10.1 Electrolysis

- In a galvanic cell $\Delta E>0$ and the reaction is spontaneous.
- In an electrolytic cell $\Delta E<0$ and the reaction is non spontaneous. (The strongest oxidizing agent is below the strongest reducing agent.)
- E.g. $Pb_{(s)} \mid ZnSO_{4(aq)} \mid Pb_{(s)}$

$Zn^{2+}_{(aq)} + 2\ e^- \rightarrow Zn_{(s)}$ $\quad E_r° = -0.76$ V

$Pb_{(s)} \rightarrow Pb^{2+}_{(aq)} + 2\ e^-$ $\quad E_r° = -0.13$ V

$\Delta E° = -0.89$ V

This reaction will not take place (non-spontaneous) and will not produce electricity.

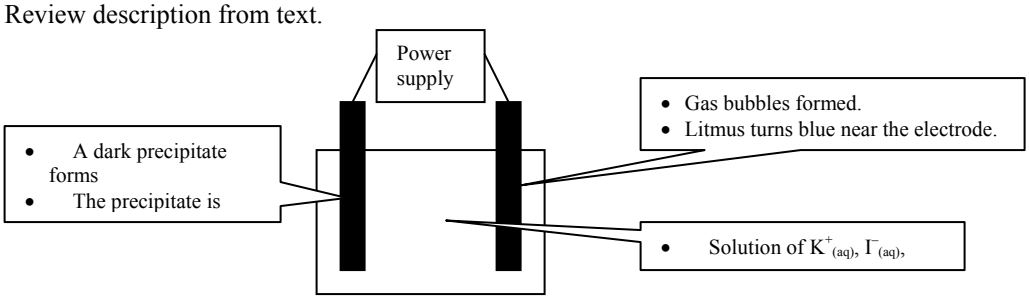
- The example above in not very useful for a battery but if you apply an electrical charge you can force the reaction to take place. This is useful in the purification of metals such as zinc and nickel.
- In the refining process, INCO uses electrolysis to refine impure nickel into 99% pure nickel.
- Electrolytic Cell: a cell that consists of a combination of two electrodes, an electrolyte, and an external battery or power source.
- Electrolysis: the process of supplying electrical energy to force a non-spontaneous redox reaction to occur.

$$\text{reactants} \underset{\text{electrolytic cell}}{\overset{\text{electric/galvanic cell}}{\rightleftharpoons}} \text{products} + \text{electrical energy}$$

- See table 1 on page 731 to see the comparisons between a galvanic cell and an electrolytic cell.
- Secondary batteries are good examples of both a galvanic and electrolytic cell. As the battery discharges it undergoes a galvanic redox reaction. When it is charged, electrons are added and it undergoes electrolysis and the redox reaction is reversed.

The Potassium Iodide Electrolytic Cell: A Synthesis

- Review description from text.



OA *SOA*

$K^+_{(aq)}, I^-_{(aq)}, H_2O_{(l)}$

SRA

bubbles *blue litmus*

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

Anode: $2I^- \rightarrow I_{2(s)} + 2\ e^-$

purple in cyclohexane

The strongest reducing agent present in the mixture has the least attraction for electrons and loses electrons at the anode.

- E.g. What is the cell potential of the above example.

OA *SOA*

$K^+_{(aq)}, I^-_{(aq)}, H_2O_{(l)}$

SRA

$2H_2O_{(l)} + 2\ e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$ $\quad E_r° = -0.83$V

$2I^- \rightarrow I_{2(s)} + 2\ e^-$ $\quad E_r° = +0.54$V

$2H_2O_{(l)} + 2I^- \rightarrow H_{2(g)} + 2OH^-_{(aq)} + I_{2(s)}$ $\quad \Delta E° = -1.37$ V