

Electrochemistry — NEET Chemistry PYQ (2005-2021)

Class 12 Chemistry · 44 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. The molar conductance of NaCl, HCl and CH₃COONa at infinite dilution are 126.45, 426.16 and 91.0 S cm² mol⁻¹ respectively. The molar conductance of CH₃COOH at infinite dilution is. Choose the right option for your answer.

- (A) 201.28 S cm² mol⁻¹
- (B) 390.71 S cm² mol⁻¹
- (C) 698.28 S cm² mol⁻¹
- (D) 540.48 S cm² mol⁻¹

NEET 2021

2. The molar conductivity of 0.007 M acetic acid is 20 S cm² mol⁻¹. What is the dissociation constant of acetic acid ? Choose the correct option.

[$\Lambda^\circ(\text{H}^+) = 350 \text{ S cm}^2 \text{ mol}^{-1}$, $\Lambda^\circ(\text{CH}_3\text{COO}^-) = 50 \text{ S cm}^2 \text{ mol}^{-1}$]

- (A) $1.75 \times 10^{-4} \text{ mol L}^{-1}$
- (B) $2.50 \times 10^{-4} \text{ mol L}^{-1}$
- (C) $1.75 \times 10^{-5} \text{ mol L}^{-1}$
- (D) $2.50 \times 10^{-5} \text{ mol L}^{-1}$

NEET 2020 · Q99

3. On electrolysis of dil. sulphuric acid using Platinum (Pt) electrode, the product obtained at anode will be :

- (A) Hydrogen gas
- (B) Oxygen gas
- (C) H₂S gas
- (D) SO₂ gas

NEET 2020 · Q106

4. The number of Faradays (F) required to produce 20 g of calcium from molten CaCl₂ (Atomic mass of Ca = 40 g mol⁻¹) is :

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

NEET 2019 · Q53

5. For the cell reaction $2\text{Fe}^{3+}(\text{aq}) + 2\text{I}^{-}(\text{aq}) \rightarrow 2\text{Fe}^{2+}(\text{aq}) + \text{I}_2(\text{aq})$, $E^\circ_{\text{cell}} = 0.24 \text{ V}$ at 298 K. The standard Gibbs energy ($\Delta_r G^\circ$) of the cell reaction is: [Given that Faraday constant $F = 96500 \text{ C mol}^{-1}$]

- (A) $-46.32 \text{ kJ mol}^{-1}$
- (B) $-23.16 \text{ kJ mol}^{-1}$
- (C) $46.32 \text{ kJ mol}^{-1}$
- (D) $23.16 \text{ kJ mol}^{-1}$

NEET 2019 · Q82

6. For a cell involving one electron $E^\circ_{\text{cell}} = 0.59 \text{ V}$ at 298 K, the equilibrium constant for the cell reaction is: [Given that $2.303RT/F = 0.059 \text{ V}$ at $T = 298 \text{ K}$]

- (A) 1.0×10^2
- (B) 1.0×10^5
- (C) 1.0×10^{10}
- (D) 1.0×10^{30}

NEET 2017 · Q25

7. In the electrochemical cell: $\text{Zn}|\text{ZnSO}_4 (0.01 \text{ M})||\text{CuSO}_4 (1.0 \text{ M})|\text{Cu}$, 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 followings, which one is the relationship between E_1 and E_2 ? (Given, $RT/F = 0.059$)

- (A) $E_1 = E_2$
- (B) $E_1 < E_2$
- (C) $E_1 > E_2$
- (D) $E_2 = 0 \neq E_1$

NEET 2017 · Q37

8. 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) Na
- (B) K
- (C) Rb
- (D) Li

NEET 2017 (Gujarati paper) · Q28

9. Given that $\Lambda^\circ_m = 133.4$ (AgNO_3); $\Lambda^\circ_m = 149.9$ (KCl); $\Lambda^\circ_m = 144.9 \text{ S cm}^2 \text{ mol}^{-1}$ (KNO_3), the molar conductivity at infinite dilution for AgCl is:

- (A) $140 \text{ S cm}^2 \text{ mol}^{-1}$
- (B) $138 \text{ S cm}^2 \text{ mol}^{-1}$
- (C) $134 \text{ S cm}^2 \text{ mol}^{-1}$
- (D) $132 \text{ S cm}^2 \text{ mol}^{-1}$

NEET 2016 Phase 2 · Q47

10. 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 is

- (A) $2.88 \text{ S cm}^2/\text{mol}$
- (B) $11.52 \text{ S cm}^2/\text{mol}$
- (C) $0.086 \text{ S cm}^2/\text{mol}$
- (D) $28.8 \text{ S cm}^2/\text{mol}$

NEET 2016 Phase 2 · Q56

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

- (A) $\Delta G^\circ > 0$; $K_{\text{eq}} < 1$
- (B) $\Delta G^\circ > 0$; $K_{\text{eq}} > 1$
- (C) $\Delta G^\circ < 0$; $K_{\text{eq}} > 1$
- (D) $\Delta G^\circ < 0$; $K_{\text{eq}} < 1$

NEET 2016 Phase 2 · Q60

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

- (A) 6×10^{23}
- (B) 6×10^{20}
- (C) 3.75×10^{20}
- (D) 7.48×10^{23}

NEET 2016 Phase 2 · Q63

13. Zinc can be coated on iron to produce galvanized iron but the reverse is not possible. It is because

- (A) zinc is lighter than iron
- (B) zinc has lower melting point than iron
- (C) zinc has lower negative electrode potential than iron
- (D) zinc has higher negative electrode potential than iron

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

- (A) 10^{-14} atm
- (B) 10^{-12} atm
- (C) 10^{-10} atm
- (D) 10^{-4} atm

AIPMT 2015

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

- (A) Ni-Cd cell
- (B) Fuel Cell
- (C) Electrolytic Cell
- (D) Dynamo

AIPMT 2014

16. The weight of silver (at. wt. = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 at STP will be:

- (A) 10.8 g
- (B) 54.0 g
- (C) 108.0 g
- (D) 5.4 g

AIPMT 2014

17. When 0.1 mol MnO_4^{2-} is oxidised the quantity of electricity required to completely oxidise MnO_4^{2-} to MnO_4^- is:

- (A) 2×96500 C
- (B) 9650 C
- (C) 96.50 C
- (D) 96500 C

NEET 2013

18. 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 one atm pressure. The oxidation potential of electrode would be

- (A) 0.059 V
- (B) 0.59 V
- (C) 0.118 V
- (D) 1.18 V

NEET 2013

19. At 25°C molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is $9.54 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$ and at infinite dilution its molar conductance is $238 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$. The degree of ionisation of ammonium hydroxide at the same concentration and temperature is

- (A) 2.080%
- (B) 20.800%
- (C) 4.008%
- (D) 40.800%

NEET 2013

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



If half cell potentials are

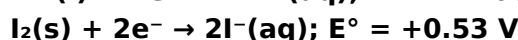
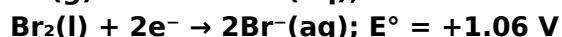
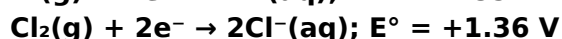
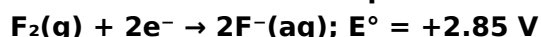


The cell potential will be

- (A) 1.10 V
- (B) 0.42 V
- (C) 0.84 V
- (D) 1.34 V

AIPMT 2012 Mains

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



The strongest oxidising and reducing agents respectively are

- (A) F_2 and I^{-}
- (B) Br_2 and Cl^{-}
- (C) Cl_2 and Br^{-}
- (D) Cl_2 and I_2

AIPMT 2012 Mains

22. Molar conductivities ($\Lambda^{\circ}\text{m}$) at infinite dilution of NaCl, HCl and CH_3COONa are 126.4, 425.9 and 91.0 $\text{S cm}^2 \text{mol}^{-1}$ respectively. $\Lambda^{\circ}\text{m}$ for CH_3COOH will be

- (A) 425.5 $\text{S cm}^2 \text{mol}^{-1}$
- (B) 180.5 $\text{S cm}^2 \text{mol}^{-1}$
- (C) 290.8 $\text{S cm}^2 \text{mol}^{-1}$
- (D) 390.5 $\text{S cm}^2 \text{mol}^{-1}$

AIPMT 2012 Prelims

23. Limiting molar conductivity of NH_4OH , i.e. $\Lambda^{\circ}\text{m}(\text{NH}_4\text{OH})$, is equal to

- (A) $\Lambda^{\circ}\text{m}(\text{NH}_4\text{Cl}) + \Lambda^{\circ}\text{m}(\text{NaOH}) - \Lambda^{\circ}\text{m}(\text{NaCl})$
- (B) $\Lambda^{\circ}\text{m}(\text{NH}_4\text{Cl}) + \Lambda^{\circ}\text{m}(\text{NaCl}) - \Lambda^{\circ}\text{m}(\text{NaOH})$
- (C) $\Lambda^{\circ}\text{m}(\text{NaOH}) + \Lambda^{\circ}\text{m}(\text{NaCl}) - \Lambda^{\circ}\text{m}(\text{NH}_4\text{Cl})$
- (D) $\Lambda^{\circ}\text{m}(\text{NH}_4\text{OH}) + \Lambda^{\circ}\text{m}(\text{NH}_4\text{Cl}) - \Lambda^{\circ}\text{m}(\text{HCl})$

AIPMT 2011 Prelims

24. The electrode potentials for $\text{Cu}^{2+}(\text{aq}) + \text{e}^{-} \rightarrow \text{Cu}^{+}(\text{aq})$ and $\text{Cu}^{+}(\text{aq}) + \text{e}^{-} \rightarrow \text{Cu(s)}$ are +0.15 V and +0.50 V respectively. The value of $E^{\circ}(\text{Cu}^{2+}/\text{Cu})$ will be

- (A) 0.150 V
- (B) 0.500 V
- (C) 0.325 V
- (D) 0.650 V

AIPMT 2011 Prelims

25. Standard electrode potential for $\text{Sn}^{4+}/\text{Sn}^{2+}$ couple is +0.15 V and that for the Cr^{3+}/Cr couple is -0.74 V. These two couples in their standard state are connected to make a cell. The cell potential will be

- (A) +1.83 V
- (B) +1.19 V
- (C) +0.89 V
- (D) +0.18 V

AIPMT 2011 Prelims

26. 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° and K_{eq} ?

- (A) $\Delta G^\circ > 0$; $K_{\text{eq}} < 1$
- (B) $\Delta G^\circ > 0$; $K_{\text{eq}} > 1$
- (C) $\Delta G^\circ < 0$; $K_{\text{eq}} > 1$
- (D) $\Delta G^\circ < 0$; $K_{\text{eq}} < 1$

AIPMT 2011 Prelims

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

- (A) $X > Y > Z$
- (B) $Y > Z > X$
- (C) $Y > X > Z$
- (D) $Z > X > Y$

AIPMT 2010 Mains · Q101

28. Consider the following relations for emf of an electrochemical cell:

- (a) $\text{emf of cell} = (\text{Oxidation potential of anode}) - (\text{Reduction potential of cathode})$
- (b) $\text{emf of cell} = (\text{Oxidation potential of anode}) + (\text{Reduction potential of cathode})$
- (c) $\text{emf of cell} = (\text{Reduction potential of anode}) + (\text{Reduction potential of cathode})$
- (d) $\text{emf of cell} = (\text{Oxidation potential of anode}) - (\text{Oxidation potential of cathode})$

Which of the above relations are correct?

- (A) (c) and (a)
- (B) (a) and (b)
- (C) (c) and (d)
- (D) (b) and (d)

AIPMT 2010 Prelims · Q51

29. An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to

- (A) Increase in number of ions
- (B) Increase in ionic mobility of ions
- (C) 100% ionisation of electrolyte at normal dilution
- (D) Increase in both i.e. number of ions and ionic mobility of ions

AIPMT 2010 Prelims · Q61

30. For the reduction of silver ions with copper metal, the standard cell potential was found to be +0.46 V at 25°C. The value of standard Gibbs energy, ΔG° will be (F = 96500 C mol⁻¹)

- (A) -98.0 kJ
- (B) -89.0 kJ
- (C) -89.0 J
- (D) -44.5 kJ

AIPMT 2009 Prelims · Q158

31. Given:

(i) $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$, $E^\circ = 0.337 \text{ V}$

(ii) $\text{Cu}^{2+} + \text{e}^- \rightarrow \text{Cu}^+$, $E^\circ = 0.153 \text{ V}$

Electrode potential, E° for the reaction, $\text{Cu}^+ + \text{e}^- \rightarrow \text{Cu}$, will be:

- (A) 0.90 V
- (B) 0.30 V
- (C) 0.38 V
- (D) 0.52 V

32. Al_2O_3 is reduced by electrolysis at low potentials and high currents. If 4.0×10^4 amperes of current is passed through molten Al_2O_3 for 6 hours, what mass of aluminium is produced? (Assume 100% current efficiency. At. mass of Al = 27 g mol^{-1})

- (A) 8.1×10^4 g
- (B) 2.4×10^5 g
- (C) 1.3×10^4 g
- (D) 9.0×10^3 g

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

- (A) 1.25×10^{-6}
- (B) 6.25×10^{-4}
- (C) 1.25×10^{-4}
- (D) 1.25×10^{-5}

34. Kohlrausch's law states that at

- (A) Infinite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte
- (B) Finite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte
- (C) Infinite dilution each ion makes definite contribution to equivalent conductance of an electrolyte depending on the nature of the other ion of the electrolyte
- (D) Infinite dilution, each ion makes definite contribution to conductance of an electrolyte whatever be the nature of the other ion of the electrolyte

35. Standard free energies of formation (in kJ/mol) at 298 K are -237.2 , -394.4 and -8.2 for $\text{H}_2\text{O}(\text{l})$, $\text{CO}_2(\text{g})$ and pentane(g) respectively. The value of E°_{cell} for the pentane-oxygen fuel cell is

- (A) 0.0968 V
- (B) 1.968 V
- (C) 2.0968 V
- (D) 1.0968 V

36. The sequence of ionic mobility in aqueous solution is

- (A) $\text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$
- (B) $\text{K}^+ > \text{Na}^+ > \text{Rb}^+ > \text{Cs}^+$
- (C) $\text{Cs}^+ > \text{Rb}^+ > \text{K}^+ > \text{Na}^+$
- (D) $\text{Rb}^+ > \text{K}^+ > \text{Cs}^+ > \text{Na}^+$

37. On the basis of the following E° values, the strongest oxidizing agent is
 $[\text{Fe}(\text{CN})_6]^{4-} \rightarrow [\text{Fe}(\text{CN})_6]^{3-} + \text{e}^-; E^\circ = -0.35 \text{ V}$
 $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-; E^\circ = -0.77 \text{ V}$

- (A) $[\text{Fe}(\text{CN})_6]^{3-}$
- (B) $[\text{Fe}(\text{CN})_6]^{4-}$
- (C) Fe^{2+}
- (D) Fe^{3+}

38. A steady current of 1.5 amp flows through a copper voltameter for 10 minutes. If the electrochemical equivalent of copper is 30×10^{-5} g coulomb⁻¹, the mass of copper deposited on the electrode will be

- (A) 0.50 g
- (B) 0.67 g
- (C) 0.27 g
- (D) 0.40 g

39. The efficiency of a fuel cell is given by

- (A) $\Delta G/\Delta S$
- (B) $\Delta G/\Delta H$
- (C) $\Delta S/\Delta G$
- (D) $\Delta H/\Delta G$

40. The equilibrium constant of the reaction:

$\text{Cu(s)} + 2\text{Ag}^+(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{Ag(s)} ; E^\circ = 0.46 \text{ V at } 298 \text{ K is}$

- (A) 2.0×10^{10}
- (B) 4.0×10^{10}
- (C) 4.0×10^{15}
- (D) 2.4×10^{10}

41. In producing chlorine through electrolysis 100 W power at 125 V is being consumed. How much chlorine per min is liberated ? ECE of chlorine is 0.367×10^{-6} kg/C :

- (A) 17.6 mg
- (B) 34.3 mg
- (C) 24.3 mg
- (D) 39.6 mg

42. If $E^\circ(\text{Fe}^{2+}/\text{Fe}) = -0.441 \text{ V}$ and $E^\circ(\text{Fe}^{3+}/\text{Fe}^{2+}) = 0.771 \text{ V}$, the standard emf of the reaction :

$\text{Fe} + 2\text{Fe}^{3+} \rightarrow 3\text{Fe}^{2+}$ will be :

- (A) 0.441 V
- (B) 1.753 V
- (C) 1.212 V
- (D) 0.211 V

43. A hypothetical electrochemical cell is shown below

$\text{A} | \text{A}^+ (\text{xM}) || \text{B}^+ (\text{yM}) | \text{B}$

The emf measured is +0.20 V. The cell reaction is :

- (A) $\text{A}^+ + \text{B} \rightarrow \text{A} + \text{B}^+$
- (B) $\text{A}^+ + \text{e}^- \rightarrow \text{A}; \text{B}^+ + \text{e}^- \rightarrow \text{B}$
- (C) the cell reaction cannot be predicted
- (D) $\text{A} + \text{B}^+ \rightarrow \text{A}^+ + \text{B}$

44. 4.5 g of aluminium (at. mass 27 amu) is deposited at cathode from Al^{3+} solution by a certain quantity of electric charge. The volume of hydrogen produced at STP from H^+ ions in solution by the same quantity of electric charge will be :

- (A) 22.4 L
(B) 32.8 L
(C) 5.6 L
(D) 11.2 L

Answer key and explanations

1. Answer: (B) $390.71 \text{ S cm}^2 \text{ mol}^{-1}$

Kohlrausch's law: $\Lambda^\circ(\text{CH}_3\text{COOH}) = \Lambda^\circ(\text{CH}_3\text{COONa}) + \Lambda^\circ(\text{HCl}) - \Lambda^\circ(\text{NaCl}) = 91.0 + 426.16 - 126.45 = 390.71 \text{ S cm}^2 \text{ mol}^{-1}$. Simply adding all three gives 643.61, which is not the right combination.

2. Answer: (C) $1.75 \times 10^{-5} \text{ mol L}^{-1}$

$\Lambda^\circ m = 350 + 50 = 400 \text{ S cm}^2 \text{ mol}^{-1}$, so $\alpha = \Lambda m / \Lambda^\circ m = 20/400 = 0.05$. $K_a = c\alpha^2/(1 - \alpha) \approx 0.007 \times 0.0025 = 1.75 \times 10^{-5} \text{ mol L}^{-1}$ (exactly 1.84×10^{-5} without approximation, still nearest).

3. Answer: (B) Oxygen gas

In dilute H_2SO_4 , oxidation of water ($2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$) is easier than oxidation of sulphate, so O_2 is liberated at the inert Pt anode. Hydrogen is formed at the cathode, not the anode.

4. Answer: (A) 1

$\text{Ca}^{2+} + 2\text{e}^- \rightarrow \text{Ca}$, so each mole of Ca needs 2 F. 20 g is $20/40 = 0.5 \text{ mol}$, which needs $0.5 \times 2 = 1 \text{ F}$. Using 2 F straight from the equation ignores that only half a mole is produced.

5. Answer: (A) $-46.32 \text{ kJ mol}^{-1}$

Two electrons are transferred, so $\Delta G^\circ = -nFE^\circ = -2 \times 96500 \times 0.24 = -46320 \text{ J} = -46.32 \text{ kJ mol}^{-1}$. Using $n = 1$ gives $-23.16 \text{ kJ mol}^{-1}$, and a positive E° must give a negative ΔG° .

6. Answer: (C) 1.0×10^{10}

$\log K = nE^\circ/0.059 = 1 \times 0.59/0.059 = 10$, so $K = 1.0 \times 10^{10}$. 10^{30} would correspond to three electrons.

7. Answer: (C) $E_1 > E_2$

$E = E^\circ - (0.059/2) \log([Zn^{2+}]/[Cu^{2+}])$. For E_1 the ratio is 0.01/1 so $E_1 = E^\circ + 0.059 \text{ V}$; for E_2 the ratio is 1/0.01 so $E_2 = E^\circ - 0.059 \text{ V}$. Hence $E_1 > E_2$; reversing the concentrations does not make the emf zero.

8. Answer: (D) Li

Li^+ is the smallest alkali metal ion, so it has the highest charge density and is the most heavily hydrated. Its large hydrated radius makes it move most slowly in solution, so Li^+ has the lowest ionic mobility even though the bare ion is the smallest.

9. Answer: (B) $138 \text{ S cm}^2 \text{ mol}^{-1}$

By Kohlrausch's law, $\Lambda^\circ(\text{AgCl}) = \Lambda^\circ(\text{AgNO}_3) + \Lambda^\circ(\text{KCl}) - \Lambda^\circ(\text{KNO}_3) = 133.4 + 149.9 - 144.9 = 138.4 \approx 138 \text{ S cm}^2 \text{ mol}^{-1}$. Adding all three, or subtracting the wrong salt, gives none of the ion combinations needed.

10. Answer: (B) $11.52 \text{ S cm}^2/\text{mol}$

$\Lambda m = \kappa \times 1000/M = 5.76 \times 10^{-3} \times 1000/0.5 = 11.52 \text{ S cm}^2 \text{ mol}^{-1}$. Multiplying by the concentration instead of dividing gives $2.88 \text{ S cm}^2/\text{mol}$.

11. Answer: (A) $\Delta G^\circ > 0$; $K_{\text{eq}} < 1$

$\Delta G^\circ = -nFE^\circ_{\text{cell}}$, so a negative E° gives a positive ΔG° . Also $\Delta G^\circ = -RT \ln K$, so a positive ΔG° means $\ln K < 0$, i.e. $K < 1$. A negative ΔG° and $K > 1$ belong to a positive E° .

12. Answer: (C) 3.75×10^{20}

Charge passed $Q = It = 1 \times 60 = 60 \text{ C}$. Number of electrons = $60/(1.60 \times 10^{-19}) = 3.75 \times 10^{20}$. 6×10^{23} is close to Avogadro's number and would need about one faraday of charge.

13. Answer: (D) zinc has higher negative electrode potential than iron

$E^\circ(\text{Zn}^{2+}/\text{Zn}) = -0.76 \text{ V}$ is more negative than $E^\circ(\text{Fe}^{2+}/\text{Fe}) = -0.44 \text{ V}$, so zinc is oxidised in preference and protects iron sacrificially. An iron coating on zinc would not protect the zinc, since iron is less easily oxidised. Melting point and density are not the reason.

14. Answer: (A) 10^{-14} atm

For $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$, $E = 0 - (0.059/2) \log(p_{\text{H}_2}/[\text{H}^+]^2)$. In pure water $[\text{H}^+] = 10^{-7} \text{ M}$, so $E = 0$ requires $p_{\text{H}_2} = [\text{H}^+]^2 = 10^{-14} \text{ atm}$. Using $[\text{H}^+]$ instead of $[\text{H}^+]^2$ would give 10^{-7} atm , which is not even offered.

15. Answer: (B) Fuel Cell

A fuel cell converts the free energy of combustion of fuels like H_2 or CH_4 directly into electricity. A Ni-Cd cell is a rechargeable storage cell, and a dynamo converts mechanical energy, not chemical.

16. Answer: (C) 108.0 g

5600 mL O_2 at STP = 0.25 mol; since $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$, this requires 1 mol electrons = 1 F. One faraday deposits 1 mol Ag = 108 g.

17. Answer: (B) 9650 C

$\text{MnO}_4^{2-} \rightarrow \text{MnO}_4^- + \text{e}^-$ (Mn +6 to +7), one electron per ion. 0.1 mol needs 0.1 F = $0.1 \times 96\,500 = 9650$ C.

18. Answer: (B) 0.59 V

For $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$ at 1 atm, $E(\text{oxidation}) = 0 - (0.059/2) \log[\text{H}^+]^2 = -0.059 \log[\text{H}^+] = 0.059 \times \text{pH}$.
With pH 10: $0.059 \times 10 = 0.59$ V. 0.059 V would correspond to pH 1.

19. Answer: (C) 4.008%

Degree of ionisation $\alpha = \Lambda_m/\Lambda^\circ_m = 9.54/238 = 0.04008$, i.e. 4.008%. 40.8% comes from misplacing the decimal.

20. Answer: (A) 1.10 V

Zinc is oxidised (anode) and Ag_2O reduced (cathode). $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = 0.34 - (-0.76) = 1.10$ V. Subtracting the magnitudes gives 0.42 V, which ignores the sign of the zinc potential.

21. Answer: (A) F_2 and I^-

The highest reduction potential (F_2 , +2.85 V) marks the strongest oxidising agent. The lowest reduction potential (I_2/I^- , +0.53 V) means I^- is most easily oxidised, so I^- is the strongest reducing agent; I_2 itself is an oxidant, not a reductant.

22. Answer: (D) $390.5 \text{ S cm}^2 \text{ mol}^{-1}$

By Kohlrausch's law, $\Lambda^\circ(\text{CH}_3\text{COOH}) = \Lambda^\circ(\text{CH}_3\text{COONa}) + \Lambda^\circ(\text{HCl}) - \Lambda^\circ(\text{NaCl}) = 91.0 + 425.9 - 126.4 = 390.5 \text{ S cm}^2 \text{ mol}^{-1}$.

23. Answer: (A) $\Lambda^\circ_m(\text{NH}_4\text{Cl}) + \Lambda^\circ_m(\text{NaOH}) - \Lambda^\circ_m(\text{NaCl})$

By Kohlrausch's law, $\Lambda^\circ_m(\text{NH}_4\text{OH}) = \lambda^\circ(\text{NH}_4^+) + \lambda^\circ(\text{OH}^-) = [\lambda^\circ(\text{NH}_4^+) + \lambda^\circ(\text{Cl}^-)] + [\lambda^\circ(\text{Na}^+) + \lambda^\circ(\text{OH}^-)] - [\lambda^\circ(\text{Na}^+) + \lambda^\circ(\text{Cl}^-)] = \Lambda^\circ_m(\text{NH}_4\text{Cl}) + \Lambda^\circ_m(\text{NaOH}) - \Lambda^\circ_m(\text{NaCl})$. The combination subtracting NaOH would cancel the OH^- contribution instead.

24. Answer: (C) 0.325 V

Potentials are not additive but free energies are: $\Delta G^\circ = -nFE^\circ$. $-2F \cdot E^\circ = -1F(0.15) - 1F(0.50)$, so $E^\circ(\text{Cu}^{2+}/\text{Cu}) = 0.65/2 = 0.325$ V. Simply adding the potentials gives 0.65 V, the trap.

25. Answer: (C) +0.89 V

The couple with higher reduction potential, $\text{Sn}^{4+}/\text{Sn}^{2+}$, is the cathode and Cr is the anode. $E^\circ_{\text{cell}} = 0.15 - (-0.74) = +0.89$ V. Multiplying by stoichiometric coefficients (to get 1.83 V) is wrong since E° is intensive.

26. Answer: (A) $\Delta G^\circ > 0$; $K_{\text{eq}} < 1$

$\Delta G^\circ = -nFE^\circ_{\text{cell}}$, so a negative E°_{cell} makes ΔG° positive. Since $\Delta G^\circ = -RT \ln K$, a positive ΔG° means $\ln K < 0$, i.e. $K < 1$: the reaction is non-spontaneous as written.

27. Answer: (D) $Z > X > Y$

The more negative the standard reduction potential, the more readily the metal is oxidised, so the stronger the reducing agent. Order: Z (−3.0 V) > X (−1.2 V) > Y (+0.5 V).

28. Answer: (D) (b) and (d)

$\text{emf} = E(\text{red, cathode}) - E(\text{red, anode})$. Since oxidation potential = −reduction potential, this equals (oxidation potential of anode) + (reduction potential of cathode), and also (oxidation potential of anode) − (oxidation potential of cathode). The relation subtracting the reduction potential of the cathode from the anode's oxidation potential gets the sign wrong.

29. Answer: (B) Increase in ionic mobility of ions

A strong electrolyte is already fully ionised, so dilution does not add ions. Dilution weakens interionic attractions, so the ions move faster: the increase is due to greater ionic mobility. More ions is the explanation for weak electrolytes.

30. Answer: (B) −89.0 kJ

$\text{Cu} + 2\text{Ag}^+ \rightarrow \text{Cu}^{2+} + 2\text{Ag}$ involves $n = 2$. $\Delta G^\circ = -nFE^\circ = -2 \times 96500 \times 0.46 = -88780 \text{ J} \approx -89.0 \text{ kJ}$. Taking $n = 1$ gives −44.5 kJ; −89.0 J has the wrong unit.

31. Answer: (D) 0.52 V

Combine free energies, not potentials: ΔG° for $\text{Cu}^+ + \text{e}^- \rightarrow \text{Cu} = \Delta G^\circ(\text{i}) - \Delta G^\circ(\text{ii}) = (-2 \times 0.337F) - (-1 \times 0.153F) = -0.521F$. With $n = 1$, $E^\circ = +0.52 \text{ V}$. Simply subtracting the potentials gives 0.18 V and adding them gives 0.49 V, both wrong.

32. Answer: (A) $8.1 \times 10^4 \text{ g}$

Charge $Q = 4.0 \times 10^4 \times 6 \times 3600 = 8.64 \times 10^8 \text{ C}$. $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$, so moles of Al = $8.64 \times 10^8 / (3 \times 96500) \approx 2984 \text{ mol}$, mass $\approx 2984 \times 27 \approx 8.1 \times 10^4 \text{ g}$. Forgetting the factor 3 gives $2.4 \times 10^5 \text{ g}$.

33. Answer: (D) 1.25×10^{-5}

Degree of dissociation $\alpha = 8.0/400 = 0.02$. $K_a = \text{Ca}^2/(1 - \alpha) \approx \text{Ca}^2 = (1/32)(0.02)^2 = 1.25 \times 10^{-5}$. Forgetting to square α gives 6.25×10^{-4} .

34. Answer: (A) Infinite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte

Kohlrausch's law of independent migration says that at infinite dilution each ion contributes a fixed amount to the limiting equivalent (or molar) conductivity, whatever the other ion is. It does not hold at finite dilution, where interionic attractions matter, and it is stated for equivalent/molar conductance, not plain conductance.

35. Answer: (D) 1.0968 V

$\text{C}_5\text{H}_{12} + 8\text{O}_2 \rightarrow 5\text{CO}_2 + 6\text{H}_2\text{O}$. $\Delta G^\circ = 5(-394.4) + 6(-237.2) - (-8.2) = -3387.0 \text{ kJ}$. Eight O_2 molecules take 4 electrons each, so $n = 32$, and $E^\circ = -\Delta G^\circ/nF = 3387000/(32 \times 96500) \approx 1.0968 \text{ V}$. Using a smaller n (for example 16) would double the voltage to about 2.19 V, which is not offered.

36. Answer: (C) $\text{Cs}^+ > \text{Rb}^+ > \text{K}^+ > \text{Na}^+$

Smaller ions have higher charge density and hold a larger shell of water molecules, so the hydrated Na^+ ion is the bulkiest and moves slowest. Mobility therefore increases down the group: $\text{Cs}^+ > \text{Rb}^+ > \text{K}^+ > \text{Na}^+$. $\text{Na}^+ > \dots > \text{Cs}^+$ follows bare ionic size and ignores hydration.

37. Answer: (D) Fe^{3+}

The values given are oxidation potentials, so the reduction potentials are +0.35 V for $[\text{Fe}(\text{CN})_6]^{3-}/[\text{Fe}(\text{CN})_6]^{4-}$ and +0.77 V for $\text{Fe}^{3+}/\text{Fe}^{2+}$. The species with the higher reduction potential is the stronger oxidising agent, so Fe^{3+} . $[\text{Fe}(\text{CN})_6]^{4-}$ and Fe^{2+} are the reduced forms and act as reducing agents.

38. Answer: (C) 0.27 g

Faraday's first law: $m = ZIt = 30 \times 10^{-5} \times 1.5 \times 600 = 0.27 \text{ g}$. Forgetting to convert 10 minutes to 600 s gives a far smaller value.

39. Answer: (B) $\Delta G/\Delta H$

A fuel cell converts the free-energy change into electrical work, while the total energy released is ΔH ; efficiency = $\Delta G/\Delta H$. Ratios involving ΔS are not an efficiency.

40. Answer: (C) 4.0×10^{15}

$\log K = nE^\circ/0.0591 = 2 \times 0.46/0.0591 = 15.57$, so $K = 10^{15.57} \approx 3.7 \times 10^{15} \approx 4.0 \times 10^{15}$. Taking $n = 1$ would give a value near 10^8 .

41. Answer: (A) 17.6 mg

The current drawn is $I = P/V = 100/125 = 0.8 \text{ A}$, so the charge passed in one minute is $0.8 \times 60 = 48 \text{ C}$. By Faraday's first law $m = ZQ = 0.367 \times 10^{-6} \times 48 \approx 1.76 \times 10^{-5} \text{ kg} = 17.6 \text{ mg}$. Forgetting the 60 s factor or using V instead of I gives none of the other values.

42. Answer: (C) 1.212 V

Fe is oxidised to Fe^{2+} (anode) and Fe^{3+} is reduced to Fe^{2+} (cathode). $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = 0.771 - (-0.441) = 1.212 \text{ V}$. Electrode potentials are intensive, so they are not multiplied by 2; simply adding them gives the wrong 0.33 V.

43. Answer: (D) $\text{A} + \text{B}^+ \rightarrow \text{A}^+ + \text{B}$

In the cell notation the left electrode is the anode (oxidation) and the right the cathode (reduction). A positive emf of +0.20 V means this cell is spontaneous as written: $\text{A} \rightarrow \text{A}^+ + \text{e}^-$ and $\text{B}^+ + \text{e}^- \rightarrow \text{B}$, i.e. $\text{A} + \text{B}^+ \rightarrow \text{A}^+ + \text{B}$. The reverse reaction would have a negative emf.

44. Answer: (C) 5.6 L

4.5 g Al = 1/6 mol; Al^{3+} needs 3 F per mol, so charge = 0.5 F. 0.5 F liberates 0.25 mol H_2 (2 F per mol H_2) = $0.25 \times 22.4 = 5.6 \text{ L}$ at STP. 11.2 L forgets that H_2 needs two electrons per molecule.

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