Chemistry 12

Electrochemistry V

Name:
Date:
Block:

1. **Electrolysis**
2. **Electrolytic Cell**

Electrolysis

Electrolysis: the transformation of ____________________ energy into ____________________ energy.

- Used mainly in industry to ____________________ a compound into its elements.
- The electrodes used are often inert (non-reactive) materials – just involved in electron transfer

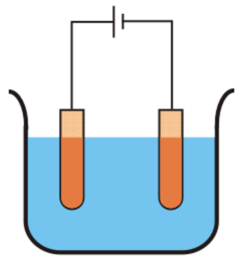
Electrochemical Cell	Electrolytic Cell
• __________ electricity. • Transforms _______________ energy into _______________ energy.	• __________ electricity. • Transforms _______________ energy into _______________ energy.
• __________ a voltage source.	• __________ a voltage source.
• __________ half cells.	• __________ cell.
• ____________________ redox reaction. • E^o is _______________.	• ____________________ redox reaction. • E^o is _______________.
• __________ salt bridge	• __________ salt bridge.
• Diagram:	• Diagram:
• Oxidation half reaction is _______________ the reduction half reaction in the SRP table.	• Oxidation half reaction is _______________ the reduction half reaction in the SRP table.
• Will use the _______________ OA and the_______________ RA.	• Will use the _______________ OA and the_______________ RA.
• Electrons travel from the _______________ to the _______________.	• Electrons travel from the _______________ to the _______________.

What Am I?

1. I have 2 half cells.
2. My oxidation half-reaction is: Ni → Ni^{2+} + 2 e- and my reduction half reaction is Fe^{2+} + 2 e- → Fe
3. Oxidation occurs at my anode.
4. I transform chemical energy into electricity
5. In order to flow, the electrical charge requires a complete path or circuit.
6. You can use the SRP table to calculate how much voltage is "takes" to operate me.
7. My E^o is +0.94V.

Electrolytic Cells

THINGS TO CONSIDER:



Liquid Content:

Molten
"melted"

Ex.

Aqueous
"dissolved in water"

Ex.

Electrodes:

Inert
"non-reactive"

Ex.

Non-inert
"reactive"

Ex.

Overpotential Effect of WATER:

H_2O exhibits a higher potential than its true position on the table and therefore needs to be re-positioned.

H_2O as a REDUCING Agent

Half Reaction:

E^o=

H_2O as an OXIDIZING Agent

Half Reaction:

E^o=

Oxidizing Agents		Reducing Agents	E° (Volts)
$ClO_4^- + 8H^+ + 8e^-$	⇄	$Cl^- + 4H_2O$	+1.39
$Cl_{2(g)} + 2e^-$	⇄	$2Cl^-$	+1.36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇄	$2Cr^{3+} + 7H_2O$	+1.23
$\frac{1}{2}O_{2(g)} + 2H^+ + 2e^-$	⇄	H_2O	+1.23
$MnO_{2(s)} + 4H^+ + 2e^-$	⇄	$Mn^{2+} + 2H_2O$	+1.22
$IO_3^- + 6H^+ + 5e^-$	⇄	$\frac{1}{2}I_{2(s)} + 3H_2O$	+1.20
$Br_{2(\ell)} + 2e^-$	⇄	$2Br^-$	+1.09
$AuCl_4^- + 3e^-$	⇄	$Au_{(s)} + 4Cl^-$	+1.00
$NO_3^- + 4H^+ + 3e^-$	⇄	$NO_{(g)} + 2H_2O$	+0.96
$Hg^{2+} + 2e^-$	⇄	$Hg_{(\ell)}$	+0.85
$\frac{1}{2}O_{2(g)} + 2H^+(10^{-7} M) + 2e^-$	⇄	H_2O	+0.82
$2NO_3^- + 4H^+ + 2e^-$	⇄	$N_2O_4 + 2H_2O$	+0.80
$Ag^+ + e^-$	⇄	$Ag_{(s)}$	+0.80
$Cr^{3+} + e^-$	⇄	Cr^{2+}	−0.41
$2H_2O + 2e^-$	⇄	$H_2 + 2OH^-(10^{-7} M)$	−0.41
$Fe^{2+} + 2e^-$	⇄	$Fe_{(s)}$	−0.45
$Ag_2S_{(s)} + 2e^-$	⇄	$2Ag_{(s)} + S^{2-}$	−0.69
$Cr^{3+} + 3e^-$	⇄	$Cr_{(s)}$	−0.74
$Zn^{2+} + 2e^-$	⇄	$Zn_{(s)}$	−0.76
$Te_{(s)} + 2H^+ + 2e^-$	⇄	H_2Te	−0.79
$2H_2O + 2e^-$	⇄	$H_{2(g)} + 2OH^-$	−0.83
$Mn^{2+} + 2e^-$	⇄	$Mn_{(s)}$	−1.19

Overpotential Effect

Overpotential Effect

Example 1: Identify the half-reactions occurring in an electrolytic cell with carbon electrodes in molten MgI_2 and predict the voltage required to operate this cell.

- Identify the oxidizing agent and the reducing agent.

- Write the two half-reactions and calculate the voltage required.

- Draw the electrolytic cell:

Example 2: Identify the half-reactions that occur in the electrolysis of an aqueous solution of manganese (II) bromide with platinum electrodes and predict the voltage required to operate this cell.

- Identify the oxidizing agent and the reducing agent.

- Write the two half-reactions and calculate the voltage required.

- Draw the electrolytic cell:

Example 3: Identify the half-reactions that occur in an electrolytic cell consisting of copper electrodes in an aqueous solution of $CrBr_3$ and predict the voltage required to operate this cell.

- Identify the oxidizing agent and the reducing agent.

- Write the two half-reactions and calculate the voltage required.

- Draw the electrolytic cell:

Practice:

For the following, draw the electrolytic cell and the half-reactions occurring within it and the voltage required to operate the cell.

1. Platinum electrodes in $CaSO_{4(aq)}$

2. Iron electrodes in $NaCl_{(aq)}$

3. Carbon electrodes in molten $NiBr_2$

4. Inert electrodes in $CuBr_{2\,(aq)}$

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