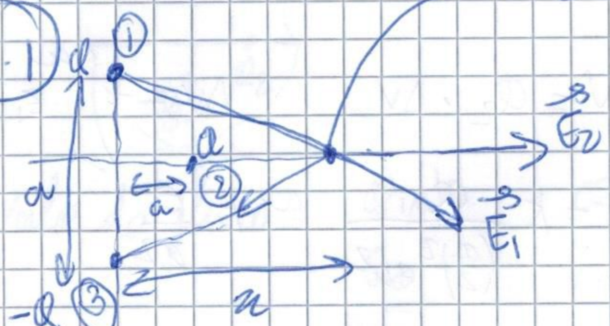
PN 9/11/18

4-1



$\vec{E} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 = (E_{1x} + \cancel{E_{2x}} + \cancel{E_{3x}})\hat{x} + (\cancel{E_{1y}} + E_{2y} + E_{3y})\hat{j}$ (V/m)

$= k\frac{Q}{x^2}\hat{i} + \left(\frac{Q}{d^2}\cos\theta + \frac{Q}{d^2}\cos\right.$

$\cos\theta = \frac{x}{\sqrt{\left(\frac{a}{2}\right)^2 + x^2}}$

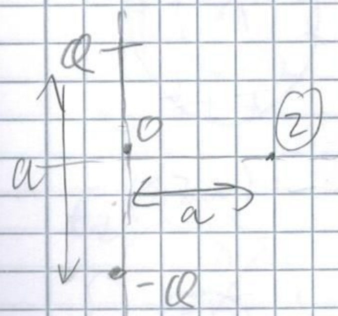
$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}(\hat{r})$ (V/m)

$\vec{E} = \left(k\frac{Q}{x^2}\right)i - 2\left(\frac{Q}{\left(\frac{a^2}{4} + x^2\right)} \cdot \frac{x}{\sqrt{\frac{a^2}{4} + x^2}}\right)\hat{j} =$

$= \left(k\frac{Q}{x^2}\right)i - 2\left(\frac{Q \cdot x}{\left(\frac{a^2}{4} + x\right)^{3/2}}\right)j$ (V/m)

$E\ (x >> a) \approx \left(k\frac{Q}{x^2}\right)i$ (V/m)

Potencial $x = 0$



$V_T(x=0) = k\frac{Q}{a}$ (V)

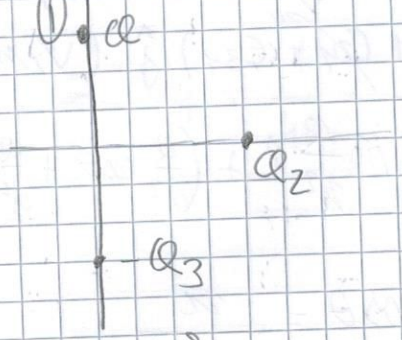
$V_0 = V_1^0 + V_2^0 + V_3^0$

$V_1(x=0) = k\frac{Q}{(a/2)}$

$V_2(x=0) = k\frac{Q}{a}$

$V_3(x=0) = \frac{k(-Q)}{a/2}$

b) Energia potencial



$\rightarrow \vec{E}_1$

- A carga Q_2 move-se no campo $\vec{E}_1$!
- Q_3 move-se no campo $\vec{E}_1$ e $\vec{E}_2$

$\rightarrow W = Q_2 \cdot \Delta V \qquad \Delta V = -\int_{\infty}^{a} E_1 \cdot dr$

$E_1 = k \dfrac{Q}{\left(\frac{a}{2}\right)^2 + a^2} \simeq k \dfrac{Q}{a^2}$

$\Delta V_1 = -\int_{\infty}^{a} k \dfrac{Q}{r^2}\, dr$

$\rightarrow W_2 = Q_2 \cdot \dfrac{kQ_1}{a} = \dfrac{kQ^2}{a}$

$\rightarrow W_3 = Q_3 \cdot \Delta V_{3,1} + Q_3 \Delta V_{3,2}$

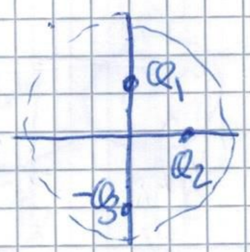
Potencial na presença da carga 1

Potencial na presença carga 2

$\Rightarrow W_3 = Q_3 k \dfrac{Q_1}{a^2} + Q_3 k \dfrac{Q_2}{a^2}$

$= -k \dfrac{Q^2}{a^2} - k \dfrac{Q^2}{a^2} = -2k \dfrac{Q^2}{a^2}$

$W \simeq W_2 + W_3 = -\dfrac{kQ^2}{a^2}$ (J) c)

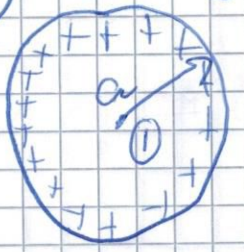


Valor do fluxo $= \dfrac{Q_{int}}{\varepsilon_0} = \dfrac{Q}{\varepsilon_0}$

Lei de Gauss

$$\underbrace{\oint \vec{E} \cdot d\vec{s}}_{\text{expressão do fluxo do campo}} = \underbrace{\frac{Q_{int}}{\varepsilon_0}}_{\text{Valor do fluxo do campo}}$$

4.2 $+Q$



a) → condutor

→ carga está à superfície

b)

$E_1 \ (r<a)$

$$\underbrace{\oint \vec{E} \cdot d\vec{s}} = \frac{Q_{int}}{\varepsilon_0}$$

$$4\pi r^2 E = 0$$

$$E_1 = 0$$

$E_2 \ (r \geq a)$

$$\underbrace{\oint \vec{E} \cdot d\vec{s}} = \frac{Q_{int}}{\varepsilon_0}$$

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

$$E_2 = \frac{Q}{4\pi \varepsilon_0 r^2} \quad (V/m)$$

$$V = -\int \vec{E} \cdot d\vec{r} = -\int E \cdot dr$$

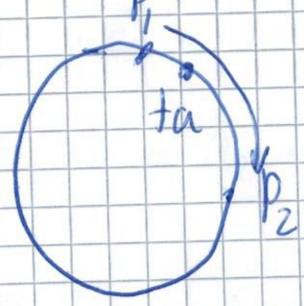
$$V_2 = -\int_{\infty}^{r} E_2 \cdot dr = -\int_{\infty}^{r} \frac{Q}{4\pi\varepsilon_0 r^2} dr = \frac{Q}{4\pi\varepsilon_0 r} \ (V)$$

$(r > a)$ $(V=0)$

$$V_1 = -\left[\int_{\infty}^{a} E_2 \cdot dr + \int_{a}^{0} \cancel{E_1} \cdot dr\right] = -\int_{\infty}^{a} E_2 \cdot dr$$

$$V_1 = -\int_{\infty}^{a} \frac{Q}{4\pi\varepsilon_0 r^2} dr = \frac{Q}{4\pi\varepsilon_0 a} \ (V)$$

c)



$$V_{(r=a)} = \frac{Q}{4\pi\varepsilon_0 a} \ (V)$$

Potencial em todos os pontos da superfície da esfera

$\Rightarrow$ superfície equipotencial

$W = q \cdot \Delta V$

$\Delta V_{(P_1 \to P_2)} = V_{P_2} - V_{P_1} = 0 \Rightarrow W = 0$

P_1 e P_2 são pontos na superfície da esfera

d) $W = q \cdot \Delta V$

$W = \vec{F} \cdot \vec{l}$

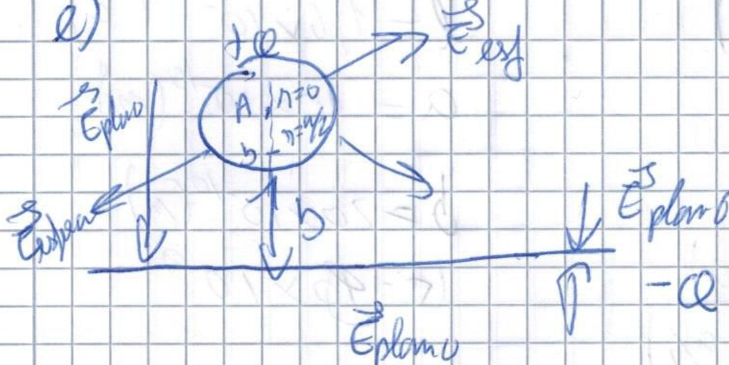
$W = F_{ele} \cdot l \cdot \cos(\vec{F}_{ele}, \vec{l})$

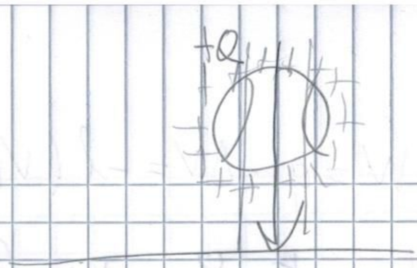
$\vec{F}_{ele} = q \cdot \vec{E}$

$\Rightarrow W = 0 \Rightarrow$ | ~~$F_{ele} = 0$~~
| ~~$l = 0$~~
| $\cos(\vec{F}_{ele}, \vec{l}) = 0 \Rightarrow \vec{F}_{ele} \perp \vec{l} \Rightarrow \vec{E} \perp \vec{l}$

47 32
57 4
8 9
7 10
8 11

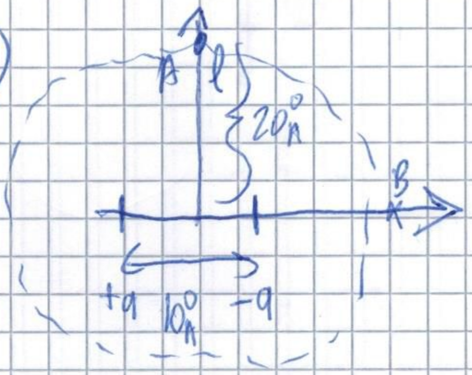
e)





$$E_{plano} = \frac{\sigma}{2\varepsilon_0}$$

4.3



a) É conservativa

W só depende dos pontos inicial e final $\Rightarrow W = q\Delta V$

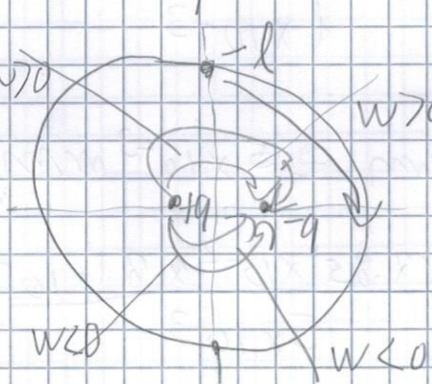
$W = q\Delta V$

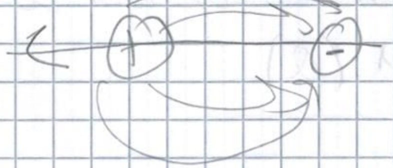
Ponto inicial ⇒ A

Ponto final ⇒ A

⇒ $\Delta V = 0$

⇒ $W = 0$





3) $W = q \cdot \Delta V = -e(V_B - V_A)$

$e = 1{,}6 \times 10^{-19}$ (C)

$a = 10 \times 10^{-10}$ (m)

$b = 20 \times 10^{-10}$ (m)

$K = 9 \times 10^{9}$

$$V_A = K\frac{q}{d} + K\frac{(-q)}{d} = 0$$

$$V_B = K\frac{q}{(b+a/2)} + K\frac{(-q)}{(b-a/2)}$$

Preparação Trabalho 4: condensador de placas paralelas

(1)

$$C = \frac{\varepsilon_r \varepsilon_0 A}{d}$$

$$\varepsilon = 8.85 \times \frac{10^{-12}\,F}{m}$$

$\varepsilon_r = 1$

$A = 8.1 \times 10^{-3} \times \pi$

Para $d = 1\,mm \Rightarrow 1 \times 10^{-3}\,m$

$$C = \frac{1 \times 8.85 \times 10^{-2} \times 8.1 \times 10^{-3}}{1 \times 10^{-3}} = 2.25 \times 10^{-10}$$

Para $d = 5\,mm \Rightarrow 5 \times 10^{-3}\,mm$

$$C = \frac{1 \times 8.85 \times 10^{-2} \times 8.1 \times 10^{-3}}{5 \times 10^{-3}} = 4.50 \times 10^{-11}$$

(2) Quanto maior for a tensão (V) maior vai ser a carga proveniente do condensador (Q)

Slope (x
Intercepti
Correl

(5) Vidro $= 3.7 - 10 = -6.3$

Vidro de quartzo $= 3.7$

Periclass $= 2.2 - 3.4 = -1.2$