

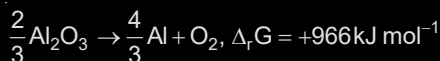
Electrochemistry

1. Given $E^\circ_{\text{Fe}^{3+}/\text{Fe}} = -0.036 \text{ V}$, $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.439 \text{ V}$

The value of standard electrode potential for the change, $\text{Fe}^{3+}_{(\text{aq})} + e^- \rightarrow \text{Fe}^{2+}(\text{aq})$ will be

[AIEEE-2009]

- (1) 0.385 V (2) 0.770 V
(3) -0.270 V (4) -0.072 V
2. The Gibbs energy for the decomposition Al_2O_3 at 500°C is as follows



The potential difference needed for electrolytic reduction of Al_2O_3 at 500°C is at least

[AIEEE-2010]

- (1) 5.0 V (2) 4.5 V
(3) 3.0 V (4) 2.5 V
3. Resistance of 0.2 M solution of an electrolyte is 50Ω . The specific conductance of the solution is 1.3 S m^{-1} . If resistance of the 0.4 M solution of the same electrolyte is 260Ω , its molar conductivity is

[AIEEE-2011]

- (1) $62.5 \text{ S m}^2 \text{ mol}^{-1}$
(2) $6250 \text{ S m}^2 \text{ mol}^{-1}$
(3) $6.25 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$
(4) $625 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$
4. The standard reduction potentials for Zn^{2+}/Zn , Ni^{2+}/Ni , and Fe^{2+}/Fe are -0.76 , -0.23 and -0.44 V respectively. The reaction $\text{X} + \text{Y}^{2+} \rightarrow \text{X}^{2+} + \text{Y}$ will be spontaneous when

[AIEEE-2012]

- (1) $\text{X} = \text{Ni}$, $\text{Y} = \text{Zn}$ (2) $\text{X} = \text{Fe}$, $\text{Y} = \text{Zn}$
(3) $\text{X} = \text{Zn}$, $\text{Y} = \text{Ni}$ (4) $\text{X} = \text{Ni}$, $\text{Y} = \text{Fe}$

5. Given

$$E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.74 \text{ V}; E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.51 \text{ V}$$

$$E^\circ_{\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{3+}} = 1.33 \text{ V}; E^\circ_{\text{Cl}_2/\text{Cl}^-} = 1.36 \text{ V}$$

Based on the data given above, strongest oxidising agent will be

[JEE (Main)-2013]

- (1) Cl^- (2) Cr^{3+}
(3) Mn^{2+} (4) MnO_4^-

6. Resistance of 0.2 M solution of an electrolyte is 50Ω . The specific conductance of the solution is 1.4 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 in $\text{S m}^2 \text{ mol}^{-1}$ is

[JEE (Main)-2014]

- (1) 5×10^{-4} (2) 5×10^{-3}
(3) 5×10^3 (4) 5×10^2

7. The equivalent conductance of NaCl at concentration C and at infinite dilution are λ_C and λ_∞ , respectively. The correct relationship between λ_C and λ_∞ is given as (where the constant B is positive)

[JEE (Main)-2014]

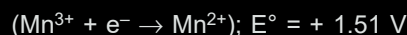
- (1) $\lambda_C = \lambda_\infty + (B)C$ (2) $\lambda_C = \lambda_\infty - (B)C$
(3) $\lambda_C = \lambda_\infty - (B)\sqrt{C}$ (4) $\lambda_C = \lambda_\infty + (B)\sqrt{C}$

8. The metal that cannot be obtained by electrolysis of an aqueous solution of its salts is

[JEE (Main)-2014]

- (1) Ag (2) Ca
(3) Cu (4) Cr

9. Given below are the half-cell reactions



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

[JEE (Main)-2014]

- (1) -2.69 V ; the reaction will not occur
(2) -2.69 V ; the reaction will occur
(3) -0.33 V ; the reaction will not occur
(4) -0.33 V ; the reaction will occur

10. Two faraday of electricity is passed through a solution of CuSO_4 . The mass of copper deposited at the cathode is (at. mass of $\text{Cu} = 63.5 \text{ amu}$)

[JEE (Main)-2015]

- (1) 0 g (2) 63.5 g
(3) 2 g (4) 127 g

11. Galvanization is applying a coating of

[JEE (Main)-2016]

- (1) Cr (2) Cu
(3) Zn (4) Pb

12. Given

$$E^\circ_{\text{Cl}_2/\text{Cl}^-} = 1.36 \text{ V}, E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.74 \text{ V}$$

$$E^\circ_{\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{3+}} = 1.33 \text{ V}, E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.51 \text{ V}$$

Among the following, the strongest reducing agent is

[JEE (Main)-2017]

- (1) Cr^{3+} (2) Cl^-
(3) Cr (4) Mn^{2+}

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

[JEE (Main)-2018]

- (1) 6.4 hours
(2) 0.8 hours
(3) 3.2 hours
(4) 1.6 hours

14. The anodic half-cell of lead-acid battery is recharged using electricity of 0.05 Faraday. The amount of PbSO_4 electrolyzed in g during the process is (Molar mass of $\text{PbSO}_4 = 303 \text{ g mol}^{-1}$)

[JEE (Main)-2019]

- (1) 7.6 (2) 15.2
(3) 11.4 (4) 22.8

15. If the standard electrode potential for a cell is 2 V at 300 K, the equilibrium constant (K) for the reaction $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightleftharpoons \text{Zn}^{2+}(\text{aq}) + \text{Cu(s)}$ at 300 K is approximately

$$(R = 8 \text{ JK}^{-1}\text{mol}^{-1}, F = 96000 \text{ Cmol}^{-1})$$

[JEE (Main)-2019]

- (1) e^{320} (2) e^{160}
(3) e^{-160} (4) e^{-80}

16. In the cell

$\text{Pt(s)}|\text{H}_2(\text{g}, 1\text{bar})||\text{HCl(aq)}|\text{AgCl(s)}|\text{Ag(s)}|\text{Pt(s)}$ the cell potential is 0.92 V when a 10^{-6} molal HCl solution is used. The standard electrode potential of ($\text{AgCl}/\text{Ag}, \text{Cl}^-$) electrode is

$$\left\{ \text{Given, } \frac{2.303RT}{F} = 0.06 \text{ V at } 298 \text{ K} \right\}$$

[JEE (Main)-2019]

- (1) 0.20 V (2) 0.40 V
(3) 0.76 V (4) 0.94 V

17. For the cell $\text{Zn(s)}|\text{Zn}^{2+}(\text{aq})||\text{M}^{x+}(\text{aq})|\text{M(s)}$, different half cells and their standard electrode potentials are given below

$\text{M}^{x+}(\text{aq})/\text{M(s)}$	$\text{Au}^{3+}(\text{aq})/\text{Au(s)}$	$\text{Ag}^+(\text{aq})/\text{Ag(s)}$	$\text{Fe}^{3+}(\text{aq})/\text{Fe}^{2+}(\text{aq})$	$\text{Fe}^{2+}(\text{aq})/\text{Fe(s)}$
$E^\circ_{\text{M}^{x+}/\text{M}}(\text{V})$	1.40	0.80	0.77	-0.44

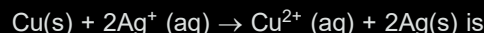
If $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$, which cathode will give a maximum value of E°_{cell} per electron transferred?

[JEE (Main)-2019]

- (1) Fe^{2+}/Fe (2) Ag^+/Ag
(3) $\text{Fe}^{3+}/\text{Fe}^{2+}$ (4) Au^{3+}/Au

18. Given the equilibrium constant :

K_C of the reaction :



10×10^{15} , calculate the E°_{cell} of this reaction at 298 K

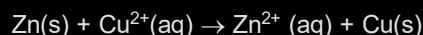
$$\left[2.303 \frac{RT}{F} \text{ at } 298 \text{ K} = 0.059 \text{ V} \right] \text{ [JEE (Main)-2019]}$$

- (1) 0.4736 mV (2) 0.4736 V
(3) 0.04736 V (4) 0.04736 mV

19. The standard electrode potential E° and its

temperature coefficient $\left(\frac{dE^\circ}{dT} \right)$ for a cell are 2 V and

$-5 \times 10^{-4} \text{ VK}^{-1}$ at 300 K respectively. The cell reaction is



The standard reaction enthalpy ($\Delta_r H^\circ$) at 300 K in kJ mol^{-1} is,

$$[\text{Use } R = 8 \text{ JK}^{-1}\text{mol}^{-1} \text{ and } F = 96,000 \text{ C mol}^{-1}]$$

[JEE (Main)-2019]

- (1) 206.4 (2) -384.0
(3) -412.8 (4) 192.0

20. Λ_m° for NaCl, HCl and NaA are 126.4, 425.9 and 100.5 S cm²mol⁻¹, respectively. If the conductivity of 0.001 M HA is 5×10^{-5} S cm⁻¹, degree of dissociation of HA is [JEE (Main)-2019]

- (1) 0.25 (2) 0.125
(3) 0.50 (4) 0.75

21. Given that $E_{O_2/H_2O}^\circ = +1.23$ V;

$$E_{S_2O_8^{2-}/SO_4^{2-}}^\circ = 2.05 \text{ V};$$

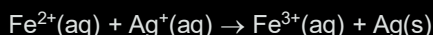
$$E_{Br_2/Br}^\circ = +1.09 \text{ V};$$

$$E_{Au^{3+}/Au}^\circ = +1.4 \text{ V}$$

The strongest oxidizing agent is

[JEE (Main)-2019]

- (1) Br₂ (2) Au³⁺
(3) S₂O₈²⁻ (4) O₂
22. Calculate the standard cell potential (in V) of the cell in which following reaction takes place :



Given that

$$E_{Ag^+/Ag}^\circ = x \text{ V}$$

$$E_{Fe^{2+}/Fe}^\circ = y \text{ V}$$

$$E_{Fe^{3+}/Fe}^\circ = z \text{ V}$$

[JEE (Main)-2019]

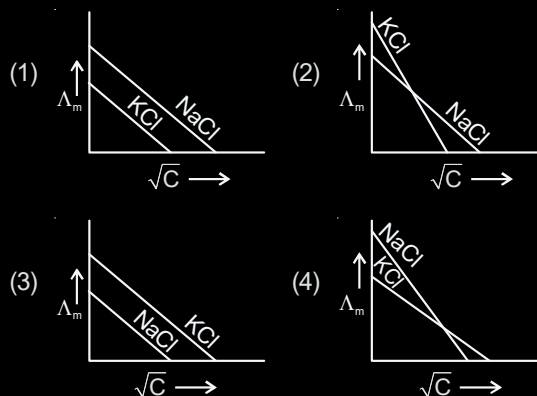
- (1) $x - y$ (2) $x + y - z$
(3) $x + 2y - 3z$ (4) $x - z$
23. The standard Gibbs energy for the given cell reaction in kJ mol⁻¹ at 298 K is
- $$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s),$$
- $E^\circ = 2 \text{ V}$ at 298 K
(Faraday's constant, $F = 96000 \text{ C mol}^{-1}$)

[JEE (Main)-2019]

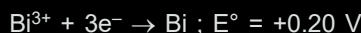
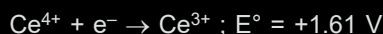
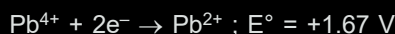
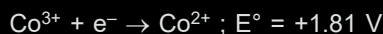
- (1) 192 (2) 384
(3) -384 (4) -192
24. A solution of Ni(NO₃)₂ is electrolysed between platinum electrodes using 0.1 Faraday electricity. How many mole of Ni will be deposited at the cathode? [JEE (Main)-2019]
- (1) 0.20 (2) 0.15
(3) 0.10 (4) 0.05

25. Which one of the following graphs between molar conductivity (Λ_m) versus \sqrt{C} is correct?

[JEE (Main)-2019]



26. Given :



Oxidizing power of the species will increase in the order :

[JEE (Main)-2019]

- (1) $Co^{3+} < Ce^{4+} < Bi^{3+} < Pb^{4+}$
(2) $Co^{3+} < Pb^{4+} < Ce^{4+} < Bi^{3+}$
(3) $Ce^{4+} < Pb^{4+} < Bi^{3+} < Co^{3+}$
(4) $Bi^{3+} < Ce^{4+} < Pb^{4+} < Co^{3+}$
27. The decreasing order of electrical conductivity of the following aqueous solutions is: [JEE (Main)-2019]
- 0.1 M Formic acid (A),
0.1 M Acetic acid (B),
0.1 M Benzoic acid (C),
- (1) $A > B > C$
(2) $A > C > B$
(3) $C > B > A$
(4) $C > A > B$
28. Consider the statements S1 and S2 :

S1 : Conductivity always increases with decrease in the concentration of electrolyte.

S2 : Molar conductivity always increases with decrease in the concentration of electrolyte.

The correct option among the following is

[JEE (Main)-2019]

- (1) S1 is wrong and S2 is correct
 (2) S1 is correct and S2 is wrong
 (3) Both S1 and S2 are wrong
 (4) Both S1 and S2 are correct
29. Given that the standard potentials (E°) of Cu^{2+}/Cu and Cu^+/Cu are 0.34 V and 0.522 V respectively, the E° of $\text{Cu}^{2+}/\text{Cu}^+$ is:

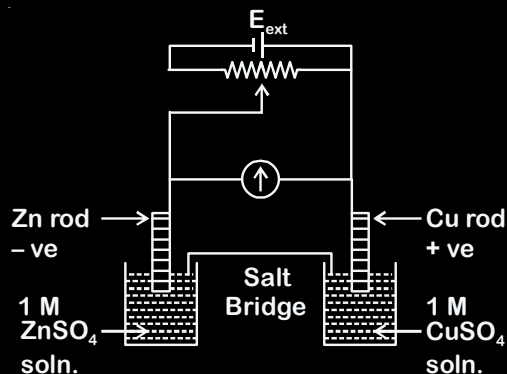
[JEE (Main)-2020]

- (1) +0.158 V (2) -0.158 V
 (3) -0.182 V (4) 0.182 V
30. The equation that is incorrect is

[JEE (Main)-2020]

- (1) $(\Delta_m^\circ)_{\text{NaBr}} - (\Delta_m^\circ)_{\text{NaCl}} = (\Delta_m^\circ)_{\text{KBr}} - (\Delta_m^\circ)_{\text{KCl}}$
 (2) $(\Delta_m^\circ)_{\text{H}_2\text{O}} = (\Delta_m^\circ)_{\text{HCl}} + (\Delta_m^\circ)_{\text{NaOH}} - (\Delta_m^\circ)_{\text{NaCl}}$
 (3) $(\Delta_m^\circ)_{\text{NaBr}} - (\Delta_m^\circ)_{\text{NaI}} = (\Delta_m^\circ)_{\text{KBr}} - (\Delta_m^\circ)_{\text{NaBr}}$
 (4) $(\Delta_m^\circ)_{\text{KCl}} - (\Delta_m^\circ)_{\text{NaCl}} = (\Delta_m^\circ)_{\text{KBr}} - (\Delta_m^\circ)_{\text{NaBr}}$

31.



$$E_{\text{Cu}^{2+}|\text{Cu}}^\circ = +0.34 \text{ V}$$

$$E_{\text{Zn}^{2+}|\text{Zn}}^\circ = -0.76 \text{ V}$$

Identify the incorrect statement from the option below for the above cell [JEE (Main)-2020]

- (1) If $E_{\text{ext}} < 1.1 \text{ V}$, Zn dissolves at anode and Cu deposits at cathode

(2) If $E_{\text{ext}} = 1.1 \text{ V}$, no flow of e^- or current occurs

(3) If $E_{\text{ext}} > 1.1 \text{ V}$, e^- flows from Cu to Zn

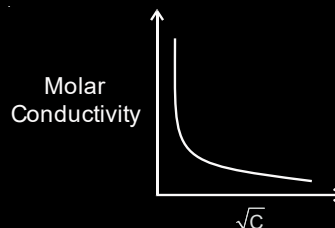
(4) If $E_{\text{ext}} > 1.1 \text{ V}$, Zn dissolves at Zn electrode and Cu deposits at Cu electrode

32. 250 mL of a waste solution obtained from the workshop of a goldsmith contains 0.1 M AgNO_3 and 0.1 M AuCl . The solution was electrolyzed at 2V by passing a current of 1A for 15 minutes. The metal/metals electrodeposited will be

$$[E_{\text{Ag}^+/\text{Ag}}^\circ = 0.80 \text{ V}, E_{\text{Au}^+/\text{Au}}^\circ = 1.69 \text{ V}]$$

[JEE (Main)-2020]

- (1) Silver and gold in equal mass proportion
 (2) Silver and gold in proportion to their atomic weights
 (3) Only gold
 (4) Only silver
33. The variation of molar conductivity with concentration of an electrolyte (X) in aqueous solution is shown in the given figure.



The electrolyte X is

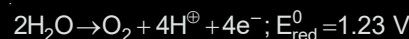
[JEE (Main)-2020]

- (1) NaCl (2) HCl
 (3) CH_3COOH (4) KNO_3
34. For the given cell;
 $\text{Cu(s)}|\text{Cu}^{2+}(\text{C}_1\text{M})||\text{Cu}^{2+}(\text{C}_2\text{M})|\text{Cu(s)}$
 change in Gibbs energy (ΔG) is negative, if

[JEE (Main)-2020]

- (1) $\text{C}_2 = \sqrt{2}\text{C}_1$ (2) $\text{C}_2 = \frac{\text{C}_1}{\sqrt{2}}$
 (3) $\text{C}_1 = 2\text{C}_2$ (4) $\text{C}_1 = \text{C}_2$
35. What would be the electrode potential for the given half cell reaction at pH = 5? _____.

[JEE (Main)-2020]



($R = 8.314 \text{ J mol}^{-1}\text{K}^{-1}$; Temp = 298 K; oxygen under std. atm. pressure of 1 bar)

36. For an electrochemical cell
 $\text{Sn(s)}|\text{Sn}^{2+}(\text{aq}, 1\text{M})||\text{Pb}^{2+}(\text{aq}, 1\text{M})|\text{Pb(s)}$
 the ratio $\frac{[\text{Sn}^{2+}]}{[\text{Pb}^{2+}]}$ when this cell attains equilibrium is _____.
 (Given : $E_{\text{Sn}^{2+}|\text{Sn}}^0 = -0.14\text{V}$,
 $E_{\text{Pb}^{2+}|\text{Pb}}^0 = -0.13\text{V}$, $\frac{2.303RT}{F} = 0.06$)
[JEE (Main)-2020]
37. 108 g of silver (molar mass 108 g mol⁻¹) is deposited at cathode from $\text{AgNO}_3(\text{aq})$ solution by a certain quantity of electricity. The volume (in L) of oxygen gas produced at 273 K and 1 bar pressure from water by the same quantity of electricity is _____.
[JEE (Main)-2020]
38. The Gibbs energy change (in J) for the given reaction at $[\text{Cu}^{2+}] = [\text{Sn}^{2+}] = 1\text{M}$ and 298 K is:
 $\text{Cu(s)} + \text{Sn}^{2+}(\text{aq.}) \rightarrow \text{Cu}^{2+}(\text{aq.}) + \text{Sn(s)}$
 ($E_{\text{Sn}^{2+}|\text{Sn}}^0 = -0.16\text{V}$, $E_{\text{Cu}^{2+}|\text{Cu}}^0 = 0.34\text{V}$
 Take $F = 96500\text{C mol}^{-1}$)
[JEE (Main)-2020]
39. For the disproportionation reaction
 $2\text{Cu}^+(\text{aq}) \rightleftharpoons \text{Cu(s)} + \text{Cu}^{2+}(\text{aq})$ at 298 K. In K (where K is the equilibrium constant) is _____ $\times 10^{-1}$.
 Given :
 ($E_{\text{Cu}^{2+}|\text{Cu}^+}^0 = 0.16\text{V}$
 $E_{\text{Cu}^+|\text{Cu}}^0 = 0.52\text{V}$
 $\frac{RT}{F} = 0.025$)
[JEE (Main)-2020]
40. The photoelectric current from Na (work function, $w_0 = 2.3\text{eV}$) is stopped by the output voltage of the cell
 $\text{Pt(s)}|\text{H}_2(\text{g}, 1\text{bar})|\text{HCl}(\text{aq.}, \text{pH} = 1)|\text{AgCl(s)}|\text{Ag(s)}$.
 The pH of aq. HCl required to stop the photoelectric current from K ($w_0 = 2.25\text{eV}$), all other conditions remaining the same, is _____ $\times 10^{-2}$ (to the nearest integer).
 Given, $2.303\frac{RT}{F} = 0.06\text{V}$; $E_{\text{AgCl}|\text{AgCl}^-}^0 = 0.22\text{V}$
[JEE (Main)-2020]
41. An acidic solution of dichromate is electrolyzed for 8 minutes using 2 A current. As per the following equation
 $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$
 The amount of Cr^{3+} obtained was 0.104 g. The efficiency of the process (in%) is (Take : $F = 96000\text{C}$, At. mass of chromium = 52) _____.
[JEE (Main)-2020]
42. An oxidation-reduction reaction in which 3 electrons are transferred has a ΔG^0 of 17.37kJ mol^{-1} at 25°C . The value of E_{cell}^0 (in V) is _____ $\times 10^{-2}$.
 (1 $F = 96,500\text{C mol}^{-1}$)
[JEE (Main)-2020]
43. Potassium chlorate is prepared by the electrolysis of KCl in basic solution
 $6\text{OH}^- + \text{Cl}^- \rightarrow \text{ClO}_3^- + 3\text{H}_2\text{O} + 6\text{e}^-$
 If only 60% of the current is utilized in the reaction, the time (rounded to the nearest hour) required to produce 10 g of KClO_3 using a current of 2 A is _____.
 (Given : $F = 96,500\text{C mol}^{-1}$; molar mass of $\text{KClO}_3 = 122\text{g mol}^{-1}$)
[JEE (Main)-2020]
44. The magnitude of the change in oxidising power of the $\text{MnO}_4^-/\text{Mn}^{2+}$ couple is $x \times 10^{-4}\text{V}$, if the H^+ concentration is decreased from 1 M to 10^{-4}M at 25°C . (Assume concentration of MnO_4^- and Mn^{2+} to be same on change in H^+ concentration). The value of x is _____. (Rounded off to the nearest integer)
 [Given; $\frac{2.303RT}{F} = 0.059$]
[JEE (Main)-2021]
45. Copper reduces NO_3^- into NO and NO_2 depending upon the concentration of HNO_3 in solution. (Assuming fixed $[\text{Cu}^{2+}]$ and $P_{\text{NO}} = P_{\text{NO}_2} = 1\text{bar}$), the HNO_3 concentration at which the thermodynamic tendency for reduction of NO_3^- into NO and NO_2 by copper is same is 10^xM . The value of $2x$ is _____. (Rounded-off to the nearest integer)
 [Given, $E_{\text{Cu}^{2+}|\text{Cu}}^0 = 0.34\text{V}$, $E_{\text{NO}_3^-|\text{NO}}^0 = 0.96\text{V}$, $E_{\text{NO}_3^-|\text{NO}_2}^0$
 $= 0.79\text{V}$ and at 298 K, $\frac{RT}{F}(2.303) = 0.059$]
[JEE (Main)-2021]

46. Consider the following reaction
 $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$, $E^\circ = 1.51 \text{ V}$.
 The quantity of electricity required in Faraday to reduce five moles of MnO_4^- is _____.
 (Integer answer) **[JEE (Main)-2021]**
47. Emf of the following cell at 298 K in V is $x \times 10^{-2}$.
 $\text{Zn}|\text{Zn}^{2+} (0.1 \text{ M})||\text{Ag}^+ (0.01 \text{ M})|\text{Ag}$
 The value of x is _____. (Rounded off to the nearest integer)
 [Given : $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$;
 $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$; $\frac{2.303RT}{F} = 0.059$]
[JEE (Main)-2021]
48. A 5.0 mol dm^{-3} aqueous solution of KCl has a conductance of 0.55 mS when measured in a cell of cell constant 1.3 cm^{-1} . The molar conductivity of this solution is _____ $\text{mS m}^2 \text{ mol}^{-1}$.
 (Round off to the Nearest Integer).
[JEE (Main)-2021]
49. A KCl solution of conductivity 0.14 S m^{-1} shows a resistance of 4.19Ω in a conductivity cell. If the same cell is filled with an HCl solution, the resistance drops of 1.03Ω . The conductivity of the HCl solution is _____ $\times 10^{-2} \text{ S m}^{-1}$. (Round off to the Nearest Integer).
[JEE (Main)-2021]
50. For the reaction
 $2\text{Fe}^{3+}(\text{aq}) + 2\text{I}^-(\text{aq}) \rightarrow 2\text{Fe}^{2+}(\text{aq}) + \text{I}_2(\text{s})$
 the magnitude of the standard molar free energy change, $\Delta_r G_m^\circ = -$ _____ kJ
 (Round off to the Nearest Integer).

$$\left[\begin{array}{l} E^\circ_{\text{Fe}^{2+}/\text{Fe}(\text{s})} = -0.440 \text{ V}; E^\circ_{\text{Fe}^{3+}/\text{Fe}(\text{s})} = -0.036 \text{ V} \\ E^\circ_{\text{I}_2/2\text{I}^-} = 0.539 \text{ V}; F = 96500 \text{ C} \end{array} \right]$$

[JEE (Main)-2021]
51. The molar conductivities at infinite dilution of barium chloride, sulphuric acid and hydrochloric acid are 280, 860 and $426 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. The molar conductivity at infinite dilution of barium sulphate is _____ $\text{S cm}^2 \text{ mol}^{-1}$. (Round off to the Nearest Integer).
[JEE (Main)-2021]
52. Potassium chlorate is prepared by electrolysis of KCl in basic solution as shown by following equation.
 $6\text{OH}^- + \text{Cl}^- \longrightarrow \text{ClO}_3^- + 3\text{H}_2\text{O} + 6\text{e}^-$
 A current of xA has to be passed for 10 h to produce 10.0 g of potassium chlorate. The value of x is _____. (Nearest integer)
 (Molar mass of $\text{KClO}_3 = 122.6 \text{ g mol}^{-1}$, $F = 96500 \text{ C}$)
[JEE (Main)-2021]
53. Assume a cell with the following reaction
 $\text{Cu}_{(\text{s})} + 2\text{Ag}^+ (1 \times 10^{-3} \text{ M}) \rightarrow \text{Cu}^{2+} (0.250 \text{ M}) + 2\text{Ag}_{(\text{s})}$
 $E^\circ_{\text{cell}} = 2.97 \text{ V}$
 E_{cell} for the above reaction is _____ V. (Nearest integer)
 [Given : $\log 2.5 = 0.3979$, $T = 298 \text{ K}$]
[JEE (Main)-2021]
54. Consider the cell at 25°C
 $\text{Zn}|\text{Zn}^{2+}(\text{aq}), (1 \text{ M})||\text{Fe}^{3+}(\text{aq}), \text{Fe}^{2+}(\text{aq})|\text{Pt}(\text{s})$
 The fraction of total iron present as Fe^{3+} ion at the cell potential of 1.500 V is $x \times 10^{-2}$. The value of x is _____. (Nearest integer)
 (Given : $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.77 \text{ V}$, $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$)
[JEE (Main)-2021]
55. The conductivity of a weak acid HA of concentration 0.001 mol L^{-1} is $2.0 \times 10^{-5} \text{ S cm}^{-1}$.
 If $\Lambda_m^\circ(\text{HA}) = 190 \text{ S cm}^2 \text{ mol}^{-1}$, the ionization constant (K_a) of HA is equal to _____ $\times 10^{-6}$.
 (Round off to the Nearest Integer)
[JEE (Main)-2021]
56. For the cell $\text{Cu}(\text{s})|\text{Cu}^{2+}(\text{aq}) (0.1 \text{ M})||\text{Ag}^+(\text{aq}) (0.01 \text{ M})|\text{Ag}(\text{s})$ the cell potential $E_1 = 0.3095 \text{ V}$
 For the cell $\text{Cu}(\text{s})|\text{Cu}^{2+}(\text{aq}) (0.01 \text{ M})||\text{Ag}^+(\text{aq}) (0.001 \text{ M})|\text{Ag}(\text{s})$ the cell potential = _____ $\times 10^{-2} \text{ V}$.
 (Round off to the Nearest Integer).
 [Use : $\frac{2.303 RT}{F} = 0.059$] **[JEE (Main)-2021]**
57. Given below are two statements :
- Statement I :** The limiting molar conductivity of KCl (strong electrolyte) is higher compared to that of CH_3COOH (weak electrolyte).
- Statement II :** Molar conductivity decreases with decrease in concentration of electrolyte.

In the light of the above statements, choose the most appropriate answer from the options given below :

- (1) Statement I is true but Statement II is false
- (2) Both Statement I and Statement II are false
- (3) Both Statement I and Statement II are true
- (4) Statement I is false but Statement II is true

[JEE (Main)-2021]

58. For the galvanic cell,



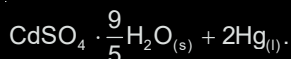
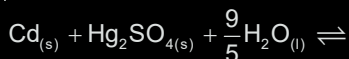
$$E_{\text{cell}} = \text{_____} \times 10^{-2} \text{ V. (Nearest integer)}$$

[Use : $E_{\text{Cu/Cu}^{2+}}^{\circ} = -0.34 \text{ V}$, $E_{\text{Zn/Zn}^{2+}}^{\circ} = +0.76 \text{ V}$,

$$\frac{2.303 RT}{F} = 0.059 \text{ V}] \quad \text{[JEE (Main)-2021]}$$

59. The resistance of a conductivity cell with cell constant 1.14 cm^{-1} , containing 0.001 M KCl at 298 K is 1500Ω . The molar conductivity of 0.001 M KCl solution at 298 K in $\text{S cm}^2 \text{ mol}^{-1}$ is _____. (Integer answer) [JEE (Main)-2021]

60. Consider the following cell reaction



The value of E_{cell}° is 4.315 V at 25°C . If $\Delta H^{\circ} = -825.2 \text{ kJ mol}^{-1}$, the standard entropy change ΔS° in J K^{-1} is _____. (Nearest integer)

[Given : Faraday constant = 96487 C mol^{-1}]

[JEE (Main)-2021]

61. Match List-I with List-II.

List-I (Parameter)	List-II (Unit)
(a) Cell constant	(i) $\text{S cm}^2 \text{ mol}^{-1}$
(b) Molar conductivity	(ii) Dimensionless
(c) Conductivity	(iii) m^{-1}
(d) Degree of dissociation of electrolyte	(iv) $\Omega^{-1} \text{ m}^{-1}$

Choose the most appropriate answer from the options given below [JEE (Main)-2021]

(1) (a)-(iii), b(i), (c)-(ii), (d)-(iv)

(2) (a)-(i), b(iv), (c)-(iii), (d)-(ii)

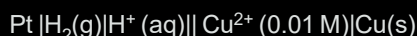
(3) (a)-(ii), b(i), (c)-(iii), (d)-(iv)

(4) (a)-(iii), b(i), (c)-(iv), (d)-(ii)

62. If the conductivity of mercury at 0°C is $1.07 \times 10^6 \text{ S m}^{-1}$ and the resistance of a cell containing mercury is 0.243Ω , then the cell constant of the cell is $x \times 10^4 \text{ m}^{-1}$. The value of x is _____. (Nearest integer)

[JEE (Main)-2021]

63. The cell potential for the following cell



is 0.576 V at 298 K . The pH of the solution is _____. (Nearest integer)

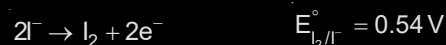
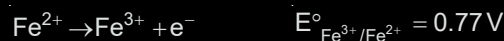
$$\text{(Given: } E_{\text{Cu}^{2+}/\text{Cu}}^{\circ} = 0.34 \text{ V and } \frac{2.303 RT}{F} = 0.06 \text{ V)}$$

[JEE (Main)-2022]

64. The resistance of a conductivity cell containing 0.01 M KCl solution at 298 K is 1750Ω . If the conductivity of 0.01 M KCl solution at 298 K is $0.152 \times 10^{-3} \text{ S cm}^{-1}$, then the cell constant of the conductivity cell is _____ $\times 10^{-3} \text{ cm}^{-1}$.

[JEE (Main)-2022]

65. In a cell, the following reactions take place



The standard electrode potential for the spontaneous reaction in the cell is $x \times 10^{-2} \text{ V}$ at 208 K . The value of x is _____. (Nearest Integer)

[JEE (Main)-2022]

66. The correct order of reduction potentials of the following pairs is

[JEE (Main)-2022]

- | | |
|-------------------------------|-----------------------------|
| (A) Cl_2/Cl^- | (B) I_2/I^- |
| (C) Ag^+/Ag | (D) Na^+/Na |
| (E) Li^+/Li | |

Choose the correct answer from the options given below:

- (1) $A > C > B > D > E$
- (2) $A > B > C > D > E$
- (3) $A > C > B > E > D$
- (4) $A > B > C > E > D$

67. A solution of $\text{Fe}_2(\text{SO}_4)_3$ is electrolyzed for 'x' min with a current of 1.5 A to deposit 0.3482 g of Fe. The value of x is _____. [nearest integer]

Given : 1 F = 96500 C mol⁻¹

Atomic mass of Fe = 56 g mol⁻¹

[JEE (Main)-2022]

68. The $\left(\frac{\partial E}{\partial T}\right)_P$ of different types of half cells are as follows:

A	B	C	D
1×10^{-4}	2×10^{-4}	0.1×10^{-4}	0.2×10^{-4}

(Where E is the electromotive force)

Which of the above half cells would be preferred to be used as reference electrode?

[JEE (Main)-2022]

- (1) A (2) B
(3) C (4) D

69. $\text{Cu(s)} + \text{Sn}^{2+}(0.001\text{M}) \rightarrow \text{Cu}^{2+}(0.01\text{M}) + \text{Sn(s)}$

The Gibbs free energy change for the above reaction at 298 K is $x \times 10^{-1} \text{ kJ mol}^{-1}$. The value of x is _____. [nearest integer]

[Given $E^\ominus_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$; $E^\ominus_{\text{Sn}^{2+}/\text{Sn}} = -0.14 \text{ V}$;

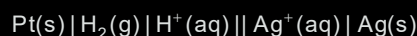
$F = 96500 \text{ C mol}^{-1}$]

[JEE (Main)-2022]

70. The limiting molar conductivities of NaI, NaNO_3 and AgNO_3 are 12.7, 12.0 and 13.3 $\text{mS m}^2 \text{ mol}^{-1}$, respectively (all at 25°C). The limiting molar conductivity of AgI at this temperature is ____ $\text{mS m}^2 \text{ mol}^{-1}$.

[JEE (Main)-2022]

71. For the reaction taking place in the cell:



$E^\ominus_{\text{cell}} = +0.5332 \text{ V}$.

The value of $\Delta_r G^\ominus$ is ____ kJ mol^{-1} [in nearest integer]

[JEE (Main)-2022]

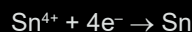
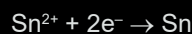
72. The solubility product of a sparingly soluble salt A_2X_3 is 1.1×10^{-23} . If specific conductance of the solution is $3 \times 10^{-5} \text{ S m}^{-1}$, the limiting molar conductivity of the solution is $x \times 10^{-3} \text{ S m}^2 \text{ mol}^{-1}$. The value of x is _____.

[JEE (Main)-2022]

73. The quantity of electricity of Faraday needed to reduce 1 mol of $\text{Cr}_2\text{O}_7^{2-}$ to Cr^{3+} is _____.

[JEE (Main)-2022]

74. For the given reactions



the electrode potentials are; $E^\ominus_{\text{Sn}^{2+}/\text{Sn}} = -0.140 \text{ V}$

and $E^\ominus_{\text{Sn}^{4+}/\text{Sn}} = 0.010 \text{ V}$. The magnitude of standard electrode potential for $\text{Sn}^{4+} / \text{Sn}^{2+}$ i.e. $E^\ominus_{\text{Sn}^{4+}/\text{Sn}^{2+}}$ is _____ $\times 10^{-2} \text{ V}$. (Nearest integer)

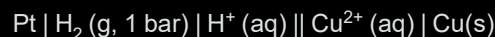
[JEE (Main)-2022]

75. A dilute solution of sulphuric acid is electrolysed using a current of 0.10 A for 2 hours to produce hydrogen and oxygen gas. The total volume of gases produced at STP is ____ cm^3 . (Nearest integer)

[Given : Faraday constant $F = 96500 \text{ C mol}^{-1}$ at STP, molar volume of an ideal gas is 22.7 L mol^{-1}]

[JEE (Main)-2022]

76. The cell potential for the given cell at 298 K



is 0.31 V. The pH of the acidic solution is found to be 3, whereas the concentration of Cu^{2+} is 10^{-x} M . The value of x is _____.

(Given: $E^\ominus_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$ and $\frac{2.303 RT}{F} = 0.06 \text{ V}$)

77. The cell potential for $\text{Zn} | \text{Zn}^{2+}(\text{aq}) || \text{Sn}^{x+} | \text{Sn}$ is 0.801 V at 298 K. The reaction quotient for the above reaction is 10^{-2} . The number of electrons involved in the given electrochemical cell reaction is _____.

(Given : $E^\ominus_{\text{Zn}^{2+}/\text{Zn}} = -0.763 \text{ V}$, $E^\ominus_{\text{Sn}^{x+}/\text{Sn}} = +0.008 \text{ V}$
and $\frac{2.303 RT}{F} = 0.06 \text{ V}$)

[JEE (Main)-2022]

78. The molar conductivity of a conductivity cell filled with 10 moles of 20 mL NaCl solution is Λ_{m_1} and that of 20 moles another identical cell having 80 mL NaCl solution is Λ_{m_2} . The conductivities exhibited by these two cells are same. The relationship between Λ_{m_2} and Λ_{m_1} is

[JEE (Main)-2022]

- (1) $\Lambda_{m_2} = 2 \Lambda_{m_1}$ (2) $\Lambda_{m_2} = \Lambda_{m_1} / 2$
 (3) $\Lambda_{m_2} = \Lambda_{m_1}$ (4) $\Lambda_{m_2} = 4 \Lambda_{m_1}$

79. The amount of charge in F (Faraday) required to obtain one mole of iron from Fe_3O_4 is _____. (Nearest integer)

[JEE (Main)-2022]

80. Match List-I with List-II :

List-I

List-II

- | | |
|---|---------------------------------------|
| (A) $\text{Cd(s)} + 2\text{Ni(OH)}_3\text{(s)} \rightarrow \text{CdO(s)} + 2\text{Ni(OH)}_2\text{(s)} + \text{H}_2\text{O(l)}$ | (I) Primary battery |
| (B) $\text{Zn(Hg)} + \text{HgO(s)} \rightarrow \text{ZnO(s)} + \text{Hg(l)}$ | (II) Discharging of secondary battery |
| (C) $2\text{PbSO}_4\text{(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Pb(s)} + \text{PbO}_2\text{(s)} + 2\text{H}_2\text{SO}_4\text{(aq)}$ | (III) Fuel cell |
| (D) $2\text{H}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{H}_2\text{O(l)}$ | (IV) Charging of secondary battery |

Choose the **correct** answer from the options given below:

[JEE (Main)-2022]

- (1) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
 (2) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

(3) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

(4) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

81. Which of the following has least tendency to liberate H_2 from mineral acids?

[JEE (Main)-2022]

- (1) Cu (2) Mn
 (3) Ni (4) Zn

82. Resistance of a conductivity cell (cell constant 129 m^{-1}) filled with 74.5 ppm solution of KCl is 100Ω (labelled as solution 1). When the same cell is filled with KCl solution of 149 ppm, the resistance is 50Ω (labelled as solution 2). The ratio of molar conductivity

of solution 1 and solution 2 is $\frac{\Lambda_1}{\Lambda_2} = x \times 10^{-3}$. The

value of x is _____. (Nearest integer)

(Given : molar mass of KCl is 74.5 g mol^{-1}).

[JEE (Main)-2022]

83. For a cell, $\text{Cu(s)} | \text{Cu}^{2+} (0.001\text{M}) || \text{Ag}^+ (0.01\text{M}) | \text{Ag(s)}$ the cell potential is found to be 0.43 V at 298 K . The magnitude of standard electrode potential for Cu^{2+}/Cu is _____ $\times 10^{-2} \text{ V}$.

$$\left[\text{Given : } E_{\text{Ag}^+/\text{Ag}}^\ominus = 0.80 \text{ V and } \frac{2.303RT}{F} = 0.06 \text{ V} \right]$$

[JEE (Main)-2022]

84. Given below are two statements :

Statement-I : For KI, molar conductivity increases steeply with dilution.

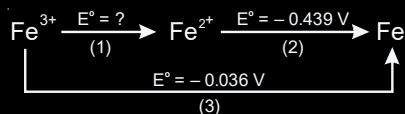
Statement-II : For carbonic acid, molar conductivity increases slowly with dilution. In the light of the above statements, choose the **correct** answer from the options given below :

[JEE (Main)-2022]

- (1) Both **Statement I** and **Statement II** are true
 (2) Both **Statement I** and **Statement II** are false
 (3) **Statement I** is true but **Statement II** is false
 (4) **Statement I** is false but **Statement II** is true

Electrochemistry

1. Answer (2)



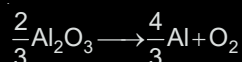
$$\Delta G_1^\circ + \Delta G_2^\circ = \Delta G_3^\circ$$

$$\Rightarrow -n_1 E_1^\circ - n_2 E_2^\circ = -n_3 E_3^\circ$$

$$\Rightarrow -E^\circ + 2 \times 0.439 = +3 \times 0.036$$

$$\Rightarrow E^\circ = +0.77 \text{ V}$$

2. Answer (4)



$$\Delta G = 966 \text{ kJ/mol}$$

$$\Rightarrow 4e^- \text{ are involved}$$

$$\therefore \Delta G = -nFE$$

$$966 \times 10^3 = -4 \times 96500 \times E$$

$$E = -\frac{966}{4 \times 965} \text{ V} = -2.5 \text{ V}$$

$\therefore 2.5 \text{ V}$ potential difference is required

3. Answer (3)

Case-I

$$G = \frac{1}{R} = \frac{1}{50} \text{ S} \quad (\text{S} = \text{Siemen})$$

$$K = G \times \text{cell constant}$$

$$\text{Cell constant} = \frac{K}{G} = \frac{1.3 \text{ S m}^{-1}}{1 \text{ S}} \times 50 = 65 \text{ m}^{-1}$$

Case-II

$$\lambda_M = \frac{K}{\text{Molarity}}$$

$$\lambda_M = \frac{G \times \text{cell constant}}{\text{Molarity}}$$

$$= \frac{1}{260} \frac{\text{S} \times 65 \text{ m}^{-1}}{0.4 \text{ mol litre}^{-1}} \quad 1 \text{ l} = 10^{-3} \text{ m}^3$$

$$\begin{aligned} &= \frac{1}{260} \frac{\text{S} \times 65 \text{ m}^{-1}}{0.4 \text{ mol} \times 1000 \text{ m}^3} \\ &= 6.25 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1} \end{aligned}$$

4. Answer (3)

5. Answer (4)

Of the given values of standard reduction potential, the value of $E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}}$ is highest. Therefore, MnO_4^- is the strongest reducing agent.

6. Answer (1)

For 0.2 M solution

$$R = 50 \Omega$$

$$\sigma = 1.4 \text{ S m}^{-1} = 1.4 \times 10^{-2} \text{ S cm}^{-1}$$

$$\Rightarrow \rho = \frac{1}{\sigma} = \frac{1}{1.4 \times 10^{-2}} \Omega \text{ cm}$$

$$\text{Now, } R = \rho \frac{l}{a}$$

$$\Rightarrow \frac{l}{a} = \frac{R}{\rho} = 50 \times 1.4 \times 10^{-2}$$

For 0.5 M solution

$$R = 280 \Omega$$

$$\sigma = ?$$

$$\frac{l}{a} = 50 \times 1.4 \times 10^{-2}$$

$$\Rightarrow R = \rho \frac{l}{a}$$

$$\Rightarrow \frac{1}{\rho} = \frac{1}{R} \times \frac{l}{a}$$

$$\Rightarrow \sigma = \frac{1}{280} \times 50 \times 1.4 \times 10^{-2}$$

$$\begin{aligned} &= \frac{1}{280} \times 70 \times 10^{-2} \\ &= 2.5 \times 10^{-3} \text{ S cm}^{-1} \end{aligned}$$

$$\begin{aligned}\text{Now, } \lambda_m &= \frac{\sigma \times 1000}{M} \\ &= \frac{2.5 \times 10^{-3} \times 1000}{0.5} \\ &= 5 \text{ S cm}^2 \text{ mol}^{-1} \\ &= 5 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}\end{aligned}$$

7. Answer (3)

According to Debye-Huckel-Onsager equation,

$$\lambda_C = \lambda_{\infty} - A\sqrt{C}$$

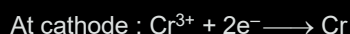
Here A = B

$$\therefore \lambda_C = \lambda_{\infty} - B\sqrt{C}$$

8. Answer (2)

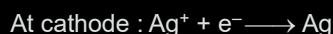
On electrolysis only in case of Ca^{2+} salt aqueous solution H_2 gas discharge at Cathode.

Case of Cr



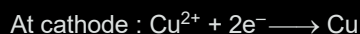
So, Cr is deposited.

Case of Ag

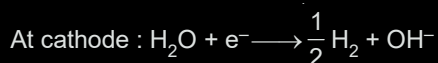


So, Ag is deposited.

Case of Cu



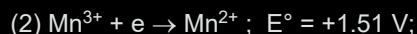
Case of Ca^{2+}



9. Answer (1)

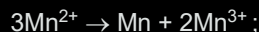


$$\Delta G_1^\circ = -2F(-1.18) = 2.36F$$



$$\Delta G_2^\circ = -F(1.51) = -1.51F$$

(1) – 2 × (2)



$$\begin{aligned}\Delta G_3^\circ &= \Delta G_1^\circ - 2\Delta G_2^\circ \\ &= [2.36 - 2(-1.51)] F \\ &= (2.36 + 3.02) F \\ &= 5.38 F\end{aligned}$$

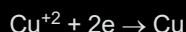
$$\text{But } \Delta G_3^\circ = -2FE^\circ$$

$$\Rightarrow 5.38F = -2FE^\circ$$

$$\Rightarrow E^\circ = -2.69\text{V}$$

As E° value is negative reaction is non spontaneous.

10. Answer (2)



So, 2 F charge deposit 1 mol of Cu. Mass deposited = 63.5 g.

11. Answer (3)

Galvanisation is coating a layer of Zn.

12. Answer (3)

$$\text{For } \text{Cr}^{3+}, E_{\text{Cr}^{3+}/\text{Cr}_2\text{O}_7^{2-}}^\circ = -1.33\text{V}$$

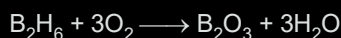
$$\text{For } \text{Cl}^-, E_{\text{Cl}^-/\text{Cl}_2}^\circ = -1.36\text{V}$$

$$\text{For Cr}, E_{\text{Cr}/\text{Cr}^{3+}}^\circ = 0.74\text{V}$$

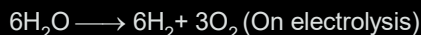
$$\text{For } \text{Mn}^{2+}, E_{\text{Mn}^{2+}/\text{MnO}_4^-}^\circ = -1.51\text{V}$$

Positive E° is for Cr, hence it is strongest reducing agent.

13. Answer (3)



27.66 g of B_2H_6 = 1 mole of B_2H_6 which requires three moles of oxygen (O_2) for complete burning



Number of faradays = 12 = Amount of charge

$$12 \times 96500 = i \times t$$

$$12 \times 96500 = 100 \times t$$

$$t = \frac{12 \times 96500}{100} \text{ second}$$

$$t = \frac{12 \times 96500}{100 \times 3600} \text{ hour}$$

$$t = 3.2 \text{ hours}$$

14. Answer (1)



$$w = Z \times I \times t$$

$$= \frac{303}{2 \times F} \times 0.05F$$

$$= 7.575$$

$$\approx 7.6\text{g}$$

15. Answer (2)

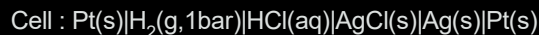
$$\ln K = \frac{nFE^\circ_{\text{Cell}}}{RT}$$

$$\ln K = \frac{2 \times 96000 \times 2}{8 \times 300}$$

$$= 160$$

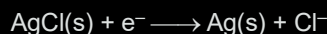
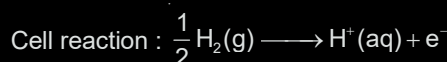
$$K = e^{160}$$

16. Answer (1)

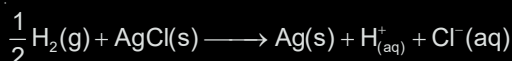


$$E_{\text{cell}} = 0.92 \text{ V}$$

$$= E^\circ_{\text{H}_2(\text{g})|\text{H}^+(\text{aq})} + E^\circ_{\text{AgCl(s)}|\text{Ag(s),Cl}^-} - \frac{0.06}{n} \log Q$$



Net cell reaction:



$$\therefore Q = \frac{[\text{H}^+][\text{Cl}^-]}{(P_{\text{H}_2})^{\frac{1}{2}}}$$

10⁻⁶ molal HCl solution is taken

Assuming molality is same as molarity

$$Q = \frac{10^{-6} \times 10^{-6}}{1} = 10^{-12}$$

$$\therefore 0.92 = E^\circ_{\text{AgCl(s)}|\text{Ag(s),Cl}^-} - \frac{0.06}{1} \log 10^{-12}$$

$$\therefore E^\circ_{\text{AgCl(s)}|\text{Ag(s),Cl}^-} = 0.92 + [0.06 \times (-12)]$$

$$= 0.92 - 0.72$$

$$= 0.20 \text{ V}$$

17. Answer (4)

$$E_{\text{cell}} = (E^\circ_{\text{R.P}})_{\text{Cathode}} - (E^\circ_{\text{R.P}})_{\text{Anode}}$$

All electrodes act as cathode w.r.t. Zn so the ion which has highest reduction potential will give maximum value of E°_{cell} so Au^{3+}/Au produce highest E°_{cell} .

18. Answer (2)

$$E^\circ_{\text{cell}} = \frac{0.059}{n} \log K_C$$

$$= \frac{0.059}{2} \log 10^{16}$$

$$= 0.472 \text{ V}$$

19. Answer (3)

$$\Delta_r H^\circ = -nFE^\circ + nFT \frac{dE^\circ}{dT}$$

Cell reaction :



$$\therefore \Delta_r H^\circ = -2 \times 96000 (2 + 300 \times 5 \times 10^{-4})$$

$$= -2 \times 96000 (2 + 0.15)$$

$$= -412.8 \times 10^3 \text{ J/mol}$$

$$\Delta_r H^\circ = -412.8 \text{ kJ/mol}$$

20. Answer (2)

$$\Lambda^\circ_m(\text{NaCl}) = 126.4 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Lambda^\circ_m(\text{HCl}) = 425.9 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Lambda^\circ_m(\text{NaA}) = 100.5 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Lambda^\circ_m(\text{HA}) = 425.9 - 126.4 + 100.5 = 400 \text{ S cm}^2 \text{ mol}^{-1}$$

$$K(\text{HA}) = 5 \times 10^{-5} \text{ S cm}^{-1}$$

$$\Lambda^c_m = \frac{K \times 1000}{\text{Molarity}} = \frac{5 \times 10^{-5} \times 1000}{0.001} = 50$$

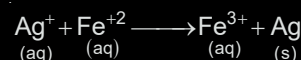
$$\alpha = \frac{\Lambda^c_m}{\Lambda^\circ_m} = \frac{50}{400} = 0.125$$

21. Answer (3)

More positive is the reduction potential stronger is the oxidising agent.

Reduction potential is maximum for $\text{S}_2\text{O}_8^{2-}$.

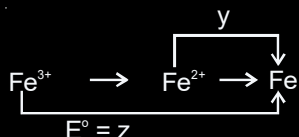
22. Answer (3)



$$E^\circ_{\text{cell}} = E^\circ_{\text{Ag}^+/\text{Ag}} - E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}}$$

To calculate

$$E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}}$$



$$E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 3z - 2y$$

$$E^\circ_{\text{Ag}^+/\text{Ag}} = x$$

$$E^\circ_{\text{cell}} = x - 3z + 2y$$

23. Answer (3)

$$\begin{aligned}
 \Delta G^\circ &= -nFE^\circ_{\text{cell}} \\
 &= -2 \times (96000) \times 2 \text{ V} \\
 &= -384 \text{ kJ/mole}
 \end{aligned}$$

24. Answer (4)

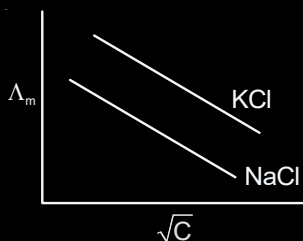
0.1 F of electricity is passed through $\text{Ni}(\text{NO}_3)_2$ solution.

\therefore Amount of Ni deposited = 0.1 eq

$$\therefore \text{Moles} = \frac{0.1}{2} = 0.05$$

25. Answer (3)

KCl is more conducting than NaCl.

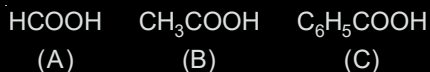


26. Answer (4)

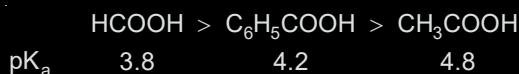
Greater the reduction potential, greater is the oxidising power.

So, $\text{Co}^{3+} > \text{Pb}^{4+} > \text{Ce}^{4+} > \text{Bi}^{3+}$

27. Answer (2)

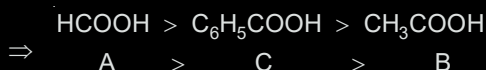


Order of acidic strength



More the acidic strength more will be the dissociation of acid into ions and more will be conductivity.

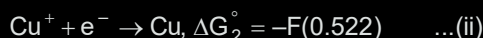
\therefore Order of conductivity:



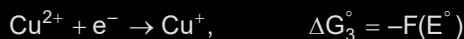
28. Answer (1)

Conductivity of an electrolyte is the conductance of 1 cm³ of the given electrolyte. So, it increases with the increase of concentration of electrolyte. Molar conductivity (λ_m) is the conductance of a solution containing 1 mole of the electrolyte. It increases with the decrease of concentration (i) due to increase in interionic attraction for strong electrolytes and (ii) due to decrease in degree of ionisation for weak electrolytes. Therefore, (S₁) is wrong and (S₂) is correct.

29. Answer (1)



Subtract (ii) from (i)



$$\therefore \Delta G_1^\circ - \Delta G_2^\circ = \Delta G_3^\circ$$

$$\Rightarrow -FE^\circ = -2F(0.34) + F(0.522)$$

$$\Rightarrow E^\circ = 0.68 - 0.522 = 0.158 \text{ V}$$

30. Answer (3)

$$\Lambda_m^\circ \text{NaBr} - \Lambda_m^\circ \text{NaI} = \Lambda_m^\circ (\text{Br}^-) - \Lambda_m^\circ (\text{I}^-) \dots(1)$$

$$\Lambda_m^\circ (\text{KBr}) - \Lambda_m^\circ (\text{NaBr}) = \Lambda_m^\circ (\text{K}^+) - \Lambda_m^\circ (\text{Na}^+) \dots(2)$$

(1) and (2) are not equal.

31. Answer (4)

$$E^\circ_{\text{cell}} = E^\circ_{\text{Cu}^{2+}/\text{Cu}} - E^\circ_{\text{Zn}^{2+}/\text{Zn}}$$

$$= 0.34 - (-0.76)$$

$$= 1.10 \text{ V}$$

if $E_{\text{ext}} < 1.1 \text{ V}$ then Zn dissolves at anode and copper deposits

if $E_{\text{ext}} > 1.1 \text{ V}$ then Zn deposited at zinc electrodes and copper dissolves

32. Answer (3)

$$\text{Millimoles of Au}^+ = 0.1 \times 250 = 25$$

$$\text{Mole of Au}^+ = \frac{25}{1000} = \frac{1}{40}$$

$$\text{Charge passed} = I \times t = 1 \times 15 \times 60 = 900 \text{ C}$$

$$\text{moles of e}^- \text{ passed} = \frac{900}{96500} = \frac{9}{965}$$

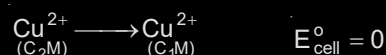
Only gold will be deposited as quantity of charge passed is less than the amount of Au^+ present.

33. Answer (3)

The electrolyte (X) must be weak electrolyte. So X is CH_3COOH .

34. Answer (1)

For the concentration cell,



$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{RT}{2F} \ln \frac{C_1}{C_2}$$

$$= \frac{RT}{2F} \ln \frac{C_2}{C_1}$$

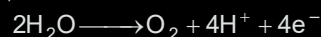
Gibb's energy is negative only when E_{cell} is positive.

$$\text{So, } \boxed{C_2 > C_1}$$

$$C_2 = \sqrt{2} C_1 \text{ is correct.}$$

35. Answer (−0.93)

The given half cell reaction is



$$E_{\text{ox}}^{\circ} = -1.23 \text{ V}$$

$$E_{\text{ox}} = E_{\text{ox}}^{\circ} - \frac{0.0591}{4} \log(\text{Po}_2)[\text{H}^+]^4$$

$$\text{At } \text{PO}_2 = 1 \text{ bar and } [\text{H}^+] = 10^{-5} \text{ M}$$

$$E_{\text{ox}} = -1.23 - \frac{0.0591}{4} \log 10^{-20}$$

$$= -1.23 + 0.2955 = -0.93 \text{ V}$$

36. Answer (2.15)

$$\text{At equilibrium state } E_{\text{cell}} = 0 \quad E_{\text{cell}}^{\circ} = 0.01 \text{ V}$$



$$E = E_{\text{cell}}^{\circ} - \frac{0.06}{n} \log \frac{[\text{P}]}{[\text{R}]}$$

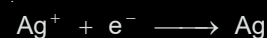
$$0 = 0.01 - \frac{0.06}{2} \log \frac{[\text{Sn}^{+2}]}{[\text{Pb}^{+2}]}$$

$$0.01 = \frac{0.06}{2} \log \frac{[\text{Sn}^{+2}]}{[\text{Pb}^{+2}]}$$

$$\frac{1}{3} = \log \frac{[\text{Sn}^{+2}]}{[\text{Pb}^{+2}]}$$

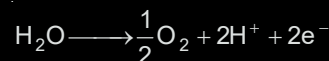
$$\frac{[\text{Sn}^{+2}]}{[\text{Pb}^{+2}]} = 10^{\frac{1}{3}} = 2.1544 \quad 2.15$$

37. Answer (5.68)



$$\text{Moles of Ag deposited} = \frac{108}{108} = 1 \text{ mole}$$

∴ 1 mole e^- or 1 F charge is required to deposit 1 mole of Ag.



$$\therefore 2 \text{ moles of e}^- \text{ liberate } \frac{1}{2} \text{ moles of O}_2$$

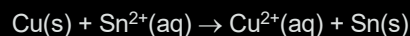
$$\therefore 1 \text{ mole or 1 F charge will liberate } \frac{1}{4} \text{ mole of O}_2$$

$$\therefore \text{Volume of O}_2 \text{ at 1 bar and 273 K} = \frac{1}{4} \times 22.7$$

$$= 5.675 \text{ L}$$

$$= 5.68 \text{ L}$$

38. Answer (96500)



$$E_{\text{cell}}^{\circ} = E_{\text{Sn}^{2+}/\text{Sn}}^{\circ} - E_{\text{Cu}^{2+}/\text{Cu}}^{\circ}$$

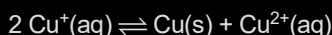
$$= -0.16 - 0.34 = -0.50 \text{ V}$$

$$\Delta G^{\circ} = -nF E_{\text{cell}}^{\circ}$$

$$= -2 \times 96500 (-0.50)$$

$$= 96500 \text{ J}$$

39. Answer (144)



$$E_{\text{Cu}^{2+}/\text{Cu}^+}^0 = 0.16 \text{ V}; E_{\text{Cu}^+/\text{Cu}}^0 = 0.52 \text{ V}$$

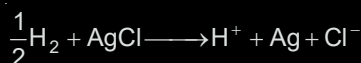
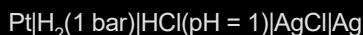
$$E_{\text{cell}}^0 = E_{\text{Cu}^+/\text{Cu}}^0 - E_{\text{Cu}^{2+}/\text{Cu}^+}^0$$

$$= 0.52 - 0.16 = 0.36 \text{ V}$$

$$E_{\text{cell}}^0 = \frac{RT}{nF} \ln K$$

$$\ln K = \frac{0.36}{0.025} = 14.4 = 144 \times 10^{-1}$$

40. Answer (142)



$$E_{\text{cell}} = E_{\text{cell}}^0 - \frac{0.06}{1} \log [\text{H}^+][\text{Cl}^-]$$

$$= 0.22 - 0.06 \log 10^{-2} = 0.34 \text{ V}$$

Work function of Na metal = 2.3 eV

KE of photoelectron = 0.34 eV

Energy of incident radiation = 2.3 + 0.34 = 2.64 eV

Also energy of incident radiation for K metal = 2.64 eV

Work function of K metal = 2.25 eV

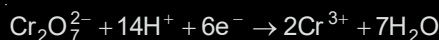
KE of photoelectrons = 2.64 - 2.25 = 0.39 eV

$$\therefore E_{\text{cell}} = 0.39 \text{ V} = 0.22 - 0.06 \log [\text{H}^+]^2$$

$$= 0.22 + 0.12 \times \text{pH}$$

$$\text{pH} \simeq 1.42 = 142 \times 10^{-2}$$

41. Answer (60.00)



I = 2 A, t = 8 min

$$Q = \frac{2 \times 8 \times 60}{96000} F$$

$$\text{Moles of } \text{Cr}_2\text{O}_7^{2-} \text{ ions reduced} = \frac{960}{96000 \times 6} = \frac{1}{600}$$

$$\text{Moles of } \text{Cr}^{3+} \text{ ions obtained} = \frac{1 \times 2}{600}$$

$$\text{Mass of } \text{Cr}^{3+} \text{ ions obtained} = \frac{2 \times 52}{600} = \frac{104}{600}$$

Mass of Cr^{3+} ions actually obtained = 0.104 gm

$$\text{Efficiency} = \frac{6 \times 0.104 \times 100}{104} = 60\%$$

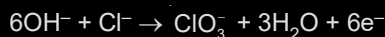
42. Answer (-6.00)

$$\Delta G^\circ = 17.37 \text{ kJ}; n = 3$$

$$\Delta G^\circ = -nFE_{\text{cell}}^0$$

$$E_{\text{cell}}^0 = -\frac{17.37 \times 1000}{3 \times 96500} = -0.06 = -6.00 \times 10^{-2}$$

43. Answer (11)



For synthesis of 1 mole of ClO_3^- , 6F of charge is required

current efficiency = 60%.

\therefore To synthesise 1 mole of ClO_3^- , 10F of charge is required.

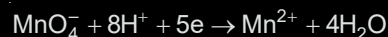
To synthesise $\frac{10}{122}$ moles of KClO_3 ,

$$\text{charge} = \frac{10 \times 10}{122} F$$

$$\therefore \frac{2 \times t(\text{hr}) \times 3600}{96500} = \frac{100}{122}$$

$$t \simeq 11$$

44. Answer (3776)



$$E_{\text{MnO}_4^-/\text{Mn}^{2+}} = E_{\text{MnO}_4^-/\text{Mn}^{2+}}^0 - \frac{0.059}{5} \log \frac{[\text{Mn}^{2+}]}{[\text{MnO}_4^-][\text{H}^+]^8}$$

$$\text{If } [\text{H}^+] = 1 \text{ M } E_{\text{MnO}_4^-/\text{Mn}^{2+}} = E_{\text{MnO}_4^-/\text{Mn}^{2+}}^0$$

$$\text{If } [\text{H}^+] = 10^{-4} \text{ M}$$

$$E_{\text{MnO}_4^-} = E_{\text{MnO}_4^-/\text{Mn}^{2+}}^0 - \frac{0.059}{5} \log 10^{32}$$

$$= E_{\text{MnO}_4^-/\text{Mn}^{2+}}^0 - 0.3776$$

Magnitude of change in oxidising power

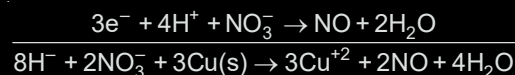
$$= 3776 \times 10^{-4}$$

45. Answer (4)

Anode:



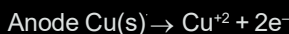
Cathode (1)



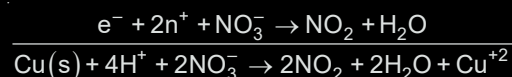
$$Q = \frac{[\text{Cu}^{+2}]^3 \times (\text{p}_{\text{NO}})^2}{[\text{NO}_3^-]^2 [\text{H}^+]^8}$$

$$E_{\text{cell}}^\circ = 1.3$$

$$E_{\text{cell}} = 1.3 - \frac{0.059}{6} \log \frac{(\text{Cu}^{+2})^3 (\text{p}_{\text{NO}})^2}{(\text{NO}_3^-)^2 \times (\text{H}^+)^8} \dots\dots(1)$$



Cathode



$$E_{\text{cell}}^\circ = 1.13$$

$$Q = \frac{(\text{Cu}^{+2})(\text{p}_{\text{NO}_2})^2}{(\text{NO}_3^-)^2 (\text{H}^+)^4}$$

$$E_{\text{cell}} = 1.13 - \frac{0.059}{2} \log \frac{(\text{Cu}^{+2})(\text{p}_{\text{NO}})^2}{(\text{NO}_3^-)^2 \times (\text{H}^+)^4}$$

$$E_{\text{cell}_1} = E_{\text{cell}_2}$$

$$1.3 - \frac{0.059}{6} \log(Q_1) = 1.13 - \frac{0.059}{2} \log(Q_2)$$

$$0.17 = \frac{0.059}{6} \{ \log(Q_1) - 3 \log(Q_2) \}$$

$$= \frac{0.059}{6} \left\{ \log \frac{(\text{Cu}^{+2})^3 \times (\text{p}_{\text{NO}})^2 \times (\text{NO}_3^-)^6 (\text{H}^+)^{12}}{(\text{NO}_3^-)^2 (\text{H}^+)^8 \times (\text{Cu}^{+2})^3 \times (\text{p}_{\text{NO}_2})^6} \right\}$$

$$= \frac{0.059}{6} \left\{ \log \frac{[\text{NO}_3^-]^4 [\text{H}^+]^{-4}}{(\text{p}_{\text{NO}_2})^4} \right\}$$

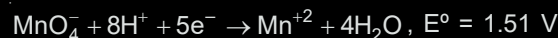
$$0.17 = \frac{0.059}{6} \times 8 \log(\text{HNO}_3)$$

$$\log(\text{HNO}_3) = 2.16$$

$$[\text{HNO}_3] = 10^{2.16} = 10^x$$

$$x = 2.16 \Rightarrow 2x = 4.32 \approx 4$$

46. Answer (25)



\therefore 1 mole of MnO_4^- required 5 moles of electrons or 5 F electricity.

\therefore 5 moles of MnO_4^- required 25 F electricity.

47. Answer (147)



$$Q = \frac{[\text{Zn}^{2+}]}{[\text{Ag}^+]^2} = \frac{(0.1)}{(10^{-2})^2} = 10^3$$

$$\text{emf} = 0.80 + 0.76 - \frac{0.059}{2} \log 10^3$$

$$= 1.47 \text{ volt}$$

$$\text{emf} = 147 \times 10^{-2} \text{ volt}$$

$$x = 147$$

48. Answer (14)

$$\text{Conductance} = \frac{\text{Conductivity}}{\text{Cell constant}}$$

$$\therefore \text{Conductivity} = 0.55 \times 10^{-3} \times 1.3 \text{ S cm}^{-1}$$

Molar conductivity

$$= \frac{\text{Conductivity (S cm}^{-1}) \times 1000}{\text{Molarity (mol/L)}}$$

$$= \frac{0.55 \times 10^{-3} \times 1.3 \times 100}{5 \times 10^{-3}}$$

$$= 143 \text{ S cm}^2 \text{ mol}^{-1}$$

$$= 14.3 \text{ mS m}^2 \text{ mol}^{-1}$$

$$\approx 14 \text{ mS m}^2 \text{ mol}^{-1}$$

49. Answer (57)

For KCl

$$k_1 = 0.14 \text{ Sm}^{-1}$$

$$R_1 = 4.19 \Omega$$

For HCl

$$k_2 = x \text{ Sm}^{-1} \text{ (Let)}$$

$$R_2 = 1.03 \Omega$$

$$R = \rho \left(\frac{l}{a} \right) \Rightarrow kR = \underbrace{\left(\frac{l}{a} \right)}_{\text{Cell constant}}$$

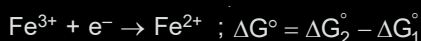
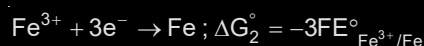
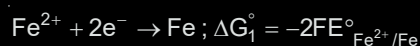
$$k_1 R_1 = k_2 R_2$$

$$0.14 \times 4.19 = 1.03 \times k_2$$

$$k_2 = 0.5695 \text{ Sm}^{-1}$$

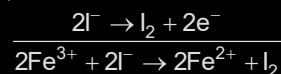
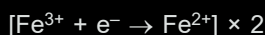
$$\approx 57 \times 10^{-2} \text{ Sm}^{-1}$$

50. Answer (45)



$$\Rightarrow \text{FE}_{\text{Fe}^{3+}/\text{Fe}^{2+}}^\circ = -3\text{FE}_{\text{Fe}^{3+}/\text{Fe}}^\circ + 2\text{FE}_{\text{Fe}^{2+}/\text{Fe}}^\circ$$

$$\begin{aligned} \Rightarrow \text{E}_{\text{Fe}^{3+}/\text{Fe}^{2+}}^\circ &= 3\text{E}_{\text{Fe}^{3+}/\text{Fe}}^\circ - 2\text{E}_{\text{Fe}^{2+}/\text{Fe}}^\circ \\ &= -3 \times 0.036 + 2 \times 0.440 \\ &= 0.772 \text{ V} \end{aligned}$$



$$\begin{aligned} \Delta_r G_m^\circ &= -2F \times 0.772 - 2F(-0.539) \\ &= -2F(0.772 - 0.539) \\ &= 44969 \text{ J} \\ &= 44.969 \text{ kJ} \\ &\approx 45 \text{ kJ} \end{aligned}$$

51. Answer (288)

$$\wedge^\infty (\text{BaCl}_2) = 280 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\wedge^\infty (\text{H}_2\text{SO}_4) = 860 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\wedge^\infty (\text{HCl}) = 426 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\begin{aligned} \wedge^\infty (\text{BaSO}_4) &= \wedge^\infty (\text{BaCl}_2) + \wedge^\infty (\text{H}_2\text{SO}_4) - 2\wedge^\infty (\text{HCl}) \\ &= 280 + 860 - 2 \times 426 \\ &= 288 \text{ S cm}^2 \text{ mol}^{-1} \end{aligned}$$

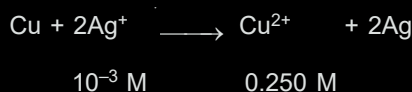
52. Answer (1)

$$\text{Mass of KClO}_3 = 10 \text{ g}$$

$$\Rightarrow \frac{10}{122.6} = \frac{x \times 10 \times 3600}{6 \times 96500}$$

$$\Rightarrow x = 1.311 \approx 1 \text{ (nearest integer)}$$

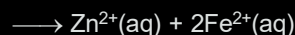
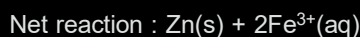
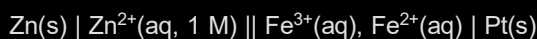
53. Answer (3)



$$\text{E}_{\text{cell}} = \text{E}_{\text{cell}}^\circ - \frac{0.059}{2} \log \frac{[\text{Cu}^{2+}]}{[\text{Ag}^+]^2}$$

$$= 2.97 - \frac{0.059}{2} \log \frac{(0.25)}{(10^{-3})^2} = 2.81 \text{ V}$$

54. Answer (24)



$$Q = \frac{[\text{Zn}^{2+}][\text{Fe}^{2+}]^2}{[\text{Fe}^{3+}]^2}$$

$$\text{E}_{\text{cell}} = \text{E}_{\text{cell}}^\circ - \frac{0.0591}{n} \log Q$$

$$1.500 = 1.53 - \frac{0.0591}{2} \log \left(\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} \right)^2$$

$$\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} = 3.218$$

$$\text{Fraction of Fe}^{3+} = \frac{1}{4.218} = 0.237 = 23.7 \times 10^{-2}$$

$$\approx 24 \times 10^{-2}$$

55. Answer (12)

$$C = 0.001 \text{ mol L}^{-1}$$

$$K = 2 \times 10^{-5} \text{ S cm}^{-1}$$

$$\Lambda_m^\infty (\text{HA}) = 190 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Lambda_m = \frac{K}{C} \times 1000$$

$$= \frac{2 \times 10^{-5} \times 10^3}{0.001}$$

$$\Lambda_m = 20$$

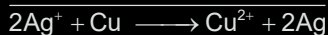
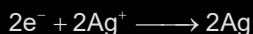
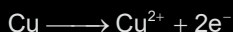
$$\alpha = \frac{\Lambda_m}{\Lambda_m^\infty} = \frac{20}{190}$$

$$K_a = \frac{C\alpha^2}{1-\alpha} = \frac{10^{-3} \left(\frac{20}{190} \right)^2}{1 - \frac{20}{190}}$$

$$= 1.2383 \times 10^{-5}$$

$$= 12.38 \times 10^{-6}$$

56. Answer (28)



$$E_1 = 0.3095 = E^\circ - \frac{RT}{nF} \ln \left(\frac{[\text{Cu}^{2+}]}{[\text{Ag}^+]^2} \right)$$

$$0.3095 = E^\circ - \frac{0.059}{2} \log \left(\frac{0.1}{(0.01)^2} \right)$$

$$E^\circ = 0.3095 + \frac{0.059}{2} \log (10^3)$$

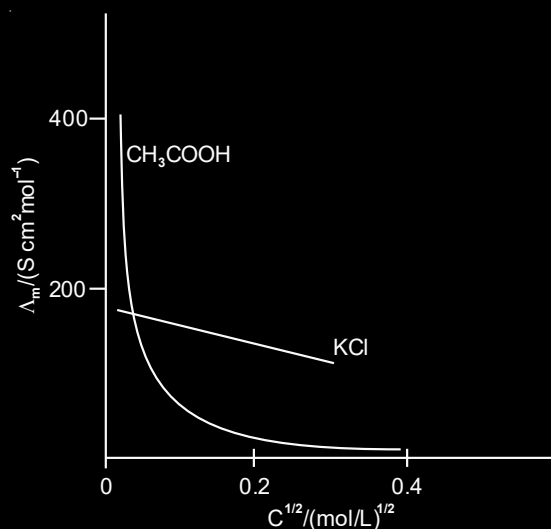
$$= 0.3095 + \frac{0.059}{2} \times 3 = 0.398 \text{ V}$$

For second cell,

$$E = 0.398 - \frac{0.059}{2} \log \left[\frac{0.01}{(0.001)^2} \right]$$

$$= 0.28 \text{ V} = 28 \times 10^{-2} \text{ V}$$

57. Answer (2)



$$\Lambda_m^\infty (\text{CH}_3\text{COOH}) = \Lambda_m^\infty (\text{CH}_3\text{COO}^-) + \Lambda_m^\infty (\text{H}^+)$$

Molar conductivity increases with decrease in concentration. This is because the total volume, V , of solution containing one mole of electrolyte also increases. It has been found that decrease in k on dilution of a solution is more than compensated by increase in its volume.

58. Answer (109)



$$Q = \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} = \frac{0.04}{0.02} = 2$$

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{0.059}{n} \log Q$$

$$E_{\text{cell}} = 1.1 - \frac{0.059}{2} \log 2$$

$$\approx 109 \times 10^{-2} \text{ V}$$

59. Answer (760)

$$\text{Cell constant} = \frac{l}{a} = 1.14 \text{ cm}^{-1}$$

$$C = 0.001 \text{ M}$$

$$T = 298 \text{ K}$$

$$R = 1500 \Omega$$

$$k = \frac{1}{R} \left(\frac{l}{a} \right) = \frac{1}{1500} \times 1.14$$

$$\Lambda_m = \frac{k \times 1000}{C}$$

$$= \frac{1}{1500} \times 1.14 \times 1000$$

$$= 760 \text{ S cm}^2 \text{ mol}^{-1}$$

60. Answer (25)

$$\Delta G = -nFE_{\text{cell}}^{\circ} = \Delta H - T\Delta S$$

$$= \frac{-2 \times 96487 \times 4.315 + 825.2 \times 10^3}{298} = -\Delta S$$

$$= \Delta S \approx 25 \text{ JK}^{-1}$$

61. Answer (4)

Parameter	Unit
Cell constant	m^{-1}
Molar conductivity	$\text{S cm}^2 \text{ mol}^{-1}$
Conductivity	$\Omega^{-1} \text{ m}^{-1}$
Degree of dissociation of electrolyte	Dimensionless

62. Answer (26)

$$\kappa = \frac{1}{R} \times (\text{Cell constant})$$

$$1.07 \times 10^6 \text{ S m}^{-1} = \frac{1}{0.243} \times (\text{Cell constant})$$

$$\text{Cell constant} = 26 \times 10^4$$

63. Answer (5)

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.06}{2} \log \frac{[\text{H}^{\oplus}]^2}{[\text{Cu}^{+2}]}$$

$$0.576 = 0.34 - 0.03 \log \frac{[\text{H}^{\oplus}]^2}{[0.01]}$$

$$0.576 - 0.34 = -0.03 \log [\text{H}^{\oplus}]^2 + 0.03 \log(0.01)$$

$$= 0.06 \text{ pH} - 0.06$$

$$\text{pH} \approx 4.93 \approx 5$$

64. Answer (266)

$$\text{Molarity of KCl solution} = 0.1 \text{ M}$$

$$\text{Resistance} = 1750 \text{ ohm}$$

$$\text{Conductivity} = 0.152 \times 10^{-3} \text{ S cm}^{-1}$$

$$\text{Conductivity} = \frac{\text{Cell constant}}{\text{Resistance}}$$

$$\therefore \text{Cell constant} = 0.152 \times 10^{-3} \times 1750$$

$$= 266 \times 10^{-3} \text{ cm}^{-1}$$

65. Answer (23)

$$E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}$$

$$= 0.77 - 0.54$$

$$= 0.23 \text{ V}$$

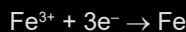
$$= 23 \times 10^{-2} \text{ V}$$

66. Answer (1)

	Standard Reduction Potential
(A) Cl_2/Cl	1.36 V
(B) I_2/I^-	0.54 V
(C) Ag^+/Ag	0.80 V
(D) Na^+/Na	-2.71 V
(E) Li^+/Li	-3.05 V

Hence, correct order is $A > C > B > D > E$

67. Answer (20)



$$\text{Moles of Fe deposited} = \frac{0.3482}{56} = 6.2 \times 10^{-3}$$

For 1 mole Fe, charge required is 3 F

For 6.2×10^{-3} mole Fe, charge required is $3 \times 6.2 \times 10^{-3} \text{ F}$

$$\text{Since, charge required} = 18.6 \times 10^{-3} \times 96500 \text{ C}$$

$$= 1794.9 \text{ C}$$

And,

$$1.5 \times t = 1794.9$$

$$t = \frac{1794.9}{1.5 \times 60} \text{ min}$$

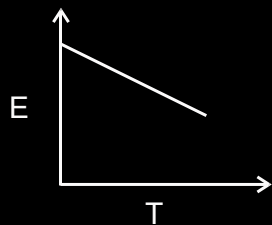
$$t \approx 20 \text{ min}$$

68. Answer (3)

We know that

$$E = E^\circ - \frac{2.303RT}{nF} \log \left[\frac{1}{(\text{oxidized form})} \right]$$

$$\text{Slope} = \frac{-2.303 R}{nF} \log \left[\frac{1}{(\text{oxidized form})} \right]$$



Higher the value of slope $\left(\frac{\partial E}{\partial T} \right)_p$, more the deviation between E and E° . Thus, half cell with least value of $\left(\frac{\partial E}{\partial T} \right)_p$ can be used as reference electrode.

69. Answer (983)



$$\begin{aligned} E_{\text{cell}}^\circ &= E_{\text{OX}}^\circ + E_{\text{Red}}^\circ \\ &= -0.34 - 0.14 \\ &= -0.48 \text{ V} \end{aligned}$$

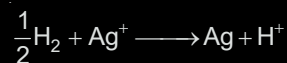
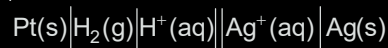
$$\begin{aligned} E &= E^\circ - \frac{0.0591}{2} \log \frac{[\text{Cu}^{+2}]}{[\text{Sn}^{+2}]} \\ &= -0.48 - 0.0295 \log 10 \\ &= -0.5095 \text{ V} \end{aligned}$$

$$\begin{aligned} \Delta G &= -nFE \\ &= -2 \times 96500 \times -0.5095 \text{ J/mol} \\ &= 98333.5 \times 10^{-3} \text{ kJ/mol} \\ &= 983.3 \times 10^{-1} \text{ kJ/mol} \\ &= 983 \times 10^{-1} \text{ kJ/mol} \end{aligned}$$

70. Answer (14)

$$\begin{aligned} \Lambda_m^\circ(\text{AgI}) &= \Lambda_m^\circ(\text{NaI}) + \Lambda_m^\circ(\text{AgNO}_3) - \Lambda_m^\circ(\text{NaNO}_3) \\ &= 12.7 + 13.3 - 12.0 \\ &= 26 - 12 \\ &= 14 \text{ mS m}^2 \text{ mol}^{-1} \end{aligned}$$

71. Answer (51)

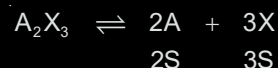


$$n = 1$$

$$E_{\text{cell}}^\circ = 0.5332$$

$$\begin{aligned} \Delta G^\circ &= -nFE^\circ \\ &= -1 \times 96500 \times 0.5332 \\ &= -51.453 \text{ kJ/mole} \\ &\approx -51 \text{ kJ/mole} \end{aligned}$$

72. Answer (3)



$$\begin{aligned} K_{\text{sp}} &= (2s)^2(3s)^3 = 1.1 \times 10^{-23} \\ S &\approx 10^{-5} \end{aligned}$$

For sparingly soluble salts

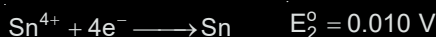
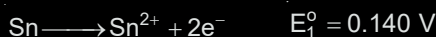
$$\begin{aligned} \Lambda_m &= \Lambda_m^\circ \\ \Lambda_m &= \frac{k}{S \times 10^3} \\ &= \frac{3 \times 10^{-5}}{10^{-5}} \times 10^{-3} \\ &= 3 \times 10^{-3} \text{ Sm}^2 \text{ mol}^{-1} \end{aligned}$$

73. Answer (6)



\therefore Each Cr is converting from +6 to +3
 \therefore 6 faradays of charge is required

74. Answer (16)



$$E_{\text{cell}}^\circ = \frac{n_2 E_2^\circ + n_1 E_1^\circ}{n} = \frac{4(0.010) + 2(0.140)}{2}$$

$$E_{\text{cell}}^\circ = 0.16 \text{ V} = 16 \times 10^{-2} \text{ V}$$

75. Answer (127)

$$2 \text{ F produces} = \frac{3}{2} \text{ mole of gas}$$

0.10 × 2 × 3600 coulomb produces

$$= \frac{\frac{3}{2} \times 0.1 \times 2 \times 3600}{2 \times 96500}$$

$$= 0.0056 \text{ moles of gas}$$

Volume of gas produced = 0.0056 × 22.7 L

$$\approx 0.127 \text{ L}$$

$$= 127 \text{ mL}$$

76. Answer (7)

$$Q = \frac{[\text{H}^+]^2}{[\text{Cu}^{+2}]\text{pH}_2} = \frac{10^{-6}}{C} \quad \text{pH}_2 = 1$$

$$E = E_{\text{cell}}^\circ - \frac{0.06}{n} \log Q$$

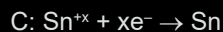
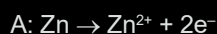
$$0.31 = 0.34 - \frac{0.06}{2} \log \frac{10^{-6}}{C}$$

$$\log \frac{10^{-6}}{C} = 1$$

$$C = 10^{-7} \text{ M}$$

$$x = 7$$

77. Answer (4)



$$E_{\text{Cell}}^\circ = E_{\text{Zn}|\text{Zn}^{2+}}^\circ + E_{\text{Sn}^{+x}|\text{Sn}}^\circ$$

$$\Rightarrow 0.763 + 0.008 = 0.771 \text{ V}$$

From Nernst equation,

$$E_{\text{Cell}} = E_{\text{Cell}}^\circ - \frac{2.303 RT}{nF} \log Q$$

$$0.801 = 0.771 - \frac{0.06}{n} \log 10^{-2}$$

$$0.03 = \frac{0.06}{n} \times 2$$

$$n = 4$$

78. Answer (1)

$$\Lambda_{m_1} = \frac{k_1 \times 1000}{M_1} = \frac{k \times 1000}{\frac{10}{0.02}}$$

$$\Lambda_{m_2} = \frac{k_2 \times 1000}{\frac{20}{0.08}}$$

It is given that $k_1 = k_2$

$$k_1 = \frac{\Lambda_{m_1}}{2} \quad k_2 = \frac{\Lambda_{m_2}}{4}$$

Applying the given condition on conductivity.

$$\frac{\Lambda_{m_1}}{2} = \frac{\Lambda_{m_2}}{4}$$

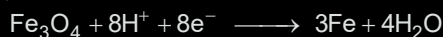
$$\boxed{\Lambda_{m_2} = 2\Lambda_{m_1}}$$

79. Answer (3)

For Fe_3O_4 ,

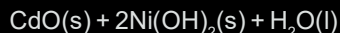
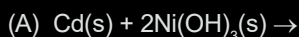
$$x = \frac{+8}{3}$$

where x is oxidation state of Fe.

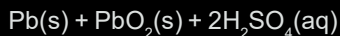
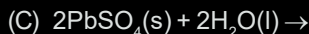
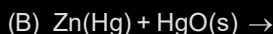


$$\text{Charge required} = \frac{8}{3} \times F = \frac{8F}{3} \approx 3F$$

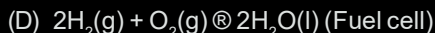
80. Answer (3)



(Discharging of secondary battery)



(Charging of secondary battery)



81. Answer (1)

The metal atom whose oxidation potential is less than that of hydrogen can release H_2 from mineral acids.

$$E^\circ_{\text{Zn/Zn}^{+2}} = 0.76$$

$$E^\circ_{\text{Ni/Ni}^{+2}} = 0.25$$

$$E^\circ_{\text{Mn/Mn}^{+2}} = 1.18$$

$$E^\circ_{\text{Cu/Cu}^{+2}} = -0.34$$

82. Answer (1000)

Solution 1, $\Lambda_{m_1} = \frac{1000 \text{ K}}{\text{M}}$

$$\text{M} = \frac{74.5}{74.5} \times \frac{1000}{10^6} = 10^{-3} \text{ M}$$

[density of solution = 1 g/mol]

$$\Lambda_1 = \frac{1000 \times 129 \times 10^{-4}}{10^{-3}} = 129 \times 10^2 \text{ Scm}^2 \text{ mol}^{-1}$$

$$\left[K = \frac{x}{R} = \frac{129 \times 10^{-2}}{100} \right]$$

Solution 2,

$$K = \frac{129 \times 10^{-2}}{50}$$

$$\Lambda_2 = \frac{1000 \times 129 \times 10^{-2}}{50 \text{ M}}$$

$$\text{M} = \frac{149}{74.5} \times \frac{1000}{10^6} = 2 \times 10^{-3} \text{ M}$$

$$\Lambda_2 = \frac{1000 \times 129 \times 10^{-2}}{50 \times 2 \times 10^{-3}} = 129 \times 10^2 \text{ Scm}^2 \text{ mol}^{-1}$$

$$\frac{\Lambda_1}{\Lambda_2} = 1 = 1000 \times 10^{-3}$$

$$\Rightarrow x = 1000$$

83. Answer (34)

$$E = E^\circ - \frac{0.06}{2} \log \frac{[\text{Cu}^{+2}]}{[\text{Ag}^+]^2}$$

$$= E^\circ - \frac{0.06}{2} \log \frac{0.001}{(0.01)^2}$$

$$0.43 = E^\circ - 0.03$$

$$E^\circ = 0.46 \text{ V}$$

$$E^\circ_{\text{Ag}^+/\text{Ag}} - E^\circ_{\text{Cu}^{+2}/\text{Cu}} = 0.46$$

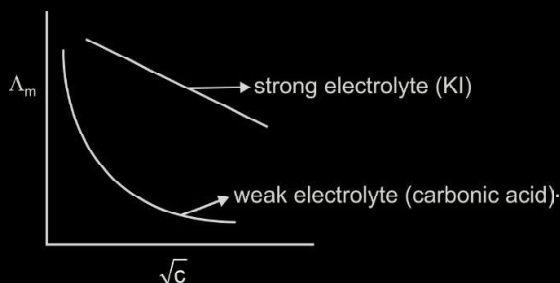
$$\therefore E^\circ_{\text{Cu}^{+2}/\text{Cu}} = 0.8 - 0.46$$

$$= 0.34 \text{ V}$$

$$= 34 \times 10^{-2} \text{ V}$$

84. Answer (2)

For any electrolyte, molar conductivity decreases with dilution.



Both Statements are false.

