{c-} = -287V,$

Reduction : $H_2O_2 + 2H^{\oplus} + 2e^{-} \rightarrow 2H_2O \quad E^{c-} = 1.77V,$

2I^(c-)rarr I_(2)+2e^(-)" "E^(c-)=-0.54V,$Whichofthefollow \in gstatementsis//$`

are correct ?

A. H_2o_2 behaves as an oxidant for I^{c-}

B. H_2O_2 behaves as a reductant for $1I_2$

C. H_2O_2 behaves as an oxidant for F^{c-}

D. H_2O_2 behaves as a reductant for F_2.

Answer: a,d

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

Given :

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

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

Which of the following statement is (are) correct ?

A. Oxygen gas can oxidize sulphate ion to per - oxo disulphate ion $\left(S_2O_8^{2-}\right)$ in acidic solution.

B. $O_2(g)$ is reduced to water.

C. Water is oxidized to O_2

D. $S_2O_8^{2-}$ ions are reduced to SO_4^{2-} ions.

Answer: c,d

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4. A current is passed through $500mL$ of an aqueous solution of CaI_2. After sometime, it is observed that 50 millimoles of I_2 have been formed. Which of the following statements is (are) correct ?

A. The number of faradays of charge passed through the solution is $0.10F$.

B. The volume of dry H_2 at STP that has been formed during electrolysis is $1120mL$.

C. The pH of the solution is nearly 0.7

D. The mass of calcium produced is $2.0g$.

Answer: a,b

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

A. The cell constant of an electrolytic cell is measured as the product : kR rather using l/a.

B. As an electrolytic solution is diluted, its conductance, equivalent conductance, and molar conductance increase.

C. Kohlraushc's law may be applied to calculate molar conductance at infinite dilution for both weak and strong electrolytes.

D. Kohlrausch's law may also be applied at any concentrated of the electrolyte.

Answer: a,b,c

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6. Predict which of the following reactions would proceed spontaneously at $298K$?

A. $Co(s) + Fe^{2+}(aq) \rightarrow Co^{2+}(aq) + Fe(s)$

$E^{c-}{\cdot}_{Co^{2+}/Co} = -0.28V$

B. $Cd^{2+}(aq) + Fe(s) \rightarrow Cd(s) + Fe^{2+}(aq)$

$E^{c-}{\cdot}_{Cd^{2+}/Cd} = -0.4V$

C. $Cd(s) + Co^{2+}(aq) \rightarrow Cd^{2+}(aq) + Co(s)$

$E^{c-}{\cdot}_{Fe^{2+}/Fe} = -0.44V$

D. $Zn^{2+}(aq) + H_2 \rightarrow Zn(s) + 2H^{\oplus}$

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

Answer: b,c

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

A. Y will oxidize X only

B. Y will oxidize Z only

C. Z will oxidize X and Y

D. Z will reduce both X and Y

Answer: a,c

Watch Video Solution

8. During the electrolysis of aqueous zinc nitrate.

A. Zince plates out at the cathode

B. Zince plates out at the anode

C. Hydrogen gen H_2 is evolved at the anode.

D. Oxygen gas O_2 is evolved at anode

Answer: a,d

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9. Which of the following changes will increase the EMF of the cell :

$$Co(s)\left|CoCl_2\left(M_2\right)\right|\left|HCl\left(M_2\right)\right| \mid \left(H_2, g\right)Pt$$

A. Increase the volume of $CoCl_2$ from $100mL$ to $200mL$

B. Increase M_2 from $0.1M$ to $0.50M$.

C. Increase the pressure of the $H_2(g)$ from 1.0 to $2.0atm$.

D. Increase M_1 from $0.01M$ to $0.50M$.

Answer: a,b

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10. Given :

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

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

Which of the following statements is / are incorrect ?

A. $AgNO_3$ can be stored in copper vessel.

B. $Cu(NO_3)_2$ 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: a,b,d

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11. Iron can be prevented from rusting by

A. Connecting iron to more electropositive metal - a case of cathodic protection

B. Connecting iron to more electropositive metal - a case of anodic protection.

C. Connecting iron to less electropositive metal - a case of anodic protection

D. Connecting iron to less electropositive metal - a case of cathodic protection.

Answer: a,c

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12. $100mL$ of buffer of $1MNH_3(aq)$ and $1MNH_4^{\oplus}(aq)$ are placed in two compartments of a voltaic cell separately. A current of $1.5A$ is passed through both cells for $20min$. If only electrolysis of water takes place, then

A. pH of LHE half celll will increase

B. pH of RHE half cell will increase

C. pH of both half cell will increase

D. pH of both half cell will decrease

Answer: B

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13. In the following electrochemical cell :

$Zn \left| Zn^{2+} \right| \left| H^{\oplus} \right| \left(H_2\right) Pt$

$E_{cell} = E^{c-}{}_{cell}$. This will be when

A. $\left[Zn^{2+}\right] = \left[H^{\oplus}\right] = 1M$ and $p_{H_2} = 1atm$

B. $\left[Zn^{2+}\right] = 0.01M, \left[H^{\oplus}\right] = 0.1M,$ and $p_{H_2} = 1atm$

C. $\left[Zn^{2+}\right] = 1M, \left[H^{\oplus}\right] = 0.1M,$ and $p_{H_2} = 1atm$

D. None of the above.

Answer: a,b

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14. For the electrochemical cell, $\left(M \mid M^{\oplus}\right) \mid \mid \left(X^{c-} \mid X\right)$, $E^{c-}{}_{\left(M^{\oplus} \mid M\right)} = 0.44V$, and $E^{c-}{}_{\left(X \mid X^{c-}\right)} = -0.33V$.

From this data, one can conclude that

A. $M + X \rightarrow M^{\oplus} + X^{c-}$ is a spontaneous reaction

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

C. $E^{c-}{}_{\cdot cell} = 0.77V$

D. $E^{c-}{}_{\cdot cell} = -0.77V$

Answer: b,c

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15. For a strong electrolyte, equivalent conductance increases slowly with dilution and can be expressed by the relationship: $\wedge_m = \wedge^{\circ}{}_{\cdot m} - A\sqrt{c}$

Which electrolyte (s) have same value of A ?

A. $NaCl$

B. $CaCl_2$

C. $ZnCl_2$

D. $MgSO_4$

Answer: b,c

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16. During electrolysis, $O_2(g)$ is evolved at anode in

A. Dilute H_2SO_4 with Pt electrode

B. Aqueous $AgNO_3$ with Pt electrode

C. Dilute H_2SO_4 with Cu electrode

D. Fused $NaOH$ with an Fe cathode and Ni anode

Answer: a,b

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

A. $Br_2(g)$ is evolved at anode

B. $Cu(s)$ is deposited at cathdoe

C. $Br_2(g)$ is evolved at anode and $H_2(g)$ at cathode

D. $H_2(g)$ is evolved at anode

Answer: a,b

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18. 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 the mass of cathode $= 3.174g$

B. Decrease in the mass of anode $= 3.174g$

C. No change in the mass of electrodes

D. The ration between the change in the mass of cathode to anode is $1:2$

Answer: a,b

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19. The EMF of the following cell :

$Cd(s)\left|CdCl_2(0.10M)\right|AgCl(s) \mid Ag(s)$ is $0.6915V$ at $0\,^{\circ}C$ and $0.6753V$ at $25\,^{\circ}C$. The ΔH of reaction in kJ at $25\,^{\circ}C$ is

A. -176

B. -234.7

C. 123.5

D. -167.6

Answer: d

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20. When $4.0A$ of current is passed through a $1.0L, 0.10MFe^{3+}(aq)$ solution for 1.0 hour, it is partly reduced to $Fe(s)$ and partly of $Fe^{2+}(aq)$. The correct statements (s) is (are):

A. $0.10mol$ of electrons are required to convert all Fe^{3+} to Fe^{2+}

B. $0.025 mol$ of $Fe(s)$ will be deposited.

C. $0.075 mol$ of iron remains as Fe^{2+}.

D. $0.050 mol$ of iron remains as Fe^{2+}

Answer: a,b,c

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21. In which of the following cells, EMF is greater than $E^{c-}{}_{cell}$?

A. $Pt, H_2(g)\left|H^{\oplus}(pH=5)\right|\left|H^{\oplus}(pH=3)\right| \mid H_2(g), Pt$

B. $Zn(s)\left|Zn^{2+}(0.2M)\right|\left|Cu^{2+}(0.1M)\right|Cu(s)$

C. $Cr(s)\left|Cr^{3+}(0.1M)\right|\left|Cu^{2+}(0.2M)\right|Cu(s)$

D. $Pt, H_2(g)\left|H^{\oplus}(pH=4)\right|\left|H^{\oplus}(pH=6)\right|H_2(g) \mid Pt$

Answer: a

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22. In the atmosphere of industrial smog, copper corrodes to form

A. Basic copper carbonate

B. Copper sulphide

C. Basic copper sulphate

D. Copper oxide

Answer: a,c

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

A. Ag_2O

B. Ag_2S

C. Ag_2CO_3

D. Ag_2SO_4

Answer: a,b

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24. If A + B $\rightleftharpoons$ C + D; $K_C = K_1$ and $E^{\ominus} = a$ V

24. If 2A + 2B $\rightleftharpoons$ 2C + 2D; $K_C = K_2$ and $E^{\ominus} = b$ V

then

A. $a = b$

B. $K_2 = K_1^2$

C. $a = 2b$

D. $b = a^2$

Answer: a,b

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25. Rusting of iron is catalyzed by

A. $H^{\oplus}$

B. Dissolved CO_2 in water

C. O_2

D. Impurities present in Fe

Answer: a,b,c,d

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26. Select the wrong relation (s).

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

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

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

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

Answer: a,d

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27. Select the correct statements (s) about NHE.

A. E^{c-} of SHE is arbitrarily assumed to be zero.

B. E^{c-} of SHE is equal to zero.

C. SHE refers as $Pt, H_2(g) 1bar \mid H^{\oplus}(aq)_{a=1}$ at $25^{\circ} C$.

D. SHE is very susceptible to dissolved O_2, H_{20S} and all other reducing agents.

Answer: a,c,d

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

A. $Pb\left|PbSO_4(s)\right|H_2SO_4\left|PbO_2(s)\right|Pb$

B. $Cd|CdO(s)|KOH(aq)\left|NiO_2(s)\right|Ni$

C. $Fe(s)|FeO(s)|KOH(aq), Ni_2O_3(s) \mid Ni$

D. $Zn\left|ZnSO_4\right|CuSO_4 \mid Cu$

Answer: a,b,c

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

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

A. Ag will oxidize to $Ag^{\oplus}$ and new $\left[Ag^{\oplus}\right] = 1.36M.$

B. $Ag^{\oplus}$ will reduce to Ag and new $\left[Ag^{\oplus}\right] = 0.64M$

C. Cu^{2+} will reduce to Cu and new $\left[Cu^{2+}\right] = 0.82M.$

D. Cu will oxidize to Cu^{2+} and new $\left[Cu^{2+}\right] = 0.82M.$

Answer: a,c

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30. The temperature coefficient of the cell is $\left(\frac{\partial E}{\partial T}\right)_P$. Choose the correct statements (s).

A. When $\left(\frac{\partial E}{\partial T}\right)_P = 0$, then $\Delta H = -nFE$

B. When $\left(\frac{\partial E}{\partial T}\right)_P < 0$, then $|nFE| > |\Delta H|$

C. When $\left(\frac{\partial E}{\partial T}\right)_P > 0$, then $|nFE| < |\Delta H|$ Exothermic reaction

D. When $\left(\frac{\partial E}{\partial T}\right)_P = 0$, then $|\Delta H| > |nFE|$ Endothermic reaction.

Answer: a,b,c

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31. During discharging of alead storage battery

A. The reaction at anode is $Pb \rightarrow Pb^{2+} + 2e^-$

B. The reaction taking place at cathode is

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

C. The overall reaction is

$$Pb + PbO_2 + 4H^{\oplus} + 2SO_4^{2-} \rightarrow 2PbSO_4 + 2H_2O$$

D. The reaction taking place at cathode is

$$PbO_2 + 4H^{\oplus} + 2e^{-} \rightarrow Pb^{2+} + 2H_2O$$

Answer: a,c,d

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

A. F_2 is the strongest oxidizing agent. F

B. Li is the strongest reducing agent.

C. $Li^{\oplus}$ is the weakest oxidizing agent.

D. F_2 has a highest reduction potential.

Answer: a,b,c,d

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33. Identify the correct statements (s):

A. $\wedge_m$ increases with increase in temperature.

B. $\wedge_m$ decreases with increase in concentration.

C. Specific conductance increase with increase in concentration.

D. Specific conductance decreases with increse in temperature.

Answer: a,b,c

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34. Which of the following cells is / are rechargeable or secondary cell (s)

?

A. Ni - Cd cell

B. Mercury cell

C. Lead storage cell

D. Lithium battery

Answer: a,c,d

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35. For $I_2 + 2e^- \rightarrow 2I^{c-}$, standard reduction potential $= +0.54V$. For $2Br^{c-} \rightarrow Br_2 + 2e^-$, standard oxidation potential $= -1.09V$. For $Fe \rightarrow Fe^{2+} + 2e^-$, standard oxidation potential $= +0.44V$. Which of the following reactions is (are) spontaneous ?

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

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

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

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

Answer: a,b,c

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36. Consider the cell :

$$Pt\left|H_2\left(p_1atm\right)\right|H^{\oplus}\left(x_1M\right) \mid \left|H^{\oplus}\left(x_2M\right)\right|H_2\left(p_2atm\right)Pt.$$

The cell reaction be spontaneous if

A. $p_1 = p_2$ and $x_1 < x_2$

B. $p_1 = p_2$ and $x_1 < x_2$

C. $x_1 = x_2$ and $p_1 > p_2$

D. $x_1 = x_2$ and $p_1 < p_2$

Answer: b,c

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37. Which of the following changes will cause the free energy of a cell reaction to decrease ?

$Zn\left|ZnSO_4(aq)\left(x_1M\right)\right|\left|HCl(aq)\left(x_2M\right)\right|H_2(g), Pt.$

A. Increase in the volume of HCl solution from $100mL$ to$200mL$

B. Increase in the pressure of hydrogen from $1atm$ to $2atm$

C. Increase in molarity x_2 from 0.1 to $1M$

D. Increase in molarity x_1 from $1M$ to $0.1M$.

Answer: c,d

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38. 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, $Q = K_{eq}, E_{cell} = 0$

Answer: a,c,d

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39. In the following electrochemical cell :

$Zn\left|Zn^{2+}\right|\left|H^{\oplus}\right|\left(H_2\right)Pt$

$E_{cell} = E^{c-}{}_{\cdot cell \cdot}$ This will be when

A. $\left[Zn^{2+}\right] = \left[H^{\oplus}\right] = 1M$ and $p_{H_2}1atm$

B. $\left[Zn^{2+}\right] = 0.01M, \left[H^{\oplus}\right] = 0.1M,$ and $p_{H_2} = 1atm$

C. $\left[Zn^{2+}\right] = 1m, \left[H^{\oplus}\right] = 0.1M,$ and $p_{H_2} = 0.01atm$

D. $\left[Zn^{2+}\right] = \left[H^{\oplus}\right] = 0.1M$ and $p_{H_2} = 0.1atm$

Answer: a,b,c,d

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40. Consider the cell :

$$Cd(s)\left|Cd^{2+}(1.0M)\right|\left|Cu^{2+}(1.0M)\right|Cu(s)$$

If we wish to make a cell with a more positive voltage using the same substances, we should

A. Increase both $\left[Cd^{2+}\right]$ and $\left[Cu^{2+}\right]$ to $2.0M$

B. Decrease the $\left[Cd^{2+}\right.$ to $1.0m$

C. Increase the $\left[Cu^{2+}\right]$ to $2.0M$

D. Decrease both the $\left[Cd^{2+}\right]$ and $\left[Cu^{2+}\right]$ to $0.01M$

Answer: b,c

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41. Electrolysis of aqueous solutions of which of the following substances results in only the decomposition of water ?

A. Potassium chloride

B. Zinc sulphate

C. Potassium hydroxide

D. Sodium phosphate

Answer: c,d

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42. When an aqueous solution of $CaCl_2$ is electrolyzed using inert electrods, which of the following is (are) true ?

A. Calcium deposites on cathode.

B. Calcium deposits an anode

C. Chloride is liberated on anode

D. Calcium hydroxide precipitates near cathode on prolonged hydrolysis

Answer: c,d

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43. On passing $0.5m\infty l$ of electrons through $CuSO_4$ and $Hg_2(NO_3)_2$ solutions in series using inert electrodes

A. $0.5mol$ of Cu is deposited

B. $0.5mol$ of Hg is deposited

C. $0.125mol$ of O_2 is produced

D. $0.5mol$ of O_2 is produced

Answer: b,c

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

A. The electrolysis of concentrated H_2SO_4 at $0 - 5^\circ C$ using a Pt electrode produces $h_2S_2O_8$.

B. The electrolysis of a brine solution produces $NaClO_3$ and $NaClO$.

C. The electrolysis of $CuSO_4$ solution using Pt electrodes causes the liberation of O_2 at anode and the deposition of copper at cathode.

D. All electrolytic reactions are redox reactions.

Answer: a,c,d

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45. 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 iron deposited in $Fe_2(SO_{4\_}(3)$ and $Fe(NO_3)_2$ are equal.

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

Answer: b,c,d

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46. Which of the following aqueous solutions remain alkaline after electrolysis ?

A. CH_3COONa

B. KNO_3

C. $NaCl$

D. LiF

Answer: a,c

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47. A solution containing $Na^{\oplus}, NO_3^{c-}, Cl^{c-}$, and SO_4^{2-} ions, all at unit concentrations, is electrolyzed between nickel anode and platinum

cathode. As the current is passed through the cell

A. Ph of the cathode increases

B. Oxygen is the major product at anode

C. Nickel is deposited at cathode.

D. Chlorine is the major product at anode.

Answer: a,d

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48. To obeserve the effect of concentration on the conductivity, electrolytes of different natures are taken in two vessels A and B, A contains weak electrolyte, $e.g.,NH_4OH$ and B contains strong electrolyte, $e.g.,NaCl$. In both containers, the concentration of respective electrolyte is increased and the conductivity observed:

A. In A conductivity increases, in B conductivity decrease

B. In A conductivity decreases while, in B conductivity decrease

C. In both A and B conductivity increases

D. In both A and B conductivity decreases

Answer: c

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49. Consider the following concentration cell :

$Zn(s)\left|Zn^{2+}(0.024M)\right|\left|Zn^{2+}(0.480M)\right|Zn(s)$

which of the following statements is / are correct?

A. The EMF of the cell at $25^{\circ}C$ is nearly $0.038V$.

B. The EMF of the cell at $25^{\circ}C$ is nearly $0.038V$.

C. If water is added in LHE, so that the $\left[Zn^{2+}\right]$ is reduced to $0.012M$, the cell voltage increases.

D. If water is added in LHE, so that the $\left[Zn^{2+}\right]$ is reduced to $0.12M$, the cell voltage remains same.

Answer: a,c

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50. Given :

Oxidation$H_2O_2 \rightarrow O_2 + 2H^{\oplus} + 2e^- \quad E^{c-} = -0.69V,$

$2F^{c-} \rightarrow F_2 + 2e^- \quad E^{c-} = -287V,$

Reduction : $H_2O_2 + 2H^{\oplus} + 2e^- \rightarrow 2H_2O \quad E^{c-} = 1.77V,$

2I^(c-)rarr I_(2)+2e^(-)" "E^(c-)=-0.54V,$Whichofthefollow \in gstatementsis//$`

are correct ?

A. H_2O_2 behaves as an oxidant for I_2/I^{c-}

B. H_2O_2 behaves as an reductant for I_2/I^{c-}

C. I^{c-}/I_2 behaves as an reductant for H_2O_2

D. None of these is correct

Answer: a,c

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51. Which of the following statements regarding rusting of iron is / are correct ?

A. It takes place is moist air.

B. It is stopped in CO_2 atmosphere

C. If produces $Fe(III)$ oxide.

D. It is an electrochemical process.

Answer: a,c,d

View Text Solution

52. Given :

$A^{2+} + 2e^- \rightarrow A(s) \quad E^{c-} = 0.08V$

$B^{\oplus} + e^- \rightarrow B(s) \quad E^{c-} = -0.64V$

$X_2(g) + 2e^- \rightarrow 2X^{c-} \quad E^{c-} = 1.03V$

Which of the following statements is / are correct ?

A. $X_2(g)$ will oxidize both (A) and (B).

B. A^{2+} will oxidize both (A) and (B)

C. The reaction

$$2X^{c-}(1.0M) + A^{2+}(1.0M) \rightarrow X_2(1atm) + A(s)$$

will be spontaneous.

D. The oxidizing power of $A^{2+}, B^{\oplus}$, and $X_2(g)$ is in the order

$X_2 > A^{2+} > B^{\oplus}$

Answer: a,b,d

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

A. Rust is Fe_2O_3

B. Zn - Cu cell is called Daniell cell

C. Saline water slows down rusting.

D. Pure metals undergo corrosino faster then impure metals.

Answer: a,c,d

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Exercises Ingle Correct

1. Which of the following solutions can be safely stored in a copper vessel ?

A. $ZnSO_4$

B. $AgNO_3$

C. $AuCl_3$

D. All of them.

Answer: a

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2. If X is the specific resistance of the solution and N is the normality of the solution, the equivalent conductivity of the solution is given by

A. $\frac{1000x}{N}$

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

C. $\frac{1000N}{x}$

D. $\frac{Nx}{1000}$

Answer: b

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3. By virtue of Faraday's second law of electrolysis, the electrochemical equivalent of the two metals liberated at the electrodes has the same ratio as that of their

A. Atomic masses

B. Molecular masses

C. Equivalent masses

D. Any of three

Answer: c

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4. The units of conductivity of the solution are

A. ohm^{-1}

B. $ohms$

C. $ohm^{-1}cm^{-1}$

D. $ohm^{-1}eq^{-1}$

Answer: c

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5. According of Kohlrausch law, the limiting value of molar conductivity of an electrolyte A_2B is

A. $\lambda^{\infty}{}_{\cdot A^{+}} + \lambda^{\infty}{}_{\cdot}\left(B^{-}\right)$

B. $\lambda^{\infty}{}_{\cdot A^{+}} - \lambda^{\infty}{}_{\cdot B^{-}}$

C. $2\lambda^{\infty}{}_{\cdot A^{+}} + \frac{1}{2}\lambda^{\infty}{}_{\cdot}\left(B^{-}\right)$

D. $2\lambda^{\infty}{}_{\cdot A^{+}} + \lambda^{\infty}{}_{\cdot B^{-}}$

Answer: d

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6. The values of $\wedge_m^{\infty}$ for $NH_4Cl, NaOH,$ and $NaCl$ are, respectively, $149.74, 248.1,$and $126.4 ohm^{-1} cm^2 eq^{-1}$. The value of $\wedge_{eq}^{\infty} NH_4OH$ is

A. 371.44

B. 271.44

C. 71.44

D. It cannot be calculated from the data given.

Answer: b

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7. $0.5F$ of electricity is passed through $500mL$ of copper sulphate solution. The amount of copper which can be deposited will be

A. $63.5g$

B. $31.75g$

C. $15.8g$

D. Unpredictable

Answer: c

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8. On carrying out the electrolysis of acidified water, the volume of hydrogen liberated at STP condition is $22.4L$. The volume of oxygen liberated is

A. $22.4L$

B. $44.8L$

C. $11.2L$

D. $2.24L$

Answer: c

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9. During the electrolysis of the aqueous solution of copper sulphate using Pt electrode, the reaction taking place at anode electrode is

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

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

C. $2H_2O \rightarrow 4H^{\oplus} + O_2 + 4e^-$

D. $H_2O + e^- \rightarrow \overset{c-}{OH} + 1/2H_2$

Answer: c

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10. In passing $3F$ of electricity through three electrolytic cells connect in series containing $Ag^{\oplus}, Ca^{2+},$ and Al^{3+} ions, respectively. The molar ratio in which the three metal ions are liberated at the electrodes is

A. $1:2:3$

B. $2:3:1$

C. $6:3:2$

D. $3:4:2$

Answer: c

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11. Given that $I_2 + 2e^- \rightarrow 2I^{c-}, \quad E^{c-} = 0.54V$

$Br_2 + 2e^- \rightarrow 2Br^-, \quad E^{c-} = 1.69V$

Predict which of the following is true.

A. I^{c-} ions will be able to reduce bromine.

B. Br^{c-} ions will be able to reduce iodine.

C. Iodine will be able to reduce broming.

D. Bromine will be able to reduce iodide ions.

Answer: a

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12. The increase in the molar conductivity of HCl with dilution is due to

A. Increase in the self ionization of water

B. Hydrolysis of HCl

C. $Decrease \in theselfionizationofwater$

D. Decrease in the interionic forces.

Answer: D

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13. An electrochemical cell stops working after some time because

A. Electrode potential of both the electrodes becomes zero.

B. Electrode potential both the electrons becomes equal.

C. One of the electrode is eaten away.

D. The reaction starts proceeding in opposite direction.

Answer: b

Watch Video Solution

14. Which of the following statements is correct for a galvanic cell?

A. Reduction occurs at cathode

B. Oxidation occurs at anode

C. Electrons flow from anode to cathode

D. All the statements are correct.

Answer: d

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15. Given

$E^{c-}\cdot_{Ag^{\oplus} \mid Ag} = +0.80V, E^{c-}\cdot_{Co^{2} \mid Co} = -0.28V, E^{c-}\cdot_{Cu^{2+} \mid Cu} = +0.34V, E^{c-}\cdot_{Zn^{2}}$

Which metal will corrode fastest ?

A. Ag will oxidize to $Ag^{\oplus}$ and new $\left[Ag^{\oplus}\right] = 1.36M.$

B. Cu

C. Co

D. Zn

Answer: d

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16. Red hot carbon will remove oxygen from the oxides XO and Yo but not from ZO. Y will remove oxygen from XO. Use this evidence to deduce the order of activity of the three metals $X, Y,$ and $Z,$ putting the most reactive first.

A. X, Y, Z

B. Z, Y, X

C. Y, X, Z

D. Z, X, Y

Answer: b

Watch Video Solution

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

A. Na and S

B. Hg, pT and S

C. $Na, Hg,$ and S

D. $Hg, Pt,$ and graphite

Answer: d

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18. In an electrolytic cell current flows

A. From cathode to anode in outer circuit

B. From anode to cathode outside the cell

C. From cathode to anode inside the cell

D. None of the above.

Answer: a

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19. The reaction $Cu^{2+}(aq) + 2Cl^{c-}(aq) \rightarrow Cu(s) + Cl_2(g)$ has $E^{c-}{\cdot}_{cell} = -1.03V$. This reaction

A. Can be made to produce electricity in voltaic cell

B. Can be made to occur in an electrolytic cell

C. Can occur in acidic medium only

D. Can occur in basic medium only.

Answer: b

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

A. $E^{\Theta}_{cell} > 0, \Delta G^{\Theta} < 0, Q < K_c$

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

C. $E^{\Theta}_{cell} > 0, \Delta G^{\Theta} > 0, Q > K_c$

D. $E^{\Theta}_{cell} > 0, \Delta G^{\Theta} > 0, Q < K_c$

Answer: A

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

A. $E^{c-}\cdot_{OP}$ of $Zn < E^{c-}\cdot_{OP}$ of Fe

B. $E^{c-}\cdot_{OP}$ of $Zn > E^{c-}\cdot_{OP}$ of Fe

C. $E^{c-}\cdot_{OP}$ of $Zn = E^{c-}\cdot_{OP}$ of Fe

D. Zn is cheaper than iron

Answer: b

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

A. $-0.59V$

B. $0.00V$

C. $+0.59V$

D. $0.059V$

Answer: c

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23. E^{c-} of $Mg^{2+}\left|Mg, Zn^{2+}\right|Zn$, and $Fe^{2+} \mid Fe$ are $-2.37V$, $-0.76V$, and $-0.44V$, respectively. Which of the following is correct ?

A. Mg oxidize Fe

B. Zn oxidizes Fe

C. Zn reduces Mg^{2+}

D. Zn reduces Fe^{2+}

Answer: d

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

A. Increases by $30mV$

B. Decreases by $30mV$

C. Increases by $59mV$

D. Decrease by $59mV$

Answer: b

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25. Deduce from the following E^{c-} values of half cells, what combination of two half cells would results in a cell with the largest potential?

$I.$	$A + e(-) \rightarrow A^{c-}$	$E^{c-} = -0.24V$
$II.$	$B^{c-} + e^{-} \rightarrow B^{2-}$	$E^{c-} = +1.25V$
$III.$	$C^{c-} + 2e^{-} \rightarrow C^{3-}$	$E^{c-} = -1.25V$
$IV.$	$D + 2e^{c-} \rightarrow D^{2-}$	$E^{c-} = +0.68V$

A. II, IV

B. II, III

C. III, IV

D. I, II

Answer: b

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26. Calculate the solubility product of $Co_2\left[Fe(CN)_6\right]$ in water at $25^\circ C$.

Given, conductivity of saturated solutions of $Co_2\left[Fe(CN)_6\right]$ is

$2.06 \times 10^{-6}\Omega^{-1}cm^{-1}$ and that of water used is $4.1 \times 10^{-7}\Omega^{-1}cm^{-1}$. The ionic molar conductivities of Co^{2+} and $\left[Fe(CN)_6\right]^4$ are $86.0\Omega cm^2 mol^{-1}$ and $444.0\Omega^{-1}cm^2 mol^{-1}$, respectivly.

A. 7.87×10^{-7}

B. 7.87×10^{-6}

C. 7.87×10^{-8}

D. 7.87×10^{-9}

Answer: a

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27. Given $E^{c-}._{Fe^{2+} \mid Fe}$ and $E^{c-}._{Fe^{3+} \mid Fe^{2+}}$ are -0.44 and $0.77V$ respectively. If Fe^{2+}, Fe^{3+} and Fe blocks are kept together, then $\left[Fe^{3+}\right]$ .... and $\left[Fe^{2+}\right]$....................... .

A. Fe^{3+} increases

B. Fe^{3+} decreases

C. Fe^{2+}, Fe^{3+} remain unchanged

D. Fe^{2+} decreases

Answer: b

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28. The dissociation of a wask electrolyte obeys the law of mass action. It was found by

A. Ostwald

B. Arrhenius

C. Berzelius

D. None of these

Answer: a

Watch Video Solution

29. During electrolysis of fused calcium hydride, the hydrogen is produced at

A. Cathode

B. Anode

C. Hydrogen is not liberated at all

D. H_2 produced reacts with oxygen to form water.

Answer: b

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30. The increase in the value of molar conducitivity of acetic acid with dilution is due to

A. Decrease in interionic forces and increases in α

B. Increase in the degree of ionization and interionic forces.

C. Increase in self ionization of water.

D. None of these

Answer: a

Watch Video Solution

31. Which of the following is anodic reaction.

A. $SO_4^{2-} + H_2O \rightarrow H_2SO_4 + 1/2O_2 + 2e^-$

B. $H^{\oplus} + e^- \rightarrow 1/2OH_2$

C. $Ag^{\oplus} + e^- \rightarrow Ag$

D. None of these

Answer: a

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32. The value of molar conductivity of HCl is greater than that of $NaCl$ at a particular temperature because

A. Molecular mass of HCl is less thatn that of $NaCl$

B. Velocity of $H^{\oplus}$ ions is more than that of $Na^{\oplus}$ ions.

C. HCl is stongly acidic.

D. Ionization of HCl is larger than that of $NaCl$.

Answer: b

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

A. 1.1 hours

B. 46 hours

C. 53.6 hourse

D. 24 hours.

Answer: c

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

A. $96500C$

B. $2 \times 96500C$

C. $3 \times 96500C$

D. $6 \times 96500C$

Answer: d

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35. In order to completely oxidize $0.1 mol$ of MnO_4^{2-} to permanganate ion. The quantity of electricity required is

A. $96500C$

B. $2 \times 96500C$

C. $9650C$

D. $96.50C$

Answer: c

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

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

B. $Pb + PbO_2 + H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O$

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

D. $PbSO_4 + 2H_2O \rightarrow Pb + PbO_2 + 2H_2SO_4 + 2e^-$

Answer: c

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37. In H_2 - O_2 fuel cell, the reaction occurring at cathode is

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

B. $H^{\oplus} + \overset{c-}{OH} \rightarrow H_2O$

C. $O_2 + 2H_2O + 4e^- \rightarrow 4\overset{c-}{OH}$

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

Answer: c

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38. The thermodynamic efficiency of cell is given by

A. $\Delta H / \Delta G$

B. $\frac{Nfe}{\Delta G}$

C. $\frac{-nFE}{\Delta H}$

D. nFE^{c-}

Answer: c

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39. $10800C$ of electricity passed through the electrolyte deposited $2.977g$ of metal with atomic mass $106.4gmol^{-1}$. The charge on the metal cation is

A. $+4$

B. $+3$

C. $+2$

D. $+1$

Answer: a

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40. In which of the following will the corrosion of iron be most rapid?

A. In pure water

B. In pure oxygen

C. In air and moisture

D. In air and saline water

Answer: d

Watch Video Solution

41. The two Pt electrodes fitted in a conductance cell are $1.5cm$ apart while the cross - sectional area of each electrode is $0.75cm$. What is the cell constant?

A. 1.125

B. $0.5cm$

C. $2.0cm^{-1}$

D. $0.2cm^{-1}$

Answer: c

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42. For a reaction $A(s) + 2B^{\oplus} \rightarrow A^{2+} + 2B$

K_c has been found to be 10^{12}. The $E^{c-}\cdot_{cell}$ is

A. $0.354V$

B. $0.708V$

C. $0.0098V$

D. $1.36V$

Answer: a

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43. Rust is a mixture of

A. FeO and $Fe(OH)_2$

B. FeO and $Fe(OH)_3$

C. Fe_2O_3 and $Fe(OH)_3$

D. Fe_3O_4 and $Fe(OH)_3$

Answer: c

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44. Galvanized iron sheets are coated with

A. Copper

B. Nickel

C. Zinc

D. Carbon

Answer: c

Watch Video Solution

45. An example of a simple fuel cell is

A. Lead storage battery

B. Leclanche cell

C. H_2 - O_2 cell

D. All of these

Answer: c

Watch Video Solution

46. For an electrolyte solution of $0.05 mol L^{-1}$, the conductivity has been found to be $0.0110 S cm^{-1}$. The molar conductivity is

A. $0.05 Scm^2 mol^{-1}$

B. $550 Scm^2 mol^{-1}$

C. $0.22 Scm^2 mol^{-1}$

D. $220 Scm^2 mol^{-1}$

Answer: d

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47. 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 $0.41V$

D. Decrease by $0.41V$

Answer: d

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48. If $E^{c-}\cdot_{Fe^{3+}\,|\,Fe}$ and $E^{c-}\cdot_{Fe^{2+}\,|\,Fe}$ are $= -0.36V$ and $-0.439V$, respectively, then the value of $E^{c-}\cdot_{Fe^{3+}\,|\,Fe^{2+}}$

A. $(-36-0.439)V$

B. $[3(-0.36-0.436)]V$

C. $(-0.36=0.436)V$

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

Answer: d

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49. The standard electrode of a metal ion $\left(Ag\,|\,Ag^{\oplus}\right)$ and metal - insoluble salt anion $\left(Ag|AgCl|Cl^{c-}\right)$ are related as

A. $E^{c-}\cdot_{Ag^{\oplus}\,|\,Ag}=E^{c-}\cdot_{Cl^{c-}\,|AgCl|Ag}+\dfrac{RT}{F}\ln K_{sp}$

B. $E^{c-}{\cdot}_{Cl^{c-}|AgCl|Ag} = E^{c-}{\cdot}_{Ag^{\oplus}Ag} + \frac{RT}{F}\ln K_{sp}$

C. $E^{c-}{\cdot}_{Ag^{\oplus}|Ag} = E^{c-}{\cdot}_{Cl^{c-}|AgCl|Ag} + \frac{RT}{F}\ln.\frac{[Cl^{c-}]}{K_{sp}}$

D. $E^{c-}{\cdot}_{Cl^{c-}|AgCl|Ag} = E^{c-}{\cdot}_{Ag^{\oplus}|Ag} + \frac{RT}{F}\ln.\frac{K_{sp}}{[Cl^{c-}]}$

Answer: b

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50. The standard reduction potential at $25^{\circ}C$ for the reaction,

$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH$ is -0.8277 volt. The

equilibrium constant for the reaction :

$2H_2O \rightleftharpoons H_3O^{\oplus} + \overset{\ominus}{O}H$ at 25°C is is

A. 10^{-12}

B. 10^{-14}

C. 10^{-11}

D. 10^{-11}

Answer: b

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51. What would be the magnitude of EMF of the following cell :

$Pt(H_2)$	0.1 M acetic acid 0.1 M sodium acetate	0.1 M formic acid 0.1 M sodium fomate	$Pt(H_2)$

$$Pt(H_2) \mid \begin{matrix} 0.1\text{ M acetic acid} \\ 0.1\text{ M sodium acetate} \end{matrix} \parallel \begin{matrix} 0.1\text{ M formic acid} \\ 0.1\text{ M sodium fomate} \end{matrix} \mid Pt(H_2)$$

at $25^{\circ}C$? The ionization constant of acetic acid, $K_a \sim 10^{-5}$, while that of formic acid, $K_a \sim 10^{-4}$

A. $0.0295V$

B. $0.059V$

C. $-0.059V$

D. $-0.0295V$

Answer: b

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52. The rusting of iron takes place as follows :

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

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

Calculae ΔG^{c-} for the net process.

A. $-322kJmol^{-10}$

B. $-161kJmol^{-1}$

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

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

Answer: a

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53. For the electrolytic production of $NaClO_4$ from $NaClO_3$ according to the reaction $NaClO_3 + H_2O \rightarrow NaClO_4 + H_2$. How many faradays of electricity would be required to produce $0.5 mole$ of $NaClO_4$?

A. 1

B. 2

C. 3

D. 1.5

Answer: a

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54. If the specific conductane of $1 M H_2SO_4$ solution is $26 \times 10^2 Scm^2$, then the equivalent conductivity would be

A. $1.3 \times 10^2 Scm^{-1}$

B. $1.6 \times 10^2 Scm^{-2}$

C. $13 Scm^2 mol^{-1}$

D. $1.3 \times 10^3 Scm^2 mol^{-1}$

Answer: a

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

A. $0.1M$ acetic acid

B. $0.1M$ chloro acetic acid

C. $0.1M$ fluoro acetic acid

D. $0.1M$ difluoro acetic acid

Answer: d

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56. Which of the following statements is wrong ?

A. The conductance of $1cm^3$ of a material is called specific conductance.

B. Specific conductance increases while equilvalent conductance decreases on progressive dilution.

C. The limiting equivalent conductances of weak electrolytes cannot be determined by the extrapolation of the plot of $\wedge$ against concentration.

D. The conductivity of metals is due to the movement of electrons.

Answer: b

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57. Which of the following statement is correct ?

A. Specific conductance of a solution decreases with dilution, whereas molar conductance increases with dilution.

B. Specific conductance of a solution increases with dilution, whereas molar conductance decreases with dilution

C. Both specific conductance and molar conductance decrease with dilution.

D. Both specific conductance and molar conductance increase with dilution.

Answer: a

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58. For a dilute solution of a strong electrolyte, the variation of molar conductivity with concentration is given by

A. $\wedge_m = \wedge^{\circ}{}_{m} + Ac$

B. $\wedge_m = \wedge^{\circ}{}_{m} - Ac$

C. $\wedge_m = \wedge^{\circ}{}_{m} + A\sqrt{c}$

D. $\wedge_m = \wedge^{\circ}{}_{\cdot m} - A\sqrt{c}$

Answer: D

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59. How many coulombs are required for the oxidation of $1mol$ of H_2O to O_2?

A. $93000C$

B. $1.93 \times 10^5 C$

C. 9.65×10^{40C}

D. $19.3 \times 10^2 C$

Answer: b

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60. On electrolysis of a solution of dilute H_2SO_4 between platinum electrodes , the gas evolved at the anoe is

A. SO_2

B. SO_3

C. O_2

D. H_2

Answer: c

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61. In electrolysis of very dilute of $NaOH$ using platinum electrodes

A. H_2 is evolved at cathode and O_2 at anode

B. NH_3 is produced at anode

C. Cl_2 is obtained at cathode

D. O_2 is produced at cathode and H_2 at anode.

Answer: a

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

A. Chloride ions are oxidized

B. Chloride ions ar reduced

C. Sodium ions ar oxidized

D. Sodium ions are reduced

Answer: a

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63. Two platinum electrodes were immersed in a solution of $CuSO_4$ and electric current was passed through the solution. After some time, it was found that colour of $CuSO_4$ disappeared with evolution of gas at the electrode. The colourless solution contains.

A. Platinum sulphate

B. Copper hydroxide

C. Copper sulphate

D. Sulphuric acid

Answer: d

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

A. Does not change

B. Increase to maximum

C. Decreases to half the value

D. Drops to zero

Answer: d

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

A. $ZnCl_2$

B. $CuSO_4$

C. Hg_2Cl_2

D. $HgCl_2$

Answer: c

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66. When electricity is passed through a solution of $AlCl_3$ and $13.5g$ of Al is deposited, the number of $Faradayofe \leq ctricitypassed\mu stbe$.......................F`.

A. 0.5

B. 1.0

C. 1.5

D. 2.0

Answer: c

Watch Video Solution

67. What weight of copper will be deposited by passing 2 faradays of electricity through a cupric salt (atomic weight of $Cu = 63.5$) ?

A. 2.0

B. 3.175

C. 63.5

D. 127.0

Answer: c

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68. A cell constant is generally found by measuring the conductivity of aqueous solution of

A. $BaCl_2$

B. KCl

C. $NaCl$

D. $MgCl_2$

Answer: b

View Text Solution

69. A solution of sodium sulphate was electrolyzed using some inert electrode. The product at the electrodes are

A. O_2, H_2

B. O_2, Na

C. O_2, SO_2

D. $O_2, S_2O_8^{2-}$

Answer: a

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70. A solution of $9.65A$ flowing for $10min$ deposits $3.0g$ of the metal which is monovalent. The atomic mass of the metal is

A. 10

B. 50

C. 30

D. 96.5

Answer: b

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71. A certain current liberates $0.5g$ of hydrogen in 2 hours. How many grams of copper can be liberated by the same current flowing for the same time in a copper sulphate solution ?

A. $12.7g$

B. $15.9g$

C. $31.8g$

D. $63.5g$

Answer: b

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72. The mass of copper that will be deposited at cathode in electrolysis of $0.2M$ solution of copper sulphate when a quantity of electricity equal to that required to liberate $2.24L$ of hydrogen from $0.1M$ aqueous H_2SO_4 is passed (atomic mass of $Cu = 63.5$) will be

A. $1.59g$

B. $3.18g$

C. $6.35g$

D. $12.70g$

Answer: c

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73. Which of the following is a strong electrolyte ?

A. $Ca(NO_3)_2$

B. HCN

C. H_2SO_3

D. NH_4OH

Answer: a

View Text Solution

74. The standard reduction potential of $Li^{\oplus}|Li, Ba^{2+}|Ba, Na^{\oplus}|Na$ and $Mg^{2+}|Mg$ are -3.05, -2.71, -2.71, and -2.37 volts, respectvely. Which one of the following is the strongest oxidizing agent ?

A. $Na^{\oplus}$

B. $Li^{\oplus}$

C. Ba^{2+}

D. Mg^{2+}

Answer: d

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

A. 4.6

B. 9.2

C. 18.4

D. 0.023

Answer: a

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76. What volume of $0.1 N FeSO_4$ can be oxidized by a current of 2 ampere hours ?

A. $0.746 L$

B. $7.46L$

C. $1.482L$

D. $0.373L$

Answer: a

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77. $500mL$ of $1N$ solution of $CuCl_2$ was electrolyszed with a current fo 2 amperes for 1 hour. What is the normality of the remaining $CuCl_2$ solution ?

A. 0.85

B. 0.15

C. 0.30

D. 1.0

Answer: a

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78. Ionic strength of $0.4MCaCl_2$ is

A. 1.2

B. 1.0

C. 0.9

D. 0.8

Answer: a

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79. Ionic strength of $0.4MCaCl_2$ is

A. 2.8

B. 1.2

C. 1.0

D. 1.8

Answer: b

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80. Ionic strength of a solution made by mixing equal volumes of $0.01 M NaCl$ and $0.02 M AlCl_3$

A. 0.065

B. 0.13

C. 0.0325

D. 0.0216

Answer: a

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81. Marshell's acid is prepared by the electrolytic oxidation of H_2SO_4 as

$2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^{\oplus} + 2e^{-}$

Oxygen and hydrogen are byproducts. In such electrolysis $2.24L$ of H_2 and $0.56L$ of O_2 were product at STP. The weight of $H_2S_2O_8$ fromed is

A. $9.7g$

B. $19.4g$

C. $14.55g$

D. $29.1g$

Answer: a

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82. The volume of gases evolved at STP by passing $0.1A$ of current for $965g$, through an aqueous solution of potassium acetate

A. $22.4mL$

B. $11.2mL$

C. $89.6mL$

D. $44.8mL$

Answer: d

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83. The mass of gases evolved in Question is

A. $0.06g$

B. $0.6g$

C. $6.0g$

D. $60g$

Answer: a

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84. The volume of gases evolved at STP by passing $0.2A$ of current for $965s$ through an aqueous solution of sodium furmarate is

A. $22.4mL$

B. $11.2mL$

C. $89.6mL$

D. $44.8mL$

Answer: c

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85. The products obtained at cathode and anode on electrolysis of aqueous sodium succinate are

A. Anode : Ehene+ CO_2, Cathode: H_2

B. Anode : Ethyne+ CO_2,Cathode : H_2

C. Anode: Ethene+ H_2, Cathode : Na

D. Anode: Ethyne $+H_2$, Cathode: Na

Answer: a

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86. What is the electrode potential of a gasous hydrogen electrode dipped in a solution $pH = 5.0$ relative to the calomel electrode with an electrode potential of $+0.28V$?

A. $0.0125V$

B. $+0.575V$

C. $+0.015V$

D. $-0.575V$

Answer: d

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87. 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. $0.0125V$

B. $0.0250V$

C. $0.0178V$

D. $0.0356V$

Answer: c

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88. A certain electrode has standard (reduction potential) of $0.384V$. The potential when measured against a normal calomel electrode (with electrode potential $= 0.28V$) is

A. 0.104

B. 0.664

C. 0.3322

D. 0.218

Answer: a

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89. The potential of a hydrogen electrode in a solution with $pOH = 4$ at $25^\circ C$ is

A. $+0.59$

B. -0.59

C. -0.295

D. 0.295

Answer: c

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

A. -0.059

B. 0.059

C. -0.59

D. 0.59

Answer: c

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91. Consider the electrode $Ag \mid AgCl(s), Cl^{c-}(0.1M), i.e.,$ silver electrode in contact with$0.1MKCl$ solution saturated with $AgCl$. If it is combined with the electrode $Ag \mid Ag^{\oplus}(0.1M)$ to form a complete cell, the EMF would be $\left(K_{sp} of AgCl = 10^{10} \text{ at } 25^{\circ} C\right)$

A. 0.799

B. - .6363

C. 0.59

D. 0.472

Answer: d

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92. A current strength of $1.0A$ is passed for $96.5s$ through $100mL$ of a solution of $0.05MKCl$. The concentration of the final solution with respect to $\overset{c-}{OH}$ ions is

A. $0.005M$

B. $0.05M$

C. $0.01M$

D. $0.001M$

Answer: c

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93. In Question pH of the final solution will be

A. 12

B. 2

C. 11.7

D. 3

Answer: a

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94. The standard EMF of decinormal calomel electrode is $0.268V$. The EMF is

A. $-0.298V$

B. $0.327V$

C. $-0.327V$

D. $0.298V$

Answer: b

Watch Video Solution

95. The satandard EMF of quinhydrone is $0.699V$. The EMF of the quinhydrone electrode dipped in a solution with $pH = 10$ is

A. $0.109V$

B. $-0.109V$

C. $1.289V$

D. $-1.289V$

Answer: a

Watch Video Solution

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

A. $\dfrac{-(E_1+E_2)}{2 \times 0.059}$

B. $\dfrac{E_1+E_2}{2 \times 0.059}$

C. $\dfrac{E_2-E_1}{2 \times 0.059}$

D. $\dfrac{-(E_1+E_1)}{0.059}$

Answer: a

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97. Given standard E^{c-} :

$Fe^{3+} + 3e^- \rightarrow Fe, \quad E^{c-} = -0.036$

Fe^(2+)+2e^(-)rarr Fe," "E^(c-)=-0.440V*The*E^(c-)*of*Fe^(3+)+e^(-) rarr Fe^(2+)

` is

A. $-0.476V$

B. $-0.404V$

C. $0.404V$

D. $0.772V$

Answer: d

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98. Given the ionic equivalent conductivities for the following ions :

$\lambda^{\circ}{}_{eq}K^{\oplus} = 73.5 cm^2 ohm^{-1} eq^{-1}$

$\lambda^{\circ}{}_{eq}Al^{3+} = 149 cm^2 ohm^{-1} eq^{-1}$

$\lambda^{\circ}{}_{eq}SO_4^{2-} = 85.8 cm^2 ohm^{-1} eq^{-1}$

The $\wedge^{\circ}_{eq}$ for potash alum $\left(K_2SO_4 . Al_2\left(SO_4\right)_3 . 24H_2O\right)$ is :

A. 215.92

B. 348.3

C. 368.2

D. 108.52

Answer: a

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99. For the cell $Zn(s)\left|Zn^{2+}\right|\left|Cu^{2+}\right|Cu(s)$, the standard cell voltage, $E^{c-}._{cell}$ is $1.10V$. When a cell using these reagents was prepared in the lab, the measured cell voltage was $0.98V$. One possible explanatino for the observed voltage is

A. There were $2.00mol$ of Zn^{2+} but only $1.00mol$ of Cu^{2+}

B. The Zn electrode had twice the surface of the Cu electrode.

C. The $\left[Zn^{2+}\right]$ was larger than the $\left[Cu^{2+}\right]$.

D. The volume of the Zn^{2+} solution was larger than the volume of the Cu^{2+} solution.

Answer: c

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100. $\Delta G = \Delta H - T\Delta S$ and ltBRgt $\Delta G = \Delta H + T\left[\frac{d(\Delta G)}{dT}\right]_p$, then $\left(\frac{dE_{cell}}{dT}\right)$ is

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

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

C. $-nFE_{cell}$

D. nFE_{cell}

Answer: a

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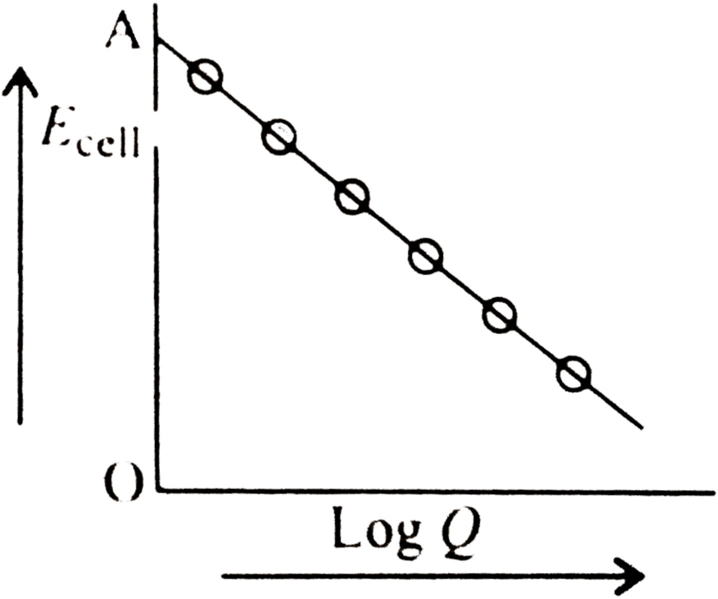
101. $Zn + Cu^{2+}(aq) \Leftrightarrow Cu + Zn^{2+}(aq)$.

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

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

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

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

Answer: b

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102. The standard reduction potentials of $Cu^{2+} \mid Cu$ and $Cu^{2+} \mid Cu^{\oplus}$ are $0.337V$ and $0.153V$, respectively. The standard electrode potential fo $Cu^{\oplus} \mid Cu$ half cell is

A. x_2 - $2x_2$

B. $x_1 + 2x_2$

C. x_1 - x_2

D. $2x_2$ - x_1

Answer: d

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103. $Zn \mid Zn^{2+}\left(C_1 \mid \mid Zn^{2+}\left(C_2 \mid Zn\right.\right.$. 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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104. $Pt(H_2)(p_1)|H^{\oplus}(1M)|(H_2)(p_2), Pt$ cell reaction will be exergonic if

A. $p_1 = p_2$

B. $p_1 > p_2$

C. $p_2 > p_1$

D. $p_1 = 1atm$

Answer: b

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105. $Pt\left(Cl_2\right)\left(p_1\right)|HCl(0.1M)|\left(Cl_2\right)\left(p_2\right)$, Pt cell reaction will be endergonic if

A. $p_1 = p_2$

B. $p_1 > p_2$

C. $p_2 > p_1$

D. $p_1 = p_2 = 1atm$

Answer: c

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106. $Pt\left(H_2\right)(1atm)$ | H_2O, electrode potential at $298K$ is

A. $-0.2364V$

B. $-0.4137V$

C. $0.4137V$

D. $0.00V$

Answer: c

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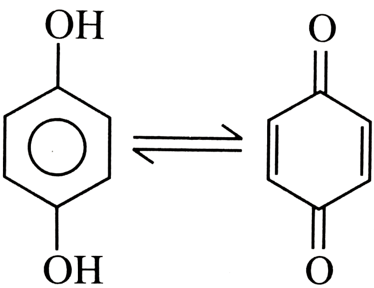
107. For the half cell



$+ 2H^{\oplus} + 2e^{-}$ $E^{\ominus} = 1.30$ V

At $pH = 2$, the electrode potential is

A. $1.36V$

B. $1.30V$

C. $1.42V$

D. $1.20V$

Answer: c

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108. Which of the following changes will increase the EMF of the cell :

$Co(s)\left|CoCl_2\left(M_2\right)\right|\left|HCl\left(M_2\right)\right| \mid \left(H_2, g\right)Pt$

A. Increae in the volume of $CoCl_2$ solution from $100mL$ to $200mL$.

B. Increase M_2 from $0.1M$ to $0.50M$.

C. Increase the pressure of the $H_2(g)$ from 1.0 to $2.0atm$.

D. Increase M_1 from $0.01M$ to $0.50M$.

Answer: b

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109. $Ag \mid Ag^{\oplus}(1M)1Lsolution \mid \quad \mid Ag^{\oplus} \mid \mid Ag1Lsolution$

$0.5F$ electricity in the $LHS($ anode $)$ and $1F$ of electricity in the $RHS($

cathode) is first passed making them independent electrolytic cells at $298K$. EMF of the cell after electrolysis will be

A. Increased

B. Decreased

C. No change

D. Time is also required

Answer: c

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110. The cell EMF is independent of the concentration of the species of the cell in

A. $Fe \overset{c-}{|} FeO(s)|KOH(aq)|NiO(s) | Ni_2O_3(s) \overset{\oplus}{|} Ni$

B. $Pt\left|\left(H_2\right)\right|HCl | \left(Cl_2\right)Pt$

C. $Zn\left|Zn^{2+}\right|\left|Cu^{2+}\right|Cu$

D. $Hg, Hg_2Cl_2|KCl|\left|AgNO_3\right|Ag$

Answer: a

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111. Assume that during the electrolysis of $AgNO+(3)$, only H_2O is electrolyzed and O_2 is formed as

$2H_2O \rightarrow 4H^{\oplus} + O_2 + 4e(-)$

O_2 formed at NTP due to passage of 2 amperes of current for 96 second is

A. $0.112L$

B. $0.224L$

C. $11.2L$

D. $22.4L$

Answer: a

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112. During electrolysis of acidified water, O_2 gas is formed at the anode . To produce O_2 gas at the anode at the rate of $0.224mL$ per second at STP, current passed is

A. $0.224A$

B. $2.24A$

C. $9.65A$

D. $3.86A$

Answer: d

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113. The gas evolved at the anode when $K_2SO_4(aq)$ is electrolyzed between Pt electrode is

A. O_2

B. H_2

C. SO_2

D. SO_3

Answer: a

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114. A quantity of electrical charge that brigns about the depositiion of $4.5gAl$ from Al^{3+} at the cathode will also produce the following volume (STP) of $H_2(g)$ from $H^{\oplus}$ at the cathode.

A. $44.8L$

B. $22.4L$

C. $11.2L$

D. $5.6L$

Answer: d

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115. $100mL$ of buffer of $1MNH_3(aq)$ and $1MNH_4^{\oplus}(aq)$ are placed in two compartments of a voltaic cell separately. A current of $1.5A$ is passed through both cells for $20min$. If only electrolysis of water takes place, then

A. pH of LHS half cell will increase.

B. pH of RHS half cell will increase

C. pH of both half cell will increase

D. Ph of both half cell will decrese

Answer: b

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116. Given the ionic conductance of $COO^{c-}|_{COO^{c-}}, K^{\oplus}$, and $Na^{\oplus}$ are $74, 50$, and $73cm^2ohm^{-1}eq^{-1}$, respectviley. The equivalent conductance at infinite dilution of the salt $COONa|_{COOK}$ is

A. $197 cm^2 ohm^{-1} eq^{-1}$

B. $172 cm^2 ohm^{-1} eq^{-1}$

C. $135.5 cm^2 ohm^{-1} eq^{-1}$

D. $160.5 cm^2 ohm^{-1} eq^{-1}$

Answer: c

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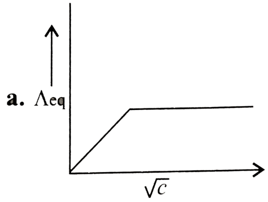
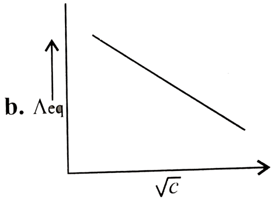
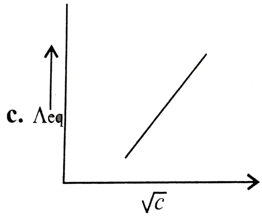
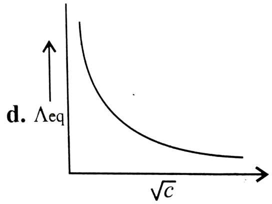
117. The variation equivalent conductance of stronge electrolyte with $\sqrt{Concentration}$ is correctly shown in the figure.

A. 

B. 

C. 

D. 

Answer: b

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118. Given the standard potential of the following at $25 ^\circ C$.

$MnO_2 \rightarrow Mn^{3+}, \quad lE^{c-} = 0.95V$

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

The standard potential of $MnO_2 \rightarrow Mn^{2+}$ is

A. $-0.56V$

B. $-2.46V$

C. $-1.23V$

D. $1.23V$

Answer: d

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119. The potential of the following cell at $25^{\circ}C$ is

$$Pt \left| \begin{matrix} H_2 \\ (1\text{ atm}) \end{matrix} \right| \begin{matrix} HNO_3 \\ (0.1\text{ M}) \end{matrix} \left\| \begin{matrix} NaOH \\ (10^{-3}\text{ M}) \end{matrix} \right| \begin{matrix} H_2 \\ (1\text{ atm}) \end{matrix} \Big| Pt$$

A. $-0.059V$

B. $0.059V$

C. $-0.59V$

D. $0.5V$

Answer: c

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120. Given the following cell at $25^{\circ} C$

$$Pt \underset{(1\ atm)}{H_2} \left| \underset{(10^{-3}M)}{CH_3COOH} \right\| \underset{(10^{-3}M)}{NaOH} \left| \underset{(1\ atm)}{H_2} \right| Pt.$$

What will be the potential of the cell ?

Given pK_a of $CH_3COOH = 4.74$

A. $-0.42V$

B. $0.42V$

C. $-0.19V$

D. $0.19V$

Answer: a

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121. What is the potential of the cell containing two hydrogen electrode as represented below ?

$$Pt, \frac{1}{2}H_2(g)\left|H_2O\right|\left|H^{\oplus}(0.01M)\right|1/2H_2(g)Pt$$

A. $-0.236V$

B. $-0.0591V$

C. $0.236V$

D. $0.0591V$

Answer: c

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122. Given electrode potentials asre

$Fe^{3+}+e^{-} \rightarrow Fe^{2+}, \quad E^{c-}=0.771V$

I_(2)+2e^(-) rarr 2I^(c-)," "E^(c-)=0.536VE^(c-)._(cell)f or $thecellreaction,$

Fe^(3+)+2I^(c-) rarr Fe^(2+)+I_(2)` is

A. $(2 \times 0.771 - 0.536) = 1.006V$

B. $(0.771 - 0.5 \times 0.536) = 0.503V$

C. $(0.771 - 0.536) = 0.235V$

D. $(0.536 - 0.771) = 0.236V$

Answer: c

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123. The following facts are availabel :

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

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

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

Which of the following statement is correct ?

A. $E^{c-}{}_{\cdot C^{c-} \mid C_2} > E^{c-}{}_{\cdot B^{c-} \mid B_2} > E^{c-}{}_{\cdot A^{c-} \mid A_2} > E^{c-}{}_{\cdot D^{c-} \mid D_2}$

B. $E^{c-}{}_{\cdot C^{c-} \mid C_2} < E^{c-}{}_{\cdot B^{c-} \mid B_2} < E^{c-}{}_{\cdot A^{c-} \mid A_2} < E^{c-}{}_{\cdot D^{c-} \mid D_2}$

C. $E^{c-}{}_{\cdot C^{c-} \mid C_2} < E^{c-}{}_{\cdot B^{c-} \mid B_2} > E^{c-}{}_{\cdot A^{c-} \mid A_2} > E^{c-}{}_{\cdot D^{c-} \mid D_2}$

D. $E^{c-}{}_{\cdot C^{c-}\,|\,C_2} > E^{c-}{}_{\cdot B^{c-}\,|\,B_2} < E^{c-}{}_{\cdot A^{c-}\,|\,A_2} < E^{c-}{}_{\cdot D^{c-}\,|\,D_2}$

Answer: b

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124. The potential the cell at $25\,^{\circ}C$ is

$$Pt \left| \begin{array}{c} H_2 \\ (1\text{ atm}) \end{array} \right| \begin{array}{c} NH_4OH \\ (10^{3}M) \end{array} \left\| \begin{array}{c} NaOH \\ (10^{-3}M) \end{array} \right| \begin{array}{c} H_2 \\ (1\text{ atm}) \end{array} \Big| Pt$$

Given pK_b of $NH_4OH = 4.74$

A. $0.05V$

B. $-0.05V$

C. $-0.28V$

D. $0.28V$

Answer: b

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125. The potential of the cell at $25^{\circ}C$ is

$$Pt \left| \begin{array}{c} H_2 \\ (1\,atm) \end{array} \right| \begin{array}{c} CH_3COONa \\ (0.1\ M) \\ + \\ CH_3COOH \\ (0.01\ M) \end{array} \left\| \begin{array}{c} NH_4Cl \\ (0.2\ M) \\ + \\ NH_4OH \\ (0.1\ M) \end{array} \right\| \begin{array}{c} H_2 \\ (1\ atm) \end{array} \Big| Pt$$

Given pK_a of CH_3COOH and pK_b of $NH_4OH = 4.74$

A. $-0.04V$

B. $0.04V$

C. $-0.189V$

D. $0.189V$

Answer: c

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126. Which metal can deposit copper from copper sulphate solution ?

A. Mercury

B. Iron

C. Gold

D. Platinum

Answer: b

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127. On the basis of position in the electrolchemical series, the metal which does not displace H_2 from water and acid is :

A. Hg

B. Al

C. Pb

D. Ba

Answer: a

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128. A dilute aqueous solution of sodium fluoride is electrolyzed, the products at the and cathode are

A. O_2, H_2

B. F_2, Na

C. O_2, Na

D. F_2, H_2

Answer: a

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129. Copper can be deposited from acidified copper sulphate and alkaline cuprous cyanide. If the same current is passed for a definite time :

A. The amount of copper deposited from acidic copper sulphate will be higher.

B. The amount of copper deposited from alkaline cuprous cyanide will be higher

C. The same amount of copper will be deposited.

D. None of these

Answer: b

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130. Silver is removed electrolytically from $200mL$ of a $0.1N$ solution of $AgNO_3$ by a current of $0.1A$. How long will it take to remove half of the silver from the solution ?

A. $0.1s$

B. $100s$

C. $965s$

D. $9650s$

Answer: d

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

A. -1

B. Zero

C. $+1$

D. $+2$

Answer: c

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132. Which of the following does not evolve oxygen at anode when the electrolysis is carried out of

A. Dilute H_2SO_4 with Pt electrode

B. Fused sodium hydroxide with Pt electrodes

C. Acidic water with Pt electrodes

D. Dilute sulphuric acid using Cu electrodes

Answer: d

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133. Calculate the potential of the following cell :

$$Pt\left|Co^{2+}, Co^{3+}\ (2.0M)\ (1.0M)\right|\left|Cr^{3+}, Cr_2O_7^{2-}, H^{\oplus}\ (1.0M)\ (4.0M)\ (1.0M)\ \right| Pt$$

$E^{c-}{}_{\cdot Co^{2+} | Co^{3+}} = -2V, E^{c-}{}_{\cdot Cr_2O_7^{2-} | Cr^{3+}} = +1.0V$

A. $1.024V$

B. $-1.024V$

C. $0.976V$

D. $-0.976V$

Answer: d

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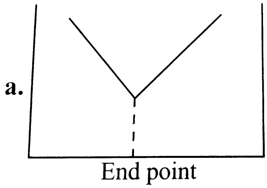
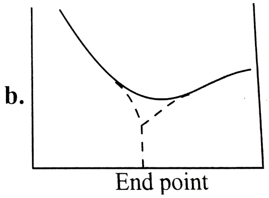
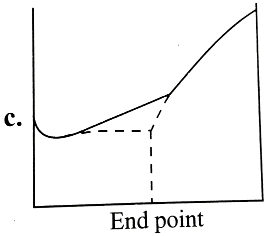
134. The electricity conductivity of a solution serves as a means of determing the end point in a chemical reaction, involved in the titration of acids, bases, or precipitation. Which of the following conductometric titrations represent the curve of $HClvsNH_4OH$

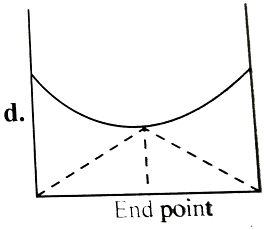
x - axis $\Rightarrow$ Volume of alkali added

y - axis $\Rightarrow$ Conductivity

A. 

B. 

C. 

D. 

Answer: b

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135. A constant current was passed through a solution of $AuCl_4^{c-}$ ion between gold electrodes. After a period of $10.0 min$, the increase in the weight of cathode was $1.314 g$. The total charge passed through solution is (atomic weight of $AuCl_4^{c-} = 339$)

A. $1.16 \times 10^{-2} F$

B. $3.5 \times 10^{-2} F$

C. $2 \times 10^{-2} F$

D. $4 \times 10^{-3} F$

Answer: c

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K_{eq_1} for $Fe^{+3} + Y^{4-} \rightleftharpoons FeY^{\ominus} = \dfrac{[FeY^{\ominus}]}{[Fe^{+3}][Y^{4-}]} = 1.3 \times 10^{25}$

K_{eq_2} for $Fe^{+2} + Y^{4-} \rightleftharpoons FeY^{2-} = \dfrac{[FeY^{2-}]}{[Fe^{+2}][Y^{4-}]} = 2.1 \times 10^{14}$,

Cell reaction is:

$$Fe^{+3} + \cancel{Y^{4-}} \rightleftharpoons FeY^{\ominus}$$

$$FeY^{2-} \rightleftharpoons Fe^{+2} + \cancel{Y^{4-}}$$

$$Fe^{+3} + FeY^{2-} \longrightarrow Fe^{+2} + FeY^{\ominus}, \quad K_{eq} = \frac{K_{eq_1}}{K_{eq_2}} = \frac{1.3 \times 10^{25}}{2.1 \times 10^{14}}$$

136.

E^{c-} for $FeY^{c-} + e^{c-} \rightarrow FeY^{2-}$

A. $0.13V$

B. $-0.636V$

C. $+0.636V$

D. $1.41V$

Answer: a

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137. Calculate E^{c-} for the reactions :

$ZnY^{2-} \Leftrightarrow Zn(s) + Y^{4-}$ where Y^{4-} is the completely deprotonated anion of EDTA. The formation constant forZnY^{2-} is 3.2×10^{16} and E^{c-} for $Zn \rightarrow Zn^{2+} + 2e^-$ is $0.76V$.

A. $-1.25V$

B. $0.48V$

C. $+0.68V$

D. $-0.27V$

Answer: a

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138. The solubility product of $Pb_3(AsO_4)_2$ is 4.1×10^{-36}. E^{c-} for the reaction :

$Pb_3(AsO_4)_2(s) + 6e^- \Leftrightarrow 3Pb(s) + 2AsO_4^{2-}$

$E^{\Theta}_{(Pb)2^+ | Pb} = -0.13V$

A. $+0.478V$

B. $-0.13V$

C. $-0.478V$

D. $+0.13V$

Answer: c

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

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

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140. E^{c-} for $Cr^{3+} + 3e^{-} \rightarrow Cr$and $Cr^{3+} + e^{-} \rightarrow Cr^{2+}$ are $-0.74V$ and $-0.40V$, respectively, E^{c-} for the reaction is $Cr^{+2} + 2e^{-} \rightarrow Cr$

A. $-0.91V$

B. $+0.91V$

C. $-1.14V$

D. $+0.34V$

Answer: a

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141. The efficiency of a fuel cell si 80% and the standard heat of reaction is $-300kJ$. The reaction involves two electrons in redox change. E^{c-} for the cell is

A. $1.24V$

B. $2.48V$

C. $0V$

D. $0.62V$

Answer: a

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142. The E_{cell} for a given cell is 1.2346 and $1.2340V$ at $300K$ and $310K$, respectively. Calculate the change in entropy during the cell reaction if the redox change involves three electrons.

A. $-17.37JK^{-1}$

B. $+17.37JK^{-1}$

C. $173.7JK^{-1}$

D. $5.79JK^{-1}$

Answer: a

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143. A curent of $3A$ was passed for 1 hour through an electrolyte solution of A_xB_y in water. If $2.977g$ of A(atomic weight 106.4) was deposited at cathode and B was a monovalent ion, the formula of electrolyte was

A. AB_2

B. AB

C. AB_3

D. AB_4

Answer: d

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144. The E^{c-} for $Cu^{2+}/Cu^{\oplus}, Cu^{\oplus}/Cu, Cu^{2+}/Cu,$ are $0.15V, 0.50V$ and $0.325V$, respectively. The redox cell showing redox reaction $2Cu^{\oplus} \rightarrow Cu^{2+} + Cu$ is made. E^{c-} of this cell reaction and ΔG^{c-} may be

A. $E^{c-} = 0.175V$ or $E^{c-} = 0.350V$

B. $n = 1 \text{ or } 2$

C. $\Delta G^{c-} = -33.775 kJ$

D. All of these

Answer: d

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145. Total charge required to convert three moles of Mn_2O_4 to MnO_4^{c-} in present of alkaline medium

A. $10F$

B. $20F$

C. $30F$

D. 40F`

Answer: c

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146. A current of $965A$ is passed for $1s$ through $1L$ solution of $0.02NNiSO_4$ using Ni electrodes. What is the new concentration of $NiSO_4$?

A. $0.01N$

B. $0.01M$

C. $0.003M$

D. $0.02M$

Answer: b

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147. For the given cell $Pt_{D_2 \mid D^{\oplus}} \mid \left| H^{\oplus} \right| Pt_{H_2}$, if $E^{c-} \cdot_{D_2 \mid D^{\oplus}} = 0.003V$, , what will be the ratio of $D^{\oplus}$ and $H^{\oplus}$ at $25^{\circ}C$ when the reaction $D_2 + 2H^{\oplus} \rightarrow 2D^{\oplus} + H_2$ attains equilibrium

A. 1.34

B. 1.24

C. 1.124

D. 1.45

Answer: c

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148. What is $E^{c}{}_{\cdot red}$ for the reaction : $Cu^{2+} + 2e^{-} \rightarrow Cu$ in the half cell $Pt_{S^{2}|CuS|Cu}$. if $E^{c-}{}_{\cdot Cu^{2+} \mid Cu}$ is $0.34V$ and K_{sp} of $CuS = 10^{-35}$?

A. $0.34V$

B. $-0.6925V$

C. $+0.6925V$

D. $-0.66V$

Answer: b

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149. The combustion of butane in O_2 at 1 bar and $298K$ shows a decrease in free energy equal to $2.95 \times 10^3 kJmol^{-1}$ in a fuel cell. K and E^{c-} of the fuel cell are

A. $9.55 \times 10^{482}, 1.096V$

B. $9.55, 1.096V$

C. $1.023 \times 10^{966}, 2.85V$

D. $5.5 \times 10^{484}, 0.55V$

Answer: a

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150. A half cell reaction $Ag_2S(s) + 2e^- \rightarrow 3Ag(s) + S^{2-}$ is carried out in a half cell $Pt_{Ag_2S \mid Ag, H_2S(0.1M)}$, at $\left[H^{\oplus}\right] = 10^{-3}$, The EMF of the half cell is $\left[E^{c-}{}_{\cdot Ag^{\oplus} \mid Ag} = 0.80V, K_a\left(H_2S\right) = 10^{-21}\right.$, and K_{sp} of $\left.Ag_2S = 10^{-49}\right]$

A. $-0.1735V$

B. $-0.19V$

C. $+0.1735V$

D. $+0.19V$

Answer: a

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151. Which one is wrong if electrolysis of $CH_3COONa(aq)$ is made using Pt electrodes ?

A. pH of solution increases.

B. Molar ratio of gases at anode and cathode is $3:1$

C. $\left[CH_3COO^{c-}\right]$ in solution decreases.

D. The molar ration of gases at anode and cathode is $2:1$

Answer: d

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152. The calomel and quinhydrone electrodes are reversible with respect to which ions, respectively ?

A. $Cl^{c-}, H^{\oplus}$

B. $H^{\oplus}, Cl^{c-}$

C. $Hg_2^{2+}, \overset{c-}{OH}$

D. $Hg_2^{2+}, H^{\oplus}$

Answer: a

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153. The EMF of Ni - Cad battery is dependent of :

A. $Cd(OH)_2$

B. $Ni(OH)_2$

C. $\overset{c-}{OH}$

D. None of these

Answer: d

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154. The electrode with reaction : $Cr_2O_7^{2-}(aq) + 14H^{\oplus}(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O$ can be represented as

A. $Pt \mid H^{\oplus}(aq), Cr_2O_7^{2-}(aq)$

B. $Pt \mid H^{\oplus}(aq), Cr_2O_7^{2-}(aq), Cr^{3+}(aq)$

C. $Pt_{H2} \mid H^{\oplus}(aq), Cr_2O_7^{2-}$

D. $Pt_{H2} \mid H^{\oplus}(aq), Cr_2O_7^{2-}(aq), Cr^{3+}(aq)$

Answer: d

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155. For a given reaction $: M^{(x+n)} + ne^{-} \rightarrow M^{c+}, E^{c-}.(red)$ is known along with M^{x+n} and M^{x+} ion concentrations. Then

A. n can be evaluated

B. x can be evaluated

C. $(x + n)$ can be evaluated

D. $n, x, (x + n)$ can be evaluated

Answer: a

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156. Select the wrong statement.

A. The electrolysis of molten CaH_2 liberates H_2 at cathode

B. During the discharge of lead storage battery, sulphuric acid is consumed.

C. Sulphur acts as a polymerizing agent in the vulcanization of rubber.

D. Galvanization of iron denotes coating with Zn.

Answer: a

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157. Select the correct statement.

A. Faraday represents 96500 coulombs per second.

B. Coulomb represents one ampere for $1/2$ second.

C. Coulomb represents $1/2$ ampere for 1 second

D. Coulomb represnts charge of one mole electrone.

Answer: d

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158. From the following information, calculate the solubility product of $AgBr$.

$AgBr(s) + e^{-} \rightarrow Ag(s) + Br^{c-}(aq), \quad E^{c-} = 0.07V$

$Ag^{\oplus}(aq) + e^{-} \rightarrow Ag(s), \quad E^{c-} = 0.080V$

A. 4×10^{-13}

B. 4×10^{-10}

C. 4×10^{-17}

D. 4×10^{-7}

Answer: a

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159. The strongest oxidizing agent among the following is

A. $K_2Cr_2O_7$

B. MnO_2

C. $KMnO_4$

D. Cl_2

Answer: c

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160. The weakest oxidizing agent among the following is

A. O_3

B. F_2

C. $KMnO_4$

D. Cl_2

Answer: d

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161. Suppose that gold is being plated onto another metal in a electrolytic cell. The half - cell reaction producing the $Au(s)$ is $AuCl_4^{c-} \rightarrow Au(s) + 4Cl^{c-} + 3e^-$

If a 0.30 - A current runs for $1.50 min$, what mass of $Au(s)$ will be plated, assuming all the electrons are used in the reduction of $AuCl_4$?

A. $0.184 g$

B. $0.551 g$

C. $1.84 g$

D. $0.613 g$

Answer: a

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162. Chromium plating is applied by electrolysis to objects suspended in a dichlromate solution , according to following (unbalanced) hald reaction :

$Cr_2O_7^{2-}(aq) + e^- + H^{\oplus}(aq) \rightarrow Cr(s) + H_2O(l)$

How many hours would it take to apply a chromium plating of thickness $2.0 \times 10^{-2} mm$ to a car bumper of suface area $0.25m^2$ in an electrolysis cell carrying a current of $75.0A$?

[Density of chromium is $7.19gcm^{-3}$]

A. $2.2h$

B. $1.5h$

C. $3.0h$

D. $0.25h$

Answer: b

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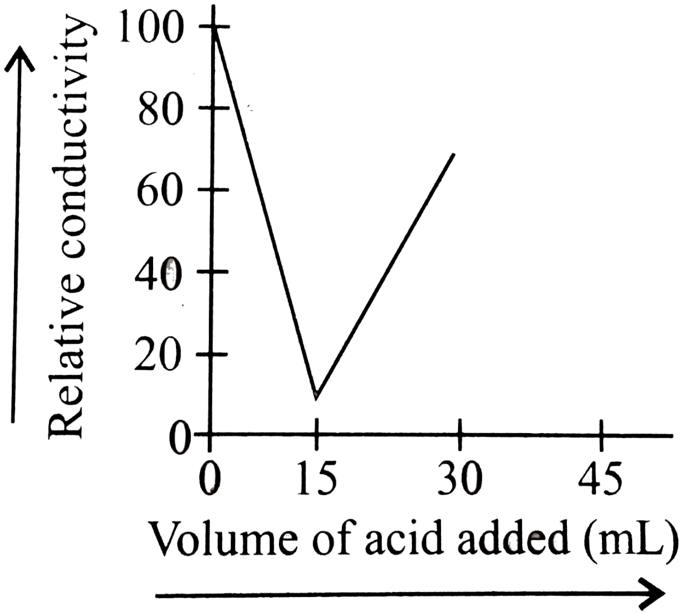
163. $20Ml$ of KOH solution was titrated with $0.20MH_2SO_4$ solution in a conductivity cell. The data obtained were plotted to give the graphe shown below.

The concentration of the KOH solution was



A. $0.30 mol L^{-1}$

B. $0.15 mol L^{-1}$

C. $0.12 mol L^{-1}$

D. $0.075 mol L^{-1}$

Answer: a

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164. What is the cell entropy change (in JK^{-1}) of the following cell :

$$Pt(s)\left|H_2(g)p=1atm\right|CH_2COOH,\ HCl0.1M\left|KCl(aq)0.1M\right|Hg_2Cl_2(s)\ |\ Hg$$

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 : $K_a\left(CH_3COOH\right) = 10^{-5}M$)

A. 60

B. 65.2

C. 69.2

D. 63.5

Answer: b

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165. $k = 4.95 \times 10^{-5}Scm^{-1}$ for a $0.001M$solution. The reciprocal of the degree of dissociation of acetic acid, if Λ_m° for acetic acid is

$400 Scm^{-2} mol^{-1}$ is :

A. 7

B. 8

C. 9

D. 10

Answer: b

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166. What is the value of $pK_b\left(CH_3COO^{c-}\right)$ if $\wedge^{\circ}{}_{m} = 390 Scm^{-1} mol^{-1}$ and $\wedge_m = 7.8 Scm^2 mol^{-1}$ for $0.04M$ of CH_3COOH at $25^{\circ} C$?

A. 9.3

B. 9.2

C. 4.7

D. 4.8

Answer: b

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167. In Hall's process , in the production of Al, carbon is used as the anode material. The reactions are

A. Anode : $Al^{3+} + 3e^{-} \rightarrow Al$

Cathode : $C(s) + 2O^{2-} \rightarrow CO_2(s) + 4e^{-}$

B. Anode: $C(s) + 2O^{2-} \rightarrow CO_2(g) + 4e^{-}$

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

C. Anode : $Al \rightarrow Ae^{3+} + e^{-}$

Cathode : $CO_2 + 4e^{-} \rightarrow C(s) + 2O^{2-}$

D. None of these

Answer: b

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168. ΔG^{c-} or the reaction is ,

$$4Al + 3O_2 + 6H_2O + 4\overset{c-}{OH} \rightarrow 4Al(OH)_4^{c-}$$

$$E^{c-}{}_{\cdot cell} = 2.73V$$

$$\Delta_f G^{c-}{}_{\cdot}\left(\overset{c}{OH}\right) = -157kJmol^{-1}$$

$$\Delta_f G^{c-}{}_{\cdot}\left(\overset{c-}{OH}\right) = -237kJmol^{-1}$$

A. $-3.16 \times 10^3 kJmol^{-1}$

B. $-0.79 \times 10^3 kJmol^{-1}$

C. $-0.263 \times 10^3 kJmol^{-1}$

D. $+0.263 \times 10^3 kJmol^{-1}$

Answer: a

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

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

B. $-0.34 - \frac{0.0591}{2}$

C. 0.34

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

Answer: d

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170. A cell $Cu\left|Cu^{2+}\right|\mid Ag^{\oplus}\mid Ag$ inintially contains $2MAg^{\oplus}$ and $2MCu^{2+}$ ion in $1L$ solution each . The change in cell potential after it has supplied $1A$ current for $96500s$ is

A. $-0.003V$

B. $-0.02V$

C. $-0.04V$

D. None of these

Answer: b

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171. The value of reaction quotient Q for the cell

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

A. 156

B. 125

C. 1.25xx10^(-2)

D. 64xx10^(-3)

Answer: d

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172. In acid medium, MnO_4^{c-} is an oxidizing agent.

$MnO_4^{c-} + 8H^{\oplus} + 5e^- \rightarrow Mn^{2+} + 4H_2O$

If $H^{\oplus}$ ion concentration is doubled, electrode potential of the half cell $MnO_4^{c-}, Mn^{2+} \mid Pt$ will

A. Increase by $28.36mV$

B. Decrease by $28.36mV$

C. Increase by $14.23mV$

D. Decrease by $142.30mV$

Answer: a

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173. During the electrolysis of $AgNO_3$, the volume of O_2 formed at STP due to passage of $2A$ of current for $965s$ is

A. $0.112L$

B. $0.224L$

C. $11.2L$

D. $22.4L$

Answer: a

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174. CH_3COOH is titrated with $NaOH$ solution. Which of the following statements is true ?

A. Conductance decreases upto equivalence point, after which it increases.

B. Conductance increases upto equivalence point,after which it decreases.

C. Conductance first decreases (but not rapidly) and then increases upto equibalence point and then increases rapidley after equivalence point.

D. None of these

Answer: c

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175. The rusting of iron takes place as follows :

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

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

Calculae ΔG^{c-} for the net process.

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

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

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

D. $-161kJmol^{-1}$

Answer: a

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176. The number of atoms of Ca that will be deposited from a solution of $CaCl_2$ by a current of $25 mA$ for $60 s$ will be

A. 4.68×10^{18}

B. 4.68×10^{15}

C. 4.68×10^{10}

D. 2.34×10^{15}

Answer: a

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177. A reaction :

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

occurs in a galvanic cell. The structure of the cell will be

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

B. $Pt, H_2(g)|HCL(sol)|AgNO_3(sol), Ag$

C. $Pt, H_2(g)|HCl(sol)|AgCl(s), Ag$

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

Answer: c

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178. During the electrolysis of aqueous solution of $HCOOK$, the number of gases obtained at cathode, anode, and total number of gases are

A. $1, 2, 3$

B. $1, 2, 2$

C. $2, 1, 3$

D. $2, 1, 2$

Answer: b

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Exerciseassertion -Reasoning

1. Assertion(A): Whne acidified $ZnSO_4$ solution is electrolyzed between Zn electrodes, it is Zn that is deposited at the cathode and $H_2(g)$ is not evolved.

Reason (R): The electrode potential of Zn is more negative than hydrogen as the overpotential for hydrogen evolution in Zn is quite large.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: C

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2. Assertion (A): A saturated solution of KCl is used in making salt bridge.

Reason (R): Ionic mobilities of K^{+} and Cl^{-} are comparable.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: A

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3. Assertion (A): When an aqueous solution of KNO_3 is electrolyzed, potassium is liberated at the cathode.

Reason (R): K^+ ions are discharged at cathode and NO_3^- at anode.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: D

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4. Assertion (A): For four half - cell reactions involving different number of electrons,

$E_4 = E_1 + E_2 + E_3$

Reaction $(R): \Delta G_4 = \Delta G_1 + \Delta G_2 + \Delta G_3$

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: D

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5. Assertion (A): 1 Faraday of electricity deposits $1g$ equivalent of Ag, Cu or Al.

Reason (R): $1mo \leq$ of electrons are required to reduce $1 mole of Ag^{\oplus}$ or $\frac{1}{2} mole of Cu^{2+}$ or $\frac{1}{3}$mole of Al^{3+} ions.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: B

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

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

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: C

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7. Assertion (A): Equivalent conductance increase with dilution for an electrolyte solution.

Reason (R): The number of ions per litre of electrolyte increases with dilution.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: A

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8. Assertion (A): $\wedge_m\left(H^{\oplus}\right)$ and $\wedge_m\left(\overset{c}{O}H\right)$ ions are very much higher than those of other ions.

Reason (R): It is due to proton jump from one water molecule to another resulting in a more rapid transfer of positive charge form one region to another.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: A

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9. Assertion (A): Ionic conductivities increase with increase of temperature and pressure.

Reason (R): Viscosity of water decreases with increasew of temperature and increases with the increases of pressure.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: D

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10. Assertion $(A:$ Cell constant is the EMF of a cell.

Reason $(R):$ Cell constant is determined by using saturated KCl solution.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: D

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11. Assertion (A): At the end of electrolysis using Pt electrodes, an aqueous solution of $CuSO_4$ turns colourless.

Reason (R): $CuSO_4$ chnages to $Cu(OH)_2$ during electrolysis.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: c

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12. Assertion (A): Cu liberates $H_2(g)$ from a dilute solution of HCl.

Reason (R): Hydrogen is below Cu in the electrochemical series.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: e

Watch Video Solution

13. Assertion(A): $Na^{\oplus}$ ions are discharged in preference to $H^{\oplus}$ ions at Hg cathode.

Reason (R): The nature of the cathode can affect the order of discharge of ions.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: a

Watch Video Solution

14. Assertion (A): Cu gets readily corroded in acidic aqueous solution.

Reason (R): Free energy of the process is positive.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: e

Watch Video Solution

15. Assertion (A): Galvanized iron does not rust.

Reason (R): Zn has a more negative electrode potential than Fe.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: a

Watch Video Solution

16. Assertion (A): For a Daniell cell :

$Zn\left|Zn^{2+}\right|\left|Cu^{2+}\right|Cu$ with $E_{cell} = 1.1V$, the application of opposite potential greater than $1.1V$ results into the flow of electron from cathod to anode.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: b

Watch Video Solution

17. Assertion (A): The electrolysis of $NaCl$ solution gives $H_2(g)$ at cathode and $Cl_2(g)$ at anode.

Reason (R): Cl_2 has higher oxidation potential than H_2O

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: c

Watch Video Solution

18. Assertion (A): Fe is protected from corrosing by connecting Mg metal with it.

Reason (R): Fe acts as cathode and Mg as anode which gradully disappears.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: a

Watch Video Solution

19. Assertion (A): The Daniell cell becomes dead after sometimes.

Reason (R): The oxidation protential of Zn anode decreases and that of Cu increases.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: a

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20. Assertion (A): $\wedge^{\circ}{}_{\cdot eq}\left(CH_3COOH\right)$ cannote be determines experimentally.

Reason (R): CH_3COOH is a weak acid and DebyeHuckel Onsager equation cannot be used. Extrapolation method cannot be employed.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: a

Watch Video Solution

21. Assertion (A): The presence of CO_2 in the air accelerates corrosion.

Reason (R): CO_2 is a poisonous gas.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: c

Watch Video Solution

22. Assertion $(A):\left(H_2+O_2\right)$ fuel cell gives a constant voltages throughout its life.

Reason (R): In this fuel cell, H_2 reacts with $\overset{c-}{OhH}$ ions, yet the over all $\left[\overset{c-}{OH}\right]$ does not change.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: a

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23. Assertion (A): In a Daniell cell, if the concentration of Cu^{2+} and Zn^{2+} ions are doubled, the EMF of the cell will be doubled.

Reason (R): If the concentration of ions in contact with metals is doubled, the electrode potential is doubled.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: d

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24. Assertion (A): The ration of specific conductivity to the observed conductance does not depend upon the concentration of the solution taken in the conductivity cell.

Reason (R): Specific conductivity decreases with dilution whereas observed conductance increases with the dilution.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: b

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25. Assertion(A): The rusting on the surface of iron involves following reaction :

$a.\ Fe(s) \rightarrow Fe^{2+}(aq) + 2e^{-}$

(at anodic site)

$b.\ O_2(g) + 4H^{\oplus}(aq) + 4e^{-} \rightarrow 2H_2O(l)$

(at cathodic site)

$c.\ 4Fe^{2+}(aq) + O_2(g) + 4H_2O(l) \rightarrow 2Fe_2O_3(s) + 8H^{\oplus}$

$d.\ Fe_2O_3(aq) + xH_2O(l) \rightarrow Fe_2O_3.\ xH_2O$

Reason (R): Rusting is accelerated in the presence of $NaCl$ and CO_2

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, (R) is correct.

Answer: b

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Exerciseinterger

1. During the electrolysis of conc H_2SO_4, it was found that $H_2S_2O_8$ and O_2 liberated in a molar ratio of $3:1$. How many moles of H_2 were found of moles of $H_2S_2O_8$?

(Express your answer as $:3 \times molesofH_2,$ integer answer is between 0 and 50

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2. How many Faradays are required to reduce $1molofBrO_3^{c-}$ to Br^{c-} in basic medium ?

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3. The total number of Faradays required to oxidize the following separately:

$a.\ 1 mol of S_2O_3^{2-}$ in acid medium

$b.\ 1$ Equivalent of $S_2O_3^{2-}$ in acid medium

$c.\ 1 mol of S_2O_3^{2-}$ in basic medium.

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4. For the oxidation of ferric oxalate to CO_2, $18F$ of electricity is required. How mnay moles of ferric oxalate is oxidized ?

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5. During the discharge of a lead storage battery, the density of $40\ \%\ H_2SO_4$ by weight fell from 1.225 to 0.98(which is $20\ \%$ by weight). What is the change in molarities of H_2SO_4?

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6. In Question above, the number of ampere hours for which the battery is used containing $1L$ of the acid is $16.08x$ ampere hour. Calculate the value of x.

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7. ΔG for the reaction :

$$\frac{4}{3}Al + O_2 \rightarrow \frac{2}{3}Al_2O_3$$

is $-772kJmol^{-1}$ of O_2.

Calculate the minimum EMF in volts required to carry out an electrolysis of Al_2O_3

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8. When electrolysis of KCl is doen in alkaline medium, $10g$ of $KClO_3$ is produced as follows :

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

A current of $2A$ is passed for 10.941 hours. Calculate the $\left(\frac{Percentagecurrentefficiency}{10}\right)$ used in the process.

$(Mw$ of $KClO_3 = 122.5)$

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Exercisefill In The Blanks

1. When an aqueous solution of $LiCl$ is electrolyzed using graphite electrodes, as the current flows, the pH of the solution around cathode ....

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2. Given $E^{c-}{}_{Fe^{2+} | Fe}$ and $E^{c-}{}_{Fe^{3+} | Fe^{2+}}$ are -0.44 and $0.77V$ respectively. If Fe^{2+}, Fe^{3+} and Fe blocks are kept together, then $\left[Fe^{3+}\right]$ .... and $\left[Fe^{2+}\right]$......................... .

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3. A certain current liberates $0.504g$ of $H_2(g)$ in 2 hours. The weight of Cu deposited by same current flowing for the same time in $CuSO_4$ solution is $\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. g.$

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4. Number of Faradays required to reduce $3mol$ of MnO_4^{c-} to MnO^{2+} is $\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.F$

Watch Video Solution

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

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6. The EMF of the cell :

$Pt, H_2(1atm)\left|H^{\oplus}(aq)\right|\left|AgCl\right|Ag$ is 0.27 and $0.26V$ at $25\,^\circ C$, respectively. The heat of the reaction occuring inside the cell at $25\,^\circ C$ is .... kJK^{-1}

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7. The electrochemical equivalent for zinc (atomic weight $= 6.4$) is ....

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8. Given :

$Fe^{2+}(aq) + 2e^- \to Fe(s), \quad E^{c-} = -0.44V$

$Al^3 + 3e^- \to Al(s), \quad E^{c-} = -1.66V$

$Br^{2+} + 2e^- \to 2Br^{c-}(aq) \quad E^{c-} = -1.08V$

The decreasing order of reducing power is ....

.

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9. When electricity is passed through a solution of $AlCl_3$ and $13.5g$ of Al is deposited, the number of $Faradayofe \leq ctricitypassed\mu stbe$......................F`.

Watch Video Solution

10. A current of $2A$ is passed for $1.93 \times 10^4 s$ through a molten tin salt depositing $23.8gSn(Aw$ of $Sn = 119)$. The oxidation state of Sn in the salt is ....

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11. $13g$ of metal M is deposited at cathode by passing $0.4F$ of electricity . The cathodic reaction is :

$M^{n+} + ne^- \rightarrow M$

The formula of metal chloride $(Aw = 65)$ is ....

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Watch Video Solution

12. If the temperature coefficient $\left(\frac{\partial E}{\partial T}\right)$ is zero for a cell reaction then out of $\Delta S, \Delta H,$ and ΔG , the .... is zero.

Watch Video Solution

13. The ionization constant $\left(K_a\right)$ of a weak electrolyte is 2.5×10^{-7}, while $\wedge_{eq}$ of its $0.01M$ solution is $19.65Scm^2eq^{-1} \wedge ^{\circ}._{eq}$ is ....

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14. When dilute H_2SO_4 is electrolyzed between Pt electrodes, the gas liberated at the anode will be.............................

Watch Video Solution

15. The amount of substance liberated when 1 ampere of current is passed for 1 second through an electrolytic solution is called ....

Watch Video Solution

16. The amount of charge carried by N^{3-} ion is ....

Watch Video Solution

17. The current is carried through metallic conductor by .... and in electrolytic substance by ....

Watch Video Solution

18. Electrolytic conductance .... with increase of temperature while metallic conductance .... with increase of temperature.

Watch Video Solution

19. According to the preferential discharge theory, out of a number of ions, the one which requires..................... energy will be liberated .... at a given substance.

Watch Video Solution

20. At infinite dilution of an electrolyte, the equivalent conductance of cations at anions are .... of each other.

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21. Cl_{20} is stronger .... agent then Br_2 and I_2 as its reduction potential is .... than that of Br_2 and I_2

Watch Video Solution

22. The Nernst equation gives.............. EMF of the cell and in a Deniell cell current flows from .... to ....

Watch Video Solution

23. Dry cell is a .... cell and lead storage cell is a .... cell.

Watch Video Solution

24. The density of H_2SO_4............................ in lead storage cell during discharging and calomel electrode is a .... electrode.

Watch Video Solution

25. Lead storage battery has anode made up of .... and cathode made up of ....

Watch Video Solution

Exercisetrue / False

1. Coper metal can reduce Fe^{2+} in acidic medium.

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2. The absolute value of standard electrode protential can be determined experimentally.

Watch Video Solution

3. Sodium cannot be obtained by the electrolysis of aqueous solution of $NaCl$ using Pt electrodes.

Watch Video Solution

4. The standard potential of $Cl^{c-}|AgCl|Ag$ half cell is related to that of $Ag^{\oplus}|Ag$ though the expression.

$$E^{c-}{}_{\cdot Ag^{\oplus}|Ag} = E^{c-}{}_{\cdot Cl^{c-}|AgCl|A} + \frac{RT}{F}\ln K_{sp}(AgCl)$$

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5. In a Daniell cell, electrons flow from zinc electrode to copper electrode outside the cell.

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6. Compounds of active metals (Zn, Na, Mg) are reducible by H_2 whereas those of noble metals (Cu, Ag, Au) are not reducible.

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7. The standard potential of hydrogen half cell is zero at all conditions of temperature and pressure.

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8. The conventional value of zero of the standard hydrogen half cell holds good at all temperature.

Watch Video Solution

9. The current - carrying ions in an electrolytic cell are not necessarily discharged at the electrodes.

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

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11. At the anode, the species having minimum reduction potential is formed form the oxidation of corresponding oxidizable species.

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12. In a galvanic cell, the half cell with higher potential provides a reducing agent.

Watch Video Solution

13. In highly alkaline medium, the anodic process during the electrolytic process is

c -

$4OH \rightarrow O_2 + 2H_2O + 4^-$

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14. Metallic anodes smore reactive than platinum tend to pass into the solution instead of O_2 being produced.

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15. The mass of a substance deposited on the cathode or anode during electrolysis is given as $m = QM/Fz$.

Watch Video Solution

16. The cell potential becomes half if the cell reaction is divided by 2 througout.

Watch Video Solution

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

Watch Video Solution

18. F_2 is prepared by the electrolysis of molten KHF_2 and anhydrous HF.

Watch Video Solution

19. In Hall's process for the preparation of Al, graphite anode has a long life.

Watch Video Solution

20. In Down's process for the manufacture of sodium , $CaCl_2$, is added to increase its melting point.

Watch Video Solution

21. In Castner - Kellner cell for the manufacture of $NaOH($ caustic soda $)$, Hg acts as cathode as well as anode.

View Text Solution

22. The amount of charge carried by an electrone is the same as carried by a $K^{\oplus}$ ion.

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23. The same quantity of electricity is passed through $Al_2(SO_4)_3$ and $AgNO_3$ solution with platinum electrodes. If n number of Al atoms are deposited on the cathode, $3n$ number of Ag atoms will be deposited on the cathode.

Watch Video Solution

24. Metals always liberate $H_2(g)$ from acids.

Watch Video Solution

25. Sn^{2+} and Fe^{3+} cannot exist in the same solution.

Watch Video Solution

26. The addition of a crystal of I_2 to $NaBr$ turns the solution violet.

Watch Video Solution

27. The addition of Br_2 to NaI turns the solution violet.

Watch Video Solution

28. Lead storage battery has anode and cathode made up of Pb.

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29. Electrode potential for the electrode $M^{n+} \mid M$ with concerntration is given by the expression under STP conditions :

$$E = E^{c-} + \frac{0.059}{n}\log\left[M^{n+}\right]$$

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30. In the electroplating of silver, $AgNO_3$ solution is usually used as an electrolyte.

Watch Video Solution

31. The conductance of electrolyte solution increases wih temperature.

Watch Video Solution

32. Resistivity is reciprocal of molar conductivity of electrolyte.

Watch Video Solution

33. Cell constant has unit m^{-1}.

Watch Video Solution

34. The conductivity of molten KCl is due to the movement of $K^{\oplus}$ and Cl^{c-} ions.

Watch Video Solution

35. Solid KCl is a good conductor of electricity.

Watch Video Solution

36. Molten Na_2SO_4 is a good conductor because of mobile electrons.

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37. Cathode is negative terminal both in electrochemical and electrolytic cells.

Watch Video Solution

38. Reduction occurs at cathdooe both in galvanic as well as in electrolytic cell.

Watch Video Solution

39. The chemical change in an electrolytic cell is non - spontaneous.

Watch Video Solution

40. The cell voltage is independent of the size of the cell or electrodes.

Watch Video Solution

Archieves (Linked Comprehension)

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

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

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

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

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

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

A. 66.13

B. 58.38

C. 28.30

D. 46.29

Answer: b

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

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

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

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

A. E_{oxid} will increase by a factor of 0.65 from $E^{c-}._{oxid}$.

B. E_{oxid} will decrease by a factor of 0.65 from $E^{c-}._{oxid}$.

C. E_{red} will increase by a factor of 0.65 from $E^{c-}._{red}$.

D. E_{red} will decrease by a factor of 0.65 from $E^{c-}._{red}$.

Answer: c

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

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

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

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

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

A. NH_3 combines with $Ag^{\oplus}$ to form a complex.

B. $\left[Ag\left(NH_3\right)_2\right]^{\oplus}$ is a stronger oxidizing reagent than $Ag^{\oplus}$

C. In the absence of NH_3, a silver salt of gluconic acid is formed.

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

Answer: d

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4. Chemical reactions involve interation of atoms and molecules. A large number of atoms / molecules (approximately 6.023×10^{23}) are present in a few grams of any chemical compound varying with their atomic / molecular masses. To handle such large numbers conveniently, the mole concept was introduced. This concept has implications 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 $4.0M$ aqueous solution of $NaCl$ is prepared and $500mL$ of this solution is electrolyzed. This leads to the evolution of chlorine gas at one of the electrodes (atomic mass of Na is 23 and Hg is $200)(1F = 96500C)$.

The total number of moles of chlorine gas evolved is

A. 0.5

B. 1.0

C. 2.0

D. 3.0

Answer: b

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5. Chemical reactions involve interation of atoms and molecules. A large number of atoms / molecules (approximately 6.023×10^{23}) are present in a few grams of any chemical compound varying with their atomic / molecular masses. To handle such large numbers conveniently, the mole concept was introduced. This concept has implications in diverse areas such as analytical chemistry, biochemistry, electrochemistry, and radiochemistry. The following example illustrates a typical case, involving chemical / electrochemical reaction, which requires a clear understanding of the mole concept.

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If the cathode is an Hg electrode, the maximum weight ($\in g$) of amalgam formed from this solution is

A. 200

B. 225

C. 400

D. 446

Answer: d

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6. Chemical reactions involve interation of atoms and molecules. A large number of atoms / molecules (approximately 6.023×10^{23}) are present in a few grams of any chemical compound varying with their atomic / molecular masses. To handle such large numbers conveniently, the mole concept was introduced. This concept has implications 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 $4.0M$ aqueous solution of $NaCl$ is prepared and $500mL$ of this solution is electrolyzed. This leads to the evolution of chlorine gas at one of the electrodes (atomic mass of Na is 23 and Hg is $200)(1F = 96500C)$.

The total charge (coulomb) required for complete electrolysis is

A. 24125

B. 48250

C. 96500

D. 193000

Answer: d

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7. Redox reactions play a pivotal role in chemistry and biology. The values standard redox potential $\left(E^{c-}\right)$ of two half cell reactions decided which way the reaction is expected to preceed. A simple example is a Daniell cell in which zinc goes into solution and copper sets deposited. Given below are a set of half cell reactions (acidic medium) along with their $E^{c-}(V$ with respect to normal hydrogen electrode) values. Using this data, obtain correct explanations for Question.

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

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

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

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

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

Among the following, identify the correct statement.

A. Chloride ion is oxidized by O_2.

B. Fe^{2+} is oxidized by iodine.

C. Iodide ion is oxidized by chlorine

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

Answer: c

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8. Redox reactions play a pivotal role in chemistry and biology. The values standard redox potential $\left(E^{c-}\right)$ of two half cell reactions decided which way the reaction is expected to preceed. A simple example is a Daniell cell in which zinc goes into solution and copper sets deposited. Given below are a set of half cell reactions (acidic medium) along with their $E^{c-}(V$ with respect to normal hydrogen electrode) values. Using this data, obtain correct explanations for Question.

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

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

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

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

While Fe^{3+} is stable, Mn^{3+} is not stable in acid solution because

A. O_2 oxidizes Mn^{2+} to Mn^{3+}

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

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

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

Answer: d

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9. Redox reactions play a pivotal role in chemistry and biology. The values standard redox potential $\left(E^{c-}\right)$ of two half cell reactions decided which way the reaction is expected to preceed. A simple example is a Daniell cell in which zinc goes into solution and copper sets deposited. Given below are a set of half cell reactions (acidic medium) along with their $E^{c-}(V$ with respect to normal hydrogen electrode) values. Using this data, obtain correct explanations for Question.

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

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

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

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

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

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

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

Answer: a

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

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

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

For the above cell

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

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

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

D. $E_{cell} > 0, \Delta G^{c-} < 0$

Answer: b

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11. 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

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

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

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

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

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

A. 1×10^{-15}

B. 4×10^{-15}

C. 1×10^{-12}

D. 4×10^{-12}

Answer: b

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13. Consider $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

If the standard emf is $E_{\text{cell}} = 2.0V \& F = 96500C$

Find $\Delta G^{\circ} (KJ\text{mol})$

A. -5.7

B. 5.7

C. 11.4

D. -11.4

Answer: d

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Archieves Multiple Correct Ansers

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

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

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

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

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

The pair(s) of metals that is / are oxidized by NO_3^{c-} in aqueous solution is / are

A. Fe and Au

B. Hg and Fe

C. V and Hg

D. Fe and V

Answer: b,c,d

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2. In a galvanic cell, the salt bridge.

A. Does not participate chemically in the cell reaction

B. Stops the diffusion of ions from one electrode to another

C. Is necessary for the occurrence of the cell reaction

D. Ensures mixing of the two electrolytic solutions

Answer: a,b,c

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Archieves Single Correct

1. The standard reduction potentials at $298K$ for the following half reactions are given against each

Which is the strongest reducting agent?

A. $Zn(s)$

B. $Cr(s)$

C. $H_2(s)$

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

Answer: a

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2. Faraday's laws of electrolysis are related to

A. The atomic number of the cation

B. The atomic number of anion

C. The equivalent weght of the electrolyte

D. The speed of the cation

Answer: c

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3. A solution containing $1mol$ per litre of each $Cu(NO_3)_2$, $AgNO_3$, and $Hg_2(NO_3)_2$ is being electrolyzed by using inert electrodes. The values of standard electrode potentials in volts (reduction potential) are

$Ag|Ag^{\oplus} = +0.80, 2Hg|Hg_2^{2+} = +0.79$

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

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

A. Ag, Hg, Cu, Mg

B. Mg, Cu, Hg, Ag

C. Ag, Hg, Cu, Mg

D. Cu, Hg, Ag, Mg

Answer: a

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4. The electrice charge for eeletrode deposition of $1g$ equivalent of a substance is

A. 1 ampere per second

B. 96500 Coulombs per second

C. 1 ampere for one hour

D. The charge on one mole of electrons

Answer: d

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5. The reaction

$1/2Hg(g) + AgCl(s) \rightarrow H^{\oplus}(aq) + Cl^{c-}(aq) + Ag(s)$ occurs in the galvanic cell.

A. $Ag|AgCl(s)|KCl(sol)\left|AgNO_3\right|Ag$

B. $Pt\left|H_2(g)\right|HCl(sol)\left|AgNO_3(SOL)\right|Ag$

C. $Pt\left|H_2(g)\right|HCl(sol)|AgCl(s)|Ag$

D. $Pt\left|H_2(g)\right|KCl(sol)|AgCl(s)|Ag$

Answer: c

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6. When a lead storage battery is discharged.

A. SO_2 is evolved

B. Lead is formed

C. Lead sulphate is consumed

D. Sulphuric acid is consumed

Answer: d

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7. The standard reductino potentials E^{c-} for the half reactinos are as follows :

$Zn \rightarrow Zn^{2+} + 2e^{-} \quad E^{c-} = +0.76V$

$Fe \rightarrow Fe^{2+} + 2e^{-} \quad E^{c-} = 0.41V$

The EMF for the cell reaction

$Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$

is

A. $-0.35V$

B. $+0.35V$

C. $+1.17V$

D. $-1.17V$

Answer: b

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8. The standard reduction potentials of $Cu^{2+} \mid Cu$ and $Cu^{2+} \mid Cu^{\oplus}$ are $0.337V$ and $0.153V$, respectively. The standard electrode potential fo $Cu^{\oplus} \mid Cu$ half cell is

A. $0.184V$

B. $0.827V$

C. $0.521V$

D. $0.490V$

Answer: c

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9. The standard reduction potential values of three metallic cations, X, Y, and Z are 0.52, -3.03, and $-0.18V$, respectively. The order of reducing power of the corresponding metal is

A. $Y > Z > X$

B. $X > Y > Z$

C. $Z > Y > X$

D. $Z > X > Y$

Answer: a

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

A. Y will oxidize X and not Z

B. Y will oxidize Z and not X.

C. Y will oxidize both X and Z.

D. Y will reduct both X and Z.

Answer: b

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11. For the electrochemical cell, $\left(M \mid M^{\oplus}\right) \mid \mid \left(X^{c-} \mid X\right), E^{c-}\cdot_{\left(M^{\oplus} \mid M\right)} = 0.44V$ and $E^{c-}\cdot_{\left(X \mid X^{c-}\right)} = 0.334V$

A. $M + X \rightarrow M^{\oplus} + X^{c-}$ is a spontaneous reaction.

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

C. $E_{cell} = 0.77V$

D. $E_{cell} = - 0.77$

Answer: b

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12. Arrange the following compounds in the order of increasing conductance : $HCl, LiCl, NaCl, KCl$.

A. $LiCl > NaCl > KCl$

B. $KCl > NaCl > LiCl$

C. $NaCl > KCl > LiCl$

D. $LiCl > KCl > NaCl$

Answer: b

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13. A standard solution of KNO_3 is used to make salt bridge, because

A. The velocity of $K^{\oplus}$ is greater than that of $NO_3^{\oplus}$.

B. The velocity of $NO_3^{\oplus}$ is greater than that of $K^{\oplus}$

C. The volocities of $K^{\oplus}$ and $NO_3^{\oplus}$ .same

D. KNO_3 is highly solubel in water.

Answer: c

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14. 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 $Fe\left(NO_3\right)_2$

A. MnO_4^{c-} can be used in aqueous HCl

B. CrO_4^{2-} can be used in aqueous HCl

C. MnO_4^{c-} 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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15. 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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16. $Zn\left|Zn^{2+}(a=0.1M)\right| \mid Fe^{2+}(a=0.01M)Fe.$

The EMF of the above cell is 0.2905. The equilibrium constant for the cell reaction is

A. $10^{0.32/0.0591}$

B. $10^{0.32/0.0295}$

C. $10^{0.26/0.0295}$

D. $e^{0.32/0.2995}$

Answer: b

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17. The rusting of iron takes place as follows :

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

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

Calculae ΔG^{c-} for the net process.

A. $-322kJmol^{1}$

B. $-161kJmol^{-1}$

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

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

Answer: a

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18. Electrolysis of dilute aqueous $NaCl$ solution was carried out by passing $10mA$ current. The time required to liberate $0.01mol$ of H_2 gas at the cathode is $\left(1F = 96500Cmol^{-1}\right)$

A. $9.65 \times 10^4 s$

B. $19.3 \times 10^4 s$

C. $28.95 \times 10^4 s$

D. $38.6 \times 10^4 s$

Answer: b

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19. Consider the following cell reation :

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

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

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

A. $1.47V$

B. $1.77V$

C. $1.87V$

D. $1.57V$

Answer: d

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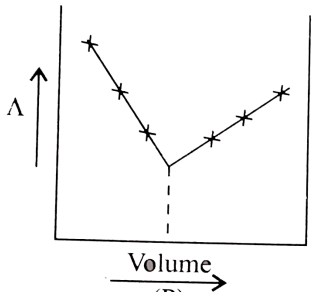
20. $AgNO_2(aq)$ was added to an aqueous KCl solution gradually and the conductivity of the solution was measured. The plot conductivity of the solution was measured. The plot of conductance (Λ) versus the volume of $AgNO_3$ is



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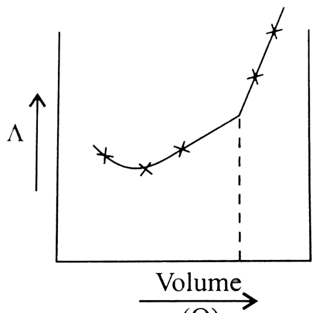

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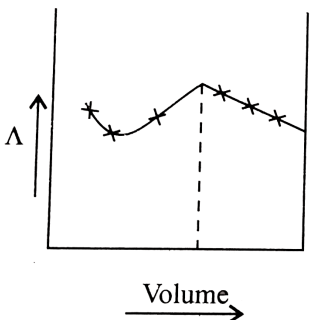

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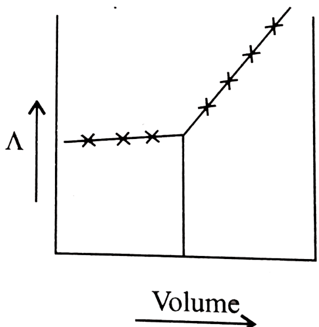

(S)

A. P

B. Q

C. R

D. S

Answer: d

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21. given $E_{S_2O_8^{2-}/SO_4^{2-}} \wedge(\circ) = 2.05V$ $E^{\circ}_{Br_2/Br^-} = 1.40V$ $E^{\circ}_{Au^{3+}/Au} = 1.10V$,brgt $E^{\circ}_{O_2/H_2O} = 1.20V$ Which of the following is the strongest oxidizing agent ?

A. Cr^{3+}

B. Mn^{2+}

C. MnO_4^{c-}

D. Cl^{c-}

Answer: c

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

A. Cu

B. Cr

C. Ag

D. Ca

Answer: d

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

A. 5×10^{3}

B. 5×10^{2}

C. 5×10^{-4}

D. 5×10^{-3}

Answer: c

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24. The equivalent conductance of $NaCl$ at concentration of C and at infinite dilution are λ_C and λ_∞ respectively. The correct relationship between λ_C and λ_∞ is given as :

(where the constant B is positive)

A. $\lambda_C = \lambda_\infty - (B)\sqrt{C}$

B. $\lambda_C = \lambda_\infty + (B)\sqrt{C}$

C. $\lambda_C = \lambda_\infty + (B)C$

D. .λC=λ∞−(B)C

Answer: a

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25. Find the standard electrode potential of $MnO_4^{c-} \mid MnO_2$. The standard electrode potential of $MnO_4^{c-} \mid Mn^{2+} = 1.51V$ and $MnO_2 \big| MnO_2 \big| Mn^{2+} = 1.23V$.

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

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

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

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

Answer: c

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Archieves Fill In The Blanks

1. Galvanization of iron denotes coating with ....

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2. The more .... the standard reduction potential, the .... its ability to displace hydrogen from acids.

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3. The electrical conductivity of a solution of acetic acid will be .... if a solution of sodium hydroxide is added.

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4. The electrolysis of molten sodium hydride liberates .... gas it the ....

Watch Video Solution

Archieves True/False

1. TRENDS IN THE $E_{M^{+3}/M^{+2}}$ VALUES OF 3d SERIES

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Archieves Subjective

1. A current of 3.7 A is passed for 6hrs. Between Ni electrodes in 0.5 L of 2 M solution of $Ni(NO_3)_2$. What will be the molarity of solutionn at the end of electrolysis?

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2. Consider the cell :

$$Zn\left|Zn^{2+}(aq)(1.0M)\right|\left|Cu^{2+}(aq)(1.0M)\right| \mid Cu$$

Thee standard reduction potentials are $0.350V$ for

$Cu^{2+}(aq) + 2e^- \rightarrow Cu$ and $-0.763V$ for

$Zn^{2+}(aq) + 2e^- \rightarrow Zn$

$a.$ Write the cell reaction.

$b.$ Calculate the EMF of the cell.

$c.$ Is the reaction spontaneous or not ?

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3. In an electrolysis experiment, current was passed for $5h$ through two cells connected in series. The first cell contains a solution of gold and second contains copper sulphate solution. In the first cell, $9.85g$ of gold was deposited. If the oxidation number of gold is $+3$, find the amount of copper deposited at the cathode of the second cell. Also calculate the magnitude of the current in ampere, (Atomic weight of Au is 1197 and atomic weight of Cu is 63.5).

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

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5. Give reasons in one or two sentences : anhydrous HCl is a bad conductor of electricity but aqueous HCl is a good conductor.

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6. The EMF of the following cellis $1.05V$ at $25^\circ C$:

$Pt, H_2(g)(1.0atm)|NaOH(0.1m), NaCl(0.1M)|AgCl(s), Ag(s)$

a. Write the cell reaction,

b. Calculate pK_w of water.

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7. During the discharge of a lead storage battery, the density of sulphuric acid fell from $1.294gmL^{-1}$ to $1.139gmL^{-}$. Sulphuric acid of density $1.294gmL^{-1}$ is 39% by weight and that of density $1.139gmL^{-1}$ 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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8. A $100 - W, 100 - V$ incardescent lamp is connected in series with an electrolyte cell containing cadmium sulphate solution. How much cadmium will be deposited by the current flowing for $10h$?

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

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

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

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

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11. An acidic solution of Cu^{2+0} salt containing $0.4g$ of Cu^{2+} is electrolyzed until all the copper is deposited. The electrolysis is continued for seven more minutes with the volume of solution kept at $100mL$ and the current at $1.2A$. Calculate the volume of gases evolved at STP during the entire electrolysis.

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

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

$2H_2O \Leftrightarrow H_3O^{\oplus} + \overset{\Theta}{OH}$ at $25^{\circ}C$.

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

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

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15. Zinc granules are added in excess to 500 mL of 1M $Ni(NO_3)_2$ solution of $25^{\circ}C$ untill the equilibrium is reached. If $E^{\circ}_{Zn^{2+}/Zn}$ and $E^{\circ}_{Ni^{2+}/Ni}$ are $-0.75V$ and $-0.24V$ respectively, find out the $[Ni^{2+}]$ at equilibrium.

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

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

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

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

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

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

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19. The standard reduction potential for the half cell :

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

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

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

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

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

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

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

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

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22. The Edison storage cell is represented as :

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

The half - cell reactions are :

$$Ni_2O_3(s) + H_2O(l) + 2e^- \rightleftharpoons 2NiO(s) + 2\overset{\ominus}{O}H ;$$
$$E^{\ominus} = +0.40\ V$$

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

a. What is the cell reaction ?

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

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

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

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

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

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

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25. How many grams of silver could be plated out on a serving tray by the electrolysis of a solution containing silver in $+1$ oxidation state of a period of $8.0h$ at a current of $8.46A$? What is the area of the ray, if the thickness of the silver plating is $0.0254cm$? The density of silver is 10.5 g cm^(-3)`.

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

$E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.68V$

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27. Calculate the equilibrium constant for the reaction :

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

The standard reduction potential in acidic conditions is $0.78V$ and $0.54V$, respectively, for $Fe^{3+} \mid Fe^{2+}$ and $I_3^{c-} \mid I^{c-}$ couples

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

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

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

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

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31. The following electrochemical cell has been set up :

$Pt(l)|Fe^{3+}, Fe(a=1)|Ce^{4+}, Ce^{3+}(a=1)|Pt(2)$

$E^{c-}\cdot\left(Fe^{3+}\quad Fe^{2+}\right)=0.77V$

and

$E^{C-} \cdot \left(Ce^{4+} \quad Ce^{3+} \right) = 1.61V$

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

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32. The standard potential of the following cell is 0.23 V at $15\,^\circ C$ and $0.21V$ at $35\,^\circ C.Pt\left|H_2\right|HCl(aq)|Agcl(s)|g(s)$

(i) write the cell reaction .

(ii) Calculate ΔH° and ΔS° for the cell reaction by assuming that these quantities remain unchanged in the range $15\,^\circ C$ to $35\,^\circ C$.

(iii) calculate the solubility of $AgCl$ in water at $25\,^\circ C$.

Give , the standard reduction potential of the $\left(Ag^+(aq)/Ag(s)\right.$ is 0.80 V at $25\,^\circ C$.

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33. 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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34. 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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35. We have taken a saturated solution of $AgBr$, whose K_{sp} is 12×10^{-14}. If $10^{-7}M$ of $AgNO_3$ are added to $1L$ of this solutino, find the conductivity (specific conductance) of the solution in terms of $10^{-7}Sm^{-1}$ units.

Given :

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

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

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

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