$Al^{3+}_{(aq)} + 3e^- \rightarrow Al_{(s)} \quad E^\circ = -1.66V$

Red: $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)} \quad E^\circ = 0.34V$

Ox: $Al_{(s)} \rightarrow Al^{3+}_{(aq)} + 3e^- \quad E^\circ = -1.66V$

$3Cu^{2+}_{(aq)} + 6e^- \rightarrow 3Cu_{(s)} \quad E^\circ = 0.34V$

$2Al_{(s)} \rightarrow 2Al^{3+}_{(aq)} + 6e^- \quad E^\circ = -1.66V$

$3Cu^{2+}_{(aq)} + 2Al_{(s)} \rightarrow 3Cu_{(s)} + 2Al^{3+}_{(aq)}$

$E^\circ_{cell} = E^\circ_{red} - E^\circ_{oxid.}$

$E^\circ_{cell} = (0.34V) - (-1.66V)$

$E^\circ_{cell} = 2.00V$

Electrolysis

Electrolysis - electrical energy is used to bring about a chemical energy

Electrolytic cell - electrochemical cell used to cause a chemical change through the application of electrical energy

- uses electrical energy to make a nonspontaneous reaction go to completion.

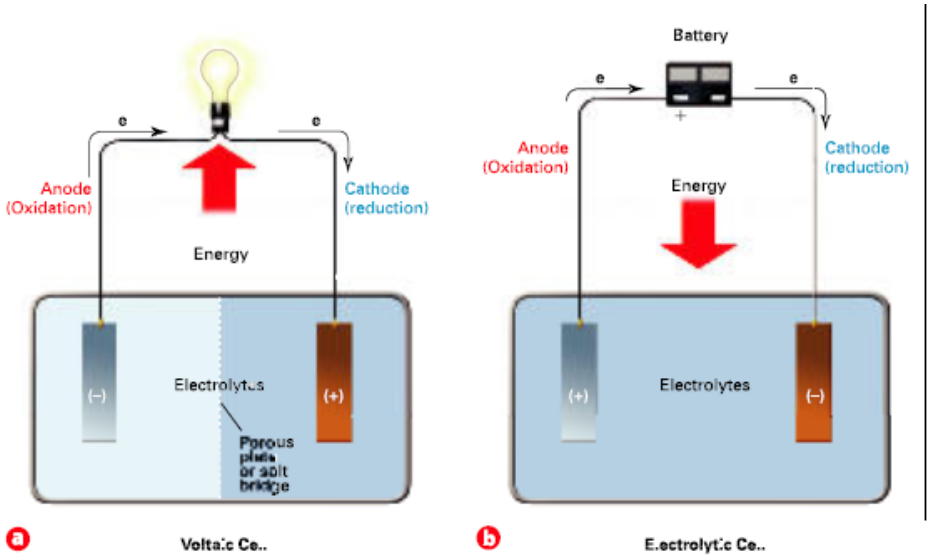
Difference between Voltaic and Electrolytic Cells

Voltaic cells - flow of electrons is the result of a spontaneous redox reaction

Anode - negative electrode
Cathode - positive electrode

Electrolytic cell - electrons are pushed by an outside power source (battery)

Anode - positive electrode
Cathode - negative electrode


e
e
Anode
(Oxidation)
Cathode
(reduction)
Energy
(–)
Electrolytes
(+)
Porous
plate
or salt
bridge
a
Voltaic Ce..
Battery
e
e
Anode
(Oxidation)
Cathode
(reduction)
Energy
(+)
Electrolytes
(–)
b
Electrolytic Ce..

Electrolysis of Water

The products of the electrolysis of water are hydrogen and oxygen gas.

Reduction: $2H_2O_{(l)} + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$

Oxidation: $2H_2O_{(l)} \rightarrow O_{2(g)} + 4H^+_{(aq)} + 4e^-$

$4H_2O_{(l)} + 4e^- \rightarrow 2H_{2(g)} + 4OH^-_{(aq)}$

$2H_2O_{(l)} \rightarrow O_{2(g)} + 4H^+_{(aq)} + 2H_{2(g)} + 4OH^-_{(aq)}$

$2H_2O_{(l)} \rightarrow O_{2(g)} + 2H_{2(g)}$

Electrolysis of Brine

If electrolyte in solution is more easily oxidized or reduced than water, the products of electrolysis will be substances other than hydrogen and oxygen.

brine - concentrated aqueous solution of sodium chloride

During electrolysis of brine, chloride ions are oxidized at the anode, and water is reduced at the cathode.

Reduction: $2H_2O_{(l)} + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$

Oxidation: $2Cl^-_{(aq)} \rightarrow Cl_{2(g)} + 2e^-$

Homework

p. 683 #20-25