

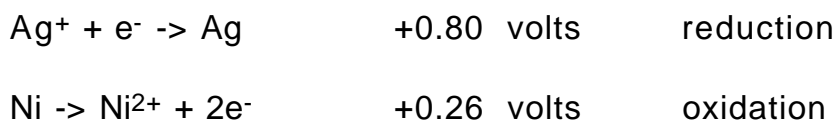
Chem12 Voltages in Electrochemical Cells : Notes/W.S. - 30

In the Standard Reduction Table, the voltages for half cell reactions are given. The half-cell reaction : $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ is assigned a voltage of 0.0 volts. This is arbitrary as the half-cell reaction : $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ which is assigned a voltage of 0.34 volts could have been assigned a voltage of 0.0 volts. This would make the hydrogen half-cell voltage equal to -0.34 volts. These half-cell voltages are relative.

These voltages do not mean anything by themselves, as a reduction cannot occur without an oxidation. The important thing is the difference in voltages between the reduction half-reaction and the oxidation half-reaction. We can then find the voltage that a particular electrochemical cell can produce under standard conditions.

Examples :

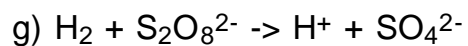
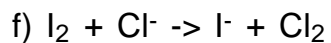
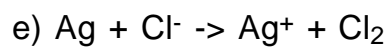
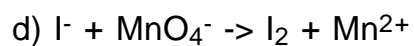
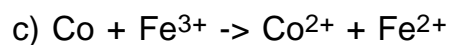
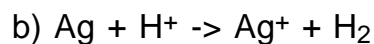
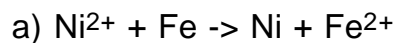
1) For a silver-nickel cell we have the following voltages :



The voltages are found in the table of reduction potentials. To find the voltage of the oxidation half-cell reaction, simply change the sign so that the nickel half-reaction has a voltage of +0.26 instead of -0.26 volts. The voltage of the cell can be found by simply **adding** the two voltages. $+0.80 + 0.26 = +1.06$ volts under standard conditions. The + sign means that the reaction is **spontaneous**. The standard conditions are : the cell electrodes are immersed in solutions with a concentration of 1.0 M, the temperature is 25°C and the pressure is 101.3 kPa (1.0 atmospheres).

2) In the above reaction : $2\text{Ag}^+ + \text{Ni} \rightarrow \text{Ni}^{2+} + 2\text{Ag}$, the overall voltage is positive so the reaction is **spontaneous**, therefore, it will proceed. For the reaction : $\text{Ni} + \text{Fe}^{2+} \rightarrow \text{Ni}^{2+} + \text{Fe}$, the cell voltage is -0.19 volts. When the cell voltage is negative, the reaction will be **non-spontaneous**. In this case energy must be supplied to the cell to make the reaction proceed.

Problems : 1) Using the Standard Reduction Potential tables, for the following redox reactions, find the cell potential, and indicate whether the reactions are spontaneous, non-spontaneous, or not possible.



Answers : 1)a) +0.19V, spontaneous, b) -0.80V, non-spontaneous, c) +1.05V, spontaneous, d) +0.97V, spontaneous, e) not possible (it is not a redox reaction), f) -0.82V, non-spontaneous, g) +2.01V, spontaneous.