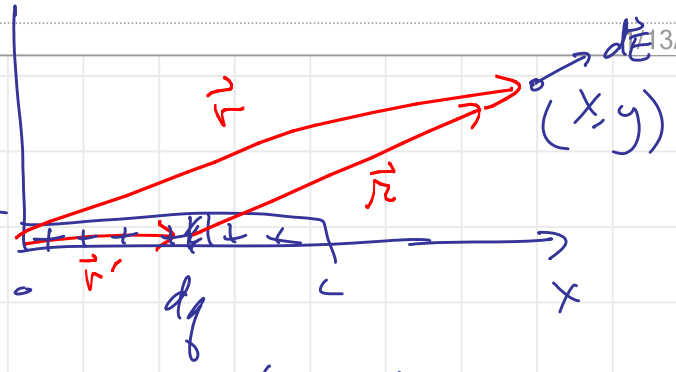
Lecture 2

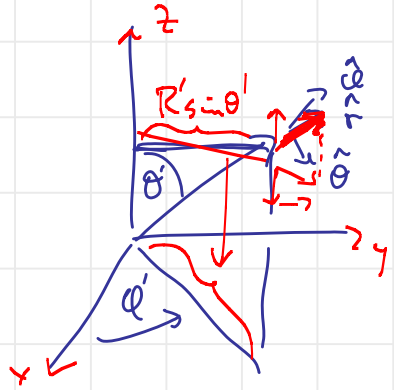
Note Title 3/2006

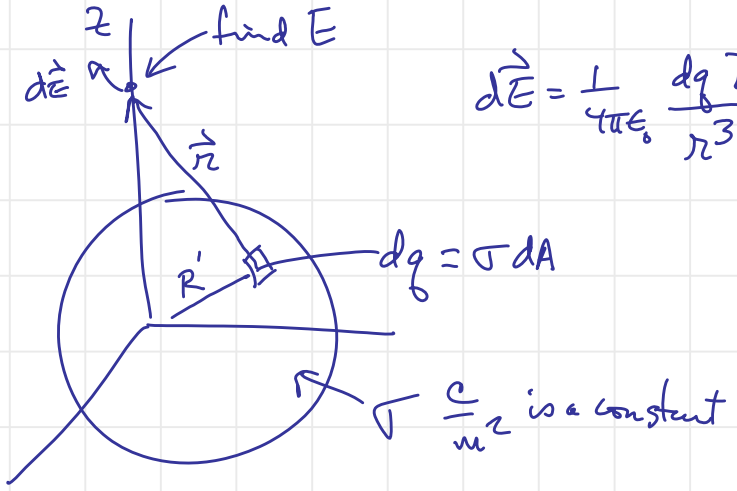
$$\vec{E} = \frac{1}{4\pi\epsilon_0}\int_0^L \frac{\lambda\, dx'\,[(x-x')\hat{i}+y\hat{j}]}{[(x-x')^2+y^2]^{3/2}}$$



$\vec{E}$ for a pt charge when $x \gg x'$ $(0 \to L)$

$$\vec{E} = \frac{1}{4\pi\epsilon_0}\int_0^L \frac{\lambda\, dx'\,[x(1-\frac{x'}{x})\hat{i}+y\hat{j}]}{[x^2(1-\frac{x'}{x})^2+y^2]^{3/2}} \qquad \delta = \frac{x'}{x} \text{ let } \delta \to 0$$





$$d\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{dq\,\vec{r}}{r^3}$$

$\vec{r} = \vec{r} - \vec{r}'$

$\vec{r} = 0\hat{i} + 0\hat{j} + z\hat{k}$

$\vec{r}' = R'\hat{r}' = R'\hat{r}$

$\vec{r}' = R'\sin\theta'\cos\varphi'\,\hat{i} + R'\sin\theta'\sin\varphi'\,\hat{j} + R'\cos\theta'\,\hat{k}$

$\vec{r} = \vec{r} - \vec{r}' = -R'\sin\theta'(\cos\varphi'\hat{i} + \sin\varphi'\hat{j}) + (z - R'\cos\theta')\hat{k}$

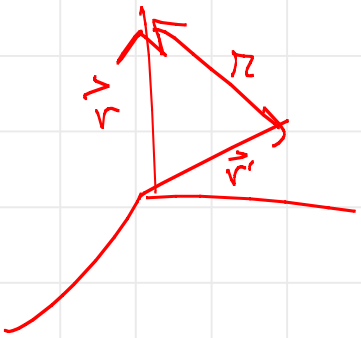
$d\vec{E} = k\frac{dq}{r^3}\vec{r} = k\frac{dq}{r^2}\hat{r}$

$$|\vec{\pi}| = \left[r'^2 \sin^2\theta' \underbrace{(\cos^2\varphi' + \sin^2\varphi')}_{1} + (z - r'\cos\theta')^2 \right]^{1/2}$$

$$z^2 - 2zr'\cos\theta' + r'^2\cos^2\theta'$$

$$|\vec{\pi}| = \left[r'^2 \sin^2\theta' + z^2 - 2zr'\cos\theta' + r'^2\cos^2\theta' \right]^{1/2}$$

$$|\vec{\pi}| = \left[r'^2 + z^2 - 2zr'\cos\theta' \right]^{1/2}$$



flux: $\int \vec{j} \cdot d\vec{a}$

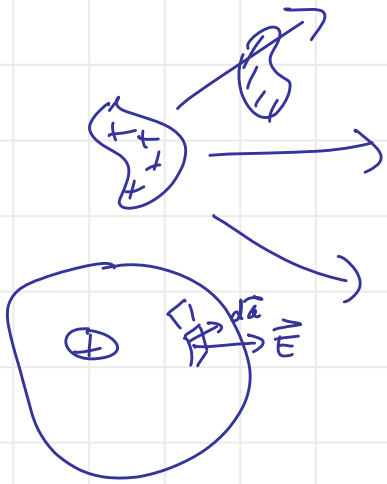
$= \rho \vec{v}$ ← $\frac{m}{s}$

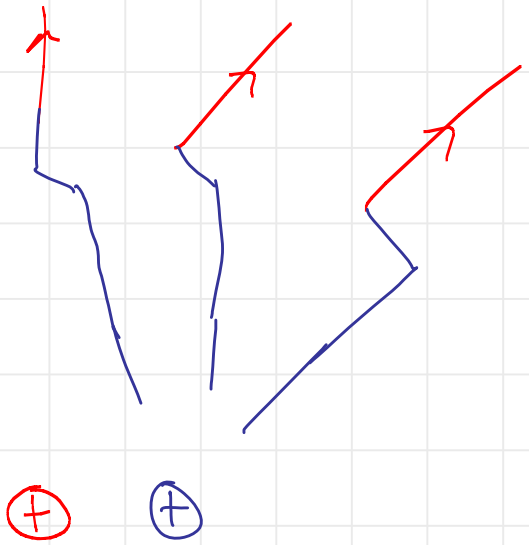
$\frac{\text{Coul}}{m^3}$

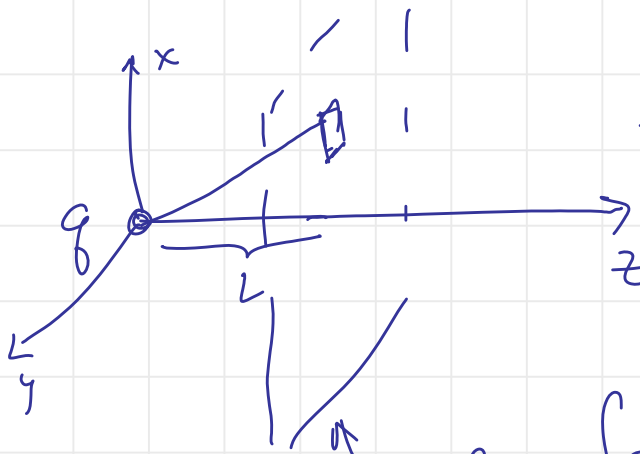
$\frac{\text{Coul}}{m^2\, s}$

$\int \vec{E} \cdot d\vec{a}$ open surface

$\oint \vec{E} \cdot d\vec{a}$ closed







find flux thru ∞ plane

$\int \vec{E} \cdot d\vec{a}$

$= dx\,dy\,\hat{k}$

$\vec{r} = \vec{r} - \vec{r}' = x\hat{i} + y\hat{j} + L\hat{k}$ ($\vec{r}' = 0$)

∞ plane $\int d\vec{E} = \int k \frac{dq}{r^2} \hat{r} \rightarrow \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} dy\,dx$ ------

$|\vec{r}| = \sqrt{x^2 + y^2 + L^2}$