7 - 5 - 2020

$\boxed{P.\ 1}$

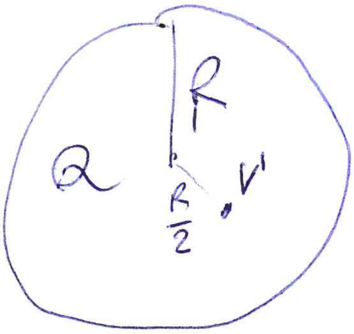
1)

$$\rho = \frac{Q}{\frac{4}{3}\pi R^3}$$

$\boxed{Q\ ,\ V'}$

$\downarrow$

$R = ?$



$$V\left(\frac{R}{2}\right) = V'$$

$$V' - \underset{0}{\cancel{V(\infty)}} = -\left[\int_{\infty}^{R} E(r)\,dr + \int_{R}^{R/2} E'(r)\,dr\right]$$

$0 < r < R$

GAUSS $\quad E'(r)\,\cancel{4\pi} r^{\cancel{2}} = \frac{1}{\varepsilon}\,\rho\,\frac{4}{3}\cancel{\pi} r^{\cancel{3}} \qquad E'(r) = \frac{\rho}{3\varepsilon} r$

$$E'(r) = \frac{Q}{\frac{4}{\cancel{3}}\pi \cancel{3}\varepsilon_0 R^3}\, r = \frac{Q}{4\pi\varepsilon_0 R^3}\, r$$

$r > R$ $\quad E(r)\,4\pi r^2 = \frac{1}{\varepsilon} Q \rightarrow E(r) = \frac{Q}{4\pi\varepsilon r^2}$

$$V' = -\int_{\infty}^{R} \frac{Q}{4\pi\varepsilon r^2}\,dr - \int_{R}^{R/2} \frac{Q}{4\pi\varepsilon R^3}\, r\,dr =$$

$$V' = \frac{Q}{4\pi\varepsilon}\frac{1}{R} - \frac{Q}{4\pi\varepsilon_0 R^3 2}\left(\frac{R^2}{4} - R^2\right) = \frac{Q}{4\pi\varepsilon}\left[\frac{1}{R} + \frac{1}{2R^3}\left(R^2 - \frac{R^2}{4}\right)\right]$$

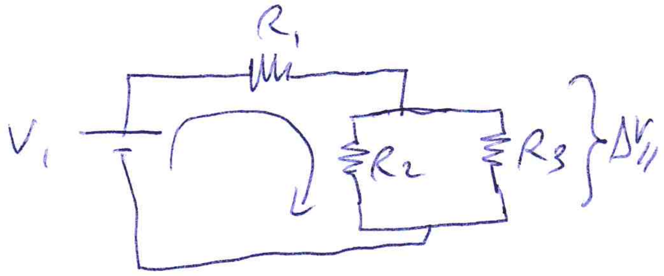
$$Q = 4\pi\varepsilon V' \Big/ \left[\frac{1}{R} + \frac{1}{2R^3}\left(R^2 - \frac{R^2}{4}\right)\right]$$

$$\Delta V_{P_2 P_2} = V(P_1) - V(P_2) = V\left(\frac{R}{3}\right) - V(3R) = -\int_{3R}^{R} E(r)\,dr - \int_{R}^{R/3} E'(r)\,dr =$$

$$= \frac{Q}{4\pi\varepsilon_0}\left(\frac{1}{R} - \frac{1}{3R}\right) - \frac{Q}{4\pi\varepsilon R^{\cancel{3}} 2}\left(\frac{\cancel{R^2}1}{9} - \frac{\cancel{R^2}}{\cancel{R}1}\right)$$

[illegible]

2) T APERTO caso (A)



$i_{gen2} = 0$ (NON E' COLLEGATO)

$$i_{gen1} = i = \frac{V_1}{R_1 + R_2//R_3} = i_{R_1}$$

$$R_2//R_3 = \frac{R_2R_3}{R_2+R_3}$$

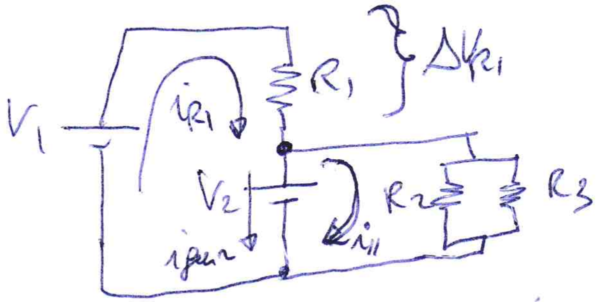
$$i_{gen1} = V_1/\left(R_1 + \frac{R_2R_3}{R_2+R_3}\right)$$

$$\Delta V_{11} = i_{gen1}(R_2//R_3) = i_{gen1}\frac{R_2R_3}{R_2+R_3}$$

$i_{R2} = \Delta V_{11}/R_2$ $\quad$ $i_{R3} = \Delta V_{11}/R_3$

T chiuso caso Ⓑ

$$R_2//R_3 = \frac{R_2R_3}{R_2+R_3}$$



$$i_{11} = \frac{V_2}{\left(\frac{R_2R_3}{R_2+R_3}\right)}$$

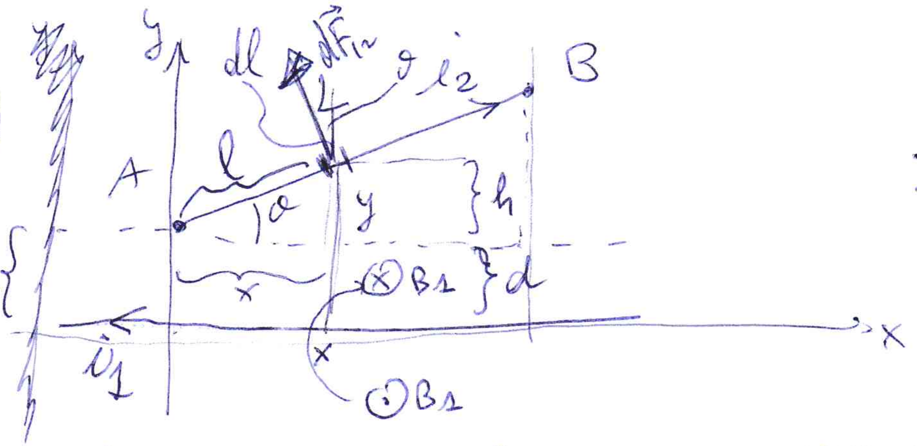
$V_{11} = V_2$

$i_{R2} = V_2/R_2$ $\quad$ $i_{R3} = V_2/R_3$ $\quad$ $\Delta V_{R1} = V_1 - V_2$

$i_{gen1} = i_{R1} = \Delta V_{R1}/R_1$

AL NODO Ⓐ $\quad i_{R1} = i_{gen2} + i_{11} \rightarrow i_{gen2} = i_{R1} - i_{11}$

3)



$$\vec F_{12} = -\vec F_{21}$$

FILO 1 PRODUCE CAMPO B_1 PER BIOT-SAVART $B_1(y) = \frac{\mu_0 i_1}{2\pi y}$
nella ZONA del FILO 2 è entrante nel foglio
$(-\hat z)$

$$y = d + h \quad \text{con } \frac{h}{x} = tg\theta \rightarrow h = x\,tg\theta$$

$$y(x) = d + x\,tg\theta \qquad x/l = \cos\theta \quad l = \frac{x}{\cos\theta} \quad dl = \frac{1}{\cos\theta}dx$$

$$dF_{12} = i_2 d\vec l \times \vec B_1 = i_2\, dl\, B_1{}^0 = i_2 \frac{dx}{\cos\theta}\frac{\mu_0 i_1}{2\pi(d + x\,tg\theta)}$$

$$F_{12} = \int_0^{L\cos\theta} dF_{12} = \int_0^{L\cos\theta} \frac{\mu_0 i_1 i_2}{2\pi\cos\theta}\frac{dx}{(x\,tg\theta + d)} =$$

$$\boxed{\begin{gathered} x\,tg\theta + d = x' \\ tg\theta\,dx = dx' \\ dx = \frac{dx'}{tg\theta} \end{gathered}}$$

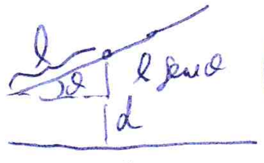
$$= \cancel{\int_0} \frac{\mu_0 i_1 i_2}{2\pi\cos\theta}\frac{1}{tg\theta}\int\frac{dx'}{x'} =$$

$$= \frac{\mu_0 i_1 i_2}{2\pi\cancel{\cos\theta}\cancel{\frac{sen\theta}{\cos\theta}}}\left[\ln\left(\frac{L\cancel{\cos\theta}\overset{sen\theta}{\cancel{tg\theta}}+d}{d}\right)\right] = \frac{\mu_0 i_1 i_2}{2\pi\,sen\theta}\ln\left(\frac{L\,sen\theta + d}{d}\right)$$

$$F_{12\,x} = -F_{12}\,sen\theta \qquad F_{12\,y} = F_{12}\cos\theta$$

$$\vec F_{12} = \hat x F_{12x} + \hat y F_{12y}$$

OPPURE



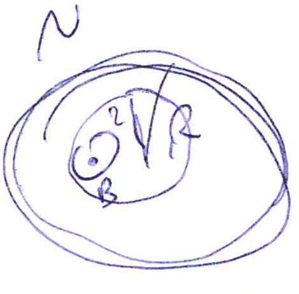
$$B = \frac{\mu_0 i}{2\pi(d + l\,sen\theta)}$$

$$dF = \frac{\mu_0 i\, i_2\, dl}{2\pi(d + l\,sen\theta)}$$

$$\rightarrow F = \int_0^L \frac{\mu_0 i_1 i_2}{2\pi}\frac{dl}{(l\,sen\theta + d)} = \frac{\mu_0 i_1 i_2}{2\pi\,sen\theta}\ln\left(\frac{L\,sen\theta + d}{d}\right)$$

etc.

4)



$$\vec{B} = B_0\left(1 - \frac{r}{2R}\right)\text{Sen}(\omega t)$$

$$\text{fem} = -\frac{d}{dt}\Phi(B)$$

$$\text{fem} = -\frac{d}{dt}\int_{\cancel{0}}^{R} N B(r)\,2\pi r\,dr = -\frac{d}{dt}N\left[\text{Sen}(\omega t)B_0\int_0^R\left(1 - \frac{r}{2R}\right)2\pi r\,dr\right] =$$

$$= -\frac{d}{dt}N\left\{B_0\,\text{Sen}(\omega t)2\pi\left[\frac{R^2}{2} - \frac{1}{2R}\int_0^R r^2\,dr\right]\right. =$$

$$= -\frac{d}{dt}B_0N\left\{\cancel{B_0}\,\text{Sen}(\omega t)2\pi\left[\frac{R^2}{2} - \frac{1}{2\cancel{R}}\frac{R^{\cancel{3}\,2}}{3}\right]\right\} = -\frac{d}{dt}NB_0\frac{\cancel{2}\,1}{\cancel{6}\,3}\text{Sen}(\omega t)R^2 2\pi =$$

$$= -N\frac{\cancel{2}\,1}{\cancel{6}\,3}B_0R^2 2\pi\frac{d}{dt}\text{Sen}(\omega t) = -\omega\frac{\cancel{2}\,1}{\cancel{6}\,3}NB_0R^2 2\pi\,\text{Cos}(\omega t)$$

$$\boxed{\text{femMAX} = 2\pi\omega N\frac{\cancel{2}\,1}{\cancel{6}\,3}R^2B_0}$$