Electrochemistry

Class 12 Chemistry · 24 NEET MCQs with answers & explanations

Electrochemistry covers electrochemical cells (galvanic and electrolytic), Nernst equation, conductivity, molar conductivity, Kohlrausch's law, Faraday's laws of electrolysis and corrosion. NEET tests Nernst equation calculations, EMF of cells, and Faraday's law problems — both conceptual and numerical.

Key Electrochemistry Concepts

Concept	Key Fact
Galvanic cell	Spontaneous; anode (−, oxidation) || cathode (+, reduction); $E°_{cell} > 0$
Nernst equation	$E = E° - (RT/nF)\ln Q$; at 25°C: $E = E° - (0.0591/n)\log Q$
Conductivity (κ)	$\kappa = 1/\rho$; units: S cm^{-1}; increases with dilution for weak electrolytes
Kohlrausch's law	$\Lambda°_m = \lambda°(\text{cation}) + \lambda°(\text{anion})$; used to find $\Lambda°_m$ of weak electrolytes
Faraday's laws	$m = (M \cdot I \cdot t)/(n \cdot F)$; F = 96485 C/mol; 1 Faraday deposits 1 equivalent
Corrosion	Electrochemical process; iron rusts at anode ($Fe \rightarrow Fe^{2+}$), O_2 reduced at cathode

Questions

Q1. The molar conductivity of a 0.050 mol L^{-1} monobasic weak acid solution is 90 S cm^2 mol^{-1}. If limiting ionic conductivities are 349.6 and 50.4 S cm^2 mol^{-1}, the degree of dissociation is:

(A) 0.225
(B) 0.215
(C) 0.115
(D) 0.125

Q2. Which of the following correctly defines corrosion according to NCERT?

(A) Electrochemical oxidation of metals by environment
(B) Rapid combustion of metals in oxygen
(C) Reduction of metal oxides to metals
(D) Neutralisation of metals by acids

Q3. Conductance of a conductor is defined as

(A) Reciprocal of its resistance
(B) Product of resistance and area
(C) Resistance divided by length
(D) Ratio of voltage to current

Q4. Faraday's first law states that the mass deposited during electrolysis is proportional to

(A) Charge passed through solution
(B) Temperature of solution
(C) Molecular weight of solvent
(D) Electrode surface area

Q5. Which of the following conditions makes a galvanic cell reaction non-spontaneous?

(A) $E_{cell} < 0$
(B) $E_{cell} > 0$
(C) $\Delta G = -nFE < 0$
(D) $Q < K$

Q6. Which electrode acts as the anode in a galvanic cell?

(A) Oxidation electrode
(B) Reduction electrode
(C) Inert electrode
(D) Reference electrode

Q7. Standard conditions for measuring standard electrode potential are

(A) 1 M concentration, 1 bar pressure, 298 K
(B) 1 M concentration, 1 atm pressure, 298 K
(C) 1 M concentration, 1 bar pressure, 273 K
(D) 1 M concentration, 1 atm pressure, 273 K

Q8. In electroplating, the object to be coated is connected as which electrode?

(A) Anode
(B) Cathode
(C) Either electrode
(D) Salt bridge

Q9. Which of the following is used as the electrolyte in a dry cell (Leclanché cell)?

(A) NH_4Cl and $ZnCl_2$ paste
(B) Dilute H_2SO_4 solution
(C) KOH solution
(D) NaCl solution

Q10. A cell reaction has $E°_{cell} = 0.0591$ V and involves transfer of 2 electrons. The equilibrium constant K at 298 K is:

(A) 10
(B) 10^2
(C) 10^{-2}
(D) 10^3

Q11. The Nernst equation shows that cell potential depends on $E°$ and

(A) Pressure of surroundings
(B) Total mass of electrodes
(C) Concentration of ions and temperature
(D) Number of moles of solvent

Q12. For a cell with $E° = 1.10$ V, calculate E_{cell} at 298 K when $Q = 1$.

(A) 1.10 V
(B) 0.55 V
(C) 0.51 V
(D) 1.69 V

Q13. A solution containing $Cu(NO_3)_2$, $AgNO_3$ and $Hg_2(NO_3)_2$ is electrolysed. Given $E°(Ag^+/Ag)=+0.80V$, $E°(Hg_2^{2+}/Hg)=+0.79V$, $E°(Cu^{2+}/Cu)=+0.34V$, the deposition order at the cathode with increasing applied voltage is:

(A) Ag deposits first, then Hg, Cu
(B) Cu deposits first, then Hg, Ag
(C) Hg deposits first, then Ag, Cu
(D) Cu deposits first, then Ag, Hg

Q14. Which statement correctly defines oxidation in terms of electron transfer?

(A) Loss of electrons
(B) Gain of electrons
(C) Gain of protons
(D) Loss of neutrons

Q15. At which condition does the EMF of a cell become exactly zero?

(A) When reaction reaches equilibrium (Q = K)
(B) When temperature is raised above 300 K
(C) When electrolyte concentration is doubled
(D) When external resistance is removed

Q16. In a redox reaction, the substance that gains electrons is called the:

(A) Oxidising agent
(B) Reducing agent
(C) Catalyst
(D) Spectator ion

Q17. The oxidation number of oxygen in H_2O_2 is:

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

Q18. Identify the oxidising agent in: $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

(A) Zn
(B) Zn^{2+}
(C) Cu
(D) Cu^{2+}

Q19. Which of the following correctly links oxidation number change to the process of oxidation?

(A) Decrease in oxidation number; electrons lost
(B) Increase in oxidation number; electrons lost
(C) Increase in oxidation number; electrons gained
(D) No change in oxidation number; electrons transferred

Q20. Which species has the highest oxidation state of sulfur among the following?

(A) H_2S
(B) SO_4^{2-}
(C) SO_2
(D) $S_2O_3^{2-}$

Q21. In the reaction $Fe^{2+} \rightarrow Fe^{3+}$, the process occurring is:

(A) Reduction
(B) Disproportionation
(C) Oxidation
(D) Neutralisation

Q22. Which of the following is a redox reaction?

(A) $NaCl \rightarrow Na^{+} + Cl^{-}$
(B) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
(C) $CaO + CO_2 \rightarrow CaCO_3$
(D) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

Q23. The oxidation number of chlorine in ClO_3^{-} is:

(A) 5
(B) 3
(C) 1
(D) -1

Q24. Which of the following statements about a reducing agent is correct?

(A) It gains electrons during reaction
(B) It gets oxidised during reaction
(C) It causes decrease in oxidation number of itself
(D) It acts as an electron acceptor

Answer key

1-A	**2-A**	**3-A**	**4-A**	**5-A**	**6-A**	**7-A**	**8-B**
9-A	**10-B**	**11-C**	**12-A**	**13-A**	**14-A**	**15-A**	**16-A**
17-C	**18-D**	**19-B**	**20-B**	**21-C**	**22-D**	**23-A**	**24-B**

Answers with explanations

Q1 — Answer: (A) 0.225
At infinite dilution, $\Lambda°m = 349.6 + 50.4 = 400$ S cm² mol^{-1}. Degree of dissociation $\alpha = \Lambda m/\Lambda°m = 90/400 = 0.225$. Options B, C and D result from arithmetic errors such as using wrong $\Lambda°m$ values or incorrect formula application.

Q2 — Answer: (A) Electrochemical oxidation of metals by environment
Corrosion is the electrochemical oxidation of metals by environmental agents (O_2, H_2O, CO_2). It is not combustion (too rapid) nor reduction (metals are oxidised, not reduced) during corrosion.

Q3 — Answer: (A) Reciprocal of its resistance
Conductance G = 1/R (S). Option D defines conductance indirectly via Ohm's law but current/voltage ratio gives conductance only when R=1Ω — not a definition. Option A is the direct NCERT definition.

Q4 — Answer: (A) Charge passed through solution
m = ZQ = ZIt; mass depends on total charge (Q = It), not temperature, solvent, or area. The trap is "molecular weight" — students confuse it with equivalent weight, which appears in Faraday's second law, not the first.

Q5 — Answer: (A) Ecell < 0
A spontaneous galvanic cell requires Ecell > 0 and ΔG < 0. When Ecell < 0, ΔG = −nFE becomes positive, confirming non-spontaneity. Option C is the trap — ΔG < 0 is the spontaneity condition, not the non-spontaneity condition.

Q6 — Answer: (A) Oxidation electrode
Anode is defined as the electrode where oxidation occurs — electrons are released here and flow through the external circuit to the cathode. The sign (negative) follows from this electron release.

Q7 — Answer: (A) 1 M concentration, 1 bar pressure, 298 K
NCERT specifies 1 bar (not 1 atm) and 298 K as standard conditions; 1 atm ≈ 1.013 bar, making Option B a common trap. Option D pairs atm with 298 K — wrong pressure unit. Standard temperature is 298 K, not 273 K.

Q8 — Answer: (B) Cathode
The object to be plated is the cathode; metal ions from the solution deposit on it by reduction. The anode is the source metal that oxidizes to replenish ions. Connecting it as anode would dissolve the object instead.

Q9 — Answer: (A) NH_4Cl and $ZnCl_2$ paste
The dry cell uses a moist paste of NH_4Cl and $ZnCl_2$ as electrolyte — not a liquid. H_2SO_4 is used in lead storage batteries. KOH is the electrolyte in mercury and alkaline cells.

Q10 — Answer: (B) 10^2
Using log K = nE°cell/0.0591 = (2×0.0591)/0.0591 = 2, hence K = 10^2. Options A, C and D do not satisfy this relation.

Q11 — Answer: (C) Concentration of ions and temperature
Nernst: E = E° − (RT/nF)ln Q. Q contains ion concentrations; R, T, F are constants with T appearing explicitly. Pressure and mass of electrodes do not appear in the equation.

Q12 — Answer: (A) 1.10 V
When Q = 1, ln Q = 0, so the Nernst correction term = 0; therefore Ecell = E° = 1.10 V regardless of n. Option B halves E° incorrectly. Option C subtracts 0.0591 without basis (log 1 = 0, not 1).

Q13 — Answer: (A) Ag deposits first, then Hg, Cu
Species with more positive reduction potential is preferentially reduced. Ag^+ (+0.80V) deposits first, then Hg_2^{2+} (+0.79V), then Cu^{2+} (+0.34V) last. More voltage must be applied to reduce the less positive species.

Q14 — Answer: (A) Loss of electrons
Oxidation is defined as loss of electrons (OIL — Oxidation Is Loss). Gain of electrons is reduction. Protons and neutrons are not involved in redox definitions.

Q15 — Answer: (A) When reaction reaches equilibrium (Q = K)
At equilibrium Q = K, so ln(Q/K) = 0, making Ecell = 0 by Nernst equation. Option B is wrong because high temperature alone does not set Q = K unless equilibrium is reached. Option D affects current flow, not EMF.

Q16 — Answer: (A) Oxidising agent
The substance that gains electrons is reduced, and by definition acts as the oxidising agent. A reducing agent loses electrons (gets oxidised). Catalysts and spectator ions do not undergo electron transfer.

Q17 — Answer: (C) -1
In peroxides (O–O bond), oxygen has oxidation number -1, not the usual -2. This is a direct NCERT exception. Option A (-2) is the most common wrong choice.

Q18 — Answer: (D) Cu^{2+}
Cu^{2+} gains electrons and is reduced to Cu, making it the oxidising agent. Zn loses electrons and is oxidised, making it the reducing agent.

Q19 — Answer: (B) Increase in oxidation number; electrons lost
Oxidation = increase in oxidation number = loss of electrons. Option C is the classic trap: students confuse increase in oxidation number with electron gain (which is actually reduction).

Q20 — Answer: (B) SO_4^{2-}
In SO_4^{2-}, sulfur is +6 (highest). H_2S = -2, SO_2 = +4, $S_2O_3^{2-}$ = +2 average. $S_2O_3^{2-}$ is a strong trap as students may confuse it with SO_4^{2-}.

Q21 — Answer: (C) Oxidation
Fe^{2+} loses one electron to become Fe^{3+} — oxidation number increases from +2 to +3, which is oxidation. Reduction would require a decrease in oxidation number.

Q22 — Answer: (D) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
Only Zn + HCl involves electron transfer: Zn (0→+2) and H (+1→0). Options A, B, C are ionic/combination reactions with no change in oxidation numbers.

Q23 — Answer: (A) 5
Using x + 3(−2) = −1: x = +5. Options +3 and +1 are traps for students who miscalculate the ion charge or count oxygen incorrectly.

Q24 — Answer: (B) It gets oxidised during reaction
A reducing agent loses electrons and thereby gets oxidised (increases its own oxidation number). Option A is the classic confusion with oxidising agent behaviour.

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