

Exercise walk-through

9.8

Galvanic (Voltaic) and Electrolytic Cells

AP Chemistry

Galvanic and electrolytic cells

Galvanic : a **spontaneous** redox reaction makes electricity (a battery).

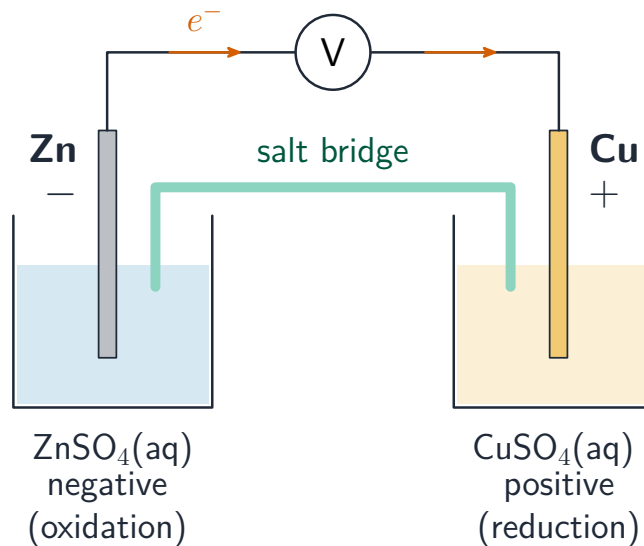
Electrolytic : an external voltage **drives** a nonspontaneous one.

Oxidation at the **anode** , reduction at the **cathode** . Electrons flow anode $\rightarrow$ cathode.



Cells convert chemical energy to electricity

A galvanic cell with a salt bridge and voltmeter



A galvanic cell with a salt bridge and voltmeter

The two kinds of electrochemical cell

Galvanic (voltaic) cell

A **galvanic (voltaic) cell** runs a spontaneous reaction ($\Delta G < 0$, $E_{cell}^{\circ} > 0$) and delivers electrical work – a battery.

Electrolytic cell

An electrolytic cell drives a non-spontaneous reaction with an external supply – plating, and the extraction of aluminium.

What is shared

Oxidation at the anode, reduction at the cathode, in both. Only the signs of the electrodes swap.

The link

$\Delta G^{\circ} = -nFE^{\circ}$ ties the cell potential to the free-energy change directly.

Sign of E_{cell}° decides which cell you have. Everything else about the two is the same chemistry.

Exercises 2.1-2.3

2.1 At which electrode does oxidation occur?

[1]

2.2 Which cell produces electricity from a favorable reaction?

[1]

2.3 In which direction do electrons flow in a galvanic cell?

[1]

Exercises 2.1-2.3

2.1 At which electrode does oxidation occur? [1]

2.1

- The anode
-

2.2 Which cell produces electricity from a favorable reaction? [1]

2.2

- A galvanic (voltaic) cell
-

2.3 In which direction do electrons flow in a galvanic cell? [1]

2.3

- From the anode to the cathode

Exercise 3.1

3.1 In any electrochemical cell, reduction occurs at the

[1]

☐

A anode

B cathode

C salt bridge

D wire

Exercise 3.1

3.1 In any electrochemical cell, reduction occurs at the

[1]

☐

A anode

B cathode

C salt bridge

D wire

3.1 B

- the cathode

Exercise 3.2 (a)

3.2 A galvanic cell uses $\text{Zn}|\text{Zn}^{2+}||\text{Cu}^{2+}|\text{Cu}$.

(a) Identify the anode and cathode.

[2]

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3.2 A galvanic cell uses $\text{Zn}|\text{Zn}^{2+}||\text{Cu}^{2+}|\text{Cu}$.

(a) Identify the anode and cathode.

[2]

(a)

- Anode: Zn (oxidized); cathode: Cu (where Cu^{2+} is reduced)

Exercise 3.2 (b)

3.2 A galvanic cell uses $\text{Zn}|\text{Zn}^{2+}||\text{Cu}^{2+}|\text{Cu}$.

(b) State the direction of electron flow.

[1]

Exercise 3.2 (b)

3.2 A galvanic cell uses $\text{Zn}|\text{Zn}^{2+}||\text{Cu}^{2+}|\text{Cu}$.

(b) State the direction of electron flow.

[1]

(b)

- From the Zn electrode to the Cu electrode

Exercise 3.3

3.3 Explain the difference between a galvanic and an electrolytic cell in terms of ΔG and energy. [2]

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3.3

- A galvanic cell runs a favorable reaction ($\Delta G < 0$) and **releases** electrical energy; an electrolytic cell uses an external power source to drive an unfavorable reaction ($\Delta G > 0$)