KIRUBHA ACADEMICS

CBSE-CLASS XII	Chemistry	Worksheet 1: Electrochemistry
Name: _____	Date: _____	Time: 60 minutes Max Marks: 28

Unit weightage: 9 marks (highest-weightage chapter in the syllabus)

General Instructions: This worksheet has four sections — A (MCQs), B (Very Short Answer), C (Short Answer), D (Long Answer). Attempt all questions. Standard electrode potential values (E°) may be assumed as per NCERT tables where required.

Section A — Multiple Choice Questions (1 mark each)

Q1. Which of the following is the correct unit for molar conductivity? *[1 mark]*

(a) S cm2 mol^{-1} (b) S cm^{-1} (c) S mol (d) Ω cm

Q2. For the cell reaction $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$, if $E°_{cell}$ = 1.10 V, the value of $\Delta G°$ is: *[1 mark]*

(a) −212.3 kJ (b) +212.3 kJ (c) −106.15 kJ (d) +106.15 kJ

Q3. Kohlrausch's law of independent migration of ions is used to determine: *[1 mark]*

(a) Molar conductivity of weak electrolytes at infinite dilution (b) Degree of dissociation only (c) EMF of a cell (d) Rate of a reaction

Q4. In a galvanic cell, the electrode at which oxidation occurs is called the: *[1 mark]*

(a) Cathode (b) Anode (c) Salt bridge (d) Reference electrode

Q5. According to Faraday's first law of electrolysis, the mass of substance deposited is directly proportional to: *[1 mark]*

(a) Time only (b) Current only (c) Quantity of charge passed (d) Resistance of the cell

Section B — Very Short Answer Questions (2 marks each)

Q6. Define 'limiting molar conductivity'. Why does molar conductivity increase with dilution for both strong and weak electrolytes? *[2 marks]*

Q7. State Nernst equation for a general electrochemical cell reaction and explain the significance of each term. *[2 marks]*

Q8. Differentiate between an electrolytic cell and a galvanic cell on the basis of energy conversion. *[2 marks]*

Q9. What is meant by 'corrosion'? Write the overall reaction involved in the rusting of iron. *[2 marks]*

Section C — Short Answer Questions (3 marks each)

Q10. Calculate the EMF of the following cell at 298 K:Mg(s) | Mg^{2+}(0.001 M) || Cu^{2+}(0.0001 M) | Cu(s)Given E°cell = 2.71 V. (Use Nernst equation; log values may be approximated.) *[3 marks]*

Q11. The conductivity of 0.20 M solution of KCl at 298 K is 0.0248 S cm^{-1}. Calculate its molar conductivity. *[3 marks]*

Q12. Describe the working of a hydrogen–oxygen fuel cell with the help of electrode reactions. State two advantages of fuel cells over conventional batteries. *[3 marks]*

Section D — Long Answer Questions (5 marks each)

Q13. (a) Derive the relationship between Gibbs free energy change (ΔG°) and standard EMF (E°cell) of a cell.(b) A voltaic cell is set up at 298 K using the following half-cells: Ag^{+}(0.001 M) | Ag and Cu^{2+}(0.10 M) | Cu.Write the cell representation, calculate the EMF of the cell, and mention which electrode acts as the cathode. (E°Ag+/Ag = 0.80 V, E°Cu2+/Cu = 0.34 V) *[5 marks]*

Answer Key & Marking Notes

Section A

1. (a) S cm² mol⁻¹ 2. (a) −212.3 kJ (ΔG° = −nFE°cell = −2 × 96500 × 1.10 J) 3. (a) Molar conductivity of weak electrolytes at infinite dilution 4. (b) Anode 5. (c) Quantity of charge passed

Section B

6. Λ°m is the molar conductivity at zero concentration (infinite dilution). It increases on dilution because ionic interactions decrease, allowing greater ionic mobility; for weak electrolytes it also increases due to greater degree of dissociation.

7. Ecell = E°cell − (RT/nF) ln Q [or (0.0591/n) log Q at 298 K]. R = gas constant, T = temperature, n = number of electrons transferred, F = Faraday constant, Q = reaction quotient.

8. Electrolytic cell converts electrical energy into chemical energy (non-spontaneous reaction driven by external current); galvanic cell converts chemical energy into electrical energy (spontaneous redox reaction).

9. Corrosion is the gradual deterioration of a metal due to reaction with atmospheric gases/moisture. Rusting: $4Fe + 3O_2 + 2xH_2O \rightarrow 2Fe_2O_3.xH_2O$ (hydrated ferric oxide).

Section C

10. Using Ecell = E°cell − (0.0591/2) log([Mg2+]/[Cu2+]); substitute values and simplify to get Ecell ≈ 2.68 V (show full log-step working for full marks).

11. $\Lambda m = (\kappa \times 1000)/C = (0.0248 \times 1000)/0.20 = 124$ S cm² mol⁻¹.

12. Anode: $2H_2 + 4OH^- \rightarrow 4H_2O + 4e^-$; Cathode: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$. Advantages: pollution-free (water as byproduct), higher efficiency than conventional fuel-burning methods.

Section D

13(a). ΔG° = −nFE°cell (derived by equating electrical work done by the cell to the free energy change of the reaction).

13(b). Cell representation: Cu(s) | Cu2+(0.10 M) || Ag+(0.001 M) | Ag(s). E°cell = 0.80 − 0.34 = 0.46 V. Apply Nernst equation with n = 2 to get Ecell; Ag electrode acts as cathode (higher reduction potential).