Exercises 2:

1. Draw the current-voltage curve of the $Zn^{2+} - H^{+} - HSO_4^{-}$ system. Assume Nernst equation to be valid at the electrode, i.e. the total potential is sum of the electrode (Nernst) potential and the Galvani potential in the diffusion boundary layer. Use concentration ratios $[ZnSO_4]/[H_2SO_4]$ = 0.01, 0.1 and 1. Express the surface concentrations and draw the plots with I/I_{lim}. Electrode reaction is

$$Zn^{2+} + 2\,e^{-} \rightarrow Zn \qquad E^{0'}_{Zn^{2+}|Zn} = -0.7626\ V$$

2. Textbook problem 3.7. Misprint: $\boldsymbol{E^{0'}}$ **should be** $\boldsymbol{E(t=0)}$**.**

3. Textbook problem 3.9.

4. Solve the concentration profile $c_2(x,t)$ in the following potential step experiment:

$$\frac{\partial c_1}{\partial t} = D_1 \frac{\partial^2 c_1}{\partial x^2} \qquad c_1(x,0) = c_1^b,\ c_1(0,t) = 0,\ \left(\frac{\partial c_1}{\partial x}\right)_{x=0} = -\frac{I(t)}{nFD_1}$$

$$\frac{\partial c_2}{\partial t} = D_2 \frac{\partial^2 c_2}{\partial x^2} - kc_2 \qquad c_2(x,0) = 0,\ \left(\frac{\partial c_2}{\partial x}\right)_{x=0} = \frac{I(t)}{nFD_2}$$

5. Textbook problem 3.12.

6. In industrial electrolysis, zinc concentration is ca. 1 M and sulfuric acid concentration ca. 1.5 M. Using the Comsol model given in MyCourses, study the behavior of the system, i.e. the current-voltage curve, potential and concentration profiles. Give a high value (e.g. 1 cm/s) for the standard rate constant and notice the difference in the current-voltage curve, **the activation overpotential**.