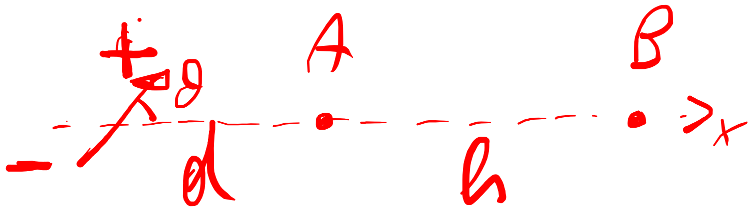
18-06-2021

1)



Siccome la particella si allontana dalla parte (+) del dipolo, la carica q deve essere positiva.

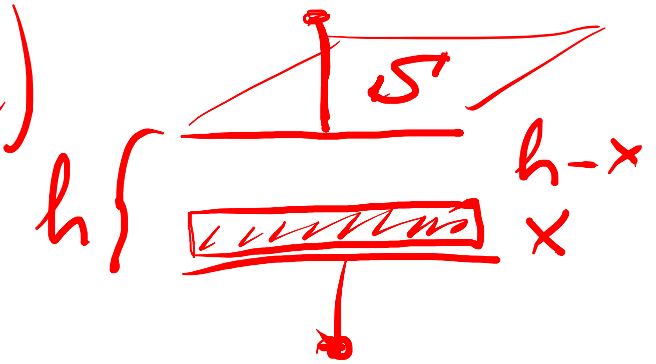
$$-q(V_B - V_A) = \frac{1}{2} m v^2 - \cancel{0} \qquad \text{CONSERV. ENERGIA}$$

$$q = \frac{m v^2}{2(V_A - V_B)}$$

$$V_A = \frac{p\cos\theta}{4\pi\varepsilon_0 d^2} \qquad V_B = \frac{p\cos\theta}{4\pi\varepsilon_0 (d+h)^2}$$

$$q = \frac{m v^2}{2\left[\frac{p\cos\theta}{4\pi\varepsilon_0}\left(\frac{1}{d^2} - \frac{1}{(d+h)^2}\right)\right]}$$

2)



$$C_0 = \varepsilon \frac{S}{h}$$

INIZIO $\quad Q_i = C_0 \Delta V$

FINE $\quad C = 2C_0 =$ serie C_x e C_{h-x}

$$C = \frac{C_x C_{h-x}}{C_x + C_{h-x}} \qquad C_x = \varepsilon_0 k \frac{S}{x}$$

$$C_{h-x} = \varepsilon_0 \frac{S}{h-x}$$

$$C = \frac{\dfrac{\varepsilon_0 k S}{x} \cdot \dfrac{\cancel{\varepsilon_0} \cancel{S}}{h-x}}{\dfrac{\cancel{\varepsilon_0} k \cancel{S}}{x} + \dfrac{\cancel{\varepsilon_0} \cancel{S}}{h-x}} =$$

P.3

$$= \frac{\dfrac{\varepsilon_0 k S}{x(h-x)}}{\dfrac{k}{x} + \dfrac{1}{h-x}} = \frac{\dfrac{\varepsilon k S}{\cancel{x(h-x)}}}{\dfrac{k(h-x)+x}{\cancel{x(h-x)}}} =$$

$$= \frac{\varepsilon k S}{kh - kx + x} = \frac{\varepsilon k S}{kh + x(1-k)}$$

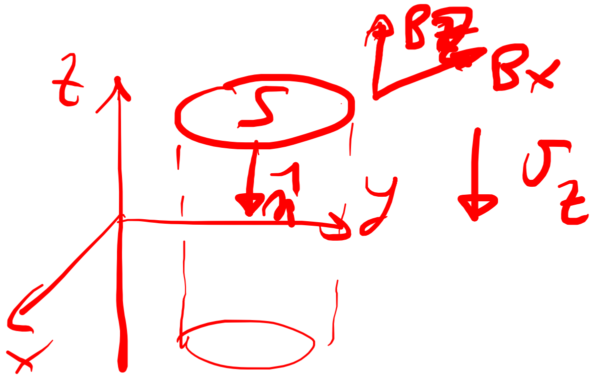
$$C = \frac{\cancel{\varepsilon} k \cancel{S}}{kh + x(1-k)} = 2C_0 = \frac{2\cancel{\varepsilon}\cancel{S}}{h}$$

$$\rightarrow \quad \cancel{kh} = \cancel{2}kh + 2x(1-k) \rightarrow$$

$$\rightarrow \quad x = \frac{kh}{2(k-1)} = \frac{h}{2\left(1-\frac{1}{k}\right)}$$

$$\Delta V_n = \frac{Q_i}{C} = \frac{Q_i}{2C_0} = \frac{\cancel{C_0}\Delta V}{2\cancel{C_0}} = \frac{\Delta V}{2}$$

3)



$\hat{n} \parallel -\hat{z}$

P.G

$$fem = -\frac{d}{dt}\phi(\vec{B}) \qquad i = \frac{1}{R} fem$$

$$\phi(B) = \int \left(B_x \underbrace{\cancel{\hat{x}\cdot\hat{n}}}_{\emptyset} + B_z \underbrace{\hat{z}\cdot\hat{n}}_{-1} \right) d\Sigma =$$

$$= \int -B_z \, d\Sigma = -kz \int d\Sigma =$$

$$= -kzS$$

$$fem = -\frac{d}{dt}\phi(\vec{B}) = kS\overbrace{\frac{dz}{dt}}^{-v_z}$$

$$|i| = \frac{|fem|}{R} = \frac{kSv_z}{R}$$

4) $$i_{eff} = \frac{V_{eff}}{Z}$$

$$\omega = 2\pi f$$

$$Z = \sqrt{(r + R_u)^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$P_{m_u} = R_u \cdot i_{eff}^2 = R_u \frac{V_{eff}^2}{Z^2}$$

$$P_{m_u} = V_{eff}^2 \cdot \frac{R_u}{(r + R_u)^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$\frac{\partial P_{m_u}}{\partial R_u} = 0$$ trovo R_u

$$\frac{\partial P_{mu}}{\partial R_u} = V_{eff}^2 \frac{(r+R_u)^2 + \left(\omega L - \frac{1}{\omega C}\right)^2 - 2R_u(r+R_u)}{\left[(R_u+r)^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right]^2} =$$

$$= V_{eff}^2 \frac{-R_u^2 + r^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}{\left[(r+R_u)^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right]^2} = 0$$

$$\frac{\partial P_{mu}}{\partial R_u} = 0 \text{ per } R_u^2 = r^2 + \left(\omega L - \frac{1}{\omega C}\right)^2$$

$$R_u = +\cancel{-}\sqrt{r^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$