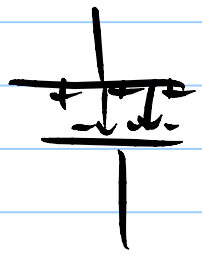
Capacitors

Note Title 2/27/2011

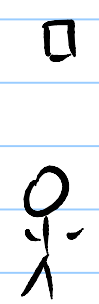
→ Applications

→ find atomic properties: polarizability α



$$\int \frac{1}{2}\epsilon_0 E^2 d\tau \rightarrow \underbrace{\frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}}_{\text{Energy}}$$

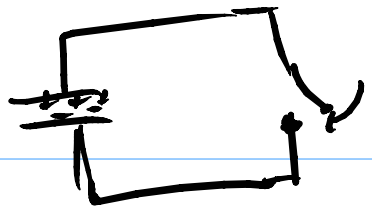
$C = 1\,\mu F \quad 1000\,V \quad E = \frac{1}{2}\,10^{-6}\,10^{6} = \frac{1}{2}\,J$



$mgh = 1(9)(1m) = 9\,J$

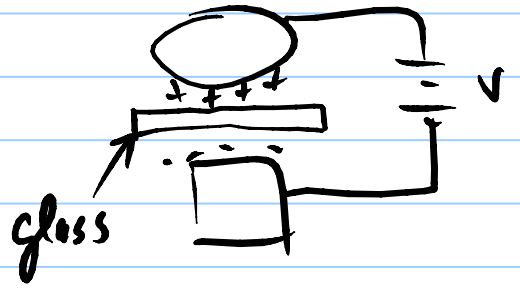
Energy can be withdrawn from a cap quickly

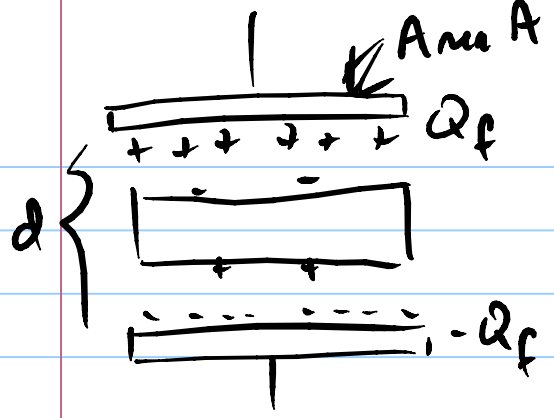
$$\frac{1\,J}{10^{-6}\,s} = 10^{6}\,W$$



heat can't dissipate very fast in 10^{-6} s so temp goes up

$C \equiv \frac{Q}{|\Delta V|}$ ← free charge





$$|\Delta V| = \int \vec{E}\cdot d\vec{\ell} = Ed = \frac{\sigma_f d}{\epsilon_0}\frac{1}{1+\chi_e}$$

E_{tot}

C_0

$$C = \frac{Q_{free}}{|\Delta V|} = \frac{\sigma_f A}{\sigma_f \frac{d}{\epsilon_0}\frac{1}{(1+\chi_e)}} = \frac{\epsilon_0 A}{d}(1+\chi_e)$$

$K = \epsilon/\epsilon_0$

$C_{glass} = C_{vac} K$

$V = V_0 e^{-t/RC}$

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

$\vec{P}\ \frac{\text{dipole mom}}{\text{vol}} = \epsilon_0 \chi_e E \quad \vec{p}\ \frac{\text{dipole mom}}{\text{atom}} = \alpha E$

$n\ \#\ \frac{\text{atoms}}{m^3}$

$$\vec{P} = \epsilon_0 \chi_e \vec{E} = n\vec{p} = n\alpha \vec{E}$$

by cap discharge