

ELECTROCHEMICAL CELLS

21 MAY 2013

Lesson Description

In this lesson, we:

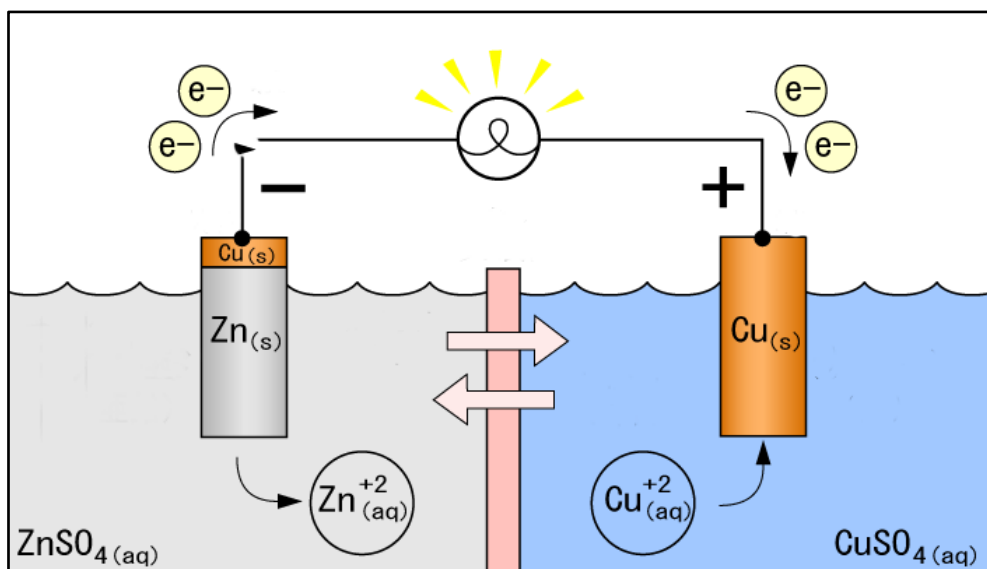
- Identify the two types of electrochemical cells
- Apply our knowledge of reduction and oxidation to understand what is taking place.
- Use electrochemical cells to make electricity and new chemicals.

Key Concepts

- Electrochemical cells fall into two categories:
- **Galvanic cells** turn **chemical potential energy** into **electrical energy**. They are spontaneous and give off energy.
- **Electrolytic cells** turn electrical energy into chemical potential energy. They are non-spontaneous and take in energy.

Galvanic Cells

- These change **Chemical Potential Energy** into **Electrical Energy**.
- What do we need?
 1. Two metals with different oxidising reducing ability.
 2. Electrolyte
- The Zinc-Copper cell is an excellent example of a galvanic cell



- Zinc electrode: $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$
- Copper electrode: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$
- Zinc is where oxidation takes place, we call this the "anode".
- Copper is where reduction takes place, this we call the "cathode".

Electrolytic Cells

- These change **Electrical Energy** into **Chemical Potential Energy**.
- What do we need?
 1. Two electrodes with a voltage across them.
 2. Electrolyte.
- Negative electrode: $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
- Positive electrode: $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{e}^- + 4\text{H}^+$

Terminology

Electrode	A conductive rod that moves electricity in and out of cells.
Cathode	The electrode where reduction takes place.
Anode	The electrode where oxidation takes place.
Oxidation	Loss of electrons.
Reduction	Gain of Electrons
Cell	A combination of reduction and oxidation half-reactions with an attached circuit.

Demonstration

We will be making a battery, using a lemon, zinc and copper.

When we plug in the different metals, the difference in reducing ability causes a spontaneous redox reaction and makes electricity in the process!

Questions

Question 1

(Adapted from Mar 2012, NSC, Paper 2, Question 2.8)

Which ONE of the following statements regarding a copper-silver galvanic cell is TRUE?

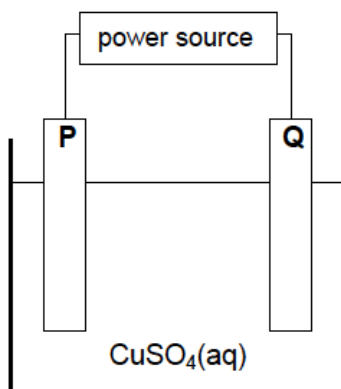
- A Silver is formed at the anode.
- B Copper is formed at the anode.
- C Silver is formed at the cathode
- D Copper is formed at the cathode.

(2)

Question 2

(Adapted from Mar 2012, NSC, Paper 2, Question 9)

The simplified diagram below represents an electrochemical cell used in the refining of copper. One of the electrodes consists of impure copper and the other one of pure copper.



- a.) What type of power source is used to drive the reaction in this cell? Write down only AC or DC. (1)
- b.) Give a reason why the copper(II) sulphate is dissolved in water before it is used in this cell. (1)

Links

- <http://www.mindset.co.za/learn/xtra>
- <http://www.education.gov.za/Examinations/PastExamPapers/tabid/351/Default.aspx>