

Lecture 9

Note Title

1/30/2006

Diagram showing three charges q_1 , q_2 , and q_3 in a triangular arrangement. q_1 is at the top, q_2 is at the origin, and q_3 is to the right of q_2 . Distances r_{12} , r_{13} , and r_{23} are indicated between the charges.

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

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

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

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

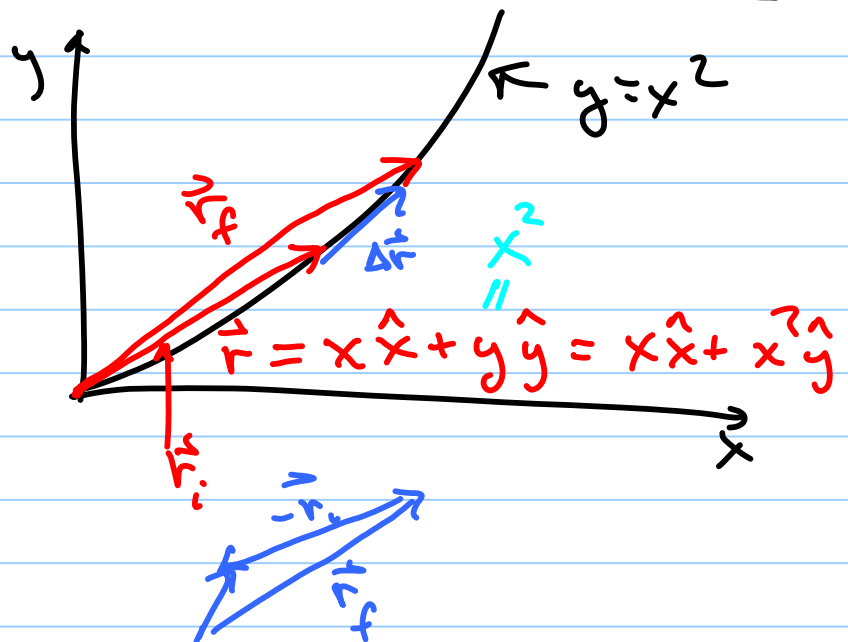
Line integrals

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

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

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

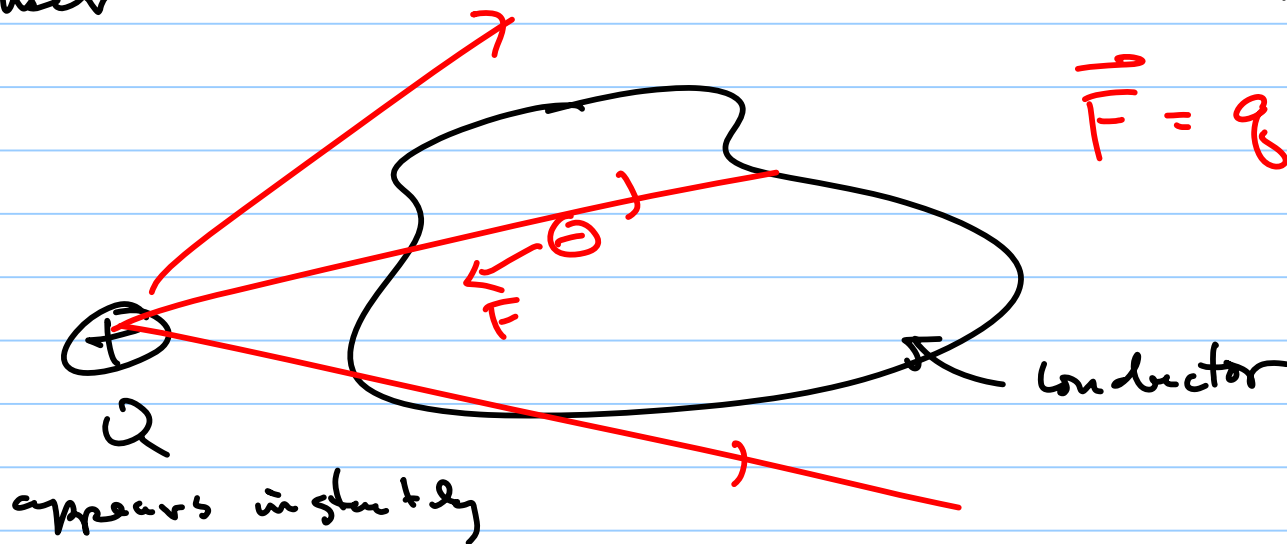
$$\frac{d\vec{r}}{dt} = \vec{v}$$



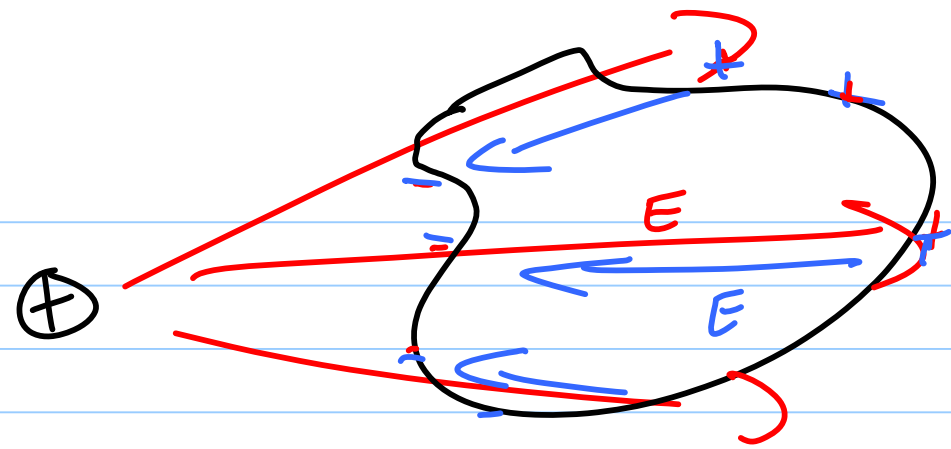
$$\int \vec{E} \cdot d\vec{l} = \int_0^5 \vec{E} \cdot (dx \hat{x} + 2x dx \hat{y})$$

Conductors: $10^{10} \frac{\text{Coul}}{\text{m}^2}$ free charge
 $1.9 \times 10^{-19} \frac{\text{Coul}}{\text{electron}}$

hammer



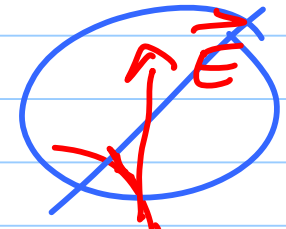
Electrostatics



Inside conductor

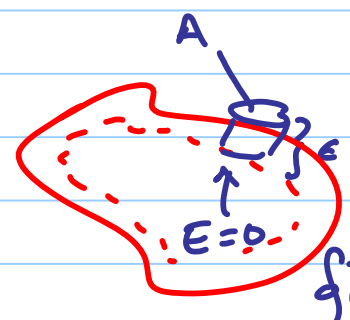
$$E = 0$$

- (1) $E = 0$ inside conductor
- (2) E_{\perp} at surface of "
- (3) ΔV thru conductor is zero



Gauss's Law

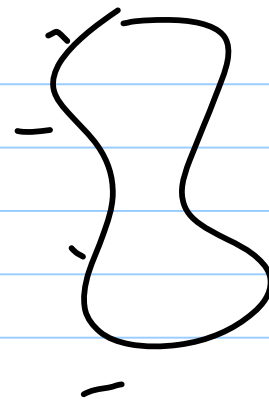
- $\rho = 0$ inside or $Q_{\text{enc}} = 0$
- $E = \frac{\sigma}{\epsilon_0}$
outside surface



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

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

Capacitors



$$AV \propto Q$$

$$AV = \frac{1}{C} Q$$

↑ geometrical factor