21 - 10 - 2021

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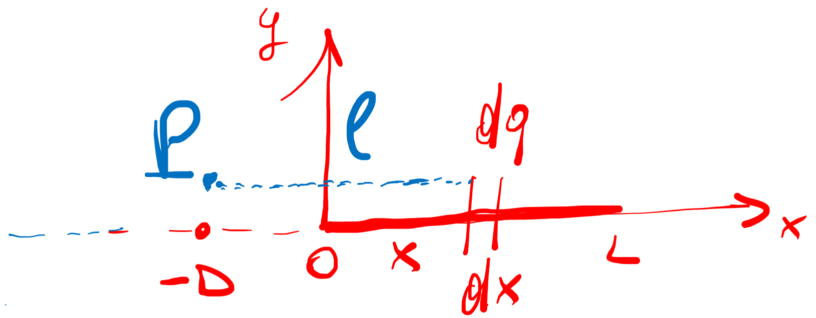
1)




$dq = \lambda(x)\,dx \qquad \lambda = k(x+D)$

$dq = k(x+D)\,dx$

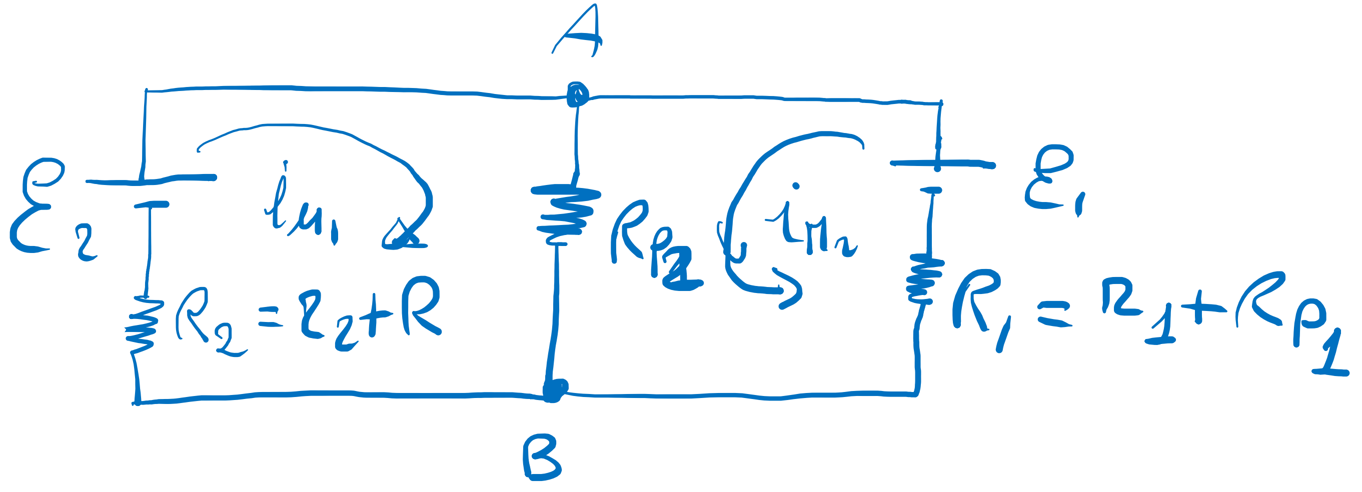
$\ell(x) = (x+D) \qquad 0 \le x \le L$

$$V(P) = \int_0^L \frac{dq(x)}{4\pi\varepsilon_0\, \ell} = \int_0^L \frac{k\cancel{(x+D)}\,dx}{4\pi\varepsilon\cancel{(x+D)}} = \frac{k}{4\pi\varepsilon_0}\int_0^L dx = \frac{kL}{4\pi\varepsilon_0}$$

$$\vec{E}(P) = -\hat{x}\,E(P) \qquad E(P) = \int_0^L \frac{dq(x)}{4\pi\varepsilon\,\ell^2(x)} = \int_0^\ell \frac{k\cancel{(x+D)}\,dx}{4\pi\varepsilon\,(x+D)^{\cancel{2}}} =$$

$$= \frac{k}{4\pi\varepsilon}\ln\left(\frac{\ell+D}{D}\right)$$

2)




$$R_{P_1} = \frac{1}{\frac{1}{R}+\frac{1}{R}+\frac{1}{R}} = \frac{R}{3}$$

$$R_{P_2} = \frac{1}{\frac{1}{R}+\frac{1}{R}} = \frac{R}{2}$$

$$\begin{cases} \mathcal{E}_2 = R_{P_2}(i_{M_1}+i_{M_2}) + R_2 i_{M_1} \\ \mathcal{E}_1 = R_{P_2}(i_{M_1}+i_{M_2}) + R_1 i_{M_2} \end{cases} = \begin{cases} i_{M_1}(R_2+R_{P_2}) + i_{M_2}(R_{P_2}) = \mathcal{E}_2 \\ i_{M_1}(R_{P_2}) + i_{M_2}(R_1+R_{P_2}) = \mathcal{E}_1 \end{cases}$$

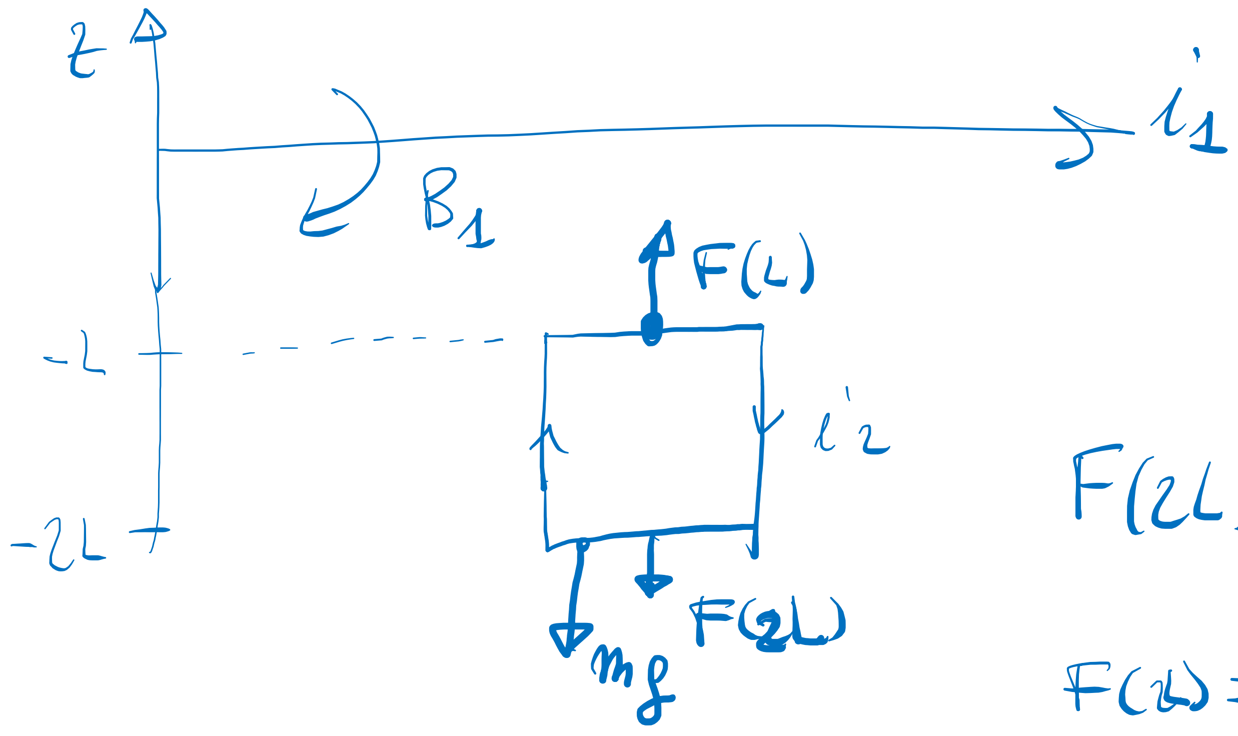
$$\Delta = (R_2+R_{P_2})(R_1+R_{P_2}) - (R_{P_2})^2 \qquad \Delta x = \mathcal{E}_2(R_1+R_{P_2}) - R_{P_2}\mathcal{E}_1$$

$$\Delta y = (R_2+R_{P_2})\mathcal{E}_1 - R_{P_2}\mathcal{E}_2 \qquad x = i_{M_1} = \frac{\Delta x}{\Delta} \qquad y = i_{M_2} = \frac{\Delta y}{\Delta}$$

$$V_A - V_B = R_{P_2} ( i_{u_1} + i_{u_2} )$$

$$P_1 = \mathcal{E}_1 \, i_{u_2} \qquad P_2 = \mathcal{E}_2 \, i_{u_1}$$

3)




$$B_1(z) = \frac{\mu_0 i_1}{2\pi |z|}$$

$$F(2L) + mg = F(L)$$

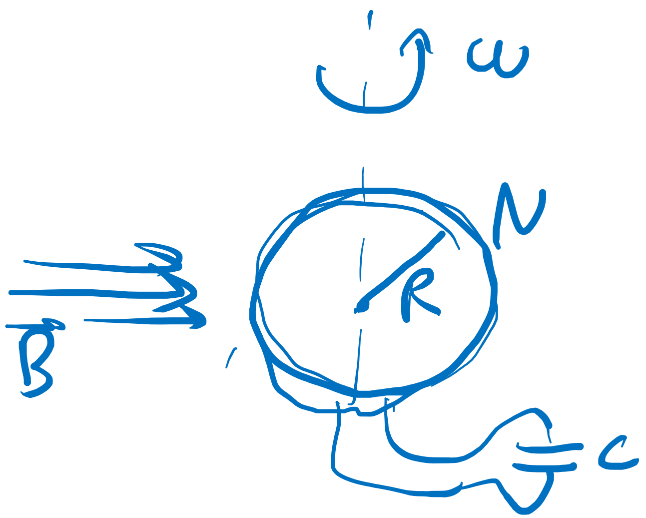
$$F(2L) = B_1(2L)\, i_2 L \qquad F(L) = B_1(L)\, i_2 L$$

$$\frac{\mu_0 i_1 i_2 \cancel{L}}{2\pi\, 2\cancel{L}} + mg = \frac{\mu_0 i_1 i_2 \cancel{L}}{2\pi \cancel{L}} \;\longrightarrow\; m = \frac{1}{g}\,\frac{\mu_0 i_1 i_2}{2\pi}\left(1 - \frac{1}{2}\right) = \frac{\mu_0 i_1 i_2}{4\pi g}$$

$$\Phi(B_1) = L \int_L^{2L} B_1(z')\, dz' = L\,\frac{\mu_0 i_1}{2\pi}\int_L^{2L} \frac{dz'}{z'} = \frac{\mu_0 i_1}{2\pi} L \ln\frac{2\cancel{L}}{\cancel{L}} = \frac{\mu_0 i_1 L}{2\pi} \ln 2$$ entrante nel foglio

con $z' = -z$

4)




$$\phi(B) = B\pi R^2 N \cos\theta(t)$$

$$\theta(t) = \omega t \qquad \phi(B) = \pi B R^2 N \cos\omega t$$

$$fem(t) = -\frac{d\phi}{dt} = \omega\pi R^2 B N \,\text{sen}(\omega t)$$

$$V_c(t) = fem(t) = \frac{q_c(t)}{C} \rightarrow q_c(t) = C \cdot fem(t)$$

$$q_c(t) = \omega\pi R^2 B N C \,\text{sen}(\omega t) \qquad i_c(t) = \frac{dq_c(t)}{dt} = \omega^2\pi R^2 B N C \cos(\omega t)$$

$$P(t) = fem(t) \cdot i_c(t) = \omega^3\pi^2 R^4 B^2 N^2 C \underbrace{\text{sen}(\omega t)\cos(\omega t)}_{\frac{1}{2}\text{sen}(2\omega t)}$$

$$P(t) = \frac{1}{2}\omega^3\pi^2 R^4 B^2 N^2 C \,\text{sen}(2\omega t) \qquad P_m = \frac{1}{T_0}\int^T P(t)\,dt = 0 \qquad \boxed{T = \frac{2\pi}{\omega}}$$