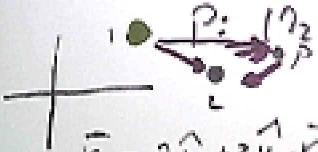
250
22

1: $(+3\mu C; 2, 3)$

2: $(-3\mu C; 1, 5)$

P: $(7, 2)$



$\vec{r}_1 = 2\hat{x} + 3\hat{y}$ $\quad \vec{r}_2 = 1\hat{x} + 5\hat{y}$ $\quad \vec{r}_p = 7\hat{x} + 2\hat{y}$

$\vec{r}_{1p} = 5\hat{x} - 1\hat{y}$ $\quad \vec{r}_{2p} = 6\hat{x} - 3\hat{y}$

$$\vec{E} = k\mu\left[\frac{2(5\hat{x} - 1\hat{y})}{[5^2 + 1^2]^{3/2}} + \frac{-3(6\hat{x} - 3\hat{y})}{[6^2 + 3^2]^{3/2}}\right]$$

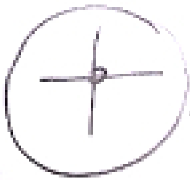
$$= k\mu\left[\frac{10\hat{x} - 2\hat{y}}{[26]^{3/2}} - \frac{18\hat{x} - 9\hat{y}}{(45)^{3/2}}\right]$$

$$= k\mu\left[(.075\hat{x} - .059\hat{x}) + (-.015\hat{y} + .029\hat{y})\right]$$

$$= k\mu\left[.016\hat{x} + .014\hat{y}\right]$$

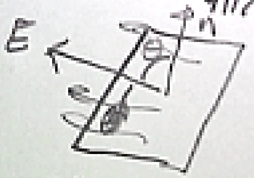
$$= 143\hat{x} + 126\hat{y}\ \frac{N}{C} \qquad \vec{F} = q\vec{E}$$

Gauss's Law



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

$$k = \frac{1}{4\pi\varepsilon_0} \quad \varepsilon_0 = \frac{1}{4\pi k}$$



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

$$\Phi_E = \oint\!\!\oint \vec{E} \cdot \hat{n} \, dA$$

$$\boxed{Q_{enc} = \iiint \rho \, d^3 r}$$

$$\Phi_E = \oint \vec{E} \cdot d\vec{A}$$

$$= \oint E \, dA$$

$$\Phi_E = \frac{q_{enc}}{\varepsilon_0} \qquad = E \boxed{\oint dA}$$

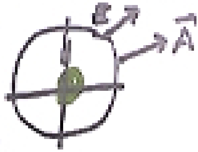
$$= E\,(4\pi r^2)$$

$$q_{enc} = q$$

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

$$E = \frac{q}{4\pi \varepsilon_0 r^2} \rightarrow E = k\frac{q}{r^2}$$

$$\vec{E} = \frac{q}{4\pi\varepsilon_0 r^2}\,\hat{r}$$



Gauss's Law

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

Φ

① Choose GS

② on GS: $\vec{E} \parallel \vec{A}$

$\vec{E}\cdot\vec{A} = EA$; E uniform

③ find Φ_E

$$\Phi_E = \oint \vec{E}\cdot d\vec{A}$$
$$= \oint E\, dA$$
$$= E \oint dA$$
$$= E(4\pi r^2)$$

④ q_{enc}

$q_{enc} = q$

⑤ Put tog

$$E(4\pi r^2) = \frac{q}{\epsilon_0}$$

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

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

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

I: Choose GS

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

$$\Phi_E = \oint \vec{E} \cdot d\vec{A} = \oint E\, dA$$

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

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

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

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

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

O $\vec{E}(4\pi r^2) = \frac{q_{enc}}{\varepsilon_0}$

$$q_{enc} = \iiint \rho \cdot d^3r$$

$$q_{enc} = \frac{q}{\frac{4}{3}\pi a^3} \cdot \frac{4}{3}\pi r^3$$

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

$$E(4\pi r^2) = \frac{q}{\varepsilon_0}\left(\frac{r^3}{a^3}\right) \Rightarrow \vec{E} = \frac{q}{4\pi\varepsilon_0}\frac{r}{a^3}\hat{r}$$

on GS:

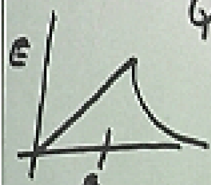
E uniform, $\vec{E} \parallel \vec{A}$

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

0 $\quad \vec{E}(4\pi r^2) = \frac{q_{enc}}{\varepsilon_0}$

$q_{enc} = \iiint \rho \cdot d^3 r$

$q_{enc} = \frac{q}{\left[\frac{4}{3}\pi a^3\right]} \cdot \left[\frac{4}{3}\pi r^3\right]$



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

$E(4\pi r^2) = \frac{q}{\varepsilon_0}\left(\frac{r^3}{a^3}\right) \Rightarrow \vec{E} = \frac{q}{4\pi\varepsilon_0}\frac{r}{a^3}\hat{r}$

Outside:

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

$$q_{enc} = \sigma(4\pi a^2)$$

$$E(4\pi r^2) = \frac{\sigma}{\varepsilon}(4\pi a^2)$$

<u>out</u> $$E = \frac{\sigma}{\varepsilon_0}\frac{a^2}{r^2}$$

In: $$q_{enc} = 0$$

$$\Rightarrow \Phi_E = 0$$

$$\Rightarrow \vec{E}_{in} = 0$$

σ

outside:

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

$$q_{enc} = \sigma(4\pi a^2)$$

$$E(4\pi r^2) = \frac{\sigma}{\varepsilon}(4\pi a^2)$$

<u>out</u> $E = \frac{\sigma}{\varepsilon_0}\frac{a^2}{r^2}$

In: $q_{enc} = 0$

$$\Rightarrow \Phi_E = 0$$

$$\Rightarrow \vec{E}_{in} = 0$$