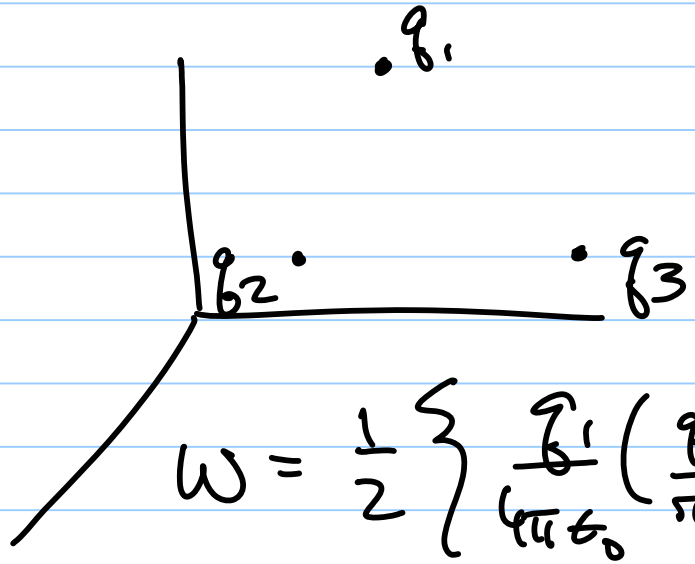
Lecture 9

Note Title 1/30/2006



$$W = k\left(\frac{q_1 q_2}{r_{12}} + \frac{q_1 q_3}{r_{13}} + \frac{q_2 q_3}{r_{23}}\right)$$

$$W = \frac{1}{2}\left\{\frac{q_1}{4\pi\epsilon_0}\left(\frac{q_2}{r_{12}} + \frac{q_3}{r_{13}}\right) + \frac{q_2}{4\pi\epsilon_0}\left(\frac{q_1}{r_{12}} + \frac{q_3}{r_{23}}\right) + \frac{q_3}{4\pi\epsilon_0}\left(\frac{q_1}{r_{13}} + \frac{q_2}{r_{23}}\right)\right\}$$

$$= \frac{1}{2}\left\{q_1 \sum_{\substack{i=2 \\ i\neq 1}}^{N} \frac{1}{4\pi\epsilon_0}\frac{q_i}{r_{1i}} + q_2 \sum_{\substack{i=1 \\ i\neq 2}}^{N} \frac{1}{4\pi\epsilon_0}\frac{q_i}{r_{2i}} + q_3 \sum_{\substack{i=1 \\ i\neq 3}}^{N} \frac{1}{4\pi\epsilon_0}\frac{q_i}{r_{3i}}\right.$$

$$= \frac{1}{2} \sum_{j=1}^{N}{}' q_j \sum_{\substack{i=1 \\ i \neq j}}^{N} \frac{1}{4\pi\epsilon_0} \frac{q_i}{r_{ji}} = \frac{1}{2} \sum_{j=1}^{N} q_j V(r_j)$$

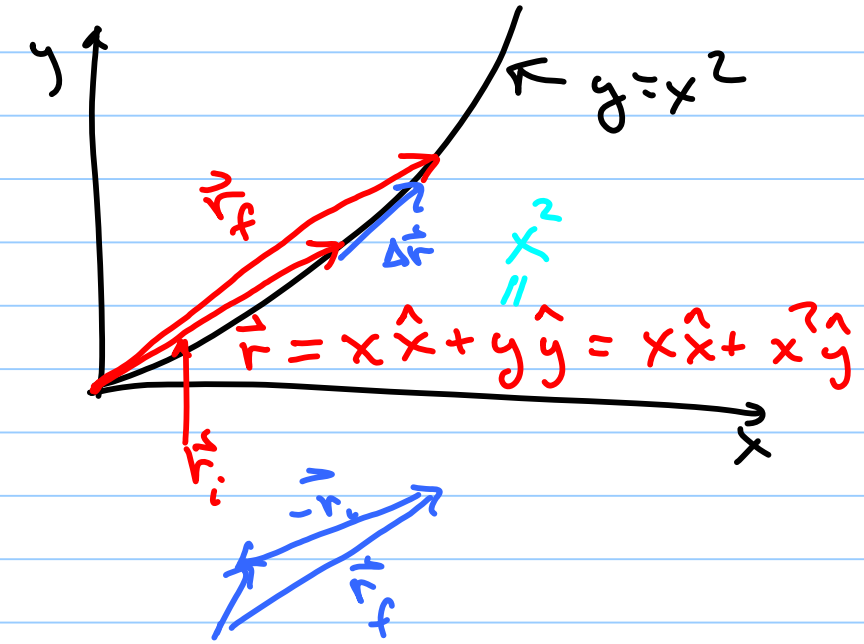
Line integrals

$$d\vec{l} = dx\,\hat{x} + dy\,\hat{y}$$

$$d\vec{r} = dx\,\hat{x} + 2x\,dx\,\hat{y} = d\vec{l}$$

$$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$$

$$\frac{d\vec{r}}{dt} = \vec{v}$$



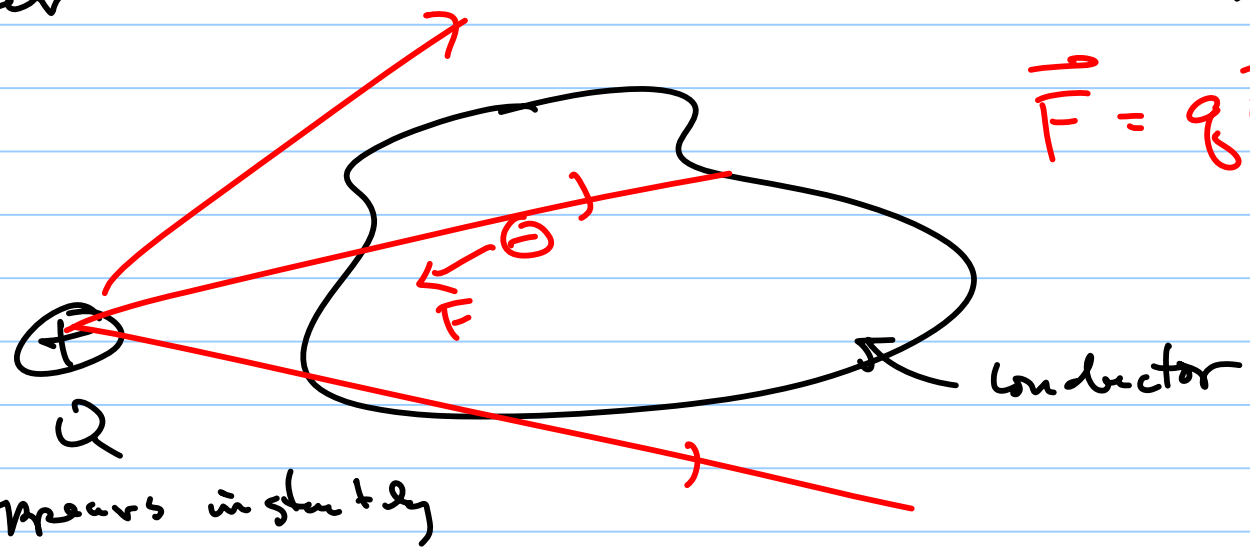
$$\int \vec{E} \cdot d\vec{\ell} = \int_0^5 \vec{E} \cdot (dx\,\hat{x} + 2x\,dx\,\hat{y})$$

Conductors: 10^{10} $\frac{\text{Coul}}{m^3}$ free charge

1.9×10^{-19} $\frac{\text{Coul}}{\text{electron}}$

hammer

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



Q

appears instantly

Electrostatics

Inside conductor

$E = 0$

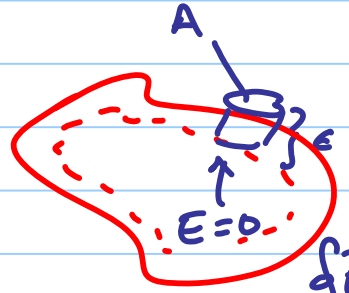
(1) $E = 0$ inside conductor

(2) $E_{\perp}$ at surface of "

(3) ΔV thru conductor is zero

Gauss's Law

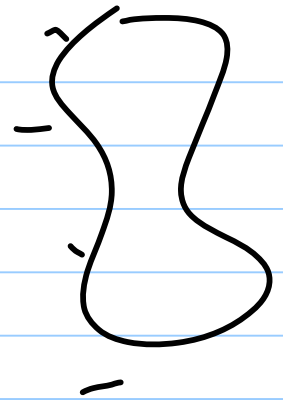
- $\rho = 0$ inside or $Q_{end} = 0$
- $E = \frac{\sigma}{\epsilon_0}$ outside surface



$$\oint \vec{E} \cdot d\vec{a} = \frac{Q_{end}}{\epsilon_0}$$

$$\oint \vec{E} \cdot d\vec{a} = EA = \frac{\sigma A}{\epsilon_0}$$

Capacitors



$\Delta V \propto Q$

$\Delta V = \frac{1}{C} Q$

↑ geometrical factor