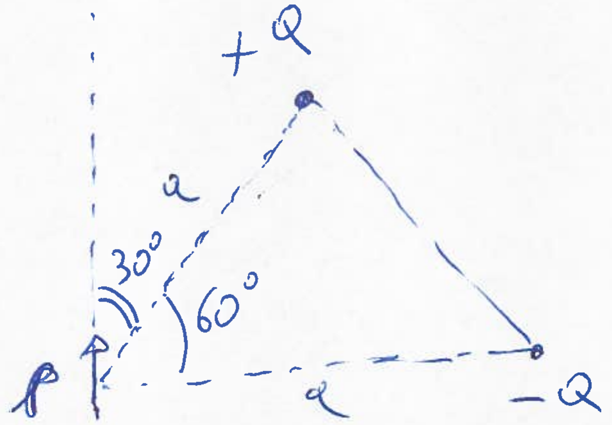
1)



POT. DIPOLO alla distanza a vista da un angolo θ

$$V(a,\theta) = \frac{p\cos\theta}{4\pi\varepsilon_0 a^2}$$

per cui Energia(dipolo, +Q) = $+Q \cdot V(a, 30°)$

$$\text{Energia(dipolo}, +Q) = \frac{+Q\,p\cos(30°)}{4\pi\varepsilon a^2} = \frac{Qp}{4\pi\varepsilon a^2}\frac{\sqrt{3}}{2}$$

Aggiungendo $-Q$:

Energia(dipolo, +Q, -Q) = Energia(dipolo, +Q) +

+ Energia(dipolo, -Q) + Energia(+Q, -Q) =

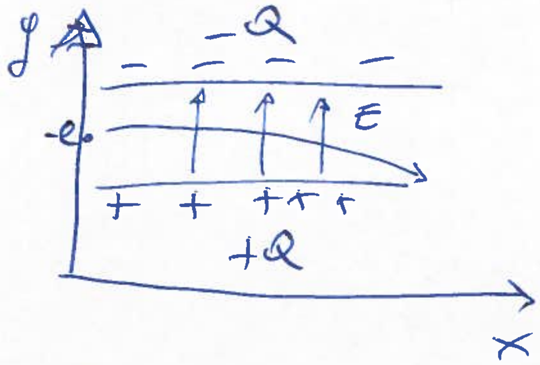
$$= \frac{Qp\frac{\sqrt{3}}{2}}{4\pi\varepsilon a^2} - \frac{Qp}{4\pi\varepsilon a^2}\cancelto{0}{\cos(90°)} - \underbrace{Q\left(\frac{Q}{4\pi\varepsilon a}\right)}_{Q \cdot V(\text{di una carica } Q \text{ a distanza } a)} =$$

$$= \frac{Q}{4\pi\varepsilon_0 a}\left[\frac{p\sqrt{3}}{2a} - Q\right]$$

2) $C = \frac{\varepsilon l^2}{d}$ $\quad \underbrace{Q = CV \quad V = Ed}_{Q = CEd} \rightarrow E = \frac{Q}{Cd}$

$$\vec F_e = -e\vec E = m_e \vec a$$

dal disegno



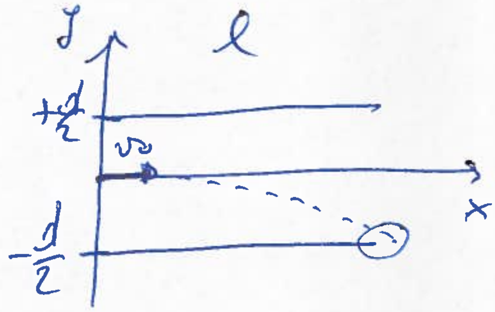
$\vec E = E\hat y$

$\vec F = -eE\hat y$

$\vec a = -\frac{e}{m_e}E\hat y$

$$\vec a = a_y \hat y = -\frac{e}{m_e}E\hat y \rightarrow a_y = -\frac{e}{m_e}E \qquad \boxed{a_x = 0}$$

$$\begin{cases} x(t^*) = l = v_0 t^* \\ y(t^*) = -\frac{d}{2} = \frac{1}{2} a_y t^{*2} = \frac{1}{2}\left(-\frac{e}{m_e}E\right)t^{*2} \end{cases}$$



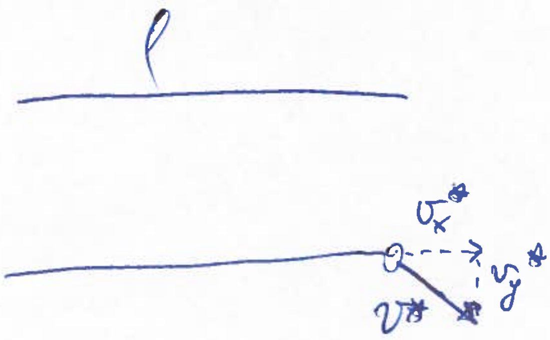
PUNTO RADENTE

$$\begin{cases} t^* = l/v_0 \\ d = \frac{e}{m_e}E t^{*2} = \frac{e}{m_e}E\frac{l^2}{v_0^2} \end{cases} \rightarrow E = \frac{d\, m_e v_0^2}{e\, l^2}$$

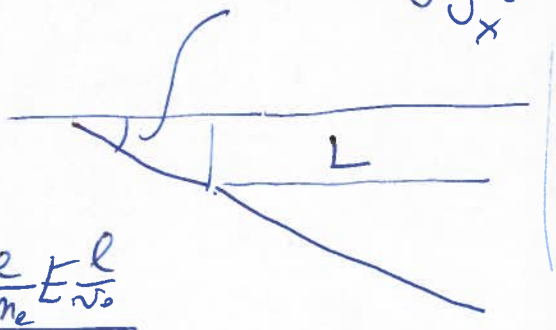
$$Q = CdE$$

poi calcolo la velocità al tempo t^*

$$\begin{cases} v_x(t^*) = v_0 = v_x^* \\ v_y(t^*) = a_y t^* = -\frac{e}{m_e}E t^* = -\frac{e}{m_e}E\frac{l}{v_0} = v_y^* \end{cases}$$

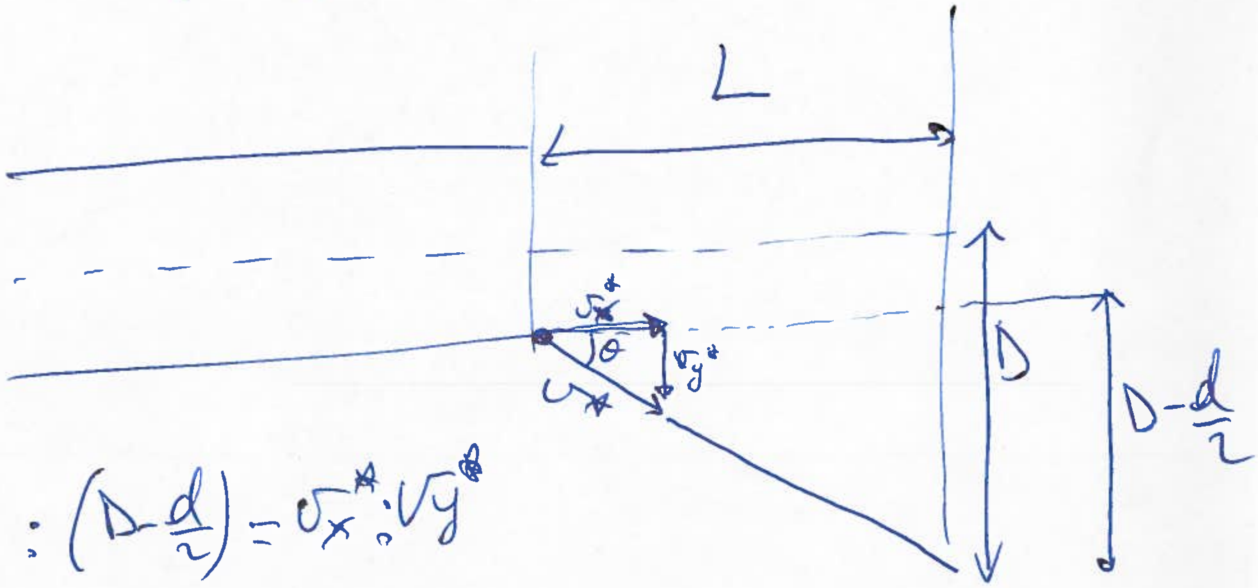


$$\theta = \operatorname{arctg} \frac{v_y^*}{v_x^*}$$



$$\theta = \operatorname{arctg} \frac{v_y^*}{v_x^*} = \operatorname{arctg} \frac{\frac{e}{m_e} E \frac{\ell}{v_0}}{v_0}$$

si può fare una proporzione

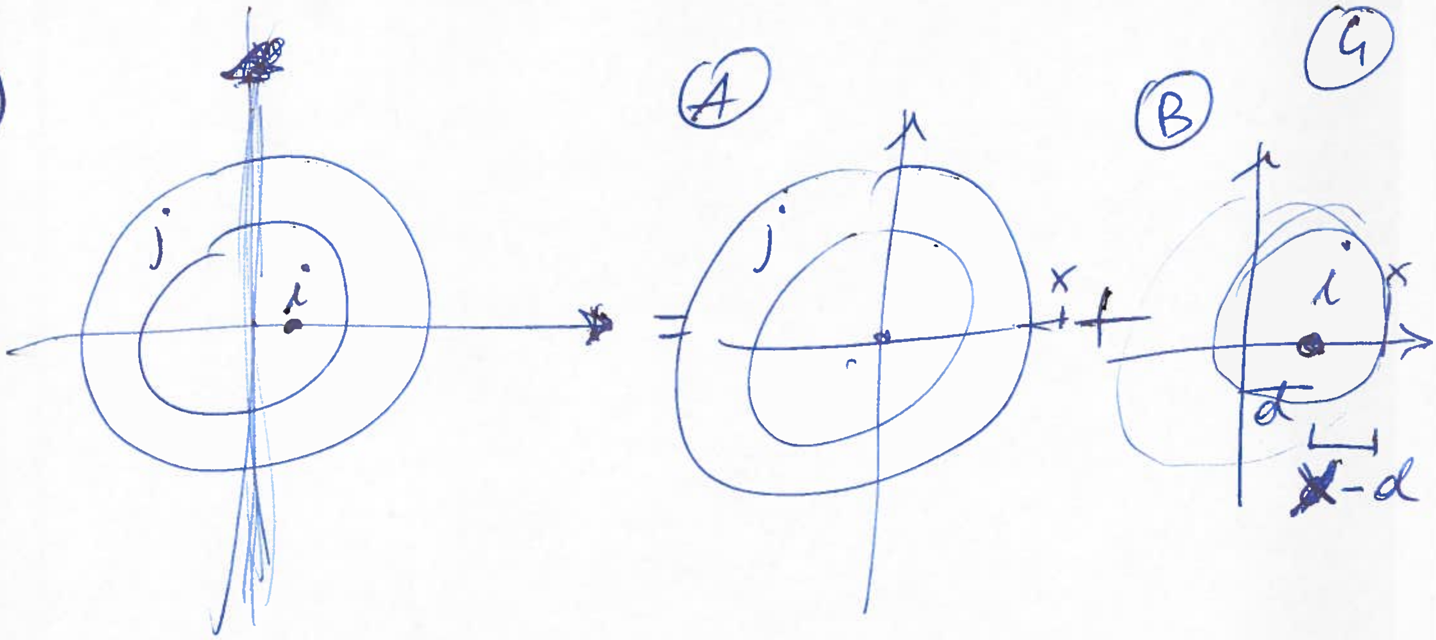


$$L : \left(D - \frac{d}{2}\right) = v_x^* : v_y^*$$

$$\frac{L}{\left(D - \frac{d}{2}\right)} = \frac{v_0^2 m_e}{\frac{eE\ell}{\cancel{m_e v_0}}} \rightarrow \left(D - \frac{d}{2}\right) = \frac{LeE\ell}{m_e v_0^2} \rightarrow$$

$$\rightarrow D = \frac{d}{2} + \frac{LeE\ell}{m_e v_0^2}$$

3)



applico AMPERE

(A) $2\pi x B_A = \mu_0 I_c = \mu_0 \left[j \cdot (\pi R_2^2 - \pi R_1^2) \right]$

(B) $2\pi (x-d) B_B = \mu_0 i$

il campo è nullo quando $B_A = B_B$ (sono opposti in verso)

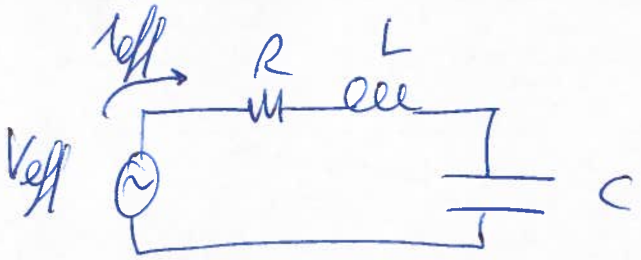
$$B_A = \frac{\cancel{\mu_0}\, j (\pi R_2^2 - \pi R_1^2)}{\cancel{2\pi} x} = B_B = \frac{\cancel{\mu_0}\, i}{\cancel{2\pi}(x-d)}$$

$$(x-d)\, j \pi (R_2^2 - R_1^2) = i x$$

$$x \left[j\pi (R_2^2 - R_1^2) - i \right] = d\, j \pi (R_2^2 - R_1^2)$$

$$x = d \frac{j\pi(R_2^2 - R_1^2)}{\left[j\pi (R_2^2 - R_1^2) - i \right]}$$

4)



$$\boxed{\omega = 2\pi f} \qquad i_{eff} = \frac{V_{eff}}{Z} \quad \text{con} \quad Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$P_m = i_{eff} V_{eff} \cos\phi = \frac{V_{eff}^2 R}{Z^2} \qquad \left(\cos\phi = \frac{R}{Z}\right)$$

è <u>max</u> quando $\omega L = \frac{1}{\omega C} \rightarrow \boxed{C = \frac{1}{L\omega^2}}$

$$C_0 = \frac{C}{3} = \frac{1}{3L\omega^2} \qquad Z_0 = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C_0}\right)^2}$$

$$i_{0eff} = \frac{V_{eff}}{Z_0} \qquad \cos\phi_0 = \frac{R}{Z_0}$$

$$P_{0,m} = i_{0eff} V_{eff} \cos\phi_0$$

$$V_{0,L\,eff} = Z_{0L}\, i_{0eff} = \omega L\, i_{0eff}$$