SmartKalike

CBSE Class 12 · Chemistry

Electrochemistry

10 most probable questions for Boards 2027

Q1. 1 mark · Very short answer

Write the overall reaction of a Daniell cell using zinc and copper(II) ions.

Answer

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$, combining zinc oxidation with copper(II) ion reduction.

Q2. 2 marks · Short answer

What is a galvanic cell? Explain how it converts the energy of a spontaneous redox reaction into electrical work.

Answer

A galvanic cell is an electrochemical cell that converts the chemical energy of a spontaneous redox reaction into electrical energy. The Gibbs energy of the redox reaction is converted into electrical work that can run a motor or other electrical gadgets.

Q3. 3 marks · Medium answer

For a Daniell cell, state how the cell potential changes when (i) the Cu^{2+} concentration is increased and (ii) the Zn^{2+} concentration is increased. Briefly explain the concentration dependence.

Answer

1. Increasing $[Cu^{2+}]$ decreases $Q = [Zn^{2+}]/[Cu^{2+}]$; therefore, Ecell increases according to $E_{cell} = E^\circ_{cell} - (RT/2F) \ln Q$.
2. Increasing $[Zn^{2+}]$ increases Q, so Ecell decreases.
3. The Nernst equation expresses the concentration dependence of cell potential; the pure solids Zn and Cu do not appear in Q because their activities are unity.

Q4. 5 marks · Long answer

Explain the conventions used to represent a galvanic cell, including the symbols for phase boundaries and the salt bridge and the expression for its emf. Also state why an individual half-cell potential cannot be measured directly and how the standard hydrogen electrode provides a reference potential.

Answer

A galvanic cell is represented by a notation that identifies its electrodes, electrolytes and cell potential.

1. The anode is written on the left and the cathode on the right. A vertical line separates a metal from its electrolyte solution; a double vertical line separates the two electrolytes connected by a salt bridge.
2. For example, the cell $Cu(s)|Cu^{2+}(aq)||Ag^{+}(aq)|Ag(s)$ follows this convention. Its emf is Ecell =

Eright − Eleft, or the cathode reduction potential minus the anode reduction potential.
3. The potential of an individual half-cell cannot be measured directly; only the difference between two half-cell potentials, which gives the cell emf, can be measured.
4. The standard hydrogen electrode (SHE), $Pt(s)|H_2(g)|H^+(aq)$, is assigned zero potential at all temperatures. It has platinum coated with platinum black, an acidic solution of 1 M H^+ and pure hydrogen at 1 bar. With the SHE as anode and the other half-cell as cathode, the cell emf gives the other half-cell's reduction potential under standard conditions.
Thus, the SHE provides the reference for determining standard electrode potentials.

Q5. 6 marks · Very long answer

Describe how the resistance of an electrolyte solution is measured using a conductivity cell and an AC source. Explain the role of the platinum electrodes coated with platinum black, derive the relation between resistance and conductivity for the solution column, and state how the cell constant is determined.

Answer

A conductivity cell is a vessel containing two platinum electrodes coated with platinum black, finely divided metallic Pt deposited electrochemically; the electrodes have area A and are separated by distance l, confining the solution as a column of length l and cross-sectional area A. The cell is connected as the unknown resistance in a Wheatstone bridge with an AC source, which prevents changes in solution composition, and its cell constant is determined using a KCl solution of known conductivity.

$R = \rho l/A$

$\kappa = 1/\rho$

$R = l/(\kappa A)$

$G^* = l/A$

$R = G^*/\kappa$

$\kappa = G^*/R$

$G^* = \kappa R$

$G^* = \kappa_{standard} R_{standard}$

$\therefore G^* = l/A = \kappa_{standard} R_{standard}$ (unit: $length^{-1}$)

Q6. 1 mark · Multiple choice

Which combination correctly describes the standard hydrogen electrode under standard conditions?
(A) Platinum coated with platinum black, immersed in 1 M acidic solution, with pure hydrogen at 1 bar bubbled over it
(B) Copper immersed in 1 M Cu^{2+} solution, with hydrogen at 1 bar bubbled over it
(C) Platinum immersed in neutral solution, with oxygen at 1 bar bubbled over it
(D) Zinc immersed in 1 M Zn^{2+} solution, with hydrogen at 1 bar bubbled over it

Full answer on SmartKalike: https://smartkalike.com/cbse/class-12/chemistry/electrochemistry

Q7. 2 marks · Multiple choice

Which statement correctly describes the electrode processes in a Daniell galvanic cell?
(A) Zinc is reduced at the cathode and Cu^{2+} is oxidised at the anode.
(B) Zinc is oxidised at the anode and Cu^{2+} is reduced at the cathode.
(C) Oxidation occurs at both electrodes.
(D) Reduction occurs at both electrodes.

Full answer on SmartKalike: https://smartkalike.com/cbse/class-12/chemistry/electrochemistry

Q8. 3 marks · Medium answer

Write the relation between molar conductivity, conductivity and concentration. Explain how molar conductivity changes on dilution and define its limiting value.

Full answer on SmartKalike: https://smartkalike.com/cbse/class-12/chemistry/electrochemistry

Q9. 5 marks · Long answer

At 298 K, calculate the cell potential for the reaction $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$, given $E°_{cell} = 1.10$ V, $[Zn^{2+}] = 0.10$ M and $[Cu^{2+}] = 1.0$ M. Use $n = 2$, $R = 8.314$ J mol^{-1} K^{-1} and $F = 96485$ C mol^{-1}.

Full answer on SmartKalike: https://smartkalike.com/cbse/class-12/chemistry/electrochemistry

Q10. 1 mark · Multiple choice

For a general cell reaction, which quantity replaces the reaction quotient in the Nernst equation when all species are in their standard states?
(A) The standard cell potential
(B) The equilibrium constant
(C) The number of electrons transferred
(D) The Faraday constant

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