

Exercise 2 “Electrolyte Conductivity and Cell Constant”

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Assistent: Adrian Mularczyk
 Tel.: (0)56-310-5726
 Email: adrian.mularczyk@psi.ch

Answers can be given in German or English. Antworten können in Deutsch oder Englisch gegeben werden.

Task 1 (5 Points):

The resistance (R) of $\text{La}_{1.7}\text{Bi}_{0.3}\text{Mo}_2\text{O}_{9.6}$ solid electrolyte was measured as a function of temperature (T):

$T, ^\circ\text{C}$	950	900	850	800
R, Ohm	62.8	76.1	96.3	128.1

Calculate the activation energy (E_a , $\text{kJ}\cdot\text{mol}^{-1}$) of conductivity (κ) assuming the following Arrhenius-like dependency:

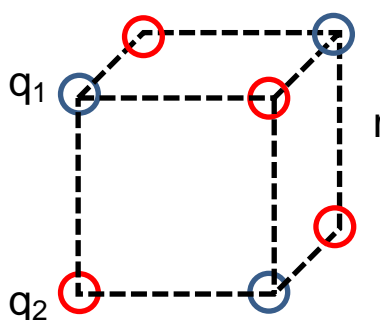
$$\kappa = \frac{\text{const}}{T} \exp\left(-\frac{E_a}{RT}\right)$$

Task 2 (5 Points):

20% (wt.) of NaOH solution (Density $1.210 \text{ g}\cdot\text{cm}^{-3}$) is filled into a reservoir between two electrodes with a surface area of $A = 4 \text{ cm}^2$ that are placed at a distance of $l = 16 \text{ cm}$. The electrical conductance of this solution L is $8.42 \cdot 10^{-2} \text{ S}$. Calculate the molar electrical conductivity of this solution (Λ_m).

Task 3 (5 Points):

How much less NaOH would have to be put into 20 ml of pure ethanol to obtain the same electrostatic force between dissolved charges as if it were put in 20 ml of pure water. Use Coulombs Law and assume full dissociation as well as an optimal distribution of charges with the dielectric constants of water (78.3) and ethanol (25.8).



Task 4 (5 Points):

Given: The conductivity of a 0.135M solution of propionic acid $\kappa_{\text{acid}} = 4.79 \times 10^{-4} \text{ S} \times \text{cm}^{-1}$ and the conductivity of 0.001M solution of sodium propionate $\kappa_{\text{salt}} = 7.54 \times 10^{-5} \text{ S} \times \text{cm}^{-1}$. The mobilities of Na^+ and H^+ are following: $\Lambda_{0_{\text{Na}^+}} = 44.4 \text{ S} \times \text{cm}^2 \times \text{mol}^{-1}$, $\Lambda_{0_{\text{H}^+}} = 349.8 \text{ S} \times \text{cm}^2 \times \text{mol}^{-1}$. Assuming that at the given concentration the salt is fully dissociated and ions don't interact with each other, calculate the dissociation constant of propionic acid.