Can we make a battery from a concentration gradient?

Our results from the $K^+$ cell say "yes we can!"

These batteries are called concentration cells

According to Nernst: \[ E_{\text{cell}} = E^\circ - \frac{RT}{nFE} \ln \frac{a_{K^+}^\circ}{a_{K^+}} \]

which was what we had before ($n = 1$)

In the previous example with Cu + Zn

we used the standard electrode potentials:

\[ \frac{1}{2} \text{Cu}^{2+} + e^- \rightarrow \frac{1}{2} \text{Cu} (s) \quad 0.339 \text{ V} \]

and:

\[ \frac{1}{2} \text{Zn}^{2+} + e^- \rightarrow \frac{1}{2} \text{Zn} (s) \quad -0.763 \text{ V} \]

These standard potentials allow us to calculate the EMF if the activities of all the components are equal to 1, if not we use Nernst.

In the book $V_0 = \Phi_\beta^0 + \Phi_\alpha^0$, but $\Phi_\alpha^0$ in this case has the opposite sign of the table of standard electrode potentials:

\[ \frac{1}{2} \text{Zn}^{2+} + e^- \rightarrow \frac{1}{2} \text{Zn} (s) \quad -0.763 \text{ V} \]

but

\[ \frac{1}{2} \text{Zn} (s) \rightarrow \frac{1}{2} \text{Zn}^{2+} + e^- \quad + 0.763 \text{ V} \]

this is the book's $\Phi_\beta^0$

We also use $V_0 = \frac{-\Delta G_{\text{f,_rxn}}^0}{nFE}$ to get $\Delta G_{\text{f,_rxn}}^0$