

Electrochemistry Quiz Questions and Answers PDF

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Discuss the role of Gibbs free energy in determining the spontaneity of an electrochemical reaction.

The spontaneity of an electrochemical reaction is determined by the change in Gibbs free energy (ΔG). If ΔG is negative, the reaction is spontaneous; if ΔG is positive, the reaction is non-spontaneous.

What is the main purpose of electroplating?

- To generate electricity
- To prevent corrosion ✓**
- To increase weight
- To produce hydrogen gas

The main purpose of electroplating is to deposit a layer of metal onto a surface to enhance its properties, such as corrosion resistance, appearance, and conductivity.

Describe the process of electroplating and its industrial applications.

Electroplating involves immersively placing an object in a solution containing metal ions and applying an electric current, which causes the metal ions to reduce and deposit onto the object's surface. Industrial applications include jewelry making, automotive parts coating, electronic components, and creating corrosion-resistant surfaces.

What is the primary function of a salt bridge in a galvanic cell?

- To generate electrons
- To maintain electrical neutrality ✓
- To increase cell potential
- To provide a surface for the reaction

The primary function of a salt bridge in a galvanic cell is to maintain electrical neutrality by allowing the flow of ions between the two half-cells, thus completing the circuit and enabling the redox reactions to occur.

Explain how Faraday's laws of electrolysis are used to calculate the mass of a substance deposited at an electrode.

To calculate the mass of a substance deposited at an electrode using Faraday's laws of electrolysis, use the formula $m = (Q * M) / (n * F)$, where m is the mass, Q is the total electric charge, M is the molar mass of the substance, n is the number of electrons involved in the reaction, and F is Faraday's constant (approximately 96485 C/mol).

Describe how the Nernst equation is used to calculate cell potential under non-standard conditions.

The Nernst equation is given by $E = E^\circ - (RT/nF) \ln(Q)$, where E is the cell potential, E° is the standard cell potential, R is the universal gas constant, T is the temperature in Kelvin, n is the number of moles of electrons transferred, F is Faraday's constant, and Q is the reaction quotient. By substituting the actual concentrations of the reactants and products into the equation, one can calculate the cell potential for the reaction under non-standard conditions.

Which of the following is a characteristic of a galvanic cell?

- Requires an external power source
- Converts chemical energy into electrical energy ✓
- Involves the electrolysis of water
- Has no salt bridge

A galvanic cell is characterized by its ability to convert chemical energy into electrical energy through spontaneous redox reactions. It typically consists of two half-cells connected by a salt bridge, allowing for the flow of electrons and ions.

Which of the following statements about corrosion are true?

- It is a redox reaction ✓
- It can be prevented by electroplating ✓
- It only occurs in metals
- It can be minimized by cathodic protection ✓

Corrosion is a natural process that involves the deterioration of materials, typically metals, due to chemical reactions with their environment. Factors such as moisture, temperature, and the presence of salts can accelerate corrosion.

Explain the difference between a galvanic cell and an electrolytic cell.

The main difference between a galvanic cell and an electrolytic cell is that a galvanic cell converts chemical energy into electrical energy through spontaneous reactions, whereas an electrolytic cell requires an external power source to drive non-spontaneous reactions, converting electrical energy into chemical energy.

Discuss the mechanisms and methods used to prevent corrosion in metals.

The primary mechanisms to prevent corrosion include applying protective coatings (like paint or galvanization), utilizing cathodic protection systems (such as sacrificial anodes), and incorporating corrosion inhibitors in the environment to reduce the electrochemical reactions that lead to corrosion.

Which of the following are components of a galvanic cell?

- Anode ✓
- Cathode ✓
- Salt bridge ✓
- External power source

A galvanic cell consists of two electrodes (anode and cathode), an electrolyte, and a salt bridge that facilitates the flow of ions. These components work together to convert chemical energy into electrical energy through spontaneous redox reactions.

What does the Nernst equation calculate?

- Standard cell potential
- Gibbs free energy
- Cell potential under non-standard conditions ✓
- Equilibrium constant

The Nernst equation calculates the electrochemical potential of a cell under non-standard conditions, allowing for the determination of the voltage produced by a redox reaction based on the concentrations of the reactants and products.

In a redox reaction, which component is reduced?

- The oxidizing agent ✓
- The reducing agent

- The catalyst
- The electrolyte

In a redox reaction, the component that is reduced is the one that gains electrons. This process decreases its oxidation state.

Which of the following metals is used as the standard electrode in electrochemical cells?

- Copper
- Zinc
- Silver
- Hydrogen ✓

The standard electrode used in electrochemical cells is the standard hydrogen electrode (SHE). It serves as a reference point for measuring the electrode potentials of other half-cells.

In an electrolytic cell, the anode is:

- Positively charged ✓
- Negatively charged
- Neutral
- Not part of the cell

In an electrolytic cell, the anode is the electrode where oxidation occurs, and it is positively charged. This is opposite to a galvanic cell, where the anode is negatively charged.

Which of the following is a secondary battery?

- Alkaline battery
- Lead-acid battery ✓
- Zinc-carbon battery
- Lithium primary battery

A secondary battery is a type of rechargeable battery that can be discharged and recharged multiple times. Common examples include lithium-ion batteries and lead-acid batteries.

Which processes occur at the cathode in an electrochemical cell?

- Oxidation
- Reduction ✓
- Electron gain ✓

- Electron loss

At the cathode of an electrochemical cell, reduction reactions occur, where electrons are gained by the species present. This process is essential for the functioning of the cell, as it allows for the conversion of electrical energy into chemical energy.

What are the characteristics of a fuel cell?

- Converts chemical energy into electrical energy ✓
- Requires continuous fuel supply ✓
- Is rechargeable
- Produces water as a byproduct ✓

Fuel cells are electrochemical devices that convert chemical energy from fuels, typically hydrogen, into electricity, with water and heat as byproducts. They are characterized by high efficiency, low emissions, and the ability to operate continuously as long as fuel is supplied.

Which of the following are applications of electrochemistry?

- Electroplating ✓
- Fuel cells ✓
- Corrosion prevention ✓
- Photosynthesis

Electrochemistry has numerous applications including batteries, fuel cells, electroplating, and corrosion prevention. These applications leverage the principles of chemical reactions and electrical energy conversion.

What factors affect the cell potential of an electrochemical cell?

- Temperature ✓
- Concentration of solutions ✓
- Pressure ✓
- Type of salt bridge

The cell potential of an electrochemical cell is influenced by factors such as temperature, concentration of reactants and products, and the nature of the electrodes used.