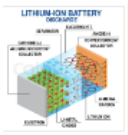
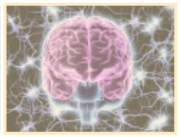
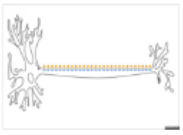
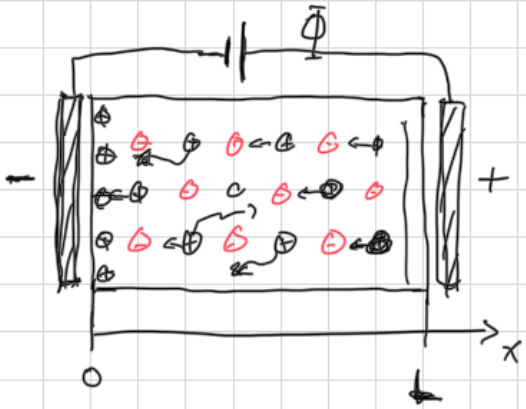
Electrolytes in electric fields



mobile
fixed

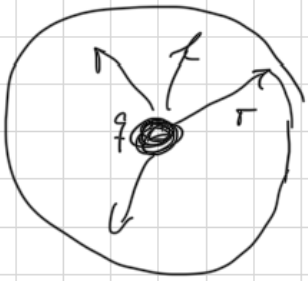


$\Phi(x=L) = \Phi_L$

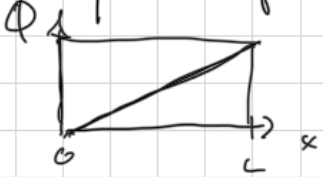
Electric potential Φ

- around a charge

$$\Phi(r) = \frac{1}{4\pi\varepsilon}\frac{q}{r}$$



- homogeneous field



$$\Phi(x) = \frac{x}{L}\Phi(L) = \frac{x}{L}\Phi_L$$

Electric field

$$\vec{E} = -\nabla\Phi$$

- around a charge : $\vec{E} = -\frac{1}{4\pi\varepsilon}\frac{q}{r^2}\hat{r}$
- homogeneous field : $\vec{E} = -\frac{\Phi(L)}{L} = -\frac{\Phi_L}{L}$

Force on a charge

$$\vec{F} = q\vec{E}$$

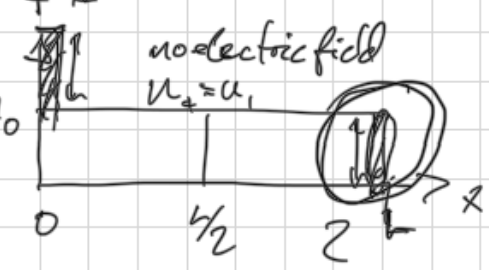
Potential energy of a charge in a field

$$\bar{F} = -\nabla U$$

$$q\bar{E} = -q\nabla\Phi = -\nabla U$$

$$U = q\Phi$$

Equilibrium



number of particles n_0

chemical equil

Chemical potential i electric field

$$\mu(x) = \mu_{int} + \mu_{ext}$$

$$= \mu_0(n_0) + kT \ln \frac{n(x)}{n_0} + q\Phi(x)$$

equilib cond. $\mu(x) = \text{const}$ $\mu(0) = \mu(L)$

$$kT \ln n(0) = kT \ln n(L) + q\Phi_L$$

$$\rightarrow \left| \frac{n(0)}{n(L)} = e^{\frac{q\Phi}{kT}} \right.$$

antisymmetric distribution

$n(\frac{L}{2}) = n_0$ $\quad n_0 = \dfrac{n(0) + n(L)}{2}$

$$n(0) = 2n_0 - n(L)$$

$$\frac{n(0)}{n(L)} = \frac{2n_0}{n(L)} - 1 = e^{\frac{q\Phi}{kT}}$$

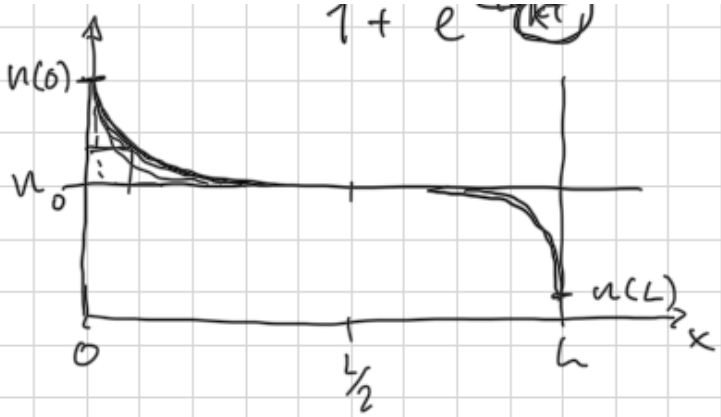
$$n(L) = \frac{2n_0}{1 + e^{q\Phi/kT}}$$

$$n(0) = 2n_0\left(1 - \frac{1}{1 + e^{q\Phi/kT}}\right)$$

$$= 2n_0\left(\frac{1 + e^{q\Phi/kT} - 1}{1 + e^{q\Phi/kT}}\right)$$

$$= \frac{2n_0}{1 + e^{-q\Phi/kT}}$$

$1 + e^{-(kT)}$



$$\mu(x) = kT \ln \frac{n(x)}{n_0} + q\phi = \mu_0$$

$$\frac{n(x)}{n_0} = e^{\frac{(q\phi - \mu_0)}{kT}}$$