CHEMISTRY

BOOKS - CHHAYA CHEMISTRY (BENGALI ENGLISH)

ELECTROCHEMISTRY

NUMERICAL EXAMPLES

1. A silver electrode is immersed in a 0.1 (M) $AgNO_3$ solution at $25^\circ C$. If $AgNO_3$ dissociates almost completely in the solution, then determine the potential of the silver electrode.

Given : $E^\circ_{Ag^+ \mid Ag} = 0.80V$.

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2. At $25^{\circ} C$, the reduction potential of $Cu^{2+} \mid Cu$ half - cell is 0.28V. If E° of $Cu^{2} \mid Cu$ half-cell is $+0.34V$, find the molar concentration of Cu^{2+} ion in the half - cell.

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3. A half - cell is constructed by dipping a Zn- rod into a solution of $ZnSO_4$ at $25^{\circ} C$. If the concentration of Zn^{2+} ion in the solution be 0.01 (M), calculate the oxidation potential of the half- cell, Given : $E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V$.

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4. For the half - cell $Fe^{3+}, Fe^{2+} \mid Pt$, the concentration of Fe^{2+} and Fe^{3+} ions are 0.1 and 0.01 (M) respectively. Determine the reduction potential of the half - cell at $25^{\circ} C$. Given : $E^{\circ}_{Fe^{3+}, Fe^{2+} \mid Pt} = +0.77V$

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5. Determine electromotive force of the given concentration cell at $25^{\circ}C$:

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

6. Calculate the reduction potential of the following half - cells at $25^{\circ}C$,

(1) $Pt|H_2(1.5\text{ atm})|HCl(0.01\text{ M})$

Given : $E^{\circ}_{\frac{1}{2}Cl_2|Cl^-} = +1.36V$

7. Calculate the reduction potential of the following half - cells at $25^{\circ}C$,

(2) $PT|Cl_2(5\text{ atm})|HCl(0.15\text{ M})$

Given : $E^{\circ}_{\frac{1}{2}Cl_2|Cl^-} = +1.36V$

8. Consider the half - cell : $Pt|H_2(1\text{ atm})|H_2SO_4$. If the reduction potential of the half - cell at $25^\circ C$ be 0.3 V, then determine the pH of H_2SO_4 solution in the half - cell.

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9. Determine the electromotive force of the following galvanic cell at $25^\circ C$. Given : $E^\circ_{Cd^{2+}|Cd} = -0.402V$

$$Cd|Cd^{2+}(0.02M)||H^+(0.2M)|H_2(0.5\text{ atm})|Pt$$

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10. Determine the electromotive force of the following galvanic cell at $25^\circ C$

$$Pt|H_2(10\text{ atm})|HCl|H_2(5\text{ atm})|Pt$$

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11. Determine the EMF of a decimolar Daniell cell at $25^{\circ}C$. Given : $E^{\circ}_{Zn^{2+}\,|\,Zn} = -0.76V$ and $E^{\circ}_{Cu^{2+}\,|\,Cu} = +0.34V$.

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12. Calculate the value of equilibrium constant of the reaction occurring in Deniell cell at $25^{\circ}C$.

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

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13. Determine the equilibrium constant for the reaction :

$Fe^{2+}(aq) + Ce^{4+}(aq) \rightarrow Fe^{3+}(aq) + Ce^{3+}(aq)$

Givne : $E^{\circ}_{Ce^{4+}\,|\,Ce^{3+}} = 1.44V \& E^{\circ}_{Fe^{3+}\,|\,Fe^{2+}} = 0.77V$.

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14. Calculte the standard free energy change for the reaction occurring in a Daniell cell $\left(E^{\circ}_{\text{cell}} = 1.10V\right)$.

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

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15. For the cell, $Zn|ZnO_4||AgNO_3|Ag$, the cell reaction is : $Zn + 2Ag^{+} \rightarrow Zn^{2+} + 2Ag$. If $E^{\circ}_{\text{cell}} = +0.36V$, then calculate Δ° for the cell reaction of that cell.

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16. Calculate the electrical work (at standard state) obtained from galvanic cell : $Mg\left|Mg^{2+}(aq)\right|\left|Ag^{+}(aq)\right|Ag$

Given : $E^{\circ}_{Mg^{2+}|Mg} = -2.36V$ and $E^{\circ}_{Ag^{2+}|Ag} = +0.80V$

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17. Distance between the electrodes of a conductivity cell is 1.75 cm, and the cross - sectional area of each electrode is $4cm^2$. If the cell is filled wich 0.5(M) solution of an electrolyte, then the resistance of the cell becomes 25 ohm. Calculate the specific conductance of the solution.

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18. Distance between the two electrodes of a conductivity cell is 1 cm, and the cross - sectional area of each electrode is $2cm^2$. If the cell is filled with 50 g,L^{-1} KCl solution, resistance of the cell appears to be 7.25 ohm. What is the molar conductivity of the solution?

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19. At $18^{\circ} C$, the specific conductance of (N/10) KCl solution is $0.0112 \text{ ohm}^{-1}.\text{ cm}^{-1}$. When a conductivity cell is filled with that solution, the resistance of the cell stands at 55 ohm. What is the cell constant of the cell?

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20. At $25^{\circ}C$ resistance of 0.01 (N) KCl and 0.01 (N) HCl solutions in the same conductivity cell are 150 ohm and 51.40 ohm, respectively. The specific conductance of the KCl solution at $25^{\circ}C$ is $1.41 \times 10^{-3}\ \text{ohm}^{-1}.cm^{-1}$. Determine the molar conductivity of HCl solution $25^{\circ}C$.

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21. At infinite dilution, molar conductivities of HCl, NaCl and CH_3COONa solution are 426.2, 126.5 and 91.0 $\text{ohm}^{-1}.\text{cm}^2.\text{mol}^{-1}$ respectively. On the basic of these values, determine the molar conductivity of CH_3COOH solution at infinite dilution.

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22. At infinite dilution, molar conductivities of $Ba(OH)_2, BaCl_2$ and NH_4Cl solution are 523.28, 280.0 and $129.8 \text{ ohm}^{-1}.\text{ cm}^2.\text{ mol}^{-1}$ respectively. Calculate the molar conductivity of NH_4Cl solution at infinite dilution.

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23. $\Lambda_m^{\circ}(NaCl) - \Lambda_m^{\circ}(NaNO_3) = 3.7 \text{ ohm}^{-1}.\text{ cm}^2.\text{ mol}^{-1}$. Find the value of $\Lambda^{\circ}_{LiCl} - \Lambda^{\circ}_{LiNO_3}$.

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24. The molar ionic conductances of $Al(3+)$ and SO_5^{2-} ions in an infinitely dilute solution of $Al_2(SO_4)_3$ are 189 and $160 \text{ ohm}^{-1}.\text{ cm}^2.\text{ mol}^{-1}$, respectively. Determine Λ° and Λ_m° of $Al_2(SO_4)_3$ solution.

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25. Molar conductivity of 0.1 (M) solution of a weak electrolyte is $0.009 \text{ ohm}^{-1}.\text{cm}^{-1}$. Its molar conductivity at infinite dilution is $260 \text{ ohm}^{-1}.\text{cm}^2.\text{mol}^{-1}$. What is the degree of dissociation of the electrolyte in the solution?

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26. At infinite dilution, molar conductivity of acetic acetic acid solution at a given temperature is $390 \text{ ohm}^{-1}.\text{cm}^2.\text{mol}^{-1}$. At the same temperature, molar conuctivity of 0.001(M) acetic acid solution is $55 \text{ ohm}^{1}.\text{cm}^2.\text{mol}^{-1}$. What is the pH of 0.001(M) acetic acid solution?

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27. 2.015 of silver is deposited at the cathode when a current of 3A is passed for 10 min through a solution of $AgNO_3$. Determine the chemical and the electro- chemical equivalent of silver.

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28. 0.59g of a metal is deposited at the cathode when 0.5A current is passed for 1 hr through a soluiton of metal sulphate. Find the equivalent mass or chemical equivalent of the metal.

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29. A current of 10A was allowed to pass through acidulated water for 3 min 13s. What mass of water will be decomposed?

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30. 0.8898 of a metal is deposited at the cathode when a current of 1.5A is passed for 30 min through a solution containing a salt of the metal. If valency of the metal is 2, calculate its relative atomic mass.

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31. A metal wire carries a current of 1A. How many electrons can pass through a point in the wire in 1 s ?

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32. A 100 W - 100 V incandescent lamp is connected in a series with an electrolytic cell containing cadmium sulphate solution. What mass of cadmium will be deposited at the electrode by a current flowing for 10 h ?

$\left(\text{Molar mass of Cd} \quad = 112.4 \text{ g.mol}^{-1}\right)$

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33. If 2 A current passes for 5 h through a molten tin salt to deposit 22.2 g tin, what will be the oxidation number of tin in the salt? [At. Mass of tin = 118.7]

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34. What is the total charge present on $1.4gN^{3-}$ ion?

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35. Determine the current (in A) to be passed for 30 min through a $CuSO_4$ solution to deposit 0.406 g of copper.

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36. How many faradays of electricity will be required to electrolyse completely 1 mol of molten Al_2O_3 to produce Al metal and O_2 gas ?

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37. What volume of H_2 gas at STP will be evolved when a current of 10 A is passed for 6 min 26 s through a dilute solution of H_2SO_4?

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38. If a current of 10 A is passed through acidulated water for 100 s then what volume of electrolytic gas at STP will be produced?

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39. A current of 0.5 A is passed through a solution of $CuSO_4$ for 20 min by using platinum electrodes. (1) What amount of copper will be deposited at the cathode ?

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40. A current of 0.5 A is passed through a solution of $CuSO_4$ for 20 min by using platinum electrodes. (2) What volume of O_2 at STP will be evolved at the anode?

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41. What volume of 0.05(N) H_2SO_4 will be required to neutralise that alkali formed by passing a current of 0.4 A for 5 min through a dilute solution of $NaCl$?

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42. Determine the amount of electricity of be required to deposit copper of thickness 10^{-3} cm on a plate having an area of $100cm^2$ by using copper sulphate solution. [Density of $Cu = 8.94g.\ cm^{-3}$, atomic mass of Cu = 63.5]

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43. If the quantity of electricity required to liberate 2.6267 g of gold from a solution of gold salt is used for the the electrolysis of $CuSO_4$ solution in presence of copper anode, then 1.26 g of copper gets dissolved. Find the oxidation number of gold in the gold salt.

$[Cu = 63, Au = 197]$

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44. Electrolysis of acidulated water yields H_2 at the cathode and O_2 at the anode. In an experiment, the total volume of liberate H_2 and O_2, gases during the electrolysis was found to be 16.8 mL at STP. What amount of electricity in coulomb was used in the experiment?

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45. Calculate the quantity of electricity 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 3.0 V,how much energy will consumed?

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PROBLEM

1. Determination of the value of electrode potential. Given E° and concentration of the reactants and products of the electrode reaction

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2. Determination of the electromotive force of a galvanic cell. Given: Standard electrode potential of the half - cells & molar concentrations of different constituents participating in cell reaction.

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3. Determination of the equilibrium constant (K) of the reaction occurring in a galvanic cell. Given : E° of the cathode and the anode, temperature.

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4. Determination of the value of ΔG and w_{el} of the cell reaction.

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5. Determination of specific conductance and molar conductivity of electrolyte solution.

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6. Determination of Λ_m° and the degree of dissociation (α) of a weak electrolyte from Kohlrausch's law/

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7. Problems based on Faraday's laws of electrolysis.

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WARM UP EXERCISE

1. What is electrode potential ? What do you mean by standard electrode potential?

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2. Sodium can displace zinc from a solutions of zinc salt. Explain whether the standard reduction potential of sodium is greater or less than that of zinc.

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3. Determine reduction potential of the given electrode reaction at $25^\circ ClCu^{2+}(0.1M, aq) + 2e \rightarrow Cu(s)$. The standard reduction potential of $Cu^{2+} \mid Cu$ system $= +0.34V$.

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4. The standard reduction potentials of $Ca^{2+}\left|Ca,\, Zn^{2+}\right|Zn,\, H^{+}\left|\frac{1}{2}H_2,\, \frac{1}{2}Br_2\right|Br^{-},\, \frac{1}{2}Cl_2 \mid Cl^{-}$ electrodes are $-2.87,\, -0.76,\, 0.00,\, +1.06$ and $+1.36V$, respectively. Among $Ca,\, Zn,\, H_2,\, Br_2$ and Cl_2, which one is the strongest reductant, and which one is the strongest oxidant?

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5. The standard reduction potentials of $Ni^{2+}\left|Ni,\, Cr^{3+}\right|Cr,\, Ag^{+}\left|Ag,\, Fe^{2+}\right|Fe$ electrodes are $-0.24,\, -0.74,\, +0.80$ and $-0.44V$, respectively. Arrange $Ni,\, Cr,\, Ag$ and Fe in increasing order of their reducing power and give reasons.

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6. Ag or Au is available in free state in nature, while Ca or K is not - explain.

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7. It the reaction, $2Ag(s) + Fe^{2+}(aq) \rightarrow 2Ag^{+}(aq) + Fe(s)$ possible?

Given : $E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V$ and $E^{\circ}_{Ag^{+} \mid Ag} = +0.80V$.

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8. Which one of Sn, Cu, Cr, Al can reduce Fe^{2+} ion in aqueous medium? Explain. The standard reduction potential of $Sn^{2+}|Sn, Cu^{2+}|Cu, Al^{3+}|Al, Cu^{3+}|Cr$ and $Fe^{2+} \mid Fe$ electrodes are $-0.14, +0.34, -1.66, -0.74$ and $-0.44V$ repectively.

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9. The standard reduction potentials of $Li^{+}|Li, Na^{+}|Na$ and $Mg^{2+}|Mg$ electrodes are $-3.05, -2.17$ and $-2.37V$, respectively. Which one of Li^{+}, Na^{+} and Mg^{2+} ions is the strongest oxidising species?

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10. Arrange the ions Ag^{+}, Zn^{2+}, H^{+} and Na^{+} in order of their increasing tendency to get liberated at cathode.

$\left[\text{Given: } E^{\circ}_{Ag^{+}\,|\,Ag} = 0.80V, E^{\circ}_{Zn^{2+}\,|\,Zn} = -0.76V,\right.$
$\left.E^{\circ}_{2H^{+}\,|\,H_2} = 0.00V, E^{\circ}_{Na^{+}\,|\,Na} = -2.17V\right]$

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11. The standard reduction potential of metals A, B, C, and D are $+0.80V, -0.76V, +20V$ and $+0.38V$, respectively. Arrange the metals in increasing order of their metallic character.

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12. Given that $E^{\circ}_{Al^{3+}\,|\,Al} = -1.66V, E^{\circ}_{Cd^{2+}\,|\,Cd} = -0.40V, E^{\circ}_{Pb^{2+}\,|\,Pb} = -0.126V$ and E

, arrange Al, Cd, Pb and Zn in increasing order of their reactivity.

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13. The concentration of each of Y^- and Z^- in a solution is 1 M. At $25^\circ C$, a gas X at a pressure of 1 atm is allowed to pass through the solution. If the values of standard reduction potentials of X, Y and Z follows the order $Z > X > Y$, then which one between Y^- and Z^- would be oxidised by X?

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14. Construct galvanic cells for the given spontaneous radox reactions.

(i) $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(\text{g, 1 atm})$

(ii) $Cl_2(\text{g, 1 atm}) + 2I^-(aq) \rightarrow I_2(aq) \rightarrow I_2(s) + 2Cl^-(aq)$

(iii) $\frac{1}{2}H_2(\text{g, 1 atm}) + \frac{1}{2}Cl_2(\text{g, 1 atm}) \rightarrow HCl(aq)$

(iv) $Fe^{2+}(aq) + Ce^{4+}(aq) \rightarrow Fe^{3+}(aq) + Ce^{3+}(aq)$

(v) $H_2(\text{g, 1 atm}) + AgCl(s) \rightarrow Ag(s) + HCl(aq)$

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15. Write Nernst equation for the redox reaction occurring in the following galvanic cells.

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

(ii) $Pt|H_2(\text{g, p atm})|H^{+}||Cl^{-}|Hg_2Cl_2(s)|Hg$

(iii) $Ag|AgCl(s)|Cl^{-}\ |\ |\ Ag^{+}|Ag$

(iv) $Pt|I_2(s)|I^{-}||Br^{-}|Br_2(l)|Pt$ (All at $25^{\circ}C$)

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16. Write the anode and cathode reactions for the given cell reactions.

$S_2O_8^{2-}(aq) + 2I^{-}(aq) \rightarrow 2SO_4^{2-}(aq) + I_2(s)$

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17. Write the anode and cathode reactions for the given cell reactions.

$Hg(l) + PbO(s) \rightarrow Pb(s) + HgO(s)$

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18. Write the anode and cathode reactions for the given cell reactions.

$$Ag(s) + \frac{1}{2}Cl_2(g) \rightarrow AgCl(s)$$

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19. Consider the galvanic cell $Cu\left|Cu^{2+}(0.13M)\right|\left|Ag^{+}(0.01M)\right|Ag$ (i) Calculate the reduction potential of each electrode and EMF of the cell

(ii) Is is reaction representing the cell spontaneous ?

$$\left[\text{Given}: \ E^{\circ}_{Cu^{2+}\,|\,Cu} = +0.34V \text{ and } E^{\circ}_{Ag^{+}\,|\,Ag} = +0.80V\right]$$

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20. Will the following reaction be spontaneous under standard conditions?

(a) $Fe + Mg^{2+} \rightarrow Fe^{2+} + Mg$

(b) $Cd + Cl_2 \rightarrow Cd^{2+} + 2Cl^{-}$

$$\left[\text{Given}: \ E^{\circ}_{Fe^{2+}\,|\,Fe} = -0.44V, E_{Mg^{2+}\,|\,Mg} = -2.37V, E^{\circ}_{Cd^{2+}\,|\,Cd} = -0.4$$

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21. The reaction $H_2(g) + Cu^{2+}(aq) \rightarrow Cu(s) + 2H^+(aq)$ occurs in a galvanic cell. Identify cathode and anode of the cell and write the reaction that occur at the electroes.

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22. Identify, with a reason, the stronger oxidising agent in each of the following pairs.

$Cl_2(g), Br_2(l)$

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23. Identify, with a reason, the stronger oxidising agent in each of the following pairs.

Pb^{2+}, Fe^{2+}

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24. Identify, with a reason, the stronger oxidising agent in each of the following pairs.

$Ag^{+}, Cu^{2+},$

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25. Identify, with a reason, the stronger oxidising agent in each of the following pairs.

Cr^{3+}, Fe^{2+}

$$\Bigg[\text{Given}: \ E^{\circ}_{\frac{1}{2}Cl_2(g)\,|\,Cl^{-}} = +1.36V,$$

$$E^{\circ}_{\frac{1}{2}Br_2(l)\,|\,Br^{-}} = +1.07V,$$

$$E^{\circ}_{Cu^{2+}\,|\,Cu} = +0.34V, E^{\circ}_{Ag^{+}\,|\,Ag} = +0.80V,$$

$$E^{\circ}_{Pb^{2+}\,|\,Pb} = -0.13V, E^{\circ}_{Fe^{2+}\,|\,Fe} = -0.44V,$$

$$E^{\circ}_{Fe^{3+}\,|\,Fe} = -0.036V, E^{\circ}_{Cr^{3+}\,|\,Cr} = -0.74V\Bigg]$$

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26. Each of the following redox reaction occurs spontaneously.

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

Arrange with explanation Zn,Cu in order of their decreasing standard reduction potential.

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27. Each of the following redox reaction occurs spontaneously.

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

Arrange with explanation Ag,Cu in order of their decreasing standard reduction potential.

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28. Each of the following redox reaction occurs spontaneously.

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

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

Arrange, with explanation, Mg, Zn, Cu and Ag in order of their decreasing standard reduction potentials.

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29. Which category of cells does the following galvanic cell belong to? What is the value of E°_{cell} for this cell? What is the condition for E_{cell} of the cell to be positive?

$Pt|Cl_2(g, p_1 atm)|Cl^-(aq, CM)|Cl_2(g, p_2 atm)|Pt$

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30. n mol of electrons are involved in a redox reaction occurring in a galvanic cell with a standard EMF of xV. Show that the equilibrium constant of the reaction, $K = 10^{16.91nx}$.

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31. For a solution of strong electrolyte, the specific conductance increase in concentration but molar conductivity decreases. Explain.

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32. Explain whether the specific conductance of a solution of weak electrolyte and a solution of strong electrolyte will increase or decrease with dilution.

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33. At constant temperature, why is the specific conductance of an electrolyte solution no dependent on the cell constant of a conductivity cell?

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34. For a weak electrolyte, the degree of dissociation decreases but specific conductance increases with the increase in concentration of its solution. Why?

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35. Why is the molar conductivity of a 0.01 M HCl solution greater than that of a 0.01 M CH_3COOH solution?

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36. Which of the following solutions has the higher molar conductivity at a given temperature, and why?

(i) $0.1 \text{ M} \quad Na_2SO_4$

(ii) $0.01 \text{ M} \quad Na_2SO_4$

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37. If equivalent conductivity of $BaSO_4$ solution be $x\ \mathrm{ohm}^{-1}.\ \mathrm{cm}^{-1}.\ \mathrm{g\text{-}equiv}^{-1}$, then calculate its molar conductivity.

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38. State and explain Kohlrusch's law of independent migration of ions.

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39. For which one of the following electrolyte solutions can we apply Kohlrausch's law to determine Λ_m° of the solution ? $CH_3COONa, HCOOH, NH_4Cl.$

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40. Calculating the value of Λ_m° for NH_4OH solution requires the value of Λ_m° for the solutions of $NH_4Cl, NaOH$ and an electrolyte. Name the electrolyte.

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41. At infinite dilution, Λ_m° for K_2SO_4 solution is x $\text{ohm}^{-1}.\text{cm}^2.\text{mol}^{-1}$, and ionic conductance (λ°) for SO_4^{2-} is $\text{y ohm}^{-1}.\text{cm}^2.\text{mol}^{-1}$. Find the value of λ° for K^+ ion.

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42. The values of Λ_m° for the aqueous solution of KCl and KNO_3 are $149.86 ohm^{-1}\text{cm}^2 mol^{-1}$ and $145 ohm^{-1} cm^2 mol^{-1}$, respectively. If $\lambda_m^\circ(Cl^-)$ is $76.44 \text{ ohm}^{-1}.\text{cm}^2.\text{mol}^{-1}$ then $\lambda_m^\circ(NO_3^-)$ will be?

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43. The equivalent conductance of an infinitely dilute solution of $Al_2(SO_4)_3$ is Λ°. What is the value of Λ_m° for the solution?

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44. Write the cathode and anode reactions for the electrolysis of aqueous $AgNO_3$ solution in presence of Ag - electrodes.

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45. An aqueous solution containing Cu^{2+}, Hg_2^{2+} and Ag^{+} ions, each with a concentration of 1M, is being electrolysed by using Pt - electrodes. If the voltage between the electrodes is increased gradually, which one of these ions will be deposited first and which one will be deposited last at the cathode?

$E^{\circ}_{Ag^{+}\mid Ag}=0.8V, E^{\circ}_{Cu^{+}\mid Cu}=0.34V \& E^{\circ}_{Hg^{+}\mid 2Hg}=0.79$

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46. What products are expected to be obtained at the cathode and the anode in the electrolysis of an aqueous solution of Na_2SO_4 by using Pt - electrodes?

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47. Calculate the amount of electricity carried by each of the following ions : (i) Cu^{2+}

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48. Calculate the amount of electricity carried by each of the following ions : (ii) Al^{3+}

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49. Calculate the amount of electricity carried by each of the following ions : (iii) Sn^{4+}

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50. Calculate the amount of electricity carried by each of the following ions : (iv) PO_4^{3-}

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51. Using Pt - electrodes, each of the following aqueous solutions with the same value is electrolysed separaely by passing 0.03 faraday of electricity in each case. Find the mole - ratio of the metals deposited at the cathodes, (i) $0.1(M)Ag^{+}$

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52. Using Pt - electrodes, each of the following aqueous solutions with the same value is electrolysed separaely by passing 0.03 faraday of electricity in each case. Find the mole - ratio of the metals deposited at the cathodes, (ii) $0.1(M)Cu^{2+}$

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53. Using Pt - electrodes, each of the following aqueous solutions with the same value is electrolysed separaely by passing 0.03 faraday of electricity in each case. Find the mole - ratio of the metals deposited at the cathodes, (iii) $0.1(M)Au^{3+}$.

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54. Between chemical equivalent (E) and electrochemical equivalent (Z), which one is larger and by what factor is it larger than the other?

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55. Why cannot we use primary batteries for a long time?

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56. How is it possible to use secondary batteries for a long time?

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57. Write the cathode, anode and overall reactions involved in charging and discharging of lead acid accumulator.

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58. What is the difference between a fuel cell and a galvanic cell?

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59. Write the electrode reaction occurring in $H_2 - O_2$ fuel cell.

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60. Write the electrode reaction involved in rusting of iron.

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61. Define : (i) Sacrificial and cathode protection

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62. Define : (ii) Galvanisation.

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QUESTION - ANSWER ZONE FOR BOARD EXAMINATION (VERY SHORT ANSWER TYPE)

1. Write the cathode and anode reaction for the electrolysis solution of K_2SO_4.

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2. At standard conditions, a solution containing Ag^{+} and Zn^{2+} ions is electrolysed. Which one between these two ions will be reduced first?

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3. What is the use of Pt foil in the hydrogen electrode?

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4. What is the sign of ΔG for a reaction (1) in galvanic cell. (2) I electrolytic cell?

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5. Name the electrode at which the following reduction reaction occurs. What is the standard reduction potential of this electrode at $25^{\circ}C$?

$2H_3O^{+}(\text{aq, 1M}) + 2e \rightarrow H_2(\text{g, 1 atm}) + 2H_2O(l)$

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6. When $CuSO_4$ solution is electrolysed in presence of two Cu - electrodes, what happens to the electrodes?

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7. What happens to the concentration of Ag^+ ions in a solution of $AgNO_3$ when it is electrolysed in presence of Ag-electrodes?

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8. Two pieces of blue litmmus paper are placed in cathode and anode compartments of an electrolytic cell used for electrolysis of Na_2SO_4 solution. Will the colour of the litmus paper change during electrolysis?

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9. What will be the value of E° for the given reaction?

(1) $Cl^{-1}(aq, 1M) \rightarrow \frac{1}{2}Cl_2(g, 1atm)$

Given : $\frac{1}{2}Cl_2(g, 1atm) + e \rightarrow Cl^{-}(aq, 1M), E^{\circ} = 1.36V$

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10. What will be the value of E° for the given reaction?

(2) $Cl_2(g, 1atm) + 2e \rightarrow 2Cl^{-}(aq, 1M)$

Given : $\frac{1}{2}Cl_2(g, 1atm) + e \rightarrow Cl^{-}(aq, 1M), E^{\circ} = 1.36V$

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11. Which is produced in anode and cathode reactions in a lead - acid storage cell during discharging?

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12. At a given temperature, the molar conductivity at infinite dilution of the electrolyte A_2B and the molar ionic conductance of B^{2-} are x and y $\text{ohm}^{-1}.\text{cm}^2.\text{mol}^{-1}$ respectively. Find the molar ionic conductance of A^+ ion.

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13. Consider the given reaction that occurs in a galvanic cell :

$Zn(s) + Ag_2O(s) + H_2O(l) \rightarrow$

$Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$

Write the cathode and the anode reactions.

Watch Video Solution

14. The half - cell reactions of a galvanic cell are :

$Ni_2O_3(s) + H_2O(s) + 2e \rightarrow 2NiO(s) + 2OH^-(aq), E^\circ = +0.4V$

$FeO(s) + H_2O(l) + 2e \rightarrow Fe(s) + 2OH^-(aq), E^\circ = -0.87V$

Write the cell reaction.

Watch Video Solution

15. The concentration of H_2SO_4 is used up.

$$\text{Cell reaction : } PbO_2(s) + 2H_2SO_4(aq) \rightarrow PbSO_4(s) + 2H_2O(l)$$

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16. Mention any two difference between an electrolytic cell and a galvanic cell.

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17. In methanol fuel cell, $CO_2(g)$ is evolved due to the oxidation of methanol at the anode, and oxygen is reduced at the cathode. Write anode and cathode reactions of the cell.

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18. Write the cell reaction of the given galvanic cell :

$Pt|H_2(\text{g, 1atm})|HCl(aq)|Hg_2Cl_2|Hg \mid Pt$

Watch Video Solution

19. (1)

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

(2)

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

(3) $Cl_2(g) + 2e \to 2Cl^-(aq), E^\circ = +1.40V$

$KMnO_4$ and $K_2Cr_2O_7$ both are well known oxidising agent and used in quantitative analysis. If a solution of a reducing agent contains HCl, which one between these two should not be used as an oxidising agent?

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QUESTION - ANSWER ZONE FOR BOARD EXAMINATION (SHORT ANSWER TYPE)

1. If Fe is allowed to react with 1(M) HCl solution, will Fe be oxidised to Fe^{2+} ? $E^{\circ}_{Fe^{+2}|Fe} = -0.44V$

Watch Video Solution

2. What is the role of $ZnCl_2$ in a Laclanche cell?

Watch Video Solution

3. Find the strongest reducing agent among the following redox couples considering their standard reduction potentials: $Zn^{2+}|Zn = -0.768V, Cr^{+3}|Cr = -0.74V, 2H^{+}|H_2(g), Pt = 0.00V,$ F

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4. Explain the feasibility of the following reaction: $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ [Given: $Zn^{2+} \mid Zn$ and $Cu^{2+} \mid Cu$ redox

couples have the standard electrode potential of $-0.76V$ and $+0.34V$, respectively.]

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5. How can the reduction potential of an electrode be increased ?

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6. Equilibrium constant is related to E°_{cell} but not $E_{\text{cell}}-$ Explain why?

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7. MCl_2 and MCl_3 are two chlorides of a metal M. Q coulomb of electricity is separately passed through the molten state of both the compounds. In which case, will the amount of metal deposited at the cathode be higher?

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8. During the electrolysis of $CuSO_4$ solution in presence of cooper electrodes, the Cu - anode is depleted. Why ?

Watch Video Solution

9. Given : $Zn^{2+}(aq) + 2e \rightarrow Zn(s), E^{\circ} = -0.76V$ and $Fe^{2+}(aq) + 2e \rightarrow Fe(s), E^{\circ} = -0.44V$.

At standard conditions, what cause minimum external potential be required to cause the following reaction : $Fe(s) + Zn^{2+}(aq) \rightarrow Fe^{2+}(aq) + Zn(s)$?

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10. I_2 and Br_2 are added to a solution containing I^- and Br^- ions. As solution I^- and Br^- ions, each with a concentration of 1M. What reactions would occur if I_2 and Br_2 are added to this solution ?

$\left[\text{Given}: \quad I_2 + 2e \rightarrow 2I^-, \qquad E^{\circ} = 0.54V \text{ and } Br_2 + 2e \rightarrow 2Br^-, E^{\circ}\right.$

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11. Iron can displace Cu from $CuSO_4$ solution, but Ag can not. Explain.

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12. The given redox reactions occur spontaneously Arrange Ag,Zn and Cu according to their increasing standard reduction potentials .

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13. Predict whether reaction will occur between the pairs given below :

$Fe^{3+} \text{ and } I^-$

$$\left[\text{ Given } E_{Fe^{3+} \mid Fe^{2+}} = +0.77V, E_{\left(\frac{1}{2}\right) I_2 \mid I^-} = +0.54V, E^\circ_{Ag^+ \mid Ag} = +0\right.$$

Watch Video Solution

14. Predict whether reaction will occur between the pairs given below :

Sn^{2+} and Fe^{3+}

$\left[\text{Given } E_{Fe^{3+}|Fe^{2+}} = +0.77V, E_{\left(\frac{1}{2}\right)I_2|I^-} = +0.54V, E^{\circ}_{Ag^+|Ag} = +($

Watch Video Solution

15. Predict whether reaction will occur between the pairs given below :

Ag and Fe^{3+}

$\left[\text{Given } E_{Fe^{3+}|Fe^{2+}} = +0.77V, E_{\left(\frac{1}{2}\right)I_2|I^-} = +0.54V, E^{\circ}_{Ag^+|Ag} = +($

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16. Can we stir $CuSO_4$ solution by a Ni saptula ? Give reasons for your answer .

[Given $E^{\circ}_{NI^{2+}|NI} < E^{\circ}_{Cu^{2+}|Cu}$,] Ni has a greater redusing power than , Cu and Cu^{2+} has a greater oxidising power than Ni^{2+} , Hence , $CuSO_4$ connot be standard be stirred with Ni spatula .

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17. Why does . Mercury cell provide constant voltage ?

Watch Video Solution

18. Which among the following vessels is used to store $CuSO_4$ solution ?

a Zn vessel

[Given

$E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V, E^{\circ}_{Cu^{2+} \mid Cu} = +0.34V$ and $E^{0}_{Ag^{+} \mid Ag} = 0.80V$]

Watch Video Solution

19. Which among the following vessels is used to store $CuSO_4$ solution ?

a Ag vessel

[Given

$E^{0}_{Zn^{2+} \mid Zn} = -0.76V, E^{0}_{Cu^{2+} \mid Cu} = +0.34V$ and $E^{0}_{Ag^{+} \mid Ag} = 0.80V$]

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20. When aqueous $CuSO_4$ solution is elestrolysed in presence of two plantinum electrodes , the solution becomes acidic . Why ?

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21. Will Sn reduce Sn^4+ to Sn^{2+} ?

[Given $E^\circ_{Sn^{2+} \mid Sn} = 0.14V, E^\circ_{Sn^{4+} \mid Sn^{2+}} = 0.15V$]

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22. Identify X^- In the following spontaneous reactions $Cl_2 + 2X^- + X_2$, where X^- is a halide ion . [Given $E^\circ_{(F_2) \mid 2F^-} = +2.87V, E^\circ_{Cl_2 \mid 2Cl^-} = +1.36V, E^\circ_{Br_2 \mid 2Br^-} = +1.06V$ and

]

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23. Of the elements Zn , Mg Cu and Ag , which are able to produce H_2 gas when they are treated with dilute HCl solutions ?

[Given

$E^{\circ}_{Zn^{2+}|Zn} = -0.76V, E^{\circ}_{Mg^{2+}|Mg} = -1.20V, E^{\circ}_{Cu^2+|Cu} + 0.34V \text{ and } E^{\circ}_{Ag}$

]

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24. Between Fe and Mn which can be converted to $+2$ oxidation state easily ?

Given : $E^{\circ}_{Fe^{2+}|Fe} = -0.44 \text{ V \& } E^{\circ}_{Mn^{2+}|Mn} = -1.20V$

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25. Show , the charge of any ion is simple integral multiple of F/N

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26. Explain why the stability of Cu^{+} io in aqueous solution is lower Cu^{2+} ion .

$E^{\circ}_{Cu^{2+}|Cu} = +0.34\text{V}$ & $E^{\circ}_{Cu^{+}|Cu} = +0.52V$

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27. How can the reduction potential of $M^{n+} \mid M$ electrode be increased at a given temperature ?

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28. Show that 1 F of electricity is required is required for liberating 1 g - eq of a substance at an electrode .

Watch Video Solution

29. During electrolysis of aqueoussolution of NaCl in presence of platinum electrodes , hydrogen is evolved at tha cathode , but in presence of mercury as cathoelede , sodium amalgam is produced during electrolysis Why ?

Watch Video Solution

30. The process of electrolysis is redox reaction .Explain .

Watch Video Solution

31. Prove that $E = Z \times F$, where E = chemical equivalent , Z = electrochemical equivalent and F = Faraday

Watch Video Solution

32. Can I F oF electricity be called I mol electricity ?

Watch Video Solution

33. Give reasons for the following .

Copper displaces silver from $AgNO_3$ solution .

Watch Video Solution

34. Give reasons for the following .

Iron pipes are usually , coated with zinc .

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35. Which one of the following aqueous solutions has the highest electrical conductance ?

$0.1(M)ClCH_2COOH$, $0.1(M)FCH_2COOH$ and F_2CHOOH

Watch Video Solution

36. The specific conductances of two electrolytes M and N are x and y $\mathrm{ohm}^{-1} cm^{-1}$ respectively , when measured in the same conductivity cell . If $y > x$, then which solution will offer a higher resistance against the flow of electricity .

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37. Arrange the following ions in order of their condutances in aqueous solution : Rb^{+}, Na^{+}, Li^{+}

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38. For the infinitely dilute aqueous solutions of LiCl, NaCl and KCl , what will the order of their molar conductivities be at a given temperature ?

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39. Why is the molar conductivity at infinite dilution greater than the molar conductivity at any other concentration of an electrolyte at a given temperature ?

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40. Why cannot we determine the molar conductivity a weak electroylte at infinite dillution ?

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41. Arrange the given electrolyte solutions in ascending order of molar conductivities : (1) $0.1(M)Na_2SO_4$,(2). 1 (M) Na_2SO_4 , (3) 0.01 (M) Na_2SO_4 , (4). Infinitely diluted Na_2SO_4 solution

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42. From the equation , $\Delta = k \times \frac{1000}{C}$, we see $\Delta \propto \frac{1}{C}$ Comment on the validity of the last relation .

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43. If an iron rod is dipped into a solution of $CuSO_4$, the blue colour of the solution gradually fades away . Why ?

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SOLVED WBCHSE SCANNER (2014)

1. Write the half - cell and the overall cell reaction for the electrochemical cell : $Sn|Sn^{2+}||Au^{3+}|Au$

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SOLVED WBCHSE SCANNER (2015)

1. State with reason whether the following reaction is spontaneous or not : $Sn^{2+} + 2Fe^{3+} \rightarrow Sn^{4+} + 2Fe^{2+}$

$\left[\text{Given, } E^{\circ}_{Fe^{3+} \mid Fe^{2+}} = +0.77V, E^{\circ}_{Sn^{4+} \mid Sn^{2+}} = +0.15V\right]$

Watch Video Solution

2. Write down the appropriate Nernst equation for the following voltaic cell and calculate the e.m.f. of the cell at 298 K.

$Fe(s) \mid Fe^{2+}(0.002M) \mid \mid Ag^{+}(0.02M) \mid Ag(s)$

$\left[\text{Given, } E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V \text{ and } E^{\circ}_{Ag^{+} \mid Ag} = +0.80V \text{ at 298K}\right]$

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3. Write down Kohlrausch's law of independent migration of ions. Find out the molar conductivity of ammonium hydroxide at infinite dilution (Λ°_{m}) at 298K, given that (Λ°_{m}) values for NH_4Cl, $NaCl$ and $NaOH$ are 149, 126 and 248 $\text{S.cm}^2.\text{mol}^{-1}$ respectively at 298 K.

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4. The specific conductance of a 0.20 mol.L^{-1} solution of KCl at 300 K is 0.026S.cm^{-1}. Calculate molar conductivity of the solution.

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5. Write down the reaction occuring at the two electrode when current is drawn from a Daniell cell.

Watch Video Solution

6. How many faraday of electricity are required to produce 18 g of Al (atomic mass = 27) from molten Al_2O_3 by electrolysis -

A. $\frac{3}{2}$

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

C. 2

D. $\frac{3}{17}$

Watch Video Solution

SOLVED WBCHSE SCANNER (2016)

1. Which is the SI unit of molar conductivity -

A. $S.m^2.\,mol^{-1}$

B. $S.m^{-1}$

C. $S.cm^2.\,mol^{-1}$

D. $S.cm.mol^{-1}$

Watch Video Solution

2. Arrange the following solutions in order of decreasing specific conductance:

(i) 0.01 M NaCl

(ii) 0.05 M NaCl

(iii) 0.1 M NaCl

(iv) 0.5 M NaCl

Resistance of a conductivity cell filled with 0.1 M KCl solution is 80 ohm. The conductivity cell has a cell constant of 1.0 cm^{-1}. Find out the molar conductance of the KCl solution.

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3. Determine ΔG° and the value of the equilibrium constant for the following reaction occurring in an electrochemical cell at $25^{\circ} C$.

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

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

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4. Write down the relation among the conductance and specific conductance of an electrolyte solution and the cell constant of the conductivity cell.

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5. Write the relation between the emf of a galvanic cell and the Gibbs energy for the chemical reaction occuring in the cell.

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SOLVED WBCHSE SCANNER (2017)

1. What is fuel cell ? Write down the anodic reaction and cathodic reaction of a hydrogen - oxygen fuel cell. Give one use of fuel cell.

Watch Video Solution

2. (i) Defind specific conductivity.

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3. (ii) A current of 35 A is passed through acidulated water for 5 min 50 s.

How many grams of hydrogen will be liberated at the cathode?

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4. The quantity of electricity required to electrolyse separately 1 M aqueous solution of $ZnSO_4$, $AlCl_3$ and $AgNO_3$ competely is in the ratio of -

A. $2:1:1$

B. $2:1:3$

C. $2:2:1$

D. $2:3:1$

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5. If 19300 C of electricity is passed through a metallic wire, how many electrons will flow through the wire ?

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6. Write the appropriate Nernst equation for the following half-cell reaction:

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

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SOLVED WBCHSE SCANNER (2018)

1. The standard electrode potential of $Cu^{2+} \mid Cu$ half cell is $+0.34V$. What does it mean?

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2. In a conductivity cell, the distance between the two Pt electrodes is 2.0 cm and each electrode has cross - sectional area of $4.0cm^2$. When the cell is filled with a 0.4 molar solution of an electrolyte, the reistance of the cell 25Ω. Calculate the molar conductivity of the solution.

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3. The unit of cell constant is

A. cm

B. cm^{-1}

C. cm^2

D. mol. lit^{-1}

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4. How many faraday of electricity is required to liberate 1 mol of copper from a copper sulphate solution?

Watch Video Solution

5. Arrange $K^{+}, Zn^{2+}, H^{+}, Cu^{2+}$ ions in order of their tendency to be liberated at cathode.

$$\left[E^{\circ}_{cu^{2+} \mid Cu} = +0.34V, E^{\circ}_{2H^{+} \mid H_2} = 0.00V, E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V E^{\circ}_{K^{+} \mid K} = -2.93V\right]$$

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SOLVED CBSE SCANNER (DELHI - 2014)

1. What type of a battery is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery when current is drawn from it.

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2. In the button cell, wiedly used in watches, the following reaction takes palce:

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

Determine E° and ΔG° for the reaction.

$\left[\text{Given}: \ E^{\circ}_{Ag^{+} \mid Ag} = +080V, E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V\right]$

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3. The resistance of a conductivity cell containing 0.001 (M) KCl solution at 298 K is 1500Ω. What is the cell constant if the conductivity of 0.001M KCl solution at 298 K is $10^{-3} S. cm^{-1}$?

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SOLVED CBSE SCANNER (OUTSIDE DELHI - 2014)

1. Defind the following terms : (i) Molar conductivity (Λ_m),

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2. Defind the following terms : (ii) Secondary batteries.

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3. Calculate $\Delta_r G^\circ$ for the reaction

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

Given : $E^\circ_{\text{cell}} = +2.71V, 1F = 96500 \text{ C.mol}^{-1}$

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4. Name the type of cell which was used in Apollo space programme for providing electrical power.

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SOLVED CBSE SCANNER (DELHI - 2015)

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

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

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

Onn the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why?

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2. Defind limiting molar conductivity. Why conductivity of an electrolyte solution decreases with the decrease in concentration?

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SOLVED CBSE SCANNER (OUTSIDE DELHI - 2015)

1. Calculate $\Delta_r G^\circ$ and emf (E) that can be obtained from the following cell under the standard conditions at $25^\circ C$? $Zn(s)\big|Zn^{2+}(aq)\big|\big|Sn^{2+}(aq)\big|Sn(s)$

$\Big[\text{Given}: \ E^\circ_{Zn^{2+}\,|\,Zn} = -0.76V, E^\circ_{Sn^{2+}\,|\,Sn} = -0.14V \text{ and } F = 96500 \text{ C.m}$

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

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

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

Calculate the $\Delta_r G^{\circ}$ and equilibrium constant of the reaction also.

$\left(E^{\circ}_{Ag^{+}|Ag} = 0.80V, E^{\circ}_{Fe^{3+}|Fe^{2+}} = 0.77V\right)$

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SOLVED CBSE SCANNER (DELHI - 2016)

1. Calculate the emf of the following call at 298 K :

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

$\left[\text{Given}: \ E^{\circ}_{(Cr^{3+}|Cr)} = -0.74V, E^{\circ}_{(Fe^{2+}|Fe)} = -0.44V\right]$

Watch Video Solution

2. From the given cells, Lead storage cell, Mercury cell, Fuel cell and Dry cell

Answer the following :

(i) Which cell is used in hearing aids?

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3. From the given cells, Lead storage cell, Mercury cell, Fuel cell and Dry cell

Answer the following :

(ii) Which cell was used in Apollo Space Programme ?

Watch Video Solution

4. From the given cells, Lead storage cell, Mercury cell, Fuel cell and Dry cell

Answer the following :

(iii) Which cell is used in automobiles and inverters"

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5. From the given cells, Lead storage cell, Mercury cell, Fuel cell and Dry cell

Answer the following :

(iv) Which cell does not have long life?

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SOLVED CBSE SCANNER (EAST ZONE - 2016)

1. Calculate E°_{cell} for the following reaction at 298K :

$2Al(s) + 3Cu^{2+}(0.01M) \rightarrow 2Al^{3+}(0.01M) + 3Cu(s)$

[GIven $E_{cell} = 1.98V$]

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2. Using the E° values of A and B, predict which is better for coating the surface of iron $\left[E^\circ\left(Fe^{2+} \mid Fe\right) = -0.44V\right]$ to prevent corrosion and why?

$\left[\text{Given }: E^{\circ}\left(A^{2+} \mid A\right) = -2.37V, E^{\circ}\left(B^{2+} \mid B\right) = -0.14V\right]$

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3. The conductivity of 0.001 mol solution of CH_3COOH is 3.905×10^{-5} $\mathrm{S.cm}^{-1}$. Calculate its molar conductivity and degree of dissociation (α). $\left[\text{Given: } \lambda^{\circ}\left(H^{+}\right) = 349.6\ \mathrm{S.cm}^{2}.\ \mathrm{mol}^{-1}\right.$ and $\left.\lambda^{\circ}\left(CH_3COO^{-}\right) = 40.9\ \mathrm{S.cm}^{2}.\ \mathrm{mol}^{-1}\right]$

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4. Defind electrochemical cell. What happens if external potential applied becomes greater than E°_{cell} of electrochemical cell?

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SOLVED CBSE SCANNER (DELHI - 2017)

1. Calculate the mass of Ag deposited at cathode when a current of 2A was passed through a solution of $AgNO_3$ for 15 min.

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2. Define fuel cell.

Watch Video Solution

3. Calculate the degree of dissociation (α) of acetic acid it its molar conductivity (Λ_m) is $39.05 \text{ S.cm}^2 . \text{ mol}^{-1}$ Given $\lambda^{\circ}_{H} = 349.6 \text{ S.cm}^2 . \text{ mol}^{-1}$ and $\lambda^{\circ}_{CH_3COO^-} = 40.9 \text{ S.cm}^2 . \text{ mol}^{-1}$.

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4. Out of Cu^{2+} and Cu^{+}, which ion is unstable in aqueous solution and why?

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SOLVED CBSE SCANNER (OUTSIDE DELHI - 2017)

1. Write the name of the cell used in hearing aids. Write the reactions takes place at the anode and the cathode of this cell.

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2. The cell in which the following reaction ocuurs:

$2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$ has $E^{\circ}_{\text{cell}} = 0.236V$ at 298K. Calculate the standard Gibbs free energy of the cell reaction. $\left(1F = 96500\text{C.mol}^{-1}\right)$

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3. How many electrons flow through a metallic wire if a current of 0.5A is passed for 2 hrs? $\left(1F = 96500\text{ C.mol}^{-1}\right)$

Watch Video Solution

4. Write the name of the cell used in transistors. Write the reactions takes place at the anode and the cathode of this cell.

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SOLVED CBSE SCANNER (ALL INDIA - 2018)

1. Write the cell reaction and calculate the emf of the following cell at 298 K.

$$Sn(s)\left|Sn^{2+}(0.004M)\right|\left|H^{+}(0.02M)\right|H_2(g)(1\text{ bar}) \mid Pt(s).$$

$$\left(E_{Sn^{2+} \mid Sn} = -0.14V\right)$$

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2. Give reason :

On the basis of E° values, O_2 gas should be liberated at anode. But it is Cl_2 gas which is liberated in the electrolysis of aqueous $NaCl$.

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3. Give reason :

Condictivity of CH_3COOH decreases on dilution.

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4. For the reaction,

$AgCl(s) + H_2(g)(1 \text{ atm}) \rightarrow Ag(s) + 2H^{+}(0.1M) + 2Cl^{-}(0.1M)$

$\Delta G^{\circ} = -43600J$ at $25^{\circ}C$. Calculate the emf of the cell $\left[\log 10^{-n} = -n\right]$

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5. Defind fuel cell and write its two advantages.

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SOLVED NCERT TEXTBOOK PROBLEMS (NCERT INTEXT QUESTIONS)

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

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

Watch Video Solution

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

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4. Represent the cell in which the given reaction occurs :

$$Mg(s) + 2Ag^+(0.0001M) \rightarrow Mg^{2+}(0.134M) + 2Ag(s)$$

Calculate its E_{cell} if $E^\circ_{\text{cell}} = 3.17V$.

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5. Calculate the equilibrium constant of the reaction :

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

$$E^\circ_{\text{cell}} = 0.46V$$

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6. The standard electrode potential of Daniell cell is 1.1V. Calculate the standard Gibbs energy for the reaction :

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

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

Watch Video Solution

8. Calculate EMF of the cell in which the given reaction occurs :

$Ni(s) + 2Ag^{+}(0.002M) \rightarrow Ni^{2+}(0.160M) + 2Ag(s)$

Given, $E^{\circ}_{\text{cell}} = 1.05V$.

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9. The cell in which the following reaction takes place : $2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$ has the cell potential, E°_{cell} at 298K. Calculate the standard Gibbs energy and equilibrium constant.

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

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11. The electrical resistance of a column of 0.5 mol.L^{-1} NaOH solution of diameter 1 cm and length 50 cm is $5.55 \times 10^3 ohm$. Calculate its resistivity, conductivity and molar conductivity.

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12. The molar conductivity of KCl solution at different concentration at 298 K are given below :

Show that a plot between Λ_m and $C^{1/2}$ is a straight line. Determine the values of Λ_m° and A for KCl.

View Text Solution

13. Calculate Λ_m° for $CaCl_2$ and $MgSO_4$ from the data given in the following table:

View Text Solution

14. Λ_m° for NaCl, HCl and NaAc are 126.4, 425.9 and $91\,\mathrm{S.cm^2.\,mol^{-1}}$ respectively. Calculate Λ° for Hac.

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15. The conductivity of $0.001028\,\mathrm{mol.L^{-1}}$ acetic acid is $4.95 \times 10^{-5}\mathrm{S.cm^{-1}}$. Calculate its dissociation constant if Λ_m° for acetic acid is $390.5\,\mathrm{S.cm^2.\,mol^{-1}}$.

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16. Why does the conductivity of a solution decrease with dilution?

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17. Suggest a way to determine the Λ_m° value of water.

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18. Molar conductivity of $0.025\,\text{mol.L}^{-1}$ methanoic acid is $46\,\text{S.cm}^2.\,\text{mol}^{-1}$. Calculate its degree of dissociation and dissociation constant.

Given :

$\lambda^{\circ}\left(HCOO^{-}\right)=54.6\,\text{S.cm}^2.\,\text{mol}^{-1}, \lambda^{\circ}\left(H^{+}\right)=349.6\,\text{S.cm}^2.\,\text{mol}^{-1}.$

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19. A solution of $CuSO_4$ is electrolysed for 10 minutes with a current of 1.5 A. What is the mass of copper deposited at the cathode?

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20. If a current of 0.5A flows through a metallic wire for 2h, then how many electrons would flow through the wire?

Watch Video Solution

21. Suggest a list of metlas extracted electrolytically.

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22. For $Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{3+} + 7H_2O$, what is the quantity of electricity in coulomb needed to reduce 1 mol of $Cr_2O_7^{2-}$?

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23. Write the chemistry of recharging the lead storage battery highlighting all the materials that are involved during reacharing.

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24. Suggest two materials other than hydrogen that can be used as fuels in fuel cells.

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25. Explain how rusting or iron is envisaged as setting up of an electrochemical cell.

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SOLVED NCERT TEXTBOOK PROBLEMS (NCERT EXERCISE QUESTIONS)

1. Arrange the following metals in the order in whiCHM they displace eaCHM other from the solution of their salts. Al, Cu, Fe, Mg, and Zn.

Watch Video Solution

2. Given : $K^{+} \mid K = -2.79V, Ag^{+} \mid Ag = 0.80V,$ $Hg^{2+} \mid Hg = 0.79V, Mg^{2+} \mid Mg = -2.37V$ and $Cr^{3+} \mid Cr = -0.74V$. Arrange these metals in their increasing order of reducing power.

Watch Video Solution

3. Depict the galvanic cell in which the reqaction $Zn(s) + 2Ag^{+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$ takes place. Further show :

(i) Which of the electrodes is negatively charged ?

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4. $Zn(s) + Cu^{2+} \rightarrow Zn^{2+} + Cu(s)$ in this reaction which is oxidant and which is reductant?

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5. Depict the galvanic cell in which the reaction $Zn(s) + 2Ag^{+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$ takes place. Further show :

(iii) Individual reaction at each electrode.

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6. Calculate the standard cell potentials of the galvanic cells in which the following reactions take place :

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

Calculate $\Delta_r G^0$, equilibrium constant of the reactions.

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7. Calculate the standard cell potentials of the galvanic cells in which the following reactions take place :

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

Calculate $\Delta_r G^0$, equilibrium constant of the reactions.

Watch Video Solution

8. Write the Nernst equation & EMF of the cells at 298 K :

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

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9. Write the Nernst equation & EMF of the cells at 298 K :

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

Watch Video Solution

10. Write the Nernst equation & EMF of the cells at 298 K :

$Sn(s)\left|Sn^{2+}(0.050M)\right|\left|H^{+}(0.020M)\right|H_2(g)(1\text{ bar}) \mid Pt(s)$

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11. Write the Nernst equation & EMF of the cells at 298 K :

$Pt(s)\left|Br_2(l)Br^{-}(0.010M)\right|\left|H^{+}(0.030M)\right|H_2(g) \mid (1\text{ bar})Pt(s)$

Watch Video Solution

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

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

Determine $\Delta_r G^\circ$ and E° for the reaction.

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13. Define conductivity and moiar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

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14. The conductivity of 0.20 M solution of KCl at 298 K is $0.0248S.\ cm^{-1}$. Calculate the molar conductivity of the KCl solution.

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15. The resistance of a conductivity cell containing 0.001M KCl solution at 298 K is 1500Ω. What is the cell constant if conductivity of 0.001 M KCl solution at 298 K is $0.146\times10^{-3}S.\ cm^{-1}$.

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16. The conductivity of sodium chloride at 298 K has been determined at different concentrations and the results are given below :

Concentration (M)	0.001	0.010	0.020	0.050	0.100
$10^2 \times k(S.m^{-1})$	1.237	11.85	23.15	55.53	106.74

Calculate Λ_m for all concentrations and draw a plot between Λ_m and $c^{1/2}$. Find the value of Λ_m°.

Watch Video Solution

17. Conductivity of $0.00241M$ acetic acid solution is $7.896 \times 10^{-5} S.cm^{-1}$. Calculate its molar conductivity. If Λ_m° for acetic acid is $390.5 S.cm^2.mol^{-1}$, what is its dissociation constant ?

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18. How much charge is required for the following reductions :

1 mol of Al^{3+} to Al ?

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19. How much charge is required for the following reductions :

1 mol of Cu^{2+} to Cu ?

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20. How much charge is required for the following reductions :

1 mol of MnO_4^- to Mn^{2+} ?

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21. How much electricity in terms of Faraday is required to produce -

20.0 g of Ca from molten $CaCl_2$?

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22. How much electricity in terms of Faraday is required to produce -

40.0 g of Al from molten Al_2O_3 ?

Watch Video Solution

23. How much electricity is required for the oxidation of -

1 mol of H_2O to O_2 ?

Watch Video Solution

24. How much electricity is required for the oxidation of -

1 mol of FeO to Fe_2O_3 ?

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

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

Watch Video Solution

27. Predict if the reaction between the following is feasible :

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

Watch Video Solution

28. Predict if the reaction between the following is feasible :

$Ag^{+}(aq)$ and $Cu(s)$

Watch Video Solution

29. Predict if the reaction between the following is feasible :

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

Watch Video Solution

30. Predict if the reaction between the following is feasible :

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

Watch Video Solution

31. Predict if the reaction between the following is feasible :

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

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32. Predict the products of electrolysis in each of the following :

An aqueous solution of $AgNO_3$ with silver electrodes.

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33. Predict the products of electrolysis in each of the following :

An aqueous solution of $AgNO_3$ with platinum electrodes.

Watch Video Solution

34. Predict the products of electrolysis in each of the following :

A dilute solution of H_2SO_4 with platinum electrodes.

Watch Video Solution

35. Predict the products of electrolysis in each of the following :

An aqueous solution of $CuCl_2$ with platinum electrodes.

Watch Video Solution

HIGHER ORDER THINKING SKILL (HOTS) QUESTIONS

1. Arrange H_2CO_3 (carbonic acid), glucose, sodium chloride and hydrochloric acid solution, each of 0.1 (M) concentration, in ascending order of their molar conductivity.

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2. The order of chemical reactivity of three elements is $A > B > C$. Arrange these elements in the ascending order of their standard reduction potentials.

Watch Video Solution

3. Will Cu dissolve as Cu^{2+} in 1 (M) HCl solution? Will it do so in 1 (M) HNO_3 solution?

$$\left[\text{Given}: \ E^{\circ}_{Cu^{2+}|Cu} = +0.34 \text{ and } E^{\circ}_{NO_3^-|NO} = +0.96\right]$$

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4. Region of the solution near an electrode becomes alkaline during electrolysis of aqueous Na_2SO_4 solution. State whether the electrode is anode or cathode.

Watch Video Solution

5. If 1 mol of an electrolyte is dissolved in V cm^3 of a solution, then molar conductivity of the solution is Λ_m= conductivity of the solution $\times$ V. If the concentration of the solution is $\frac{M}{10}$, then find the value of V.

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6. Will 0.1 (M) KCl solution show different values for conductance, specific conductivity and equivalent conductivity, if they are measured with different conductivity cells?

Watch Video Solution

7. Given : (1) $A + H_2SO_4(aq) \rightarrow ASO_4(aq) + H_2,$

Arrange the following elements in ascending order of their standard electrode potential: H (hydrogen), A, B, M, D and G.

Watch Video Solution

8. Given : (2) $M + Acl_2(aq) \rightarrow MCl_2(aq) + A$

Arrange the following elements in ascending order of their standard electrode potential: H (hydrogen), A, B, M, D and G.

Watch Video Solution

9. Given : (3) $M + GCl_2(aq) \rightarrow X$

Arrange the following elements in ascending order of their standard electrode potential: H (hydrogen), A, B, M, D and G.

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10. Given : (4) $D + 2BCl(aq) \rightarrow DCl_2(aq) + 2B$

Arrange the following elements in ascending order of their standard electrode potential: H (hydrogen), A, B, M, D and G.

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11. Given : (5) $D + H_2SO_4 \rightarrow X.$

Arrange the following elements in ascending order of their standard electrode potential: H (hydrogen), A, B, M, D and G.

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12. Between (a) 0.01 (M) H_2SO_4 and (b) 0.01 (M) H_3PO_4 solution, which one has higher equivalent conductivity? (Assume that, each solution has the same specific conductance and the degree of dissociation of each acid is equal to unity).

Watch Video Solution

13. Represent symbolically the galvanic cells in which the following reaction occurs. Calculate the standard electromotive forces of the cells :

(1) $Fe + CuSO_4 \to FeSO_4 + Cu$

Given : $E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V$, $E^{\circ}_{Sn^{2+} \mid Zn} = -0.14V$,

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

$E^{\circ}_{H^{+} \mid \frac{1}{2}H_2} = 0.00V$.

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14. Represent symbolically the galvanic cells in which the following reaction occurs. Calculate the standard electromotive forces of the cells :

(2) $Fe + Sn^{2+} \to Fe^{2+} + Sn$

Given : $E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V$, $E^{\circ}_{Sn^{2+} \mid Zn} = -0.14V$,

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

$E^{\circ}_{H^{+} \mid \frac{1}{2}H_2} = 0.00V$.

Watch Video Solution

15. Represent symbolically the galvanic cells in which the following reaction occurs. Calculate the standard electromotive forces of the cells :

(3) $Zn + H_2SO_4 \to ZnSO_4 + H_2$

Given : $E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V, E^{\circ}_{Sn^{2+} \mid Zn} = -0.14V,$

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

$E^{\circ}_{H^{+} \mid \frac{1}{2}H_2} = 0.00V.$

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16. Given that,

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

$E^{\circ}_{Ni^{2+} \mid Ni} = -0.25V \text{ and } E^{\circ}_{Ag^{+} \mid Ag} = +0.80V$

Which metal ions will be oxidised by Ag^{+} ion?

Watch Video Solution

17. Given that,

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

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

Which metal ions will be oxidised by Zn^{2+} ion?

Watch Video Solution

18. Given that,

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

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

Which metal ions cannot be reduced by Cu?

Watch Video Solution

19. Given that,

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

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

Which metal ions are reduced by Ni?

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20. Given that,

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

$$E^{\circ}_{Ni^{2+} \mid Ni} = -0.25V \text{ and } E^{\circ}_{Ag^{+} \mid Ag} = +0.80V$$

Which metal ions are reduced by Ag^{+}?

Watch Video Solution

21. Given that,

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

$$E^{\circ}_{Ni^{2+} \mid Ni} = -0.25V \text{ and } E^{\circ}_{Ag^{+} \mid Ag} = +0.80V$$

Which metals are displaced by Ni from the solutions of their salts ?

Watch Video Solution

22. Given that : $E^{\circ}_{Ni^{2+} \mid Ni} = -0.25V$,

$$E^{\circ}_{Cd^{2+} \mid Cd} = -0.40V, e^{\circ}_{Fe^{2+} \mid Fe} = -0.44V,$$

$$E^{\circ}_{Cu^{2+} \mid Cu} = +0.34V, E^{\circ}_{Fe^{3+} \mid Fe} = -0.036V,$$

$$E^{\circ}_{2H^{+} \mid H_2} = 0.00V, E_{I_2} \mid \left(2I^{-}\right)^{\circ} = +0.80V$$

Select appropriate species in each of the following cases :

Ni^{2+} is reduced but not Fe^{2+}

Watch Video Solution

23. Given that : $E^{\circ}_{Ni^{2+}|Ni} = -0.25V,$

$E^{\circ}_{Cd^{2+}|Cd} = -0.40V, e^{\circ}_{Fe^{2+}|Fe} = -0.44V,$

$E^{\circ}_{Cu^{2+}|Cu} = +0.34V, E^{\circ}_{Fe^{3+}|Fe} = -0.036V,$

$E^{\circ}_{2H^{+}|H_2} = 0.00V, E_{I_2} \mid (2I^{-})^{\circ} = +0.80V$

Select appropriate species in each of the following cases :

Cu^{2+} is reduced but not Fe^{3+}

Watch Video Solution

24. Given that : $E^{\circ}_{Ni^{2+}|Ni} = -0.25V,$

$E^{\circ}_{Cd^{2+}|Cd} = -0.40V, e^{\circ}_{Fe^{2+}|Fe} = -0.44V,$

$E^{\circ}_{Cu^{2+}|Cu} = +0.34V, E^{\circ}_{Fe^{3+}|Fe} = -0.036V,$

$E^{\circ}_{2H^{+}|H_2} = 0.00V, E_{I_2} \mid (2I^{-})^{\circ} = +0.80V$

Select appropriate species in each of the following cases :

I^{-} is oxidised but not Br^{-}.

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25. See whether the cell representation given below is in accordance with the conventation or not. If it is not, then write the correct representation and reaction of the cell. Calculate the standard EMF of the cell: $Cu\left|Cu^{2+}\right|\left|Zn\right|Zn^{2+}$.

$\left[\text{Given}: \ E^{\circ}_{Cu^{2+} \mid Cu} = +0.34V, E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V\right]$

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26. Obtain a relation between E_1°, E_2° and E_3° , where $E_1^{\circ} = E^{\circ}_{Fe^{2+} \mid Fe}, E_2^{\circ} = E^{\circ}_{Fe^{3+} \mid Fe(2+)} \& E_3^{\circ} = E^{\circ}_{Fe^{3+} \mid Fe}$.

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27. Why is the conductivity of 0.1 (N) HCl solution greater than 0.1 (N) CH_3COOH solution?

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28. Between 0.1 (M) NH_4OH and 0.1 (M) NaOH solutions, which one has a greater conductivity?

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29. On the basis of following data, explain why Co(III) is not stable in aqueous solution?

(1) $Co^{3+}(aq) + e \rightarrow Co^{2+}(aq), E^{\circ} = +1.32V$

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

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30. Calomel electrode is represented as -

$Hg(l)|Hg_2Cl_2(s)|HCl(aq)$, Its E° value is $+0.24V$. When it is connected to $Cu \mid Cu^{2+}(1M)$ electrode $(E^\circ = +0.34V)$, what chemical reaction occurs at the calomel electrode?

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ADVANCED LEVEL NUMERICAL BANK

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

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2. A current of 1.70A is passed through 300.0 mL of 0.160 M solution at $ZnSO_4$ 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.

Watch Video Solution

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

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

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

$2Cl^-(aq) + 2H_2O \rightarrow 2OH^-(aq) + H_2(g) + Cl_2(g)$

A direct current of 25A with 62% efficiency is passed through 20 L NaCl solution (20% by weight). (1) Give the reaction occurring at anode and cathode.

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5. A aqueous solution of $NaCl$ on electrolysis gives $H_2(g), Cl_2(g)$, and $NaOH$ according to the reaction :

$2Cl^{-}(aq) + 2H_2O \rightarrow 2OH^{-}(aq) + H_2(g) + Cl_2(g)$

A direct current of 25A with 62% efficiency is passed through 20 L NaCl solution (20% by weight). (2) How long will it take to form 1kg Cl_2?

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6. A aqueous solution of $NaCl$ on electrolysis gives $H_2(g), Cl_2(g)$, and $NaOH$ according to the reaction :

$2Cl^{-}(aq) + 2H_2O \rightarrow 2OH^{-}(aq) + H_2(g) + Cl_2(g)$

A direct current of 25A with 62% efficiency is passed through 20 L NaCl solution (20% by weight). (3) What will be the molarity of the solution with respect to OH^-? (Assume no loss due to evaporation)

Watch Video Solution

7. The standard reduction potential of the half - cell:

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

(1) Calculate the reduction potential in 8 M H^+.

View Text Solution

8. The standard reduction potential of the half - cell:

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

(2) What will be the reduction potential of the half - cell in neutral solution? Assume all other species has unit concentration.

Watch Video Solution

9. Chromium metal can be plated out from an acidic solution containing CrO_3 according to the following equation: $CrO_3(aq) + 6H^+(aq) + 6e \rightarrow Cr(s) + 3H_2O$ (1) How many grams of chromium will be plated out by 24000C?

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10. Chromium metal can be plated out from an acidic solution containing CrO_3 according to the following equation: $CrO_3(aq) + 6H^+(aq) + 6e \rightarrow Cr(s) + 3H_2O$ (2) How long will it take to plate out 1.5 g of chromium by using 12.5 A current?

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

Watch Video Solution

12. The Edison strong cell is represented as :

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

The half - cell reactions are as follows:

$Ni_2O_3(s) + H_2O(l) + 2e \Leftrightarrow 2NiO(s) + 2OH^-, E^\circ = +0.40V$

$FeO(s) + H_2O(l) + 2e \Leftrightarrow Fe(s) + 2OH, E^\circ = -0.87V$

(1) What is the cell reaction?

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13. The Edison strong cell is represented as :

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

The half - cell reactions are as follows:

$Ni_2O_3(s) + H_2O(l) + 2e \Leftrightarrow 2NiO(s) + 2OH^-, E^\circ = +0.40V$

$FeO(s) + H_2O(l) + 2e \Leftrightarrow Fe(s) + 2OH, E^\circ = -0.87V$

(2) What is the cell EMF? How does it depend on the concentration of KOH?

Watch Video Solution

14. The Edison strong cell is represented as :

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

The half - cell reactions are as follows:

$Ni_2O_3(s) + H_2O(l) + 2e \Leftrightarrow 2NiO(s) + 2OH^-, E^\circ = +0.40V$

$FeO(s) + H_2O(l) + 2e \Leftrightarrow Fe(s) + 2OH, E^\circ = -0.87V$

(3) What is maximum amount of electrical energy that can be obtained from 1 mol of Ni_2O_3?

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15. An excess of liquid mercury is added to an acidified solution of $1.0 \times 10^{-3} MFe^{3+}$. If is found that 5% of Fe^{3+} remains at equilibrium at $25^\circ C$. Calculate $E^\circ_{(Hg^{2+}|Hg)}$ assuming that only the following reaction occurs : $2Hg + 2Fe^{3+} \rightarrow Hg_2^{2+} + 2Fe^{2+}$

Given : $E^\circ_{(Fe^{3+}|Fe^{2+})} = 0.77V$

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

Watch Video Solution

17. Calculate the equilibrium constant for the reaction:

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

Given : $E^{\circ}_{(Ce^{4+} \mid Ce^{3+})} = 1.44V, e^{\circ}_{(Fe^{3+} \mid Fe^{3+})} = 0.68V$

Watch Video Solution

18. 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 8.0 h at a current of 8.46 A ? What is the area of the tray, if the thickness of the silver plating is 0.0254 cm?

$\left[\text{The density of silver is } 10.5 \text{ g.cm}^{-3}\right]$

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19. Calculate the equilibrium constant for the reaction : $2Fe^{3+}+3I^{-}\Leftrightarrow 2Fe^{2+}+I_3^{-}$. Given: Standard reduction potential in acidic conditions is 0.78 V and 0.54 V, respectively, for $Fe^{3+} \mid Fe^{2+}$ and $I_3^{-} \mid I^{-}$ couples.

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20. Find the solubility product of a saturated solution of Ag_2CrO_4 in water 298 K, if the EMF of the cell : $Ag|Ag^{+}(\text{sat}\ \ Ag_2CrO_4\text{sol}\ \ )||Ag^{+}(0.1M)|Ag$ is 0.164V(298K).`

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

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22. Copper sulphate solution (250 mL) was electrolysed using a platinum anode and a copper cathode. A constant current of 2mA was passed for 16 min. It was found that after electrolysis the absorbance of the solution was reduced to 50% of its original value. Calculate the concentration of $CuSO_4$ in the solution to begin with.

Watch Video Solution

23. The following electrochemical cell has been set up: $Pt(1)\left|Fe^{3+}, Fe(a=1)\right|\left|Ce^{4+}, Ce^{3+}(a=1)\right|Pt(2)$. 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 ? Given: $E^{\circ}_{(Fe^{3+}|Fe^{2+})}=0.77V$ and $E^{\circ}_{(Ce^{4+}|Ce^{3+})}=1.61V$

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24. The students use same stock solution of $ZnSO_4$ and a solution of $CuSO_4$. The EMF of one cell is 0.03V higher than the other. The concentration of $CuSO_4$ in the cell with higher EMF value is 0.5 M. Find the concentration of $CuSO_4$ in the other cell. (Take, 2.303 RT/F =0.06)

Watch Video Solution

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

$Pt|H_2(g)|HCl(aq)|AgCl(s)|Ag(s)$

(1) Write the cell reaction.

Watch Video Solution

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

$Pt|H_2(g)|HCl(aq)|AgCl(s)|Ag(s)$

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

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

$Pt|H_2(g)|HCl(aq)|AgCl(s)|Ag(s)$

(3) Calculate the solubility of $AgCl$ in water at $25^{\circ}C$. Given : Standard reduc-tion potential of $Ag^{+}(aq) \mid Ag(s)$ is 0.80 V at $25^{\circ}C$.

Watch Video Solution

28. Find the equilibrium constant for the reaction:

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

Given : $E^{\circ}_{Cu^{2+} \mid Cu^{+}} = 0.15V$, $E^{\circ}_{In^{2+} \mid In^{+}} = -0.4V$,

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

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29. What will be the standard electrode potential for the change,

$Fe^{3+}(aq) + e \rightarrow Fe^{2+}(aq)$.

Given : $E^{\circ}_{Fe^{3+}|Fe} = -0.036V, E^{\circ}_{Fe^{2+}|Fe} = -0.439V$

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30. Calculate $\Delta_r G^{\circ}$ of the following reaction:

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

Given: $\Delta_r G^{\circ}(AgCl) = -109\text{kJ.mol}^{-1}$,

$\Delta_r G^{\circ}(Cl^{-}) = -129\text{kJ.mol}^{-1}, \Delta_r G^{\circ}(Ag^{+}) = 77.\text{kJ.mol}^{-1}$.

Represent the reaction in the form of E° of the cell. Find $\log_{10} K_{sp}$ of $AgCl$.

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31. In an experiment, $6.539 \times 10^{-2} g$ of metallic Zn (M = 65.39) was added to 100 mL of saturated solution of $AgCl$. Calculate $\log[Zn^{2+}]/[Ag^{+}]^2$, given that: $Ag^{+} + e \rightarrow Ag, \quad E^{\circ} = 0.80V$,

$Zn^{2+} + 2e \rightarrow Zn, E^{\circ} = -0.78$

Also calculate the number of moles of Ag formed.

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32. 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 1 L of this solution, find the conductivity of the solution in terms of 10^{-7}S.m^{-1} units. Given that λ° values of the Ag^{+}, Br^{-} and NO_3^{-} ions are $6 \times 10^{-3}, 8 \times 10^{-3}$ and $7 \times 10^{-3}\text{S.m}^2.\text{mol}^{-1}$ respectively.

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33. The standard reduction potential of a silver chloride electrode is 0.2V and that of silver electrode is 0.79V. Calculate the maximum amount of AgCl that can be dissolved in 10^6 L of a 0.1 M $AgNO_3$ solution.

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34. Standard oxidation potential of $Ni \mid Ni^{2+}$ electrode is 0.236V. If it is combined with a hydrogen electrode in acid solution, at what pH of the solution will the measured EMF be zero at $25^{\circ} C$? Assume $\left[Ni^{2+}\right] = 1M$ and $p(H_2) = 1atm$.

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35. During the discharge of lead storage battery, density of H_2SO_4 fell from $1.294 \text{ to } 1.139 \text{ g.cm}^{-3}$. Sulphuric acid of density 1.294g.cm^{-3} is 39% by mass and that of density 1.139 g.cm^{-3} is 20% by mass. The battery holds 3.5L of acid and the volume remains practically constant during discharge. Calculate the no. of ampere-hours for which battery must have been used.

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36. Zinc electrode is constituted at 298kby placing Zn - rod in 0.1 (M) aqueous solution of $ZnSO_4$ which is 95%. dissociated at this concentration. What will be the electrode potential $\left(E_{Zn^{2+} \mid Zn}\right)$ of the electrode?

$\left(\text{Given that, } \quad E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V\right)$.

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37. How many grams of silver could be plated out on a serving tray by electrolysis of a solution containing Ag^{+} for a period of 8.0 h at a current of 8.46 A. What is the area of tray if the thickness of Ag-plating is 0.00254 cm? Density of $\text{Ag} = 10.5 \text{ g.cm}^{-3}$.

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38. Nernst equation for $Zn^{2+} \mid Zn$ electrode is given as -

$$E_{Zn^{2+} \mid Zn} = E^{\circ}_{Zn^{2+} \mid Zn} - \frac{0.059}{2} \log . \frac{[Zn(s)]}{[Zn^{2+}]}$$

What will be the plot of $E_{Zn^{2+} \mid Zn}$ vs log $\left[Zn^{2+}\right]$ look like?

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1. On passing 'c' ampere of current for time 't' s through 1 L of 2(M) $CuSO_4$ solution (atomic mass of Cu = 63.5), the amount 'm' of Cu (in g) deposited on cathode will be -

A. $m = ct / (63.5 \times 96500)$

B. $m = ct / (31.25 \times 96500)$

C. $m = (c \times 96500) / (31.25t)$

D. $m = (31.25 \times c \times t) / 96500$

Answer: D

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2. Li occupies higher position in the electrochemical series of metals as compared to Cu since -

A. the standard reduction potential of $Li^{+} \mid Li$ is lower than that of $Cu^{2+} \mid Cu$

B. the standard reduction potential of $Cu^{2+} \mid Cu$ is lower than that of $Li^{+} \mid Li$

C. Li is smaller in size as compared to Cu

D.

Answer: A

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3. Equivalent conductivity at infinite dilution for sodium - potasium oxalate $\left[(COO^{-})_2 Na^{+} K^{+}\right]$ will be [given, molar conductivity of oxalate, K^{+} and Na^{+} ions at infinite dilution are $148.2, 50.1, 73.5 \text{ S.cm}^2. \text{ mol}^{-1}$ respectively]-

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

B. $67.95 \text{ S.cm}^2 \text{eq}^{-1}$

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

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

Answer: D

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4. A conductivity cell has beeen calibrated with a 0.01 M $1:1$ electrolyte solution (specific conductance, $\kappa = 1.25 \times 10^{-3}\text{S.cm}^{-1}$) in the cell and the measured resistance was 800 ohm at $25^\circ C$. The cell constant will be -

A. $1.02\ \text{cm}^{-1}$

B. $0.102\ \text{cm}^{-1}$

C. $1.00\ \text{cm}^{-1}$

D. $0.5\ \text{cm}^{-1}$

Answer: C

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5. The correct order of equivalent conductivities at infinite dilution in water at room temperature for $H^{+}, K^{+}, CH_3COO^{-}$ and OH^{-} ions is -

A. $OH^{-} > H^{+} > K^{+} > CH_3COO^{-}$

B. $H^{+} > OH^{-} > K^{+} > CH_3COO^{-}$

C. $H^{+} > K^{+} > OH^{-} > CH_3COO^{-}$

D. $H^{+} > K^{+} > CH_3COO^{-} > OH^{-}$

Answer: B

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6. The formal potential of $Fe^{3+} \mid Fe^{2+}$ in a sulphuric acid and phosphoric and mixture $(E^{\circ} = +0.61V)$ is much lower than the standard potential $(E^{\circ} = +0.77V)$. The is due to -

A. formation of the species $[FeHPO_4]^{+}$

B. lowering of potential upon complexation

C. formation of the species $[FeSO_4]^+$

D. high acidity of the medium

Answer: A::B::D

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7. At $25^\circ C$, molar conductivity of 0.007 M HF acid is $150 \text{ ohm}^{\wedge}\text{-}1.\text{cm}^2.\text{ mol}^{-1}$. Its $\Lambda_m^\circ = 500 \text{ ohm}^{\wedge}\text{-}1.\text{cm}^2.\text{ mol}^{-1}$. The value of the dissociation constant of the acid at the given concentration at $25^\circ C$ is -

A. $7 \times 10^{-4} M$

B. $7 \times 10^{-5} M$

C. $9 \times 10^{-3} M$

D. $9 \times 10^{-4} M$

Answer: D

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8. The two half - cell reactions of an electrochemical cell is given as -

$$Ag^{+} + e \rightarrow Ag, E^{\circ}_{Ag^{+} \mid Ag} = -0.3995V$$

$$Fe^{2+} \rightarrow Fe^{3+} + e, E^{\circ}_{Fe^{3+} \mid Fe^{2+}} = -0.7120V$$

The value of cell Ecell will be -

A. $-0.3125V$

B. $0.3125V$

C. $1.114V$

D. $-1.114V$

Answer: B

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9. The quantity of electricity needed to separately electrolyse 1 M solution of $ZnSO_4$, $AlCl_3$ and $AgNO_3$ completelyis in the ratio of -

A. $2:3:1$

B. $2:1:1$

C. $2:1:3$

D. $2:2:1$

Answer: A

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10. At a particular temperature, the ratio of equivalent conductance to specific conductance of a 0.01 N $NaCl$ solution is -

A. $10^5 cm^3$

B. $10^3 cm^3$

C. $10 cm^3$

D. $10^5 cm^2$

Answer: A

Watch Video Solution

11. The order of equivalent conductance at infinite dilution for $LiCl$, $NaCl$ and KCl is -

A. $LiCl > NaCl > KCl$

B. $KCl > NaCl > LiCl$

C. $NaCl > KCl > LiCl$

D. $LiCl > KCl > NaCl$

Answer: B

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12. How many faradays are required to reduce, 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+} in acid medium -

A. 2

B. 3

C. 5

D. 6

Answer: D

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13. During electrolysis of molten $NaCl$, some water was added. What will happen -

A. electrolysis will stop

B. hydrogen will be evolved

C. some amount of caustic soda will be formed

D. a fire is likely

Answer: B::C::D

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14. Given the standard half - cell potentials (E°) of the following as :

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

$Fe \rightarrow Fe^{2+} + 2e, E^\circ = 0.41V$

The the standard EMF of the cell with the 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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ENTRANCE QUESTION BANK (JEE-MAIN)

1. What amount of electricity can deposit 1 mol of Al metal at cathode when passing through molten $AlCl_3$-

A. 0.3 F

B. 1 F

C. 3 F

D. $\frac{1}{3}F$

Answer: C

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2. The reduction potential of hydrogen half - cell will be negative if -

A. $p_{(H_2)} = 1 \text{ atm and } [H^+] = 1.0M$

B. $p_{(H_2)} = 2 \text{ atm and } [H^+] = 1.0M$

C. $p_{(H_2)} = 2 \text{ atm and } [H^+] = 2.0M$

D. $p_{(H_2)} = 1 \text{ atm and } [H^+] = 2.0M$

Answer: B

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3. The standard reduction potentials for $Zn^{2+}|Zn, Ni^{2+}|Ni$ and $Fe^{2+} | Fe$ are $-0.76, -0.23$ and $0.44V$ respectively. The reaction $x + y^{2+} \rightarrow x^{2+} + y$ will be spontaneous when -

A. x = Ni, y = Zn

B. x = Fe, y = Zn

C. x = Zn, y = Ni

D. x = Ni, y = Fe

Answer: C::D

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4. Given : $E^{\circ}_{Cr^{3+} \mid Cr} = -0.74V, E^{\circ}_{MnO_4^- \mid Mn^{2+}} = 1.51V$

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

Based on the data, strongest oxidising agent -

A. Cl^-

B. Cr^{3+}

C. Mn^{2+}

D. MnO_4^-

Answer: D

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5. Resistance of 0.2 M solution of an electrolyte is 50Ω. The specific conductance of the solutions is $1.4\,\mathrm{S.m}^{-1}$. The resistance of 0.5 M solution of the same electrolyte is 280Ω. The molar conductivity of 0.5 M solution of the electrolyte is $\mathrm{S.m}^2.\,\mathrm{mol}^{-1}$-

A. 5×10^2

B. 5×10^{-4}

C. 5×10^{-3}

D. 5×10^3

Answer: B

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6. Equivalent conductivity of $NaCl$ at concentration C and at infinite dilution are λ_C and λ_∞ respectively. The correct relationship between λ_C and λ_∞ is given as -

A. $\lambda_C = \lambda_\infty + (B)\sqrt{C}$

B. $\lambda_C = \lambda_\infty + (B)C$

C. $\lambda_C = \lambda_\infty - (B)C$

D. $\lambda_C = \lambda_\infty - (B)\sqrt{C}$

Answer: D

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7. Given below are the half -cell reactions

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

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

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

A. $-033V$, the reaction will occur

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

C. $-2.269V$, the reaction will occur

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

Answer: B

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8. Two faraday of electricity is passed through a solution of $CuSO_4$. The mass of copper deposited at the cathode is (at. Mass of Cu = 63.5u) -

A. 0 g

B. 63.5 g

C. 2 g

D. 127 g

Answer: B

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9. Given : $E^{\circ}_{Cl_2|Cl^-} = 1.36V$, $E^{\circ}_{Cr^{3+}|Cr} = -0.74V$,

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

Among the following the strongest reducing agent is -

A. Cr^{3+}

B. Cl^{-}

C. Cr

D. Mn^{2+}

Answer: C

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10. How long (approximate) should water be electrolysed by passing through 100 amperes current so that the oxygen released can completely burn 27.66g of diborane (atomic mass of B = 10.8 u)-

A. 3.2 h

B. 1.6 h

C. 6.4 h

D. 0.8 h

Answer: A

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ENTRANCE QUESTION BANK (NEET)

1. A solution contains Fe^{3+}, Fe^{2+} and I^{-} ions. This solution was treated with iodine at $35^{\circ}C$.

$E^{\circ}_{Fe^{3+} \mid Fe^{2+}} = +0.77V$ and $E^{\circ}_{I_2 \mid 2I^{-}} = \pm .536V$. The favourable redox reaction is -

A. I_2 will be reduced to I^{-}

B. there will be bo redox reaction

C. I^{-} will be oxidised to I_2

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

Answer: C

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2. If the E°_{cell} for a given reaction has a negative value, then which of the following give the correct relationships for the value of ΔG° and K_{eq}-

A. $\Delta G^{\circ} > 0, K_{eq} < 1$

B. $\Delta G^{\circ} > 0, K_{eq} > 1$

C. $\Delta G^{\circ} < 0, K_{eq} > 1$

D. $\Delta G^{\circ} < 0, K_{eq} < 1$

Answer: B

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

A. $X > Y > Z$

B. $Y > Z > X$

C. $Y > X > Z$

D. $Z > X > Y$

Answer: D

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4. The electrode potential for $Cu^{2+}(aq) + e \rightarrow Cu^{+}(aq)$ and $Cu^{+}(aq) + e \rightarrow Cu(s)$ are 0.15V and 0.50V respectively. The value of $E_{Cu^{2+}} \mid Cu^{\circ}$ will be -

A. $0.150V$

B. $0.500V$

C. $0.325V$

D. $0.650V$

Answer: C

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5. Limiting molar conductivity of NH_4OH [i.e., $\Lambda_m^\circ(NH_4OH)$] is equal to -

A. $\Lambda_m^\circ(NH_4OH) + \Lambda_m^\circ(NH_4Cl) - \Lambda_m^\circ(HCl)$

B. $\Lambda_m^\circ(NH_4Cl) + \Lambda_m^\circ(NaOH) - \Lambda_m^\circ(NaCl)$

C. $\Lambda_m^\circ(NH_4Cl) + \Lambda_m^\circ(NaCl) - \Lambda_m^\circ(NaOH)$

D. $\Lambda_m^\circ(NaOH) + \Lambda_m^\circ(NaCl) - \Lambda_m^\circ(NH_4Cl)$

Answer: B

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6. For successive members of the first series of the transition metals are listed below. For which one of the them the standard potential

$\left(E^{\circ}_{M^{2+}|M}\right)$ value has a positive sign -

A. $Ni(Z = 28)$

B. $Cu(Z = 29)$

C. $Fe(Z = 26)$

D. $Co(Z = 27)$

Answer: B

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7. Standard reduction potentials of the half reactions are given below :

$F_2(g) + 2e \rightarrow 2F^-(aq), E^{\circ} = +2.85V$

$Cl_2(g) + 2e \rightarrow 2Cl^-(aq), E^{\circ} = +1.36V$

$Br_2(l) + 2e \rightarrow 2Br^-(aq), E^{\circ} = +1.06V$

$I_2(s) + 2e \rightarrow 2I^-(aq), E^{\circ} = +0.53V$

The strongest oxidising and reducing agents respectively are -

A. Br_2 and Cl^-

B. Cl_2 and Br^-

C. Cl_2 and I^-

D. F_2 and I^-

Answer: D

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8. Λ_m° of NaCl, HCl and CH_3COONa are 126.4, 425.9 and $91.0 \text{ S.cm}^2.\text{ mol}^{-1}$ respectively. Λ_m° for CH_3COOH will be -

A. $180.5 \text{ S.cm}^2.\text{ mol}^{-1}$

B. $290.8 \text{ S.cm}^2.\text{ mol}^{-1}$

C. $390.5 \text{ S.cm}^2.\text{ mol}^{-1}$

D. $425.5 \text{ S.cm}^2.\text{ mol}^{-1}$

Answer: C

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9. The Gibbs energy for the decomposition of Al_2O_3 at $500^\circ C$ is as follows : $\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2, \Delta_r G = +960 \text{ kJ.mol}^{-1}$. The potential difference needed for the electrolytic reduction of aluminium oxide (Al_2O_3) at $500^\circ C$ is at least -

A. 3.0V

B. 2..5V

C. 5.0V

D. 4.5V

Answer: B

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10. A button cell used in watches functions as following :

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

In half - cell potentials are :

$Zn^{2+}(aq) + 2e \rightarrow Zn(s), E^\circ = -0.76V$ and $Ag_2O(s) + H_2O(l) + 2e$ –

A. 1.34V

B. 1.10V

C. 0.42V

D. 0.84V

Answer: B

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11. A hydrogen gas electrode is made by dipping platinum wire in a solution of HCl of pH = 10 and by passing hydrogen gas around the platinum wire at 1 atm pressure. The oxidation potential of electrode would be -

A. 1.18V

B. 0.059V

C. 0.59V

D. 0.118V

Answer: C

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12. At $25^\circ C$ molar conductivity of 0.1 molar aqueous of ammonium hydroxide is $9.54\ \mathrm{ohm}^{-1}.\ \mathrm{cm}^2.\ \mathrm{mol}^{-1}$ and at infinite dilution its molar conductivity is $239\ \mathrm{ohm}^{-1}.\ \mathrm{cm}^2.\ \mathrm{mol}^{-1}$. The degree of ionisation of ammonium hydroxide at the same concentration and temperature is -

A. $40.800\ \%$

B. $2.080\ \%$

C. $20.800\ \%$

D. $4.008\ \%$

Answer: D

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13. Weight of Ag (at wt. = 108) displaced by a quantity of electricity that displaced by a quantity of electricity that displaces 5600 mL O_2 at STP-

A. 5.4 g

B. 10.8 g

C. 54.9 g

D. 108.0 g

Answer: D

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14. When 0.1 mol MnO_4^{2-} is oxidised, quantity of electricity required to completely oxidise MnO_4^{2-} to MnO_4^{-} is -

A. 96500C

B. $2 \times 96500C$

C. 9650 C

D. 96.50 C

Answer: C

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15. A device that converts energy of combustion of fuels like hydrogen and methane directly into electrical energy is known as -

A. dynamo

B. Ni - Cd cell

C. fuel cell

D. electrolytic cell

Answer: C

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16. The pressure of H_2 required to make the potential of H_2 - electrode zero in pure water at 298 K is -

A. $10^{-10} atm$

B. $10^{-4} atm$

C. $10^{-14} atm$

D. $10^{-12} atm$

Answer: C

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17. The molar conductivity of a 0.5 mol.dm^3 solution of $AgNO_3$ with electrolytic conductivity of $5.76 \times 10^{-3} \text{S.cm}^{-1}$ at 298 K in $\text{S.cm}^2.\text{ mol}^{-1}$ is -

A. 2.88

B. 11.52

C. 0.086

D. 28.8

Answer: B

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18. If the E°_{cell} for a given reaction has a negative value, which of the following gives the correct relationships for the value of ΔG° and K_{eq}-

A. $\Delta G^\circ > 0, K_{eq} < 1$

B. $\Delta G^\circ > 0, K_{eq} > 1$

C. $\Delta G^\circ < 0, K_{eq} > 1$

D. $\Delta G^\circ < 0, K_{eq} < 1$

Answer: B

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19. During the electrolysis of molten sodium chloride the time required to produce 0.10 mol of chlorine gas using a current of 3A is -

A. 330 min

B. 55 min

C. 110 min

D. 220 min

Answer: C

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20. The number of electron delivered at the cathode during electrolysis by a current of 1A in 60s is (charge on electron $= 1.60 \times 10^{-19} C$)-

A. 7.48×10^{23}

B. 6×10^{23}

C. 6×10^{20}

D. 3.75×10^{20}

Answer: D

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21. In the electrochemical cell:

$Zn|ZnSO_4(0.01M)||CuSO_4(1.0M)|Cu$

The EMF of this Daniel cell is E_1. When the concentration of $ZnSO_4$ is changed to 1.0(M) and that of $CuSO_4$ changed to 0.01(M), the EMF changes to E_2. From the following which one is the relationship between E_1 and E_2 $\left(\text{Given, } \frac{RT}{F} = 0.059\right)$-

A. $E_1 < E_2$

B. $E_1 > E_2$

C. $E_2 = 0 \neq E_1$

D. $E_1 = E_2$

Answer: B

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

A. K

B. Pb

C. Li

D. Na

Answer: C

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23. Consider the change in oxidation state of bromine corresponding to different EMF values as shown in the diagram below:

$BrO_4^- \xrightarrow{1.82V} BrO_3^- \xrightarrow{1.5V} HBrO \xrightarrow{1.595V} Br_2 \xrightarrow{1.0652V} Br^-$

Then the species undergoing disproportionation is -

A. $HBrO$

B. BrO_3^-

C. Br_2

D. BrO_4^-

Answer: A

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ENTRANCE QUESTION BANK (AIIMS)

1. For $Zn^{2+} \mid Zn, E^\circ = -0.76V$ then EMF of the cell $Zn|Zn^{2+}(1M)||2H^+(1M)|H_2(1atm)$ will be -

A. $-0.76V$

B. $0.76V$

C. $0.38V$

D. $-0.38V$

Answer: B

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2. Electode potential of hydrogen electrode is 18 mV, then $[H^+]$ is -

A. 0.2 M

B. 1 M

C. 2 M

D. 5 M

Answer: C

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

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

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

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

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

Answer: C

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4. What is the amount of chlorine liberated when 2 A of current is passed for 60 minutes in an aqueous solution of NaCl?

A. 2.507g

B. 1.364 g

C. 2.648g

D. 2.648g

Answer: C

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5. A conductivity cell has a cell constant of 0.5 cm^{-1}. This cell when filled with 0.01 M NaCl solution has a resistance of $384 \text{ ohm at } 25^{\circ} C$. Calculate the equivalent conductance of the given solution.

A. $130.2\Omega.\ cm^2.\ g - eq^{-1}$

B. $137.4\Omega.\ cm^2.\ g - eq^{-1}$

C. $154.6\Omega.\ cm^2.\ g - eq^{-1}$

D. $169.2\Omega.\ cm^2.\ g - eq^{-1}$

Answer: A

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6. How many faradays of electricity are required for the given reaction to occur -

$MnO_4^- \rightarrow Mn^{2+}$

A. 5F

B. 3F

C. 1F

D. 7F

Answer: A

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7.

Electrolyte	KCl	KNO_3	HCl	$NaOAc$	$NaCl$
Λ^{∞} $(\mathrm{S.cm^2.mol^{-1}})$	149.9	145.0	426.2	91.0	126.5

Calculate $\Lambda^{\infty}_{HOAc}\left(\text{in } \mathrm{S.cm^2.\ mol^{-1}}\right)$ using appropriate molar conductances of the electrolytes listed above at infinite dilution in H_2O at $25^{\circ}C$.

A. 517.2

B. 552.7

C. 390.7

D. 217.5

Answer: C

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8. 0.1 M solution is present in a conductivity cell wich electrode of $100cm^2$ area placed 1 cm apart and resistance observed is 5×10^3 ohm. What is the molar conductivity of this solution?

A. $5 \times 10^2 \mathrm{S.cm}^2 . \mathrm{mol}^{-1}$

B. $10^4 \mathrm{S.cm}^2 . \mathrm{mol}^{-1}$

C. $200 \mathrm{S.cm}^2 . \mathrm{mol}^{-1}$

D. $0.02 \mathrm{S.cm}^2 . \mathrm{mol}^{-1}$

Answer: D

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9. Time taken to completely decompose 36 g of water by passing 3A current is -

A. 35.8 h

B. 40 h

C. 51.8 h

D. 22.5 h

Answer: A

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10. Cell equation :

$A + 2B^{+} \rightarrow A^{2+} + 2B, A^{2+} + 2e \rightarrow A, E^{\circ} = +0.34V$ and $\log_{10} K =$

for cell reactions. Find E° for $B^+ + e \rightarrow B$-

$$\left[\text{Given: } \frac{2.303RT}{nF} = 0.059 \text{ at } 300\text{K}\right]$$

A. 0.80V

B. 1.26V

C. $-0.54V$

D. $+0.94V$

Answer: A

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SOLVED NCERT EXEMPLAR PROBLEMS (Multiple Choice Question)(Single Correct Type)

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

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

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

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

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

Answer: C

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2. Electrode potential of Mg- electrode varies as - $E^\circ_{Mg^{2+}|Mg} = E^\circ_{Mg^{2+}|Mg} - \frac{0.059}{2}\log.\frac{1}{[Mg^{2+}]}$. The graph of $E^\circ_{Mg^{2+}|Mg}$ vs. $\log[Mg^{2+}]$ is -

A.

B.

C.

D.

Answer: B

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3. Which of the following statement is correct -

A. $E_{\text{cell}} \& \Delta_r G$ of cell reaction are extensive properties

B. $E_{\text{cell}} \& \Delta_r G$ of cell reaction are intensive property while $\Delta_r G$ of cell reaction is an extensive property

C. E_{cell} is an intensive property while $\Delta_r G$ of cell reaction is an extensive property

D. E_{cell} is an intensive property while $\Delta_r G$ of cell reaction is an intensive property

Answer: C

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4. Difference between electrode potentials of 2 electrodes when no current is drawn through the cell is called -

A. cell potnetial

B. cell emf

C. potential difference

D. cell voltage

Answer: B

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

A. it does not participate in the cell reaction

B. it provides surface either for oxidation of reduction

C. it provides surface for conduction of electrons

D. it provides surface for redox reaction

Answer: D

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

A. $E_{\text{cell}} = 0$

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

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

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

Answer: C

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7. Which statement about electrolytic solution is incorrect -

A. it provides surface for redox reacion

B. conductivity depends upon viscosity of solution

C. conductivity does not depend upon solvation of ions

D. conductivity of solution increases with temperature

Answer: C

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8. Using the data find out the strongest reducing agent -

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

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

A. Cl^-

B. Cr

C. Cr^{3+}

D. Mn^{+2}

Answer: B

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9. Use the given data -

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

$E^{\circ}_{MnO_4^-|Mn^{2+}} = +1.51V, E^{\circ}_{Cr^{3+}|Cr} = -0.74V$ and find out which of the following is the strongest oxidising agent -

A. Cl^-

B. Mn^{2+}

C. MnO_4^-

D. Cr^{3+}

Answer: C

View Text Solution

10. Use the given data

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

$E^{\circ}_{MnO_4^-|Mn^{2+}} = +1.51V, E^{\circ}_{Cr^{3+}|Cr} = -0.74V$ find out in which option the order of reducing power is correct -

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

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

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

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

Answer: B

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11. Use the given data -

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

$E^{\circ}_{MnO_4^-|Mn^{2+}} = +1.51V, E^{\circ}_{Cr^{3+}|Cr} = -0.74V$ and find out the most stable ion in its reduced form -

A. Cl^-

B. Cr^{3+}

C. Cr

D. Mn^{2+}

Answer: D

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12. Use the given data -

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

$E^\circ_{MnO_4^-|Mn^{2+}} = +1.51V, E^\circ_{Cr^{3+}|Cr} = -0.74V$ and find out the most stable oxidised species -

A. Cr^{3+}

B. MnO_4^{2-}

C. $Cr_2O_7^{2-}$

D. Mn^{2+}

Answer: A

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13. The quantitiy of charge required to obtain one mole of aluminimum from Al_2O_3 is -

A. 1 F

B. 6 F

C. 3 F

D. 2 F

Answer: C

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14. The cell constant of a conductivity cell -

A. changes with change if electrolyte

B. changes with change of concentration of electrolyte

C. change with temperature of electrolyte

D. remains constant for a cell

Answer: D

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15. While charging the leas storage battery -

A. $PbSO_4$- anode is reduced to Pb

B. $PbSO_4$- cathode is reduced to Pb

C. $PbSO_4 -$ cathode is oxidised to Pb

D. $PbSO_4 -$ anode is oxidised to PbO_2

Answer: A

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16. $\Lambda_{m(NH_4OH)^{\circ}}$ is equal to -

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

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

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

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

Answer: B

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17. In the electrolysis of aqueous sodium chloride solution, which of the half - cell reaction will occur at anode -

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

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

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

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

Answer: D

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SOLVED NCERT EXEMPLAR PROBLEMS (Multiple Choice Question)(More Than One Correct Type)

1. The positive value of the standard electrode potential of $Cu^{2+} \mid Cu$ indicates that -

A. this redox couple is a stronger reducing agent than the $H^{+} \mid H_2$ couple

B. this redox couple is stronger oxidising agent than $H^{+} \mid H_2$

C. Cu can displace H_2 from acid

D. Cu cannot displace H_2 from acid

Answer: B::D

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2. E°_{cell} for some half - cell reactions are given below. On the basis of these mark the correct answer -

(a) $H^{+}(aq) + e \rightarrow \frac{1}{2}H_2(g), E^{\circ}_{\text{cell}} = 0.00V$

(b) $2H_2O(l) \rightarrow O_2(g) + 4H^{+}(aq) + 4e, E^{\circ}_{\text{cell}} = +1.23V$

(c) $2SO_4^{2-}(aq) \rightarrow S_2O_8^{2-}(aq) + 2e, E^{\circ}_{\text{cell}} = +1.96V$

A. in dilute H_2SO_4 solution, hydrogen will be reduced at cathode

B. in cocentrated H_2SO_4 solution, water will be oxidised at anode

C. in dilute H_2SO_4 solution, water will be oxidised at anode

D. in dilute H_2SO_4 solution, SO_4^{2-} ion will be oxidised to tetrahionate ion at anode

Answer: A::C

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3. $E^\circ_{\text{cell}} = 1.1V$ for Daniell cell. Which of the following expressions are correct description of state of equilibrium in this cell -

A. $1.1 = K_c$

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

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

D. $\log K_c = 1.1$

Answer: :C

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4. Conductivity of an electrolytic solution depends on -

A. nature of electrolyte

B. concentration of electrolyte

C. power of AC source

D. distance between the electrodes

Answer: A::B

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5. $\Lambda_{m(H_2O)^{\circ}}$ is equal to -

A. $\Lambda^{\circ}_{m(HCl)} + \Lambda^{\circ}_{m(NaOH)} - \Lambda^{\circ}_{m(NaCl)}$

B. $\Lambda^{\circ}_{m(HNO_3)} + \Lambda^{\circ}_{m(NaNO_3)} - \Lambda^{\circ}_{m(NaOH)}$

C. $\Lambda^{\circ}_{m(HNO_3)} + \Lambda^{\circ}_{m(NaOH)} - \Lambda^{\circ}_{m(NaNO_3)}$

D. $\Lambda^{\circ}_{(NH_4OH)} + \Lambda^{\circ}_{m(HCl)} - \Lambda^{\circ}_{m(NH_4Cl)}$

Answer: A::C::D

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

A. copper will deposit at cathode

B. copper will deposit at anode

C. oxygen will be released at anode

D. copper will dissolve at anode

Answer: A::C

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7. What will happen during the electrolysis of aqueous solution of $CuSO_4$ in the presence of $Cu-$ electrodes -

A. copper will deposit at cathode

B. copper will be released at anode

C. oxygen will be released at anode

D. copper will deposit at anode

Answer: A::B

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8. Conductivity (κ) is equal to -

A. $\frac{l}{R}\left(\frac{l}{A}\right)$

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

C. Λ_m

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

Answer: A::B

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9. Molar conductivity of ionic solution depends on -

A. temperature

B. distance between electrodes

C. concentration of electrolytes in solution

D. surface area of electrodes

Answer: A::C

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

A. Mg is cathode

B. Cu is cathode

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

D. Cu is the oxidising agent

Answer: B::C::D

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SOLVED NCERT EXEMPLAR PROBLEMS (Short Answer Type)

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

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2. Can E°_{cell} or ΔG° for cell reaction ever be equal to zero?

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3. Under what condition is $E_{\text{cell}} = 0$ or $\Delta_r G = 0$?

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

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

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6. Depict the galvanic cell in which the cell reaction is $Cu + 2Ag^{+} \rightarrow 2Ag + Cu^{2+}$.

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7. Value of standard electrode potential for the oxidation of Cl^{-} ions is more positive than that of water, even then in the electrolysis of aqueous sodium chloride, why is Cl^{-} oxidised at anode instead of water ?

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8. What is electrode potential ?

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

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

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

current flowing through the cell ?

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

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

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14. Solutions of two electrolytes 'A' and 'B' are diluted. The Λ_m of 'B' increases 1.5 times while that of A increases 25 times. Which of the two is a strong electrolyte? Justify your answer.

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15. When acidulated water (dil. H_2SO_4 solution) is electrolysed, will pH of the solution be affected? Justify.

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16. In an aqueous solution how does specific conductivity of electrolytes change with addition of water?

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17. Which reference electrode is used to measure the electrode potential of other electrodes?

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18. Consider the following galvanic cell given below-

$Cu|Cu^{2+}||Cl^-|Cl_2$, Pt. Write the reactions that occur at anode and cathode.

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19. Write the Nernst equation for the cell reaction in the Daniel cell. How will the E_{cell} be affected when concentration of Zn^{2+} ions is increased?

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

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

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22. Why on dilution Λ_m of CH_3COOH increases drasti- cally, but that of CH_3COONa increases gradually?

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SOLVED NCERT EXEMPLAR PROBLEMS (Matching Type)

1.

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2.

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3.

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4.

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5.

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6. Match the items of Column - I and Column - II on the basis of data given below :

$E^{\circ}_{F_2 | F^-} = 2.87V, E^{\circ}_{Li^+ | Li} = -3.5V,$

$E^{\circ}_{Au^{3+} | Au} = 1.4V, E^{\circ}_{Br_2 | Br^-} = 1.09V.$

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SOLVED NCERT EXEMPLAR PROBLEMS (Assertion-Reason Type)

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

Reason (R) : $E^{\circ}_{Cu^{2+} | Cu}$ is negative.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) and (R) both are incorrect statements.

Answer: C

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2. Assertion (A) : E°_{cell} should have a positive value for the cell to function.

Reason (R) : $E_{\text{cathode}} < E_{\text{anode}}$

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) and (R) both are incorrect statements.

Answer: C

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3. Assertion (A): Conductivity of all electrolytes decreases on dilution.

Reason (R):On dilution number of ions per unit Reason volume decreases.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) and (R) both are incorrect statements.

Answer: A

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4. Assertion (A): Λ_m for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.

Reason (R) : For the weak electrolytes, degree of dissociation increases with dilution of electrolytic solution.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) and (R) both are incorrect statements.

Answer: A

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5. Assertion (A): Hg-cell does not give steady potential.

Reason (R): In the cell reaction, ions are not involved in solution.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) is wrong but (R) is correct statements.

Answer: D

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

Reason (R): Formation of oxygen at anode requires overvoltage.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) and (R) both are incorrect statements.

Answer: A

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7. Assertion (A): For measuring resistance of an ionic solution an AC source is used.

Reason (R): Concentration of ionic solution will change if DC source is used.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) and (R) both are incorrect statements.

Answer: A

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8. Assertion (A): Current stops flowing when E_{cell} value becomes zero.

Reason (R) : Equilibrium of the cell reaction is attained.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) and (R) both are incorrect statements.

Answer: A

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

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

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) and (R) both are incorrect statements.

Answer: B

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10. Assertion (A): $CuSO_4$ can be stored in zinc vessel.

Reason (R): Zinc is less reactive than copper.

A. (A) and (R) both are correct statements and (R) is correct explanation for (A).

B. (A) and (R) both are correct statements but (R) is not correct explanation for (A).

C. (A) is correct statement but (R) is wrong statement.

D. (A) and (R) both are incorrect statements.

Answer: D

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SOLVED NCERT EXEMPLAR PROBLEMS (Long Answer Type)

1. Consider the figure given below and then answer the questions.

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

(ii) If cell 'A' has $E_{\text{cell}} = 0.5V$ and cell 'B' has $E_{\text{cell}} = 1.1V$ then what will be the reactions at anode and cathode?

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2. Consider the figure given below and then answer the questions.

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

(ii) Is silver plate the anode or cathode?

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

(iv) When will the cell stop functioning?

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

(vi) How will the concentration of Zn^{2+} ions and Ag^{+} ions be affected after the cell becomes 'dead'?

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

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MCQ (HOTSPOT) (Single Correct Type)

1. If 4A of electric current is passed through an acidulated water for 30 min, then the volume of H_2 gas to be produced at STP is -

A. 1100.84 mL

B. 835.52 mL

C. 1671.3 mL

D. 927.4mL

Answer: B

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2. The given redox reaction occurs in a galvanic cell :

$Zn(s) + Cu^{2+}(0.1M) \rightarrow Zn^{2+}(1M) + Cu(s)$.

If $E^{\circ}_{Zn^{2+}|Zn} = -0.76V$ and $E^{\circ}_{Cu^{2+}|Cu} = +0.34V$, then at $25^{\circ}C$, the value of E_{cell} is -

A. 1.04 V

B. 1.10 V

C. 1.16 V

D. 1.07 V

Answer: D

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3. At which of the following concentration would a solution of an electrolyte show a maximum molar conductivity ?

A. 0.005 M

B. 0.004 M

C. 0.003 M

D. 0.002 M

Answer: D

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4. Under standard conditions, the following reactions occur spontaneously :

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

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

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

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

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

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

If $E^{\circ}_{Zn^{2+}\,|\,Zn}$, $E^{\circ}_{Fe^{2+}\,|\,Fe}$, $E^{\circ}_{Ag^{+}\,|\,Ag}$ and $E^{\circ}_{Cu^{2+}\,|\,Cu}$ have value of x, y, z and p volt respectively, then -

A. $x > y > p > z$

B. $x < y < p < z$

C. $x > y > p > z$

D. $x > y > p > z$

Answer: B

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5. Given,

$E^{\circ}_{Cu^{2+}\,|\,Cu} = +0.34V$, $E^{\circ}_{Fe^{3+}\,|\,Fe} = -0.036V$, $E^{\circ}_{I_2\,|\,2I^{-}} = +0.54V$ and E°_{B}

. Which of the following statement is incorrect -

A. Fe^{3+} ion is reduced by I^-

B. Cu^{2+} is reduced by Fe

C. Br^- ion is oxidised by I_2

D. Cu^{2+} is reduced by I^-

Answer: B

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6. In an aqueous solution containing Cu^{2+}, Ag^+, Sn^{2+} and Hg_2^{2+} ions, the concentration of each ion is 1 (M). Electrolysis of the solution is carried out in presence of inert electrodes. Given: $E^\circ_{Hg_2^{2+} | Hg} = +0.79V$ and $E^\circ_{Sn^{2+} | Sn} = -0.14V$.

If the voltage applied on the electrodes is gradually increased, then the metal that will deposit first and that at the end of the process at the cathode, respectively, are -

A. Sn, Ag

B. Cu, Hg

C. Cu, Sn

D. Ag, Sn

Answer: D

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7. The reaction at the anode and the cathode during the electrolysis of a concentrated aqueous solution of $NaCl$ in presence of inert electrodes are :

Anode: $2Cl^{-}(aq) \rightarrow Cl_2(g) + 2e, E^{\circ}_{\text{Red}} = +1.36V$

Cathode : $2H_2O(l) + 2e \rightarrow H_2(g) + 2OH^{-}(aq)' E^{\circ}_{\text{Red}} = -0.83V.$

Cell reaction : $2Cl^{-}(aq) + 2H_2O(l) \rightarrow H_2 + Cl_2 + 2OH^{-}(aq)$. Which of the following statement is correct -

A. under standard conditions, the overall reaction is spontaneous

B. in the electrolytic process, $E^{\circ}_{\text{cell}} = +2.19V$

C. under standard conditions minimum $+2.19V$ is required for the initiation of the electrolysis

D. all of the above

Answer: C

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8. If an electric current of 10mA is passed through an aqueous solution of $NaCl$, then time required to produce 0.01 mol of H_2 gas at the cathode is -

A. 26.8 h

B. 53.61 h

C. 80.41 h

D. 107.22 h

Answer: B

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9. An electric current of 4×10^4 A is passed through molten Al_2O_3 for 6 h. The amount of aluminium that will deposit at the cathode is -

A. 81 kg

B. 240 kg

C. 13 kg

D. 9 kg

Answer: A

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10. If the equivalent ionic conductances of Al^{3+} and SO_4^{2-} ions are $\lambda^\circ_{Al^{3+}}$ and $\lambda^\circ_{SO_4^{2-}}$, respectively, in an infinitely dilute solution of $Al_2(SO_4)_3$, then the equivalent conductance of the solution would be -

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

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

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

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

Answer: B

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11. Electrolysis of aqueous solution of Ag_2SO_4 is carried out by passing a certain amount of electricity in presence of platinum electrodes. As a result of this, 1.6g of O_2 is produced at the anode. The amount of Ag (atomic mass = 108) deposited at the cathode is -

A. 10.8 g

B. 21.6 g

C. 32.4 g

D. 5.4 g

Answer: B

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12. Aqueous solution of $AgNO_3$ is electrolysed in presence of Ag electrodes. As result, 10.8 g of Ag (atomic mass = 108) is deposited at the cathode. If the same amount of electricity is used to carry out the electrolysis of an aqueous solution of $CuSO_4$ in presence of Cu electrodes, then -

A. $0.1gH_2$ gas will be liberated at the cathode

B. Mass of the cathode will increase by 6.35 g

C. Mass of the anode will decrease by 3.175 g

D. $0.8gO_2$ gas will be liberated at the anode.

Answer: C

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13. With increase in dilution of the solution of an electrolyte -

A. both specific conductance and molar conductivity increase

B. both specific conductance and molar conductivity decrease

C. specific conductance decreases but molar conductance increases

D. specific conductance increases but molar conductance decreases.

Answer: C

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14. In an electrolytic cell, the ratio of the distance between the electrodes and its cross - sectional area is 0.5. When this cell is completely filled with a 1 M solution of an electrolyte, the resistance offered by the solution is 50 ohm. The molar conductivity $\left(\mathrm{ohm}^{-1}.\,\mathrm{cm}^2.\,\mathrm{mol}^{-1}\right)$ of the solution is -

A. 25

B. 10

C. 78

D. 84

Answer: B

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15. 4.5 g Al is produced at the cathode during the electrolysis of molten Al_2O_3. If the same amount of electricity is passed through acidulated water, then at STP the volume of liberated oxygen at the anode would be -

A. 3.6 L

B. 5.6 L

C. 2.8 L

D. 4.2 L

Answer: C

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16. An electric current of 0.25 A is passed through a solution of an electrolyte for t seconds. As a result, the amount of a substance produced at the cathode is 2x g. If the electrochemical equivalent of the substance is $xg. C^{-1}$, then the value of t is -

A. 2

B. 4

C. 8

D. 16

Answer: C

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17. At $25^{\circ} C$, if the molar ionic conductance of Ca^{2+} and Cl^{-} ions in an infinitely dilute soltuion of $CaCl_2$ are

$119 \text{ ohm}^{-1}. \text{cm}^2. \text{mol}^{-1}$ and $76.5 \text{ ohm}^{-1}. \text{cm}^2. \text{mol}^{-1}$, respectively, then for the solution -

A. molar conductivity $= 195.5 \text{ ohm}^{-1}. \text{cm}^2. \text{mol}^{-1}$

B. equivalent conductivity $= 391 \text{ ohm}^{-1}. \text{cm}^2. \text{g-equiv}^{-1}$

C. molar conductivity $= 212.5 \text{ ohm}^{-1}. \text{cm}^2. \text{mol}^{-1}$

D. equivalent conductivity $= 136 \text{ ohm}^{-1}. \text{cm}^2. \text{g.equiv}^{-1}$

Answer: D

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18. At $25^\circ C$, the molar conductivity of an infinitely dilute solution of CH_3COOH is $390.8 \text{ ohm}^{-1}\text{cm}^2\text{mol}^{-1}$. At the same temperature, if the degree of ionisation of CH_3COOH in its aqueous solution at a given concentration is 3.5%, then the molar conductivity of the solution would be -

A. 18.29

B. 13.67

C. 24.02

D. 32.94

Answer: B

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19. In which of the given galvanic cells does the following reaction occuu -

$2AgCl(s) + H_2(g) \rightarrow 2Ag(s) + 2HCl(aq)$

A. $Pt|H_2(g)|KCl(aq)|AgCl(s)|AG$

B. $Pt|H_2(g)|HCl(aq)|Ag^+(aq)|Ag$

C. $Pt|H_2(g)|HCl(aq), AgCl(s) \mid Ag$

D. $Pt|H_2(g)|HCl(aq)|Ag|AgCl(s)$

Answer: C

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20. Consider the following concentration cell : $M(s)|M^+(aq, 0.04M)||M^+(aq, 0.08M)|M(s)$. $|E_{\text{cell}}|$ for the cell is 60 mV. In the cell, if the concentration of the solution of M^+ ions is 0.04 M instead of 0.02M, then the cell potential will be -

A. 60 mV

B. 200 mV

C. 319.3 mV

D. 256.3 mV

Answer: C

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21. During the charging of a lead acid storage cell -

A. chemical energy is converted into electrical energy

B. cathode reaction : $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e$

C. anode reaction :

$PbO_2(s) + 4H^+(aq) + 6SO_4^{2-}(aq) + 2e \rightarrow PbSO_4(s) + 2H_2O(l)$

D. overall reaction :

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

Answer: D

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22. At $25^\circ C$, the specific conductance and the resistance of a 1N solution of KCl in a conductivity cell are found to be $2.765 \times 10^{-3} \text{ ohm}^{-1}.\text{cm}^{-1}$ and 400 ohm respectively. The cell constant of the cell is -

A. 0.763 cm^{-1}

B. $0.904cm^{-1}$

C. 1.106 cm^{-1}

D. 1.561 cm^{-1}

Answer: C

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23. The reduction potential of the electrode $Pt|H_2(\text{g, 2 atm})|H^+(aq, pH = 3)$ is -

A. $+0.177V$

B. $-0.185V$

C. $-0.162V$

D. $+0.185V$

Answer: B

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24. At $25^\circ C$ temperature, $E^\circ_{Zn^{2+}\,|\,Zn} = -0.76V$ and $E^\circ_{Ag^{2+}\,|\,Ag} = +0.80V$. If the E°_{cell} for a galvanic cell formed by combining

the two half - cells, $Zn^{2+}(1M)|Zn$ and $Cu^{2+}(1M)|Cu$ is $1.1V$, then E°_{cell} for a galvanic cell formed by combining the two half - cells, $Cu^{2+}(1M)|Cu$ and $Ag^{+}(1M)|Ag$, will be -

A. 0.98 V

B. 0.52 V

C. 0.46 V

D. $+1.14V$

Answer: C

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25. The standard free energy of the reaction $Fe(s) + Sn^{2+}(aq, 1M) \rightarrow Fe^{2+}(aq, 1M) + Sn(s)$ is $\left(\text{given : at } \ 25^{\circ}C, E^{\circ}_{Fe^{2+}|Fe} = -0.44V \text{ and } E^{\circ}_{Sn^{2+}|Sn} = -0.14V\right)$ -

A. $-193\ \text{kJ.mol}^{-1}$

B. $-57.9\ \text{kJ.mol}^{-1}$

C. $+115.8 \text{ kJ.mol}^{-1}$

D. $+96.5 \text{ kJ.mol}^{-1}$

Answer: B

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26. Given :,

$E^{\circ}_{Fe^{3+} | Fe^{2+}} = +0.77V, E^{\circ}_{Al^{3+} | Al} = -1.66V$ and $E^{\circ}_{1/2Br_2 | Br^-} = +1.08V$ at $25^{\circ}C$. The increasing order of the reducing power of Al, Br^- and Fe^{2+} is -

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

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

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

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

Answer: D

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27. Given : $E^{\circ}_{Li^{+}\,|\,Li} = -3.05V$, $E_{Mg^{2+}\,|\,Mg} = -2.36V$, $E^{\circ}_{Ba^{2+}\,|\,Ba} = -2.90V$ and E°_{N}

at $25^{\circ}C$. Which one of the following ions has the greatest reducing power -

A. Li^{+}

B. Mg^{2+}

C. Ba^{2+}

D. Na^{+}

Answer: A

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28. Given : $E^{\circ}_{Pb^{2+}\,|\,Pb} = -0.13V$ and $E^{\circ}_{Fe^{2+}\,|\,Fe} = -0.44V$ at $25^{\circ}C$. In a aqueous solution containing Pb^{2+} and Fe^{2+} ions, concenraction of each ion is 1M. If Pb and Fe power are added to the this soltuion, then in the solution -

A. amount of Pb will decrease

B. amount of Fe^{2+} will decrease

C. amount of Pb will decrease and that of Fe will increase

D. amount of Pb will increase and that of Fe will decrease.

Answer: D

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29. If $E^{\circ}_{Cu^{2+}|Cu^{+}} = +0.15V$ and $E^{\circ}_{Cu^{2+}|Cu}$ and $E^{\circ}_{Cu^{2+}|Cu} = +0.34V$ at $25^{\circ}C$, then E° value of the reaction $2Cu^{+}(aq) \rightarrow Cu^{2+}(aq) + Cu(s)$is -

A. $+0.38V$

B. $+0.34V$

C. $-0.34V$

D. $0.19V$

Answer: D

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30. The value of standard hydrogen electrode potential is taken as zero, because -

A. hydrogen has a high reducing power

B. hydrogen is the lightest element

C. according to convention, its potntilal is taken as zero

D. this electrode can be easily constructed

Answer: C

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31. At $25^{\circ}C$ tempertaure, E_{cell} of the galvanic cell $Zn|Zn^{2+}(aq, 1M)||H^{+}(aq)|H_2(\text{g, 1 atm}) \mid Pt$ is $+0.583V$. If $E^{\circ}_{Zn^{2+}\mid Zn} = -0.76V$, then pH of the aqueous solution present in the reduction half - cell is -

A. 2

B. 3

C. 4

D. 4.5

Answer: B

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32. $Pt|H_2(1\text{ atm})|H^{+}(10^{-8}M) \mid |H^{+}(0.025M)|H_2(1\text{ atm})Pt$- at $25^{\circ}C$, then E_{cell} value of this galvanic cell is -

A. $-0.24V$

B. $-0.38V$

C. $+0.18V$

D. $+0.38V$

Answer: D

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33. At $25^{\circ}C, E_{\text{cell}}$ of the galvanic cell $Zn|Zn^{2+}(aq, 0.01M)||Cu^{2+}(aq, 0.01M)|Cu$ is $+1.07V$. The equilibrium constant of the cell reaction occurring in this cell is -

A. $10^{28.79}$

B. $10^{37.25}$

C. $10^{42.56}$

D. $10^{42.56}$

Answer: C

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34. Rusting of iron, basically is an electrochemical reaction. In this process -

A. $Fe^{2+}(aq)$ and O_2 are formed due to the oxidation of Fe and $H_2O(l)$ respectively

B. reduction of Fe^{2+} leads of the formation of $Fe(s)$ and reduction of $O_2(g)$ in presenceo of and $H^+(aq)$ leads to the formation of $H_2O(l)$

C. oxidation of Fe leads to the formation of $Fe^{2+}(aq)$ ion and reduction of O_2 in presence of $H^+(aq)$ leads to the formation of $H_2O(l)$

D. oxidation of Fe leads to the formation of $Fe^{3+}(aq)$ ion and reduction of $H_2O(l)$ leads to the formation of $O^{2-}(aq)$

Answer: C

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35. Given :

$H^+(aq, 1M) + e \rightarrow \frac{1}{2}H_2(\text{g, 1atm}), E^\circ = 0.00V\, Hg_2Cl_2(s) + 2e \rightarrow Hg(l$

In which of following galvanic cell, the given reaction occurs -

$H_2(\text{g, 1atm}) + Hg_2Cl_2(s) \rightarrow 2Hg(l) + 2H^+(1M) + 2Cl^-(1M)$

A. $Hg|Hg_2Cl_2(s)|Cl^-(1M) \mid |H^+(1M)H_2(\text{g, 1atm})|Pt$

B. $Hg|Hg_2Cl_2(s)||H^+(1M)|H_2(\text{g, 1atm}) \mid Pt$

C. $Pt|H_2(\text{g, 1 atm})|H^+(1M) \mid |H_2Cl_2(s)|Hg$

D. $Pt|H_2(\text{g, 1atm})H^+(1M)||Cl^-(1M)|Hg_2Cl_2(s) \mid Hg$

Answer: D

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36. In a galvanic cell, the given cell - reaction takes place -

$Cd(s) + NiO_2(s) + 2H_2O(l) \rightarrow Cd(OH)_2(s) + Ni(OH)_2(s)$

The standard potentials of the half- cell reactions are -

(1) $Cd(OH)_2(s) + 2e \rightarrow Cd(s) + 2OH^-(aq), E^\circ = -0.81V$

(2)

$NiO_2(s) + 2H_2O(l) + 2e \rightarrow Ni(OH)_2(s) + 2OH^-(aq), E^\circ = +0.50V$

. The standard potential of the cell is -

A. -0.31

B. $+0.52$

C. $+0.46$

D. $+0.46V$

Answer: B

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37. If $E^\circ_{\frac{1}{2}X_2|X^-} < E^\circ_{\frac{1}{2}Y_2|Y^-} < E^\circ_{\frac{1}{2}Z_2|Z^-}$, under standard conditions, which of the following of the following reaction will be spontaneous -

A. $Y_2 + 2Z^- \rightarrow Z_2 + 2Y^-$

B. $X_2 + 2Z^- \rightarrow Z_2 + 2X^-$

C. $Z_2 + 2X^- \rightarrow X_2 + 2Z^-$

D. $X_2 + 2Y^- \rightarrow Y_2 + 2X^-$

Answer: C

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38. At $26^\circ C, \Lambda_m^\circ(NH_4Cl) = 129.8 \text{ ohm}^{-1}. \text{cm}^2. \text{mol}^{-1}$ and $\Lambda_m^\circ(NaCl) = 126.5 \text{ ohm}^{-1}. \text{cm}^2. \text{mol}^{-1}$. Apart from the values of $\Lambda_m^\circ(NH_4Cl)$ and $\Lambda_m^\circ(NaCl)$, which of the following quantities should be known, to determine the value of $\Lambda_m^\circ(NH_4OH)$ –

A. molar ionic conductance of $OH^-(aq)$ at infinite dilution

B. Λ_m° value of NaOH solution

C. extent of ionisation of NH_4OH

D. Λ_m° value of HCl solution

Answer: B

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39. Choose the correct answer -

A. $\Lambda_m^\circ(NaCl) - \Lambda_m^\circ(NaNO_3) = \Lambda_m^\circ(HCl) - \Lambda_m^\circ(HNO_3)$

B. $\Lambda_m^\circ(KCl) - \Lambda_m^\circ(KNO_3) = \Lambda_m^\circ(NaCl) - \Lambda_m^\circ(NaNO_3)$

C. $\Lambda_m^\circ(KCl) - \Lambda_m^\circ(NaCl) = \Lambda_m^\circ(KOH) - \Lambda_m^\circ(NaOH)$

D. all of the above

Answer: D

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40. At $25^\circ C$, the correct order of molar ionic conductances of the ions H^+, Li^+, Na^+ and K^+ in infinite dilute aqueous solution is -

A. $H^+ < Li^+ < Na^+ < K^+$

B. $K^+ < Na^+ < Li^+ < H^+$

C. $Li^+ < Na^+ < K^+ < H^+$

D. $Li^+ < K^+ < H^+ < Na^+$

Answer: C

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41. Under standard conditions, which one of the reactions is not feasible

$\left(E^\circ_{Ni^{2+}|Ni} = -0.25V, E^\circ_{Cd^{2+}|Cd} = -0.4V, E^\circ_{Fe^{2+}|Fe} = -0.44V, E^\circ_{cu^{\circ+}|}\right.$

-

A. $Cd(s) + Ni^{2+}(aq) \rightarrow Ni(s) + Cd^{2+}(aq)$

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

C. $H_2(g) + Cu^{2+}(aq) \rightarrow Cu(s) + 2H^+(aq)$

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

Answer: B

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42. The resistance of a 0.1 M solution of KCl is measured at different conductivity cells. Which one of the following quantities will be the same for all the cells?

A. cell constant

B. conductance

C. specific conductance

D. molar conductivity

Answer: C

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43. Reaction at the anode during the electrolysis of aqueous $CuSO_4$ solution in presence of Cu electrode is -

A. $Cu(s) \rightarrow Cu^2(aq) + 2e, E^\circ_{\text{Red}} = +0.34V$

B. $H_2O(l) \rightarrow \frac{1}{2}O_2(g) + 2H^+(aq) + 2e, E^\circ_{\text{Red}} = +0.40V$

C. $2OH^-(aq) \rightarrow \frac{1}{2}O_2(g) + H_2O(l) + 2e, E^\circ_{\text{Red}} = +0.40V$

D. $SO_4^{2-}(aq) \rightarrow S_2O_8^{2-}(aq) + 2e, E^\circ_{\text{Red}} = +2.0V$

Answer: A

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44. Which one of the following comments regarding the galvanic cell $Ag|Ag^+(aq, 0.01)||Ag^+(aq, 0.1M)|Ag$ is correct -

A. this type of cell is not possible since the half - cells are the same.

B. E°_{cell} of the cell = 0.80 V

C. E°_{cell} of the cell = 0.859 V

D. E°_{cell} of the cell = 0.059V

Answer: D

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45. Under standard conditions, ΔG° for the reaction $Cr_2O_7^{2-} + 6I^-(aq) \rightarrow 2Cr^{3+}(aq) + 3I_2(s)$ is [Given : $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e \rightarrow 2Cr^{3+}(aq) + 7H_2O(l) E^\circ = +1.33V$,]-

A. $-1082.73 \text{ kJ.mol}^{-1}$

B. $-457.41 \text{ kJ.mol}^{-1}$

C. $-541.37 \text{ kJ.mol}^{-1}$

D. $-612.83 \text{ kJ.mol}^{-1}$

Answer: B

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46. What will the EMF of the given cell be -

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

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

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

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

D. none of these

Answer: B

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47. Consider the following four electrodes :

$P = Cu^{2+}(0.001M) \mid Cu(s)$

$Q = Cu^{2+}((0.1 \text{ M}) \mid Cu(s)$

$R = Cu^{2+}(0.01 \text{ M}) \mid Cu(s)$

$S = Cu^{2+}(0.001) \mid Cu(s)$

If the standard electrode potential of $Cu^{2+} \mid Cu$ is $+0.34V$, the reduction potential in volts of the above electrodes follows the order-

A. $P > S > R > Q$

B. $S > R > O > P$

C. $R > S > O > P$

D. $Q > R > S > P$

Answer: D

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MCQ (HOTSPOT) (More Than one Correct Type)

1. In presence of Pt-electrodes, electrolysis of the following aqueous solutions are carried out. In which of the following cases, the substances liberated at the cathode and anode will be the same -

A. $NaOH$

B. $CuSO_4$

C. dil. H_2SO_4

D. $AgNO_3$

Answer: A::C

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2. Given :

$E^{\circ}_{Ni^{2+}|Ni} = -0.25V, E^{\circ}_{Zn^{2+}|Zn} = -0.76V, E^{\circ}_{Cu^{2+}|Cu} = +0.34V, E^{\circ}_{Ag^{+}|A}$

. Under standard conditions, which reaction(s) will occur spontaneously -

A. $Ni(s) + Zn^{2+}(aq) \rightarrow Ni^{2+}(aq) + Zn(s)$

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

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

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

Answer: B::C::D

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3. Given :

$E^{\circ}_{Fe^{3+} | Fe^{2+}} = +0.77V, E^{\circ}_{\frac{1}{2}I_2 | I^-} = +0.54V, E^{\circ}_{Ag^+ | Ag} = +0.80V$ and E°_{S}

. Under standard conditions, which one of the following substances would react with Fe^{3+} ion -

A. Sn^{2+}

B. I_2

C. I^-

D. Ag

Answer: A::C

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4. If pH in the cathode compartment of the galvanic cell $Zn|Zn^{2+}||H^+|H_2[\text{g, P }(1\text{ atm})]$ Pt is increased, then -

A. equilibrium of the cell reaction will shift towards left

B. equilibrium of the cell reaction shift towards right

C. E_{cell} will increase

D. E_{cell} will decrease

Answer: B::D

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5. With increase in dilution -

A. specific conductance of CH_3COOH solution increases

B. specific conductance of $NaCl$ solution decreases

C. molar conductivity of CH_3COOH solution increases

D. molar conductivity of $NaCl$ solution decreases

Answer: B::C::D

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6. At a certain temperature, the specific conductance of 0.001 (M) aqueous solution of acetic acid is $5 \times 10^{-5} \mathrm{S.cm}^{-1}$. At the same temperature, if the molar conductivity of an infinitely dilute aqueous solution of acetic acid is $400\ \mathrm{S.cm}^2.\ \mathrm{mol}^{-1}$, then -

A. molar conductivity of 0.001 (M) CH_3COOH solution $= 50\ \mathrm{S.cm}^2.\ \mathrm{mol}^{-1}$

B. extent of ionisation of CH_3COOH in 0.001(M) solution $= 15.82\ \%$

C. $\mathrm{pH\ of\ 0.001\ (M)}\ \ CH_3COOH\ \ \mathrm{solution} = 3.9$

D. ionisation constant of $CH_3COOH = 5.6 \times 10^{-4}$

Answer: A::C

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7. Given : (i) $A^{+}+B \rightarrow A+B^{+}$ (ii) $B^{+}+C \rightarrow X$ (iii) $C^{+}+D \rightarrow C+D^{+}$ (iv) $B+D^{+} \rightarrow B^{+}+D$ (v) $A+C^{+} \rightarrow A^{+}+C$. If the standard potential value of $A^{+}|A, B^{+}|B, C^{+} \mid C$ and $D^{+} \mid D$ are p, q, r and s volt respectively, then which of the following is correct -

A. $q < p < r$

B. $r > q > s$

C. $s > p > r$

D. $q < s < r$

Answer: A::D

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8. 27 g metallic Al is deposited at the cathode, when 10 A current is passed through molten Al_2O_3. Which of the following comments are correct -

A. for the formation of the said amount of $Al, 10A$ current was passed for 28950s.

B. amount of current passed through molten Al_2O_3 is 2.5F

C. at STP, volume of oxygen liberated at the anode is 16. 8L.

D. number of participating electrons in this process $= 1.8069 \times 10^{24}$

Answer: A::C::D

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9. Which of the following relations are not correct -

(Symbols represent their usual meanings)

A. $\Lambda_m = \dfrac{\kappa \times 1000}{M}$

B. $\kappa = L \times \dfrac{A}{l}$

C. $R = \rho \times \dfrac{l}{A}$

D. $\dfrac{l}{A} = \kappa \times \dfrac{1}{R}$

Answer: B::D

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10. In which pair of electrodes, will the reductant of the first electrode reduce the oxidant of the second electrode -

$$\left[\text{Given}: \quad E^\circ_{Mg^{2+}|Mg} < E^\circ_{Al^{3+}|Al} < E^\circ_{Zn^{2+}|Zn} < E^\circ_{Fe^{2+}|Fe} < E^\circ_{Ni^{2+}|Ni} < E^\circ_{C}\right.$$

A. $Zn^{2+}|Zn, Ni^{2+}|Ni$

B. $Sn^{2+} \mid Sn, Mg^{2+}|Mg$

C. $Cu^{2+} \mid Cu, Ag^{+}|Ag$

D. $Fe^{2+}|Fe, Al^{3+}|Al$

Answer: A::C

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11. Which of the following comments are true -

A. rusting of iron occurs at a faster rate in salty water than in pure water

B. active metals corrode rapidly

C. presence of air and moisture decrease the rate of corrosion

D. if an object made up of metal has dent's knksor cracks on its surface, then its corrosion occurs at a slow rate

Answer: A::B

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12. Which of the following metal can liberate H_2 gas from acid -

A. Fe

B. Ni

C. Cu

D. Ag

Answer: A::B

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13. Which of the following comments are true for a dry cell -

A. a Zn can (or container) acts as the anode MnO_2 and carbon black remain in contact with a Zn can

B. it can be recharged

C. a graphite rod serves as the cathode

D.

Answer: A::D

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14. Which of the following statements are not true -

A. molar conductivity of the solution of a weak electrolyte is less compared to the solution of a strong electrolyte with the same concentration.

B. molar conductivity of the solution of an electrolyte increases with concentration

C. specific conductance of the solution of an electrolyte increases with decrease in temperature

D. specific conductance of the solution of an electrolyte increases with concentration

Answer: B::C::D

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15. Which of the following relations are not true (Symbols have their usual significances) -

A. $E^{\circ}_{\text{cell}} = \dfrac{2.303RT}{nF} \log K$

B. $\Delta G^{\circ} = nFE^{\circ}$

C. $\Delta G^{\circ} = RT \ln K$

D. $\log K = \dfrac{nE^{\circ}_{\text{cell}}}{0.059} (\text{at } 298\text{K})$

Answer: B::C

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16. Which of the following comments are true -

A. electrolysis of a dilute solution of $NaCl$ results in formation H_2 and O_2 gases

B. electrolysis of a concentrated solution of H_2SO_4

C. produces H_2 and O_2 gases

D. electrolysis of molten KHF_2 leads to the production of F_2 gas at anode

Answer: A::C::D

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17. Which of the following comments are not true -

A. if the same amount of electricity is passed through the solutions of ferrous sulphate and ferric sulphate with the same concentration, then the amount of iron to be deposited will be more in case of ferric sulphate solution

B. electrochemical equivalent $(ECE) = \frac{E}{F}$

C. 1 mol of a substance is produced or dissolved by 1 F of electricity

D. a bulb of 60 W gives up an energy of 60 joule per second

Answer: A::C

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EXERCISE (VERY SHORT ANSWER-TYPE QUESTIONS)

1. What is the charge of cathode and anode in a galvanic cell.

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2. Why is KNO_3 used in salt-bridge?

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3. In hydrogen electrode, why is the platinum foil covered with platinum black?

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4. What does the high negative value of standard reduction potential of an electrode indicate?

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5. What does the high positive value of standard reduction potential of an electrode indicate?

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6. Write the direction of electron flow in the outer circuit when a standard hydrogen electrode is connected with Cu-electrode.

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7. How does the reducing power of elements change from top to bottom of the electrochemical series?

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8. On what factors, does the value of electrode potential depend?

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9. The standard reduction potential of $Zn^{2+} \mid Zn$ electrode is $-0.76V$. What will be the electrode reactions if this electrode is coupled with a standard hydrogen electrode?

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10. What will be the standard reduction potential of an electrode, if its standard oxidation potential is x volt? Explain.

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11. Write the electrode reactions and cell reactions of a Daniell cell.

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12. Write the equation for determination of electromotive force of a cell in accordance with IUPAC rule.

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13. Standard reduction potential of the electrode $X \mid X^{+}$ is $+0.80V$. If this electrode is connected to a standard hydrogen electrode, What will be the direction of electron flow in the outer circuit?

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14. What will be the electrode potential of a standard hydrogen electrode at 323 K?

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15. Write symbolic representation of a standard hydrogen electrode.

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16. What does the negative value of E°_{cell} of a galvanic cell mean?

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17. Write the relation between the E°_{cell} of a galvanic cell and the equilibrium constant (K) of the cell reaction.

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18. Which one among Li^{+}, Na^{+} and Mg^{2+} is the most powerful oxidising agent? Given : $E^{\circ}_{Li^{+}|Li} = -3.05V, E^{\circ}_{Na^{+}|Na} = -2.17V$ and $E^{\circ}_{Mg^{2+}|Mg} = -2.37V$

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19. The standard reduction potential of metals A, B and C are $-2.37V$, $+1.85V$ and $+1.36V$, respectively. What will be the order of reducing power of the metals?

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20. Arrange Ag^+, Zn^{2+}, H^+ and Na^+ in order of their tendency to be liberated at cathode.

$\left[\text{Given}: \ E^\circ_{Ag^+|Ag} = +0.80V, E^\circ_{Zn^{2+}|Zn} = -0.76V, E^\circ_{2H^+|H_2} = 0.00V, \right.$

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21. What is meant by 1 F ?

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22. What is the significance of $\frac{E}{N}$?

Watch Video Solution

23. What amount of charge in coulomb is carried by Avagadro number of electrons.

Watch Video Solution

24. What is the unit of eletrochemical equivalent?

Watch Video Solution

25. Write the units of molar conductivity and specific conductance.

Watch Video Solution

26. What is the amount of charge carried by 1 mol PO_4^{3-} ion?

Watch Video Solution

27. What is the unit of specific conductance?

Watch Video Solution

28. How many coulombs of electricity will be required to reduce 1 mol of MnO_4^- of Mn^{2+}.

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29. Λ_m° values of KCl and KNO_3 is 149.86 and $154.96 \text{ ohm}^{-1}.\text{ cm}^{-1}.\text{ mol}^{-1}$. If $\lambda_m^\circ(Cl^-)$?

$= 71.44 \text{ ohm}^{-1}.\text{ cm}^2.\text{ mol}^{-1}$, calculate $\lambda_m^\circ(NO_3^-)$.

View Text Solution

30. The electrolyte A_2B dissociates in aqueous solution as $A_2B(aq) \rightarrow 2A^+(aq) + B^{2-}(aq)$. If molar ionic conductance at infinite dilution of A^{+} and B^{2-} ions are $\lambda_m^{\circ}(A^{+})$ and $\lambda_m^{\circ}(B^{2-})$ respectively when what will be the value of Λ_m° of A_2B ?

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31. Which of $AlCl_3$ and $NaCl$ in molten state will produce 1 gram-atom metal, if 1 faraday electricity is passed during electrolysis?

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32. How many amperes of current will have to be sent to discharge 1 gram equivalent of a substance at the electrode per second?

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33. At a definite temperature, the molar conductivity of a weak electrolytic solution of concentration, C(M) is Λ_m and the value of the molar conductivity at infinite dilution of the same electrolysis solution is Λ_m°.

What will be the value of degree of dissociation of the electrolytr C(M) solution?

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34. Why is H_2 gas evolved instead of Na, when aqueous solution of NaCl is electrolysed?

Watch Video Solution

35. What will be the ratio of number of moles of the metals discharged at cathode, when 3 faraday of electricity is passed through $AgNO_3, CuSO_4$ and $AuCl_3$ solutions ?

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36. Name the substance liberated at cathode and anode, when aqueous solution of NaBr is electrolysed?

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EXERCISE (Fill in the blanks)

1. The standard reduction potential of Zn-electrode is $-0.76V$. The standard oxidation potential of the electrode will be ___________.

Watch Video Solution

2. For a galvanic cell, $E_{\text{cell}} = (\_\_\_\_\_\_\_\_\_\_ \text{ potential of RHE}) - (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \text{ potential of LH}$

Watch Video Solution

3. Zn replaces Cu from $CuSo_4$ solution because the satandard reduction potential of Zn is _____than that of Cu.

Watch Video Solution

4. If the value of standard electromortive force $\left(E^{\circ}_{\text{cell}}\right)$ of a galvanic cell is ________, then the cell reaction will be spontaneous.

Watch Video Solution

5. In an electrolytic cell, the cathode is ________ charged and the anode is_______charged but in a galvanic cell the cathode is __________ charged and the anode is _______charged.

Watch Video Solution

6. If the concentration of the reactants in the electrode reaction is of _______ activity, then the electrode potential is called ________ potential.

Watch Video Solution

7. The cation and anion of the electrolyte used in salt-bridge have __________ mobility.

Watch Video Solution

8. $E^{\circ}_{Zn^{2+}|Zn} = -0.76V$ and $E^{\circ}_{Ag^{+}|Ag} = +0.799V$ and a galvanic cell has $Zn^{2+} | Zn$ and $Ag^{+}|Ag$ electrodes. The Zn - electrode will be __________ and Ag - electrode will be ____________ .

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9. 10.788 g Ag is deposited at the cathode when ________ faraday of electricity is passed through $AgNO_3$ solution.

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10. During electrolysis of an aqueous aluminium salt solution _______ is produced at the cathode.

Watch Video Solution

11. During electrolysis of silver salts in the presence of Ag electrodes, Ag is ______ at the anode.

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12. $NaCl$ solution has the ability to conduct electricity because it is a ________ compound but urea cannot conduct electricity because it is a __________ compound.

Watch Video Solution

13. The amount of charge carried by one gram Al^{3+} ion _______.

Watch Video Solution

14. If an aqueous solution of NaCl is concentrated, its specific conductance is _____ and if it is diluted, its equivalent conductivity is _________.

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15. The unit of cell constant of a conductivity cell is ___________.

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16. The equivalent conductivity of 0.1 (M) Na_2SO_4 is ________ than the equivalent conductivity of 0.01 (M) Na_2SO_4 solution.

Watch Video Solution

17. During electrolysis of fused sodium hydroxide, ________ gas is liberated at the _______ electrode.

Watch Video Solution

18. During electrolysis of an aqueous solution containing SO_4^{2-}, ______ is produced at the anode.

Watch Video Solution

19. If $NaOH$ solution is added to acetic acid solution the conductance of the mixed solution will be ________.

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EXERCISE (SHORT ANSWER-TYPE QUESTIONS)

1. What is a salt-bridge? What are its components?

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2. Why is salt-bridge used?

Watch Video Solution

3. Write Nernst equation for the cell potential of a cell in which the following cell reaction occurs,

$2Cr + 3Fe^{2+} \rightarrow 2Cr^{3+} + 3Fe.$

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4. You are given two electrodes whose standard reduction potentials are also given. Which one should you use as cathode and as anode?

Watch Video Solution

5. What will be the change in the half-cell potential, if the concen-tration of Zn^{2+} is diluted 100 times of a $Zn^{2+} \mid Zn$ half-cell?

Watch Video Solution

6. Which one of the following reactions will be spontaneous if the standard reduction potential of $M^{+} \mid M$ and $X \mid X^{-}$ electrodes of the galvanic cell. $M|M^{+}||X^{-}|X$ is $+0.44V$ and $+0.33V$ respectively? (i) $M + X \rightarrow M^{+} + X^{-}$, (ii) $M^{+} + X^{-} \rightarrow M + X$.

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7. Why are the elements at higher positions in the electrochemical series not available in free state in nature?

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8. A solution contains X^- and Z^- of concentration 1(M) each. A gas X is passed through the solution at 1 atm and $25^\circ C$. If the order of standard reduction potential of X, Y and Z is Z > Y > X, which one out of X and Z will be oxidised by Y?

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9. What is the way to detect whether the representation of a chemical cell is right or wrong?

Watch Video Solution

10. Show that the chemical equivalent of an element is 96500 times of its electrochemical equivalent.

Watch Video Solution

11. Which one among conductance, specific conductance and equivalent conductivity is dependent on the cell constant of the conductivity cell? Why?

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12. Why is alternating current used instead of direct current, for measurements of conductivity of solutions?

Watch Video Solution

13. Which of the following has a greater equivalent s conductivity? (a)100mL aqueous solution in which 1 mol NaCl is dissolved. (b) 300mL aqueous solution in which 1 mol NaCl is dissolved.

Watch Video Solution

14. If at a definite temperature, the equivalent conductivity at S infinite dilution of aqueous solution of $Al_2(SO_4)_3$ is Λ° what will be the value of Λ_m° of the solution.

Watch Video Solution

15. When an aqueous solution of KBr is electrolysed, Br_2 is evolved at anode but when an aqueous solution of KF is electrolysed, F_2 does not evolve at anode. Why?

Watch Video Solution

16. What is conductance ratio? What is the relation of this to the degree of dissociation of a weak electrolyte?

Watch Video Solution

17. Arrange the following aqueous solutions in ascending order of their molar conductivity, when each of them is 0.1 (M) in concentration : $[Cr(NH_3)_6]Cl_3$, $[Cr(NH_3)_5Cl]Cl_2$ and $[Cr(NH_3)_4Cl_2]Cl$.

Watch Video Solution

18. What are the factors that determine the cnductance of an aqueous electrolytic solution.

Watch Video Solution

19. At a particular temperature, the molar conductivity at infinite dilution of aqueous solution of $Ba(OH)_2$, $BaCl_2$ and NH_4Cl are x_1, x_2 and x_3 $\text{ohm}^{-1}.\text{cm}^2.\text{mol}^{-1}$. What will be molar conductivity of NH_4OH at infinite dilution, at the same temperature?

Watch Video Solution

20. At a definite temperature, with the same conductivity cell, the specific conductance of 0.01 (N) KCl and 0.01 (N) NaCl solution is $y\,\text{ohm}^{-1}.\,\text{cm}^{-1}.$ and $z\,\text{ohm}^{-1}.\,\text{cm}^{-1}$ respectively. If the conductance of KCl solution is $x\,\text{ohm}^{-1}$, what will be the conductance of $NaCl$ solution?

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21. Write Nernst equation for electrode potential for the following electrodes :

(a) $Zn^{2+}+2e\rightarrow Zn$

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22. Write Nernst equation for electrode potential for the following electrodes :

(b) $Fe^{2+}\rightarrow Fe^{3+}+e$

Watch Video Solution

23. For the following electrode reaction, write Nernst equation of electrode potential.

(b) $\frac{1}{2}Cl_2(\text{p atm}) + e \rightarrow Cl^-$

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24. A platinum foil coated with platinum black is dipped in an acid solution through which pure hydrogen gas is bubbled. This is a hydrogen electrode. State the conditions at which it will act as a standard hydrogen electrode.

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25. A galvanic cell has two electrodes, $X^{n+}|X$ and $Y^{n+}|Y$. It is seen that current flows from Y electrode towards X electrode. Between these two electrodes, which one has a higher reduction potential? Explain.

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26. The standard reduction potential of Zn is $-0.76V$ and that of Cu is $+0.34V$. What do they indicate?

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27. Can $CuSO_4$ solution be stored in a zinc container?

Watch Video Solution

28. What do you understand by EMF and standard EMF of a galvanic cell? Write the equation relating standard electromotive force of a galvanic cell with the Gibbs's free energy of the cell reaction.

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29. How can the equilibrium constant of the cell reaction be determined with the help of Nernst equation?

Watch Video Solution

30. For the galvanic cell, $Cu|Cu^{2+}(0.13M)||Ag^{+}(0.01M)|Ag$

(i) Determine the reduction potential of each electrode and the EMF of the cell.

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31. For the galvanic cell, $Cu|Cu^{2+}(0.13M)||Ag^{+}(0.01M)|Ag$

(ii) Is the cell reaction spontaneous ?

$\left[\text{Given}: \ E^{\circ}_{Cu^{2+}|Cu} = +0.34V \text{ and } E^{\circ}_{Ag^{+}|Ag} = +0.80V\right]$.

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32. Zinc replaces hydrogen from acid solution and hydrogen produces silver form silver salts. Explain.

Watch Video Solution

33. Are the following reactions spontaneous?

(a) $Fe + Mg^{2+} \rightarrow Fe^{2+} + Mg$

$$\text{Given}: \quad E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V, E^{\circ}_{Mg^{2+} \mid Mg} = -2.37V,$$

$$E^{\circ}_{Cd^{2+} \mid Cd} = -0.40V, E^{\circ}_{\frac{1}{2}Cl_2 \mid Cl^-} = +1.36V$$

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34. Are the following reactions spontaneous?

(b) $Cd + Cl_2 \rightarrow Cd^{2+} + 2Cl^-$

$$\text{Given}: \quad E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V, E^{\circ}_{Mg^{2+} \mid Mg} = -2.37V,$$

$$E^{\circ}_{Cd^{2+} \mid Cd} = -0.40V, E^{\circ}_{\frac{1}{2}Cl_2 \mid Cl^-} = +1.36V$$

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35. $H_2(g) + Cu^{2+}(aq) \rightarrow Cu(s) + 2H^+(aq)$. The above reaction occurs in a galvanic cell. Identify the cathode and the anode and write the cell reactions.

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36. $2Cr(s) + 3Sn^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Sn(s)$. The reaction occurs in a galvanic cell. Predict the cathode and the anode and write the electrode reactions.

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37. Find the stronger oxidising agent in each pair, stating reason.

(a) Cl_2, Br_2

$\text{Given}: \ E^{\circ}_{\frac{1}{2}Cl_2 \mid Cl^-} = +1.36V, E^{\circ}_{\frac{1}{2}Br_2 \mid Br^-} = +1.07V,$

$E^{\circ}_{Cu^{2+} \mid Cu} = +0.34V, E^{\circ}_{Ag^+ \mid Ag} = +0.80V,$

$E^{\circ}_{Pb^{2+} \mid Pb} = -0.13V, E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V,$

$E^{\circ}_{Fe^{3+} \mid Fe} = -0.036V, E^{\circ}_{Cr^{3+} \mid Cr} = -0.74V$

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38. Find the stronger oxidising agent in each pair, stating reason.

(c) Ag^{+}, Cu^{2+}

$$\text{Given}: \quad E^{\circ}_{\frac{1}{2}Cl_2|Cl^-} = +1.36V, E^{\circ}_{\frac{1}{2}Br_2|Br^-} = +1.07V,$$

$$E^{\circ}_{Cu^{2+}|Cu} = +0.34V, E^{\circ}_{Ag^{+}|Ag} = +0.80V,$$

$$E^{\circ}_{Pb^{2+}|Pb} = -0.13V, E^{\circ}_{Fe^{2+}|Fe} = -0.44V,$$

$$E^{\circ}_{Fe^{3+}|Fe} = -0.036V, E^{\circ}_{Cr^{3+}|Cr} = -0.74V$$

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39. Find the stronger oxidising agent in each pair, stating reason.

(d) Cr^{3+}, Fe^{3+}

$$\text{Given}: \quad E^{\circ}_{\frac{1}{2}Cl_2|Cl^-} = +1.36V, E^{\circ}_{\frac{1}{2}Br_2|Br^-} = +1.07V,$$

$$E^{\circ}_{Cu^{2+}|Cu} = +0.34V, E^{\circ}_{Ag^{+}|Ag} = +0.80V,$$

$$E^{\circ}_{Pb^{2+}|Pb} = -0.13V, E^{\circ}_{Fe^{2+}|Fe} = -0.44V,$$

$$E^{\circ}_{Fe^{3+}|Fe} = -0.036V, E^{\circ}_{Cr^{3+}|Cr} = -0.74V$$

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40. Can Fe^{2+} be produced in the reaction of Fe with 1(M) HCl solution? Explain. Given : $E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V$

Watch Video Solution

41. During discharging and charging of a secondary battery, what type of energy conversion takes place?

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42. Explain the causes of rusting of iron.

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43. A few half - cell reactions and their standard reduction potentials are given belwo :

$Pb^{2+} + 2e \rightarrow Pb, \quad E^\circ = -0.126V, \quad Al^{3+} + 3e \rightarrow Al,$

$E^\circ = -1.66V$

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

$Cd^{2+} + 2e \rightarrow Cd, E^\circ = -0.402V$

Arrange Zm Pb, Cd and Al in ascending order of their ability to act as reducing agent.

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44. Given : $E^\circ_{Cr^{3+} \mid Cr} = -0.74V, E^\circ_{Fe^{3+} \mid Fe^{2+}} = +0.77V$. What happens when Cr is mixed with a solution of $Fe(III)$ ion?

Watch Video Solution

45. The standard reduction potential of metals A, B, C and D are $+0.80V, -0.76V, +0.20V$ and $+0.38V$ respectively. Arrange the metals in the ascending order of their electropositivity.

Watch Video Solution

46. Arrange Al, Cd, Pb & Zn in order of increasing chemical activity. Given :

$E^{\circ}_{Al^{3+}\,|\,Al} = -1.66V,$

$E^{\circ}_{Cd^{2+}\,|\,Cd} = -0.402V,$ $E^{\circ}_{Pb^{2+}\,|\,Pb} = -0.126V,$

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

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47. Deduce a relation between Faraday (F), Avogadro's number (N) and charge of an electron (e) and also determine the charge of an electron.

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48. Determine how many coulombs make 1 faraday with the help of Faraday's laws.

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49. How are resistance and conductivity related? What do you understand by specific conductance of a solution of an electrolyte? What is its unit?

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50. The molar conductivity at infinite dilution of an electrolyte reaches a maximum value. Explain.

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51. Define molar conductivity. Establish a mathematical equation between molar conductivity and specific conductance.

Watch Video Solution

52. The molar conductivity changes with the concentration of an electrolytic solution. Explain.

Watch Video Solution

53. What is molar conductivity at infinite dilution?

Watch Video Solution

54. State and explain the Kohlrausch's law of independent migration of ions.

Watch Video Solution

55. From Kohlrausch's law of independent migration of ions, how is the molar conductivity of infinitely dilute solution of a weak electrolyte determined?

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56. Dissociation of a molecule of an electrolyte produces cations (or anions) whose total valency is nz. Establish a relation between molar and equivalent conductivity of that electrolytic solution.

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57. (a) Define electrochemical equivalent from Faraday's 1st law.

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58. (b) What is the total charge of 1.6g O^{2-} ion ?

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59. Aqueous solution of $AgNO_3$ is electrolysed using the following electrodes: (a) Both cathode and anode are of Pt

Mention the electrode reactions and the substances that are liberated in each case.

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60. Aqueous solution of $AgNO_3$ is electrolysed using the following electrodes: (b) Both cathode and anode are of Ag.

Mention the electrode reactions and the substances that are liberated in each case.

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61. (a) Which of Na^+ or K^+ has a higher molar conductivity? Why?

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62. (b) At a constant temperature, the molar conductivity at infinite dilution of weak electrolyte is $\mathrm{x\,ohm}^{-1}.\,cm^2.\,mol^{-1}$. If at the same

temperature, the molar conductivity of the same electrolytic solution of a definite concentration is $0.02 \text{ x ohm}^{-1}.\text{ cm}^2.\text{ mol}^{-1}$, what is the degree of dissociation of the electrolyte in the solution?

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NUMERICAL PROBLEMS

1. Calculate E°_{cell} of the cell $Mg|Mg^{2+}||Cu^+ \mid Cu$

Given : $E^\circ_{Mg^{2+} \mid Mg} = -2.37V$ and $E^\circ_{Cu^+ \mid Cu} = +0.15V$.

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2. For the cell, $Cu|Cu^{2+}| \mid Hg^{2+}|Hg, E^\circ_{\text{cell}} = +0.45V$. Find the standard reduction potential of $Hg^{2+}|Hg$ electrode. Given : $E^\circ_{Cu^{2+} \mid Cu} = +0.34V$.

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3. A Zn - electrode is dipped in a 0.1 (M) $ZnSO_4$ solution. The salt in 95% dissociated in solution. Find the reduction potential of the electrode. Given : Temperature $= 298K, E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V$

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4. The EMF of the galvanic cell, $Zn\left|Zn^{2+}(2.0M)\right| \mid Cu^{+}(xM)Cu$ is 0.86V. If $E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V$ and $E^{\circ}_{Cu^{+} \mid Cu} = +0.15V$, then find the value of x.

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5. A galvanic cell is made by dipping a Zn - rod in 0.1 (M) $Zn(NO_3)_2$ and a Pb - rod in $0.25(M)Pb(NO_3)_2$ solution. Calculate EMF of the cell, write the cell reaction and represent the cell. Given : $E^{\circ}_{Pb^{2+} \mid Pb} = -0.13V, E^{\circ}_{Zn^{2+} \mid Zn} = -0.77V.$

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6. Given :

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

. (i) Construct a galvanic cell with these two electrodes. (ii) If at $25^{\circ}C$ the concentration of Cu^{2+} is 0.01 (M), what should be the value of concentration of Ag^{+} to make the cell potential equal to zero?

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7. Calculate the value of the equilibrium constant of the given reaction at 298 K:

$$4Br^{-} + O_2 + 4H^{+} \rightarrow 2Br_2 + 2H_2O$$

Given : $E^{\circ}_{\text{cell}} = +0.16V$

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8. Calculate the value of the equilibrium constant of the following reaction at 298 K:

Given: $E^{\circ}_{Cu^{2+}|Cu} = +0.34V$ and $E^{\circ}_{Cl_2|2Cl^{-}} = +1.36V$

Watch Video Solution

9. Determine the maximum amount of work that can be derived from the cell, $Zn|Zn^{2+}(1M)||Cu^{2+}(1M)|Cu.$

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

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10. The standard reduction potential of the reaction, $2H_2O + 2e \rightarrow H_2 + 2OH^-$ is $-0.8277V$ at $25^{\circ}C$. Find the value of the equilibrium constant of the reaction $2H_2O \rightarrow H_3O^+ + OH^-$ at the same temperature.

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11. The standard reduction potential of the following reaction at $25^{\circ}C$, is $0.78V$, $NO_3^-(aq) + 2H^+(aq) + e \rightarrow NO_2 + H_2O.$

(i) If the concentration of H^+ is 8(M), what will be the standard reduction potential of the half - cell ? (ii) What will be the reduction potential of the half - cell in neutral solution? Suppose all other constituents are at unit concentration.

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12. $Zn(s) + 2H^{+}(aq) \rightarrow Zn^{2+}(0.1M) + H_2(g, 1 \text{ atm})$

Cell potential of a chemical cell in which the above reaction occurs is $+0.28V$ at $25^{\circ}C$. Write the half-cell reactions and calculate the pH of the hydrogen electrode.

Give : $E^{\circ}_{Zn^{2+} \mid Zn} = -0.76V$ and $E^{\circ}_{2H^{+} \mid H_2} = 0.00V$.

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13. Calculate cell potential of

$Fe \mid Fe^{2+}(a = 0.6) \mid\mid Sn^{2+}(a = 0.2) \mid Sn$

Given : $E^{\circ}_{Fe^{2+} \mid Fe} = -0.44V, E^{\circ}_{Sn^{2+} \mid Sn} = +0.14V$

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14. Initially the concentration of Ag^{+} and Cu^{2+} is 1 (M) each in the electrolytic cell, $Ag|Ag^{+}||Cu^{2+} \mid Cu$. If 9.65 A of current is passed through the cell for one hour, what will be the change in the cell potential?

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15. $4.5 mM Cr_2O_7^{2-}$ and 15mM Cr^{3+} is mixed to produce a solution of pH = 2.0. What will be the reduction potential of the half - cell? Given : For the change $Cr_2O_7^{2-} \rightarrow Cr^{3+}$, the standard reduction potential is 1.33V`.

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16. The values of Λ_{eq}° of KI and KCl solutions are 150.30 and $149.90 \text{ ohm}^{-1}.\text{ cm}^{2}.\text{ g-equiv}^{-1}$ respectively. If λ° value of Cl^{-} ion is $76.34 \text{ ohm}^{-1}.\text{ cm}^{2}.\text{ g - equiv}^{-1}$, find the value of $\lambda_{I^{-}}^{\circ}$.

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17. If the dimensions of electrodes of a conductivity cell are 0.90 cm and 1.005 cm and distance between them is 0.45 cm, find the value of the cell constant.

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18. Area of each electrode of a conductivity cell is $1.25\,\mathrm{cm}^2$. The cell is filled with a solution of resistance of 160 ohm. If specific conductance of the solution is $0.016\,\mathrm{ohm}^{-1}.\,\mathrm{cm}^{-1}$, calculates the distance between the electrodes, and the cell constant.

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19. At a definite temperature, a conductivity cell is filled with 0.02 (N) KCl solution, the resistance is 380 ohm. If the specific conductance of 0.02(N) KCl solution at the same temperature be $0.002758\,\mathrm{ohm.cm}^{-1}$. Find the cell constant. If the distance between the electrodes is 0.80 cm, what is the average area of the electrodes?

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20. The electrodes $(5cm \times 1cm)$ are held parallel at a distance of 1.5 cm apart and are dipped in a 0.1 (N) solution of an electrolyte. The resistance measured was 50 ohm. What will be the equivalent conductivity of the solution?

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21. The cell constant of a conductivity cell is 0.228 cm^{-1}. If the cell is filled with $0.005(N)K_2SO_4$ solution, the resistance recorded is 326 ohm at $25^\circ C$. What will be (i) the specific conductance and (ii) the equivalent conductivity of the solution?

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22. The specific conductance of 0.01 (N) KCl solution at $25^\circ C$, is $0.00140 \text{ ohm}^{-1}.\text{cm}^{-1}$. The same conductivity cell when filled with $\left(\frac{N}{100}\right)NaOH$ solution, the resistance of the solution was 14.8 ohm. If the resistance of the KCl solution is 25 ohm, what will be the equivalent conductivity of NaOH at $25^\circ C$?

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23. A conductivity cell when filled with 0.1 (N) KCl at $25^\circ C$ the resistance at $25^\circ C$ becomes 307.62 ohm, and when filled in with $0.1(N)AgNO_3$ solution, the resistance becomes 362.65 ohm at the same temperature. At $25^\circ C$, the specific conductance of 0.1 (N) KCl solution is $0.01286 \text{ ohm}^{-1}.\text{cm}^{-1}$. From these data, calculate (i) cell constant (ii) equivalent conductivity of $0.1(N)AgNO_3$ solution.

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24. Equivalent conductivities at infinite dilution (Λ°) of NH_4Cl, $NaOH$ and $NaCl$ are 130, 217.6 and $108.9 \text{ ohm}^{-1}.\text{ cm}^2.\ g - \equiv^{-1}$ respectively at $25^\circ C$. Calculate Λ° of NH_4OH at $25^\circ C$

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25. Resistance is 82.3 ohm, when a conductivity cell is filled with 0.02 (N) KCl solution at a definite temperature. At the same temperature, the specific conductance of 0.02 (N) KCl solution is $0.002758 \text{ ohm.cm}^{-1}$. The resistance is 324 ohm when the cell is filled with $: 0.05(N)K_2SO_4$ solution. Calculated the equivalent and molar conductivity of K_2SO_4 solution.

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26. The value of Λ° of $ClCH_2COONa$, $NaCl$ and HCl solutions are 224, 38.2 and $203 \text{ ohm}^{-1}.\text{ cm.}^2 g - \equiv^{-1}$ respectively. Calculate the value of Λ° of aqueous solution of $ClCH_2COOH$.

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27. At a given temperature, specific conductance of 0.001(M) acetic acid solution is $5 \times 10^{-5} \mathrm{S.cm}^{-1}$ and equivalent conductivity at infinite dilution is $390.5\ \mathrm{S.cm}^2.\ mol^{-1}$. What is the value of dissociation constant of acetic acid at the same temperature.

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28. At infinite dilution of $MgCl_2$ solution, $\lambda^\circ_{Mg^{2+}} = 53.06$ and $\lambda^\circ_{Cl^-} = 76.34\ \mathrm{ohm}^{-1}.\ \mathrm{cm}^2.\ \mathrm{g\text{-}equiv}^{-1}$. Find Λ°_{eq} and Λ°_m of the solution.

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29. 19 g molten $SnCl_2$ was electrolysed by two inert electrodes. On electrolysis, 0.119 g of Sn was deposited at cathode. Find the ratio of weights of $SnCl_2$ and $SnCl_4$ after electrolysis, assuming, there is no loss of materíal during electrolysis.

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30. 0.2964 g of copper is deposited, when 0.5 A current is passed through copper sulphate solution for 30 min. What is the electrochemical equivalent of copper?

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31. Calculate the amount of Zn produced, if 2 A current is passed through a $ZnCl_2$ solution for 20 min?

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32. When 2 A current was passed for 1h through a copper sulphate solution, 2.369 g of copper was discharged. Find the atomic weight of copper.

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33. It 1 A current is passed through a metallic wire, how many electrons pass through a point in the wire per second.

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34. What should be the current strength to produce 1 mL H_2 passed through acidified water for 5 h?

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35. Calculate the weight of water decomposed, if 5 ampere current is passed through acidified water for 5 h?

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36. 5 A current is passed for 5 min through acidified water at NTP, producing 175 mL H_2 at the cathode. Find the electrochemical equivalent of H_2 .

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37. How much current in amperes should be passed for 100s through acidified water to produce 174 mL electrolysed gas at STP?

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38. How much electricity is required to coat an iron cup with 2.16 g of Ag?

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39. At STP, 2.8L of oxygen is produced at the anode, during electrolysis of aqueous NaOH solution. Find the volume of the other gas produced at the cathode?

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40. Find the number of Al-atoms, discharged when 2 C electricity is passed through molten Al-salt.

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41. Find the amount of Fe^{2+} and Fe^{3+} discharged (in grams) by 1 faraday of electricity? [Fe = 56]

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42. If 200 A current is passed through molten NaCl for 1 min , how many moles of Cl_2 , is produced ?

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43. If 10 C of electricity is passed through an aqueous solution of a metal salt , 2.08×10^{19} atoms are produced at the cathode . Find the equivalent weight of the metal , if its atomic weight is 27 .

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44. The cost of electrical energy in the production of $\mathrm{x\,L\,H_2}$ at STP by electrolysis of acidified water , is x rupees . Calculate the cost of electrical energy to produce xL of o^2 at STP .

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45. Calculate the charge of 0.1 mol of $P_2O_7^{4-}$ ion.

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46. To reduce 1 mol $Cr_2O_7^{2-}$ to Cr^{3+} , find the amount of electricity required ?

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47. The same amount of electricity required to produce 10g Ag from $AgNO_3$ solution by electrolysis , is passed through aqueous solution of a gold salt , when 6.08g gold is deposited . Find the charge of gold in the solution ?

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48. 3.7 A current was passed for 6h through 0.5L 2(M) solution of $Ni(NO_3)_2$. What will be the molarity of the solution after electrolysis ?

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49. 27g Al is discharged , when 0.5 A current is passed through molten $AlCl^3$. Calculate (1) the number of gram equivalents of Al discharged (ii) the number of gram atoms of Al discharged (iii) the number of molecules of Al discharged (iv) the number of electrons that took part in the process (v) the amount of electricity (in F) that was used (vi) the duration of passage of electricity (vil) the volume of Cl_2 , (in L) produced at STP .

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50. Calculate the time to electroplate a metal surface of area 80 cm^2 and thickness 0.005 mm , by passing a current of 3A through an $AgNO_3$ solution . (Density of $Ag = 10.5g. cm^{-3}$)

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51. If 1 mol electron is passed through each of $AgNO_3$, $CuSO_4$ and $AiCl^3$, solutions , calculate the ratio of number of moles of Ag , Cu and

Al formed at cathode .

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52. Two electrolytic cells A and B contain gold salt and copper sulphate solution respectively . Two cells are combined in series and current is passed for 5 h . If the oxidation state of gold in gold salt solution is +3 and the amount of gold accumulated in cell A is 9.85 g , then find the amount of copper discharged in cell B ? [Au = 197 , Cu = 63.5]

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53. The same amount of electricity is passed through acidified water and an aqueous solution of a metal chloride . As a result 7.4L H_2 , gas at STP in the first case and 21 g metal in the second case are produced . Calculate the equivalent weight of the metal ? If the specific heat of the metal is 0.094 , then find the atomic weight of the metal ?

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54. In an electrolytic cell , molten Al_2O_3 is taken , through which a current of 125A is passed for sometime , when 125g Al is produced . Calculate the time required .

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55. Cr is produced by electrolysis of an acidic solution of CrO_3 . The reaction is : $CrO_3(aq) + 6H^+ 6e \rightarrow Cr(s) + 3H_2O$. Calculate : (i) the amount of Cr produced (in grams) , when 24000 C of electricity is passed ? (Cr = 52) (ii) the time required to produce 1.5 g Cr when 12.5 A current is passed ?

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56. MnO_2 , is prepared by electrolysis of an aqueous solution of mnso4 acidified with H_2SO_4 . The reaction is $Mn^{2+}(aq) + 2H_2O \rightarrow MnO_2(s) + 2H^+(aq) + H^2(g)$. 1kg of MnO_2 , is produced , when 27A current is passed for 24 h . What is the efficiency of the current passed ? Write the cathode and anode reactions .

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57. On electrolysis of aq NaCl solution , $H_2(g)$, $Cl_2(g)$ and NaOH are produced :

$2Cl^-(aq) + 2H_2O \rightarrow 2OH^-(aq) + H_2(g) + Cl_2(g)$

62% efficient 25 A electricity is passed through 20L 20 % NaCl solution . (i) Write the electrode reactions (ii) How much time will it take to produce 1 kg Cl_2 (iii) What will be the molarity at that time with respect to OH^- ? (suppose no volume change occurs during electrolysis)

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58. 0.617g metal is produced at cathode during electrolysis of a metal iodide . 46.3 mL of 0.124 (M) Na_2S0_4 solution is required to reduce the I_2 produced at anode completely . Find the equivalent mass of the metal .

[I = 127]

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59. 500 mL 4 (M) of $NaCl$ solution is electrolysed liberating $Cl_2(g)$ at an electrode. Calculate (i) the total number of moles of Cl_2 (ii) the maximum amount of amalgam, if Hg- cathode is used. (Hg = 200) (iii) the amount of electricity required for complete electrolysis.

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PRACTICE SET 4(Choose the correct alternative)

1. If the E°_{cell} for a given reaction has a negative value, then which of the following gives the correct relationships for the values of ΔG^0 and K_{eq}-

A. $\Delta G^{\circ} > 0, K_{eq} < 1$

B. $\Delta G^{\circ} > 0, K_{eq} > 1$

C. $\Delta G^{\circ} < 0, K_{eq} > 1$

D. $\Delta G^{\circ} < 0, K_{eq} < 1$

Answer: A

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2. In which of the following concentrations of a particular electrolyte molar conductivity will be maximum -

A. 0.005 M

B. 0.004 M

C. 0.003 M

D. 0.002 M

Answer: D

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3. Equivalent conductivity at infinite dilution for sodium potassium oxalate $\left[(COO^{-})_2 Na^{+} K^{+}\right]$ will be [given, molar conductivity of oxalate, K^{+} and Na^{+} ions at infinite dilute are $148.2, 50.1, 73.5\ \ \mathrm{S.cm^2.mol^{-1}}$. Respectively -

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

B. $67.95\mathrm{S.cm}^2.\, eq^{-1}$

C. $542.6\mathrm{S.cm}^2.\, eq^{-1}$

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

Answer: D

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4. In a galvanic cell reaction, the electrons flow from -

A. anode to cathod through the solution

B. cathode to anode through the solution

C. anode to cathode through the external circuit

D. cathode to anode through the external circuit

Answer: C

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5. The metal that does not displace hydrogen from an acid is -

A. Ca

B. Al

C. Zn

D. Hg

Answer: D

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6. If 'F' is Faraday and 'N' is Avogadro number, then charge of electron can be expressed as -

A. $F \times N$

B. $\frac{F}{N}$

C. $\frac{N}{F}$

D. F^2N

Answer: B

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PRACTICE SET 4(Answer the following questions)

1. What is overvoltage?

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2. Why is H_2 gas evolved instead of Na when aqueous solution of $NaCl$ is electrolysed?

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3. What are secondary cells?

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4. Calculate the total charge carried by 1.6 g of O^{2-} ion.

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5. Write the cathode and anode reactions involved in rusting of iorn.

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6. What is electrochemical equivalent?

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7. At a definite temperature, with the same conductivity cell, the specific conductance of 0.01 N KCl and 0.01 N NaCl solutions are $\text{y ohm}^{-1}.\text{ cm}^{-1}$ and $\text{z ohm}^{-1}.\text{ cm}^{-1}$ respectively. If the conductance of KCl solution is x ohm^{-1}, what will be the conductance of $NaCl$ solution?

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8. Why is alternating current used instead of direct current for the measurements of conductivity of solutions?

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9. The molar conductivity at infinite dilution of an electrolyte reaches its maximum value. Explan.

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10. $Zn(s) + 2H^{+}(aq) \rightarrow Zn^{2+}(0.1M) + H_2(g, 1 \text{ atm})$

Cell potential of a chemical cell in which the above reaction occurs is $+0.28V$ at $25^{\circ}C$. Write the half-cell reactions and calculate the pH of the hydrogen electrode.

Give : $E^{\circ}_{Zn^{2+}\,||\,Zn} = -0.76V$ and $E^{\circ}_{2H^{+}\,||\,H} = 0.00V$

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11. A conductivity cell when filled with 0.1 N KCl at $25^{\circ}C$ the resistance becomes 307.62 ohm at the same temperature. At $25^{\circ}C$, the specific conductance of 0.1 N KCl solution is $0.01286 \text{ ohm}^{-1}.\text{cm}^{-1}$. From these data calculate (1) cell constant (2) equivalent conductance of 0.1 N AgNO_3 solution and ressistance 362.65 ohm.

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12. 500 mL 4 M of NaCl solution is electrolysed liberating $Cl_2(g)$ at an electrode. Calculate (1) the total number of moles of Cl_2

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13. 500 mL 4 M of NaCl solution is electrolysed liberating $Cl_2(g)$ at an electrode. Calculate (2) the maximum amount of amalgam if Hg - cathode is used (atomic mass of Hg = 200)

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14. 500 mL 4 M of NaCl solution is electrolysed liberating $Cl_2(g)$ at an electrode. Calculate (3) the amount of electricity required for complete electrolysis.

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