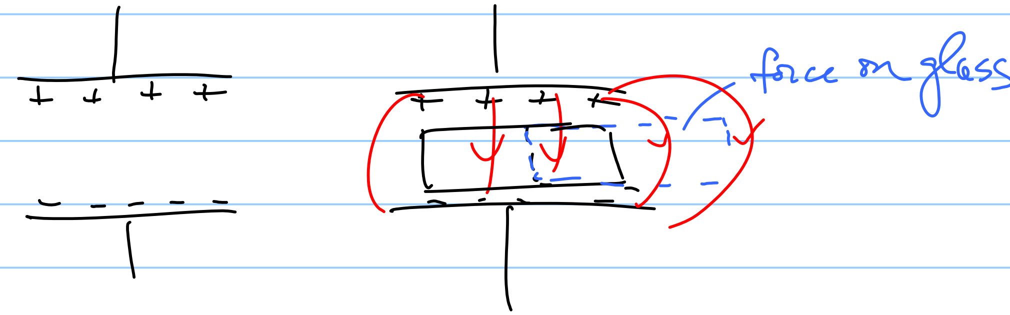
Lecture 22

Note Title 3/10/2006

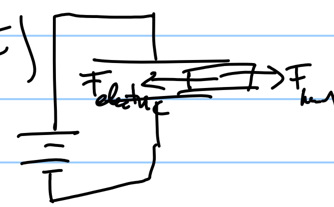


1.) find σ_b & ρ_b $\quad dF = dq\,E \quad$ hard

2.) Energy:

$$W_{NC} = \Delta(KE + PE)$$

choose "0"



$W_{me} + W_{battery}$ to maintain constant voltage

$$dW_{batt} = V\,dq$$

ΔPE_{cap}

$$\int dW_{conservative} = \int dq\,V(q) = \int dq\,\frac{q}{C} = \frac{1}{2}\frac{q^2}{C}$$

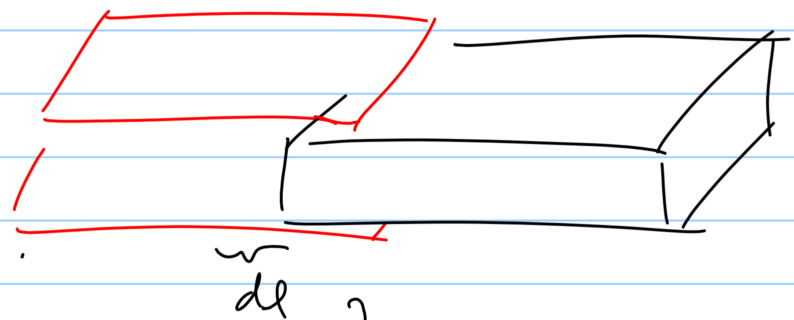
$$C = \frac{q}{V}$$

$$= \frac{1}{2} C V^2$$

assume no battery

$W_{me} = \Delta PE = \frac{1}{2}\frac{q^2}{C_f} - \frac{1}{2}\frac{q^2}{C_i}$

$dW = F_{me}\, dl = -\underset{\substack{\text{electric force}\\\text{on dielectric}}}{F}\, dl \Rightarrow F_{elec} = -\frac{dW}{dl}$



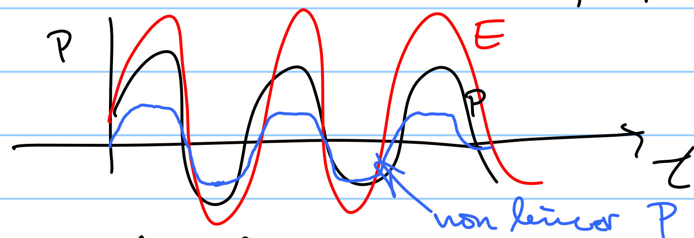
$\frac{dW}{dl} = \frac{d}{dl}\,\frac{1}{2}\frac{q^2}{C(l)}$

linear materials $\quad \vec{P} = \epsilon_0 \chi_e \vec{E}$

χ_e ← dimensionless

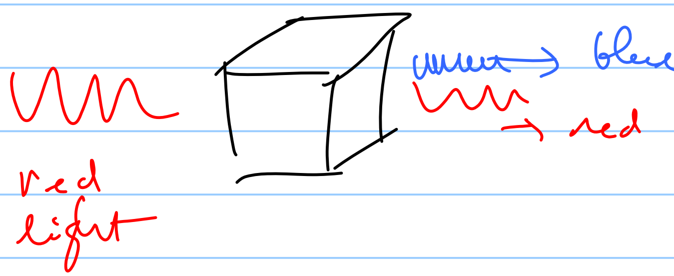
$\vec{D} = \epsilon_0 \vec{E} + \epsilon_0 \chi_e \vec{E} = \underbrace{\epsilon_0 (1+\chi_e)}_{\epsilon} \vec{E}$

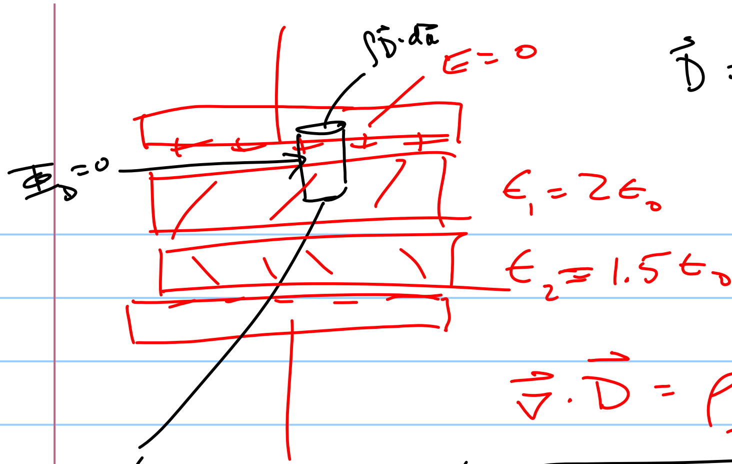
$\vec{E}(x,t) = E_0 e^{i(kx-\omega t)} \Rightarrow$ oscillating dipole $p = \alpha E$



Non linear material $\bar{P} = \epsilon_0 \chi_1 E + \epsilon_0 \chi_2 E^2 + \dots$

Fourier components of non linear motion
have fundamental $\omega \pm 2\omega$
O ~~scillating~~ dipole or accel generates radiation





$$\vec{D} = \epsilon_0 \overset{\overset{\text{metal}}{0}}{\vec{E}} + \underset{0}{\vec{P}} = 0$$

$$D = \epsilon E$$

$$\vec{\nabla}\cdot\vec{D} = \rho_f \Rightarrow \oint \vec{D}\cdot d\vec{a} = Q_f$$

$$D\cancel{A} = Q_{f\,\text{enclos}} = \sigma_f \cancel{A}$$

$$\boxed{D = \sigma_f \quad \text{everywhere inside cap}}$$

dielectric ①

$$D = \underset{2\epsilon_0}{\epsilon} E_1 = \sigma_f$$

$$E_1 = \frac{\sigma_f}{2\epsilon_0}$$