10.4

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: $V_{cell} = \cancel{V_0}^{\,0} - \frac{RT}{nF} \ln \frac{a^{\beta}_{K^+}}{a^{\alpha}_{K^+}}$ (since $E^o_{K^+} - E^o_{K^+} = 0$), which was what we had before $(n=1)$

In the previous example with Cu + Zn we used the standard electrode potentials:

$$\tfrac{1}{2}Cu^{2+} + e^- \rightarrow \tfrac{1}{2}Cu_{(s)} \quad 0.339\,V$$

and: $$\tfrac{1}{2}Zn^{2+} + e^- \rightarrow \tfrac{1}{2}Zn_{(s)} \quad -0.763\,V$$

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 $V_0 = \phi^{o\beta}_E + \phi^{o\alpha}_E$ but ϕ^{α}_E in this case has the opposite sign as the table of standard electrode potentials:

$$\tfrac{1}{2}Zn^{2+} + e^- \rightarrow \tfrac{1}{2}Zn_{(s)} \quad -0.763\,V$$

but $$\underbrace{\tfrac{1}{2}Zn_{(s)} \rightarrow \tfrac{1}{2}Zn^{2+} + e^-}_{\text{this is the books } \phi^{o\alpha}_E} \quad +0.763\,V$$

We also use $V_0 = \frac{-\Delta G^o_{rxn}}{nF}$ to get ΔG^o_{rxn}