

1. Calculate approximately the thickness of ionic atmosphere for 0.001M HCl at 25 °C. The dielectric constant for H₂O is 78.36.

$$\begin{aligned} \kappa^{-1} &= \sqrt{\frac{1000\varepsilon KT}{8\pi N_A e^2}} \frac{1}{\sqrt{I}} \\ &= \sqrt{\frac{1000 \cdot 78.36 \cdot (1.38 \cdot 10^{-16}) \cdot 298.15}{8 \cdot 3.14 \cdot (6.023 \cdot 10^{23}) \cdot (4.830 \cdot 10^{-10}) \cdot (4.803 \cdot 10^{-10})}} \frac{1}{\sqrt{0.001}} \\ &= \sqrt{\frac{3.2241 \cdot 10^{-9}}{25.12 \cdot (6.023 \cdot 10^{23}) \cdot (2.3069 \cdot 10^{-19}) \cdot 0.001}} \\ &= \sqrt{\frac{3.2241 \cdot 10^{-9}}{25.12 \cdot 138944.587 \cdot 0.001}} \\ &= \frac{\sqrt{3.2241 \cdot 10^{-9}}}{\sqrt{3490.288}} \\ &= \frac{5.6781 \cdot 10^{-5}}{59.07866} \\ &= 9.6111 \cdot 10^{-7} \text{ Cm} \\ &= 9.6111 \cdot 10^{-7} \cdot 10^{-2} \text{ m} \\ &= 9.6111 \cdot 10^{-9} \text{ m} \\ &= 9.6111 \cdot 10^{-9} \cdot \frac{10^{-1}}{10^{-1}} \\ \kappa^{-1} &= 96.11 \cdot 10^{-10} \text{ m} \end{aligned}$$

2. Calculate the thickness of ionic atmosphere for 0.01 M MgCl₂ at 25 °C. The dielectric constant for H₂O is 78.36.

$$\kappa^{-1} = \sqrt{\frac{1000\epsilon KT}{8\pi N_A e_0^2}} \frac{1}{\sqrt{I}}$$

$$= \sqrt{\frac{1000 * 78.36 * (1.38 * 10^{-16}) * 298.15}{8 * 3.14 * (6.023 * 10^{23}) * (4.803 * 10^{-10})^2}} \frac{1}{\sqrt{I}}$$

$$= \sqrt{\frac{3.2241 * 10^{-9}}{25.12 * 138944.587}} \frac{1}{\sqrt{I}}$$

$$I = \frac{1}{2} \sum C_i Z_i^2$$

$$= \frac{1}{2} [0.01(+2)^2 + 2 * 0.01(-1)^2]$$

$$= \frac{1}{2} [0.04 + 0.02]$$

$$= \frac{0.06}{2}$$

$$= 0.03$$

$$= \sqrt{\frac{3.2241 * 10^{-9}}{25.12 * 138944.587}} \frac{1}{\sqrt{0.03}}$$

$$= \sqrt{\frac{3.2241 * 10^{-9}}{25.12 * 138944.587 * 0.03}}$$

$$= \sqrt{\frac{3.2241 * 10^{-9}}{104708.6408}}$$

$$= \frac{\sqrt{3.2241 * 10^{-9}}}{\sqrt{104708.6408}}$$

$$= \frac{5.6781 * 10^{-5}}{323.5871}$$

$$= 1.7547 * 10^{-7} \text{ Cm}$$

$$\kappa^{-1} = 17.54 \text{ \AA}$$