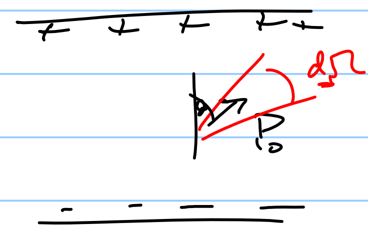
Lecture 37 April 24

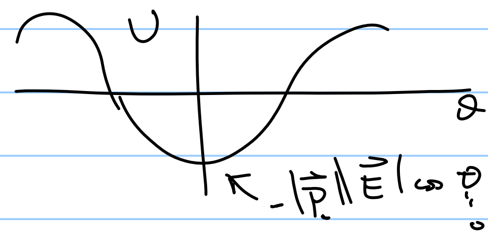
Note Title 4/24/2006

ways $\propto e^{-E/kT}$

H_2O permanent dipole moment



$U = -\vec{p}_0 \cdot \vec{E}$



$dV = r^2 \sin\theta \, d\theta \, d\varphi$

solid angle

$d\Omega = \sin\theta \, d\theta \, d\varphi$

$n(\theta) = n_0 e^{p_0 E \cos\theta / kT}$

↑ $\frac{\text{\# of molecules}}{\text{volume solid angle}}$

find normalization factor n_0

$$\int n(\theta) \, d\Omega = n_0 \int e^{pE\cos\theta/kT} \, d\Omega = N$$

↑ $\frac{\text{\# of molecules}}{\text{vol}}$

But we want $\vec{P}$ $\frac{\text{dipole mom}}{\text{vol}}$ ($\vec{E}$ along $\hat{z}$)

$$\int \underbrace{p_0 \cos\theta\, \hat{z}}\; n(\theta)\, d\Omega = \vec{P}$$

component of p_0 in $\hat{z}$ direction

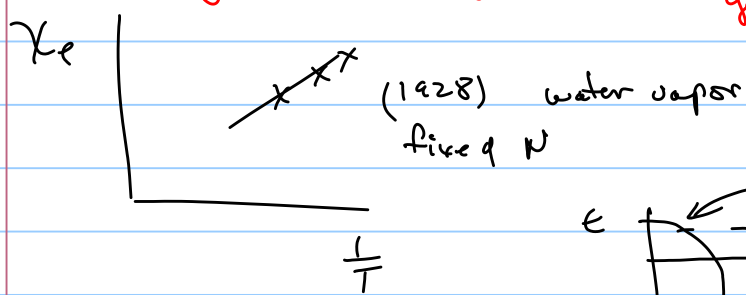
$n(\theta)$: $\frac{\#\text{ of molecules}}{\text{volume solid angle at } (\theta)}$

Assume $\vec{p}\cdot\vec{E} \ll kT$ $\qquad e^{\delta} \simeq 1 + \delta + \cdots$

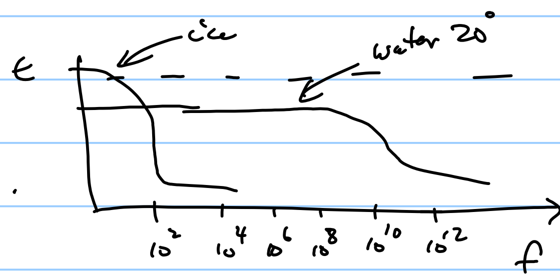
$$\vec{P} \simeq \frac{N p_0^2 \vec{E}}{3kT} = \chi_e \vec{E} \quad \text{linear dielectric}$$

$$K = \frac{\epsilon}{\epsilon_0} = 1 + \chi_e$$

Measuring capacitance get χ_e (macroscopic measurement yields p_0 dipole moment of H_2O)



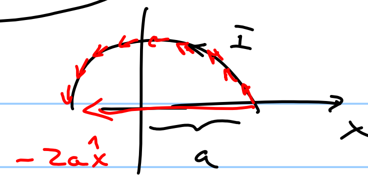
Vary freq of applied ϵ.



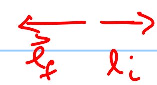
$$\int d\vec{F} = \int I \, d\vec{l} \times \vec{B} = I \left(\int d\vec{l} \right) \times \vec{B}$$

($\vec{B}$ constant)

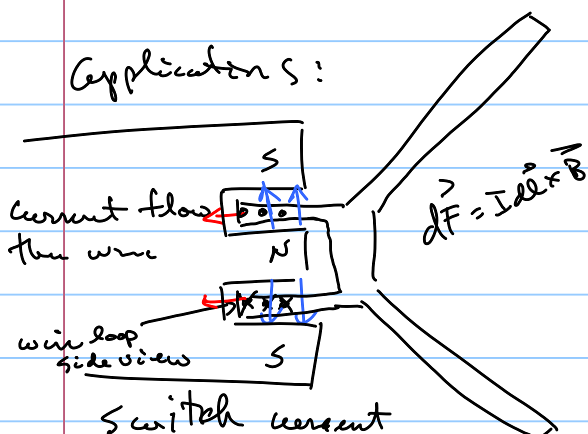
$$\int d\vec{l} = \int a \, d\theta \, \hat{\theta}$$



$$= \Delta\vec{l} = l_f - l_i$$



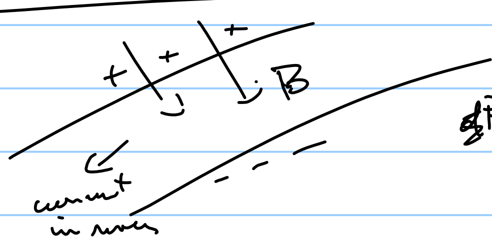
Applications:



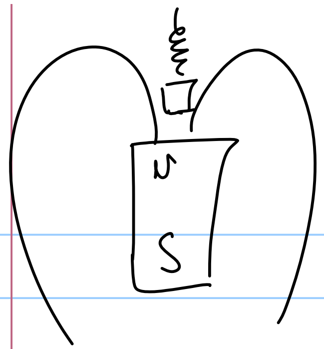
Switch current direction The force is to right

Faraday's law

$$Emf = -\frac{d\Phi_B}{dt}$$



$$\vec{F} = q\vec{v} \times B$$


N
S