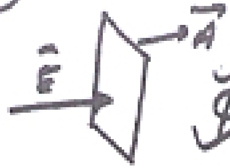
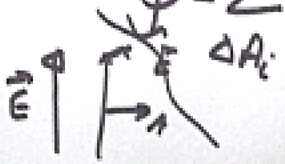
220 FM



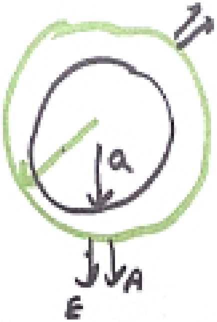
$$\Phi = \vec{E}\cdot\vec{A}$$

$$\Phi = \sum \vec{E}_i \cdot \Delta\vec{A}_i$$



$\underset{\phi}{EA}\ \left[\frac{N}{C}\right]\cdot\left[m^2\right]$

$$\boxed{\Phi_E = \frac{Q_{enc}}{\varepsilon_0}}$$



Q $\rho \ \frac{C}{m^3}$

$\sigma \ \frac{C}{m^2}$

$\lambda \ \frac{C}{m}$

outside

Choose GS $r \geq a$

Spherical GS

centered on Q

on GS: $|\vec{E}|$ constant

on GS: $\vec{E} \parallel \vec{A}$

$$\oint_{S} = \sum_{\Delta A_i} \vec{E}_i \cdot \Delta \vec{A}_i = \frac{Q_{enc}}{\varepsilon_0}$$

$$= \sum_{\Delta A_i} E_i \, \Delta A_i$$

$$= E \sum_{\Delta A_i} \Delta A_i$$

$$= E(4\pi r^2) = \frac{Q}{\varepsilon_0}$$

$$\vec{E}_{outside} = \frac{Q}{4\pi \varepsilon_0 r^2} \hat{n}$$

$$\rho = \frac{Q}{\text{Volume}} = \frac{Q}{\frac{4}{3}\pi a^3}$$

$$Q_{enc} = \rho \cdot \text{Volume of GS}$$

$$= \frac{Q}{\frac{4}{3}\pi a^3}\left(\frac{4}{3}\pi r^3\right)$$

$$= Q\left(\frac{r^3}{a^3}\right)$$

$$\Phi_E = \frac{Q_{enc}}{\varepsilon_0}$$

$$\Phi_E = \sum_{\Delta A_i} \vec{E}_i \cdot \Delta\vec{A}_i$$

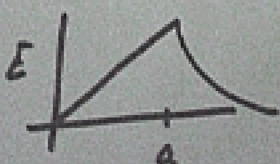
$$= \sum_{\Delta A_i} E_i \, \Delta A_i$$

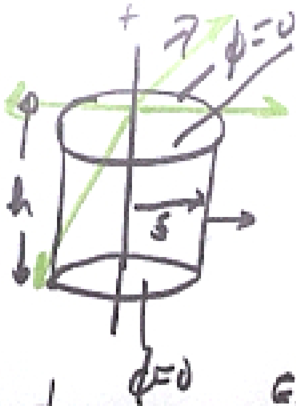
$$= E \sum_{\Delta A_i} \Delta A_i$$

$$= E(4\pi r^2)$$

$$E(4\pi r^2) = \frac{Q}{\varepsilon_0}\left(\frac{r^3}{a^3}\right)$$

$$\vec{E} = \frac{Q}{4\pi\varepsilon_0}\frac{r}{a^3}\,\hat{r}$$





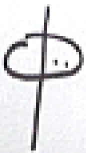
On GS:

LSA: $|\vec{E}|$ uniform

$\vec{E} \parallel \vec{A}$

ENDS:

$\vec{E} \perp \vec{A}$



$$\Phi = \Phi_{LSA} + \Phi_{ENDS} \leftarrow 0$$

$$= \sum_{\Delta A_i} \vec{E}_i \cdot \Delta \vec{A}_i = \sum_{\Delta A_i} E_i \Delta A_i$$

$$\phi = E \sum \Delta A_i$$

$$= E(2\pi s h)$$

$\oint = 0$

ENDS:

$\vec{E} \perp \vec{A}$

$$\oint = \oint_{LSA} + \oint_{ENDS} \leftarrow 0$$

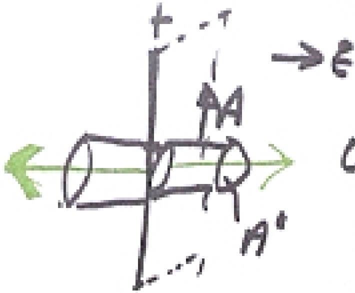
$$= \sum_{\Delta A_i} \vec{E}_i \cdot \Delta \vec{A}_i = \sum_{\Delta A_i} E_i \Delta A_i$$

$$= E(2\pi s h)$$

$$q_{enc} = \lambda h$$

$$E(2\pi s h) = \frac{\lambda h}{\varepsilon_0}$$

$$\vec{E} = \frac{\lambda}{2\pi \varepsilon_0 s} \hat{s}$$



On LSA:
$\vec{A} \perp \vec{E}$

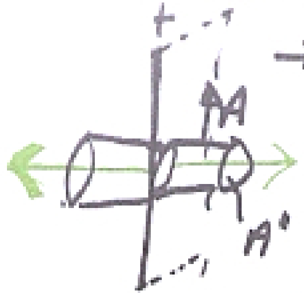
On ENDS:
$\vec{E} \parallel \vec{A}$

$$\Phi_E = \frac{q_{enc}}{\epsilon_0}$$

$|E|$ constant

$$\Phi_E = \sum_{\Delta A_i}^{ENDS} \vec{E}_i \cdot \Delta \vec{A}_i + \sum_{\Delta A_i}^{LSA} \underbrace{\vec{E}_i \cdot \Delta \vec{A}_i}_{0}$$

$$= \sum_{\Delta A_i} E_i \Delta A_i = EA' \cdot 2$$



on LSA:
$\vec{A} \perp \vec{E}$

on ENDS:
$\vec{E} \parallel \vec{A}$

$|\vec{E}|$ constant

$$\oint_E = \frac{q_{enc}}{\varepsilon_0}$$

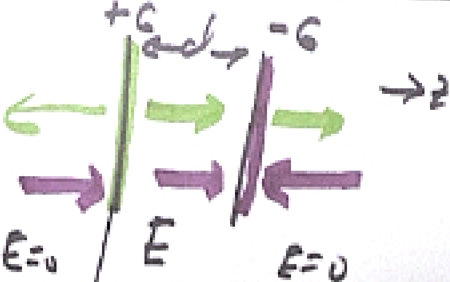
$$\oint_E = \sum_{\Delta A_i}^{ENDS} \vec{E}_i \cdot \Delta\vec{A}_i + \underbrace{\sum_{\Delta A_i}^{LSA} \vec{E}_i \cdot \Delta\vec{A}_i}_{0}$$

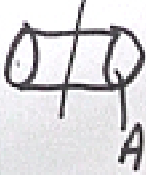
$$= \sum_{\Delta A_i} E_i \Delta A_i = EA' \cdot 2$$

$$q_{enc} = \sigma A'$$

$$2EA' = \frac{\sigma A'}{\varepsilon_0}$$

$$\vec{E} = \frac{\sigma}{\varepsilon_0} \begin{cases} \hat{z}; & z > 0 \\ -\hat{z}; & z < 0 \end{cases}$$





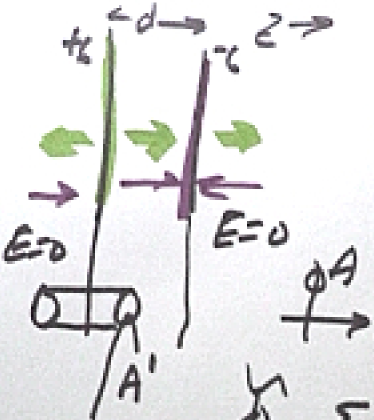
$$\Phi_h = EA'$$

$$Q_{enc} = \sigma A'$$

$$\Rightarrow EA' = \frac{\sigma A'}{\varepsilon_0}$$

$$\boxed{\vec{E} = \frac{\sigma}{\varepsilon_0}\hat{z}}$$

$E=0$ if $z>d$, <0



$\phi = \frac{Q_{enc}}{\varepsilon_0}$

$\vec{E}\cdot\vec{A} = 0$

$\phi = \sum_{\Delta A_i} \vec{E_i}\cdot\Delta\vec{A_i}$

$= E(A')$

$Q_{enc} = \sigma A'$

$EA' = \frac{\sigma A'}{\varepsilon_0} \Rightarrow \vec{E} = \frac{\sigma}{\varepsilon_0}\hat{z}$

(inside)