



Attempt all questions before checking the answer key.
Use $F = 96500 \text{ C/mol}$ and $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$. At 298 K use $E = E^\circ - (0.0591/n) \log Q$.

A. Very short answers - 1 mark each

1. Where does oxidation occur in a galvanic cell?
2. Define standard electrode potential.
3. What is the role of a salt bridge?
4. State the SI unit of conductivity.
5. What happens to molar conductivity of a weak electrolyte on dilution?
6. Write the relation between standard cell potential and standard Gibbs energy change.

B. Short answers / practice - 2 marks each

7. Write cell notation and half-reactions for a Zn-Cu galvanic cell.
8. For $E^\circ(\text{Cu}^{2+}/\text{Cu}) = +0.34 \text{ V}$ and $E^\circ(\text{Zn}^{2+}/\text{Zn}) = -0.76 \text{ V}$, find E°_{cell} .
9. Distinguish conductivity from molar conductivity and explain their different trends on dilution.
10. State Kohlrausch's law of independent migration of ions.
11. Why is an ordinary dry cell called a primary cell?
12. Write the overall reaction in a hydrogen-oxygen fuel cell.
13. Find charge carried by 0.10 mol electrons.
14. Does oxidation always occur at the anode?
15. Find conductance of a 200Ω solution.
16. Find ΔG° for $n=2$ and $E^\circ=1.0 \text{ V}$.
17. Can a cell with $E_{\text{cell}}=0$ deliver a spontaneous net current at equilibrium?
18. Find silver deposited by 965 C from Ag^+ ; $M_{\text{Ag}}=108 \text{ g/mol}$.

C. Short answers - 3 marks each

19. Find E_{cell} at 298 K for $\text{Zn}|\text{Zn}^{2+}(0.10 \text{ M})||\text{Cu}^{2+}(0.010 \text{ M})|\text{Cu}$, given $E^\circ_{\text{cell}} = 1.10 \text{ V}$.
20. A conductivity cell has cell constant 1.25 cm^{-1} and resistance 250Ω . Find conductivity and molar conductivity for a 0.10 M solution.

21. Using $\Lambda^\circ(\text{HCl}) = 426$, $\Lambda^\circ(\text{NaCl}) = 126$ and $\Lambda^\circ(\text{CH}_3\text{COONa}) = 91 \text{ S cm}^2/\text{mol}$, calculate $\Lambda^\circ(\text{CH}_3\text{COOH})$.

22. A weak acid has molar conductivity $40 \text{ S cm}^2/\text{mol}$ at 0.01 M and limiting value $400 \text{ S cm}^2/\text{mol}$. Find degree of dissociation and K_a using the concentration approximation.

23. How much copper is deposited by 2 A in 30 min from Cu^{2+} solution? Use molar mass 63.5 g/mol and 100% current efficiency.

24. Explain corrosion of iron as an electrochemical process, identifying anodic and cathodic regions.

D. Long answers - 5 marks each

25. Derive the Nernst equation from Gibbs energy relations. Apply it to a Daniell cell and explain concentration effects and the equilibrium condition.
26. Derive the relation between E°_{cell} and equilibrium constant. Calculate $\log K$ at 298 K for a two-electron cell with $E^\circ_{\text{cell}} = 0.1773 \text{ V}$.
27. Explain measurement of conductivity using a conductivity cell. Define cell constant and molar conductivity, and sketch limiting-dilution trends for strong and weak electrolytes.
28. Describe the lead storage battery during discharge with balanced electrode and overall reactions. Explain what reverses on charging and why it is a secondary cell.
29. State Faraday's laws. The same charge passes through Ag^+ and Cu^{2+} solutions; if 1.08 g Ag is deposited, find copper mass and charge using molar masses $\text{Ag } 108$ and $\text{Cu } 63.5 \text{ g/mol}$.
30. Explain a hydrogen-oxygen fuel cell with electrode reactions in alkaline medium. Compare it with combustion in terms of energy conversion and discuss why continuous reactant supply is needed.

ANSWER KEY - Numerical / short answers

8) 1.10 V . 13) 9650 C . 14) Yes, in both galvanic and electrolytic cells. 15) 0.005 S . 16) -193 kJ/mol of reaction. 17) No. 18) 1.08 g . 19) 1.07045 V . 20) 0.0050 S/cm ; $50 \text{ S cm}^2/\text{mol}$. 21) $391 \text{ S cm}^2/\text{mol}$. 22) $\alpha=0.10$; $K_a \approx 1.11 \times 10^{-4} \text{ mol/L}$. 23) 1.184 g . 26) $\log K=6$; $K=10^6$. 29) $\text{Cu } 0.3175 \text{ g}$; charge 965 C .