AP1 FÍSICA 3A 1/2011

Problema 1 a) $\sigma = 1{,}0 \times 10^{-9}\ C/m^2$

$n_e = 1{,}0 \times 10^{9}\ C/m^2$

$$n = \frac{1{,}0 \times 10^{-9}\ C/m^2}{1{,}6 \times 10^{-19}\ C} = 6{,}3 \times 10^{9}\ /m^2$$

Resp.: $6{,}3 \times 10^{9}$ elétrons por metro quadrado

b) $$v = at = \frac{F}{m_e} t = \frac{q\sigma}{2\varepsilon_0 m_e} t$$

$$v = \frac{1{,}6 \times 10^{-19}\ C \cdot 1{,}0 \times 10^{-9}\ C/m^2 \cdot 1{,}0 \times 10^{-3}\ s}{2 \cdot 9{,}1 \times 10^{-31}\ kg} \times 36\pi \times 10^{9}\ \frac{N \cdot m^2}{C^2}$$

$$= 9{,}9 \times 10^{9}\ m/s > c\ !!!$$

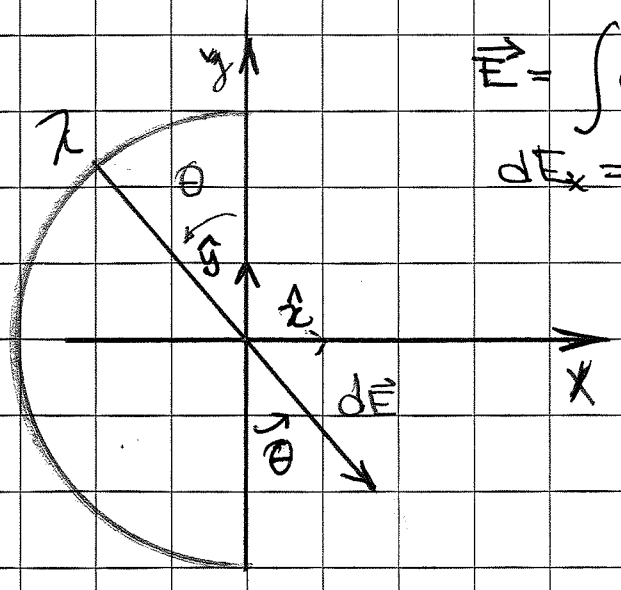
c) A mesma porque p/ uma distribuição planar de extensão infinita, o campo $\vec{E}$ não depende do ponto, i.e.: é uniforme.

[$a = F/m_e = qE/m_e$, $E = \sigma/(2\varepsilon_0)$]

Problema 2

$$d\vec{E} = dE_x \hat{x} + dE_y \hat{y}$$

$$\vec{E} = \int d\vec{E}$$



$$dE_x = dE \operatorname{sen}\theta = \frac{dq}{4\pi\varepsilon R^2} \operatorname{sen}\theta$$

$$dq = \lambda R\, d\theta$$

$$dE_x = \frac{\lambda}{4\pi\varepsilon R} \operatorname{sen}\theta\, d\theta$$

$$E_x = \frac{\lambda}{4\pi\varepsilon_0 R}\int_0^{\pi} \operatorname{Sen}\theta \, d\theta$$

$$= \frac{\lambda}{4\pi\varepsilon_0 R} \left. -\operatorname{Cos}\theta \right|_0^{\pi}$$

$$= \frac{\lambda}{4\pi\varepsilon_0 R}\left(-\operatorname{Cos}\pi + \operatorname{Cos}0\right) = \frac{\lambda}{4\pi\varepsilon_0 R} \times 2$$

$$\vec{E} = E_x \hat{x} = \frac{\lambda}{2\pi\varepsilon_0 R}\hat{x}$$

E_y é zero por simetria

b) lembrando que a carga teste é positiva,

$$\vec{E} = 2E_x \hat{x} = \frac{\lambda}{\pi\varepsilon_0 R}\hat{x}$$

c) $$dV = \frac{dq}{4\pi\varepsilon_0 R}, \quad V_+(0) = \frac{\lambda(\pi R)}{4\pi\varepsilon_0 R} = \frac{\lambda}{4\varepsilon_0}$$

d) $$V(0) = V_+(0) + V_-(0) = \frac{\lambda}{4\varepsilon_0} - \frac{\lambda}{4\varepsilon_0} = 0$$

e)

$$U = q\,V(0) = 0$$

Problema 3

a) $\Phi = \frac{q}{\varepsilon_0} = 5 \times 10^{-6} C \cdot 36\pi \times 10^{9} \frac{N \cdot m^2}{C^2}$

$\Phi = 5{,}7 \times 10^{5} \, (N/C) \cdot m^2$

b) $\Phi = 0$

c) $\vec{E} = \vec{E}_1 + \vec{E}_2$

$$= \frac{q}{4\pi\varepsilon_0 \left(R - \frac{2}{3}R\right)^2} \hat{\mu} - \frac{q}{4\pi\varepsilon_0 \left(\frac{8R}{3} - R\right)^2} \hat{\mu}$$

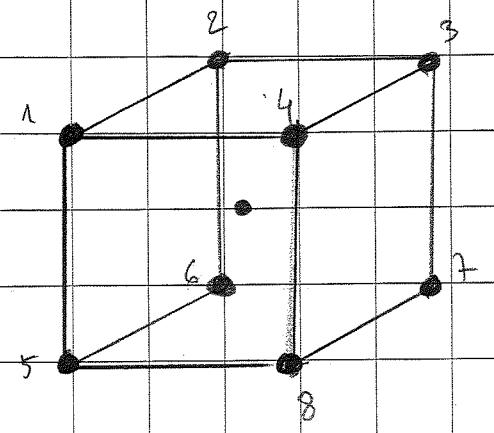
$$= \frac{q}{4\pi\varepsilon_0 R^2} \hat{\mu} \left[\frac{1}{\left(1 - \frac{2}{3}\right)^2} - \frac{1}{\left(\frac{8}{3} - 1\right)^2} \right]$$

$$= \frac{q}{4\pi\varepsilon_0} \frac{\hat{\mu}}{R^2} \left(\frac{1}{\frac{1}{9}} - \frac{1}{\frac{25}{9}} \right)$$

$$= \frac{q}{4\pi\varepsilon_0} \frac{\hat{\mu}}{R^2} \left(9 - \frac{9}{25} \right)$$

$$\vec{E} = \frac{216}{25} \frac{q}{4\pi\varepsilon_0} \frac{\hat{\mu}}{R^2}$$

Problema 4



a) $$n = \binom{N}{2} = \binom{9}{2} = \frac{9!}{2!(9-2)!} = \frac{9 \cdot 8 \cdot \cancel{7!}}{2 \cdot \cancel{7!}}$$

$$= 36 \text{ termos}$$

b)

12 termos	tipo	$\sqrt{2}\,a$
4 termos	tipo	$\sqrt{3}\,a$
12 termos	tipo	a
8 termos	tipo	$\sqrt{3}\,a/2$

Total 36 termos

$$U_e = \frac{q^2}{4\pi\varepsilon_0 a}\left(\frac{12}{\sqrt{2}} + \frac{4}{\sqrt{3}} + 12 + \frac{8}{\sqrt{3}/2}\right)$$