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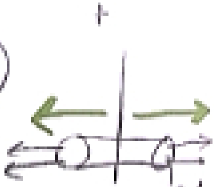


$$\Phi_E = \frac{q_{enc}}{\varepsilon_0}$$

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

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

E uniform on ENDS

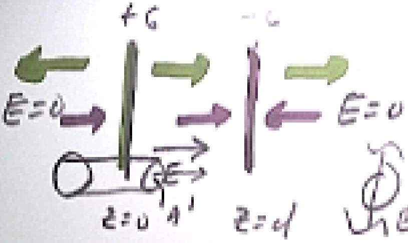
$$q_{enc} = \sigma A'$$

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

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

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

$$\vec{E} = \frac{\sigma}{2\varepsilon_0} \begin{cases} -\hat{z}, & z<0 \\ +\hat{z}, & z>0 \end{cases}$$



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

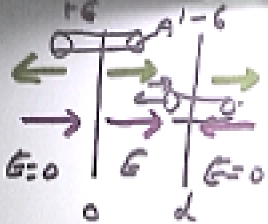
$$\Phi_E = \sum_{\Delta A_i} \vec{E}_i \cdot \Delta \vec{A}_i$$

$$= \sum \vec{E}_i \cdot \Delta A_i = E(A')$$

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

$$EA' = \frac{\sigma A'}{\varepsilon_0} \Rightarrow \vec{E} = \frac{\sigma}{\varepsilon_0}\hat{z} \quad (0<z<d)$$

$= 0$ outside



$$\sigma = \frac{Q}{Area} = \frac{1\mu C}{1 m^2}$$

$$\sigma = 1 \mu C/m^2$$

$$\oint \Phi_E = \frac{q_{enc}}{\varepsilon_0}$$

$$\oint \Phi_E = \sum_{\Delta A_i} \vec{E_i} \cdot \Delta \vec{A_i} = EA'$$

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

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

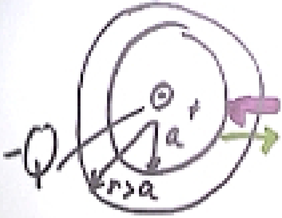
$$\varepsilon_0 = \frac{1}{4\pi k} = \frac{\mu}{4\pi \mu k} = \frac{1}{4\pi \cdot 8990} \times 10^{-6}$$

$$(8.85 \times 10^{-6}) \times 10^{-6} \approx 8.8 \times 10^{-12}$$

$$E = \frac{1\mu C \leftarrow 1\times 10^{-6}}{8.8 \times 10^{-6} \times 10^{-6}}$$

$$= \frac{1}{8.8} \times 10^{6}$$

$$= .1 \times 10^{6} = 1 \times 10^{5} \frac{N}{C}$$



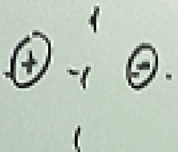
$$\vec{E}_{q} = \frac{-q}{4\pi\epsilon_0 r^2}\hat{r}$$

$$= k\frac{(-q)}{r^2}\hat{r}$$

Q outside: $\oint_G = \frac{Q_{enc}}{\epsilon_0}$

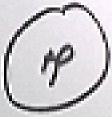
$$\frac{+Q}{4\pi\epsilon_0 r^2}\hat{r} + \frac{-Q}{4\pi\epsilon_0 r^2}\hat{r} = 0$$

$$\Rightarrow \vec{E} = \vec{0} \text{ outside}$$



-Q ; +Q sph

$$\vec{E}_{-Q} = \frac{-Q}{4\pi\epsilon_0 r^2}\hat{r}$$



: $\rho = \frac{+Q}{\frac{4}{3}\pi a^3}$

$$\Phi_G = \frac{Q_{enc}}{\epsilon_0}$$

on GS: $\vec{E} \parallel \hat{n}$

E unifor

$$Q_{enc} = \rho \cdot \frac{4}{3}\pi r^3$$

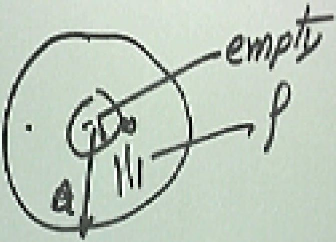
$$= \frac{+Q}{\frac{4}{3}\pi a^3}\cdot\frac{4}{3}\pi r^3 = Q\left(\frac{r}{a}\right)^3$$

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

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

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

$$\vec{E} = \left[\frac{-Q}{4\pi\varepsilon_0 r^2} + \frac{Q}{4\pi\varepsilon_0}\,\frac{r}{a^3}\right]\hat{r}$$



$\rho \quad \frac{4}{3}\pi(a^3 - b^3)$

1: $(1\mu; -1, 0)$ P: $(0, 0)$

2: $(-1\mu; 1, 0)$

3: $(1\mu; 0, 1)$

$\vec{r}_1 = -1\hat{x} + 0\hat{y}$ $\vec{r}_3 = 0\hat{x} + 1\hat{y}$

$\vec{r}_2 = 1\hat{x} + 0\hat{y}$ $\vec{r}_p = 0\hat{x} + 0\hat{y}$

$\vec{r}_{1p} = \vec{r}_p - \vec{r}_1 =$

$\vec{r}_{1p} = 1\hat{x} + 0\hat{y}$ $\vec{r}_{2p} = -1\hat{x} + 0\hat{y}$

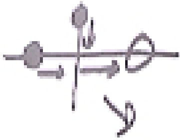
$\vec{r}_{3p} = 0\hat{x} - 1\hat{y}$

$[0^2 + 1^2]^{3/2} = 1$

1: $(1M; -1, 0)$ $\quad$ P: $(0,0)$

2: $(-1M; 1, 0)$

3: $(1M; 0, 1)$



$$\vec{r}_1 = -1\hat{x} + 0\hat{y} \qquad \vec{r}_3 = 0\hat{x} + 1\hat{y}$$

$$\vec{r}_2 = 1\hat{x} + 0\hat{y} \qquad \vec{r}_p = 0\hat{x} + 0\hat{y}$$

$$\vec{r}_{1p} = \vec{r}_p - \vec{r}_1 =$$

$$\vec{r}_{1p} = 1\hat{x} + 0\hat{y} \qquad \vec{r}_{2p} = -1\hat{x} + 0\hat{y}$$

$$\vec{r}_{3p} = 0\hat{x} - 1\hat{y}$$

$$\vec{E}_p = kM\left[\frac{+1\hat{x}+0\hat{y}}{1} - \frac{-1\hat{x}+0\hat{y}}{1} + \frac{0\hat{x}-1\hat{y}}{1}\right]$$

$$= kM\left[2\hat{x} - 1\hat{y}\right] \Rightarrow$$

$$\vec{E}_p = 17980\hat{x} - 8990\hat{y}\ \frac{N}{C}$$

$$= \left[1.8\times10^{4}\hat{x} - 9.0\times10^{3}\hat{y}\right]\frac{N}{C}$$

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