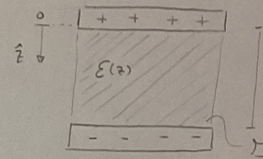
ESERCIZI DI ELETTRICITÀ E MAGNETISMO

FOGLIO EM-A7

1, 3, 4, 8, 7

1| $\Sigma = 0{,}1\ m^2$, $h = 1\ cm$, $\Delta V = 1000\ V$

$\varepsilon_{r_1} = 3$ $\quad$ $\varepsilon_{r_2} = 5$ $\quad$ $\varepsilon(z) = \varepsilon_{r_1} - z(\varepsilon_r - \varepsilon_{r_2})$



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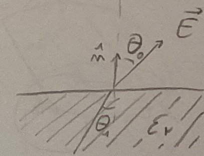
NEL VUOTO

$$\begin{cases} C_0 = \varepsilon_0 \dfrac{\Sigma}{h} = 8{,}85 \cdot 10^{-11}\ F \\ q_0 = C_0 \Delta V = 8{,}85 \cdot 10^{-8}\ C \end{cases}$$

$\sigma_0 = q_0 / \Sigma =$

$\boxed{2}$ $\vec{E}_0$: $E_0 = 200\ V/m$ $\quad \varepsilon_r = 4 \quad \theta_0 = 30°$



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USO IL FATTO $D_n = \text{COST} = \varepsilon E_n$

$$\varepsilon_r E_n = \varepsilon_{r_0} E_{0n} \quad ; \quad \varepsilon_r E \cos\theta_1 = \varepsilon_{r_0} E_0 \cos\theta_0$$

PERÒ SO $E_t = \text{COST} \Rightarrow E \sin\theta_1 = E_0 \sin\theta_0$

$$\Rightarrow \varepsilon_r E_0 \frac{\sin\theta_0}{\sin\theta_1}\cos\theta_1 = \varepsilon_{r_0} E_0 \cos\theta_0 \quad ; \quad \boxed{\frac{\varepsilon_r}{\varepsilon_{r_0}} = \frac{tg\,\theta_1}{tg\,\theta_0}} \Rightarrow \theta_1 = tg^{-1}\left(\frac{\varepsilon_r}{\varepsilon_{r_0}} tg\,\theta_0\right) = 66{,}58°$$

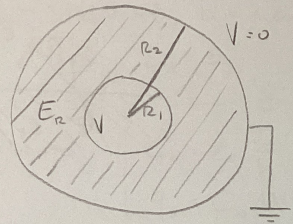
COSI $\varepsilon_r E \cos\theta_1 = \varepsilon_{r_0} E_0 \cos\theta_0 \Rightarrow E = \dfrac{E_0 \cos\theta_0}{\varepsilon_r \cos\theta_1} = 108{,}9\ V/m$

$$\vec{P} = \varepsilon_0(\varepsilon_r - 1)\vec{E} \Rightarrow |P| = 2{,}89 \cdot 10^{-9}\ V/m$$

$$\sigma_p = \vec{P} \cdot \hat{n} = P \cos\theta_1 = \boxed{1{,}15 \cdot 10^{-9}\ C/m^2}$$

SEGNO MENO ESCE SE $\vec{E}_0$ ENTRANTE IN ε_r COSI $E_n = -E_0 \cos\theta_0$

3

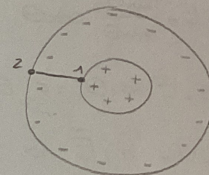


RIGIDITÀ DIELETTRICA È IL VALORE DI CAMPO ELETTRICO MASSIMO APPLICABILE PRIMA DELLE SCARICHE

QUINDI DEVE SEMPRE VALERE

$$E < E_R$$

$$V < V_R =$$



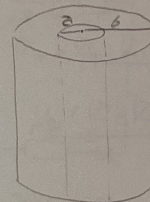
SONO NEL VUOTO, SO $C_0 = 4\pi\varepsilon_0 \dfrac{R_1 R_2}{R_2 - R_1}$

$$V_1 - V_2 = \boxed{V_1 = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)} = \frac{q}{4\pi\varepsilon_0}\,\frac{R_2 - R_1}{R_1 R_2}$$

IN UN DIELETTRICO SO $V_k = \dfrac{V_0}{\varepsilon_r}$

4 | $\rho = 2\ \Omega m$, $d = 2\ cm$, $a = 2\ mm$, $b = 5\ mm$, $V = 20\ V$

1) CASO i // ALL'ASSE



$$\Sigma = \pi(b^2 - a^2) \qquad \tau = \pi d (b^2 - a^2)$$

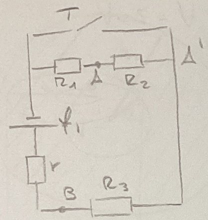
CALCOLO $\quad R = \rho \frac{d}{\Sigma} = 606,3\ \Omega$

$$\boxed{i = \frac{V}{R} = 0,033\ A} \Rightarrow \boxed{\vec{J} = \frac{i}{\Sigma} = 500,2\ A/m^2}$$

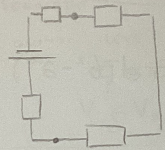
$$\boxed{P = V i = 0,66\ W}$$

2) CASO i RADIALE

5



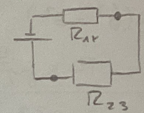
SE T APERTO HO



$R_{23} = R_2 + R_3$

$R_{1r} = R_1 + r$

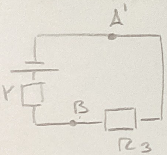
$\Rightarrow$



È UN PARTITORE RESISTIVO E VOGLIO $V_{R_{23}} \equiv V_{AB}$

$$i_{TOT} = \frac{f}{R_{1r}+R_{23}} \quad , \quad V_{R_{23}} = R_{23}\, i_{TOT} = \boxed{V_{AB} = f\,\frac{R_2+R_3}{r+R_2+R_3+R_1}}$$

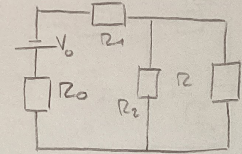
SE T CHIUSO NEL RAMO DI R_1, R_2 NON PASSA CORRENTE



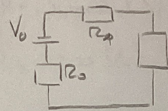
HO DI NUOVO UN PARTITORE DI TENSIONE

$$i_{TOT} = \frac{f}{r+R_3} \quad , \quad V_{R3} = V_{A'B} = i_{TOT}\, R_3 = \boxed{f\,\frac{R_3}{r+R_3}}$$

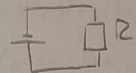
$\boxed{6}$



$\Rightarrow$



$R_2' = \frac{R_2 R}{R_2+R}$ $\Rightarrow$



$$R_T = R_0 + R_1 + \frac{R_2 R}{R_2+R}$$

$$i_T = \frac{V_0}{R_T} = \frac{V(R_2+R)}{R_0R_2+RR_0+R_1R_2+RR_1+R_2R} = \frac{V_0(R_2+R)}{(R_2+R)(R_0+R_1)+R_2R} = \frac{V_0(R+R_2)}{\alpha}$$

$$\cancel{P = iV = \frac{V_0^2(R_2R)}{(R_2+R)(R_0+R_1)+R_2R} = \frac{V_0^2(R_2R)}{\alpha}}$$

$$\cancel{\frac{\partial P}{\partial R} = \frac{V^2R_2}{\alpha} + \left(-V_0^2R_2R\frac{R_0+R_1+R_2}{\alpha^2}\right) = 0}$$

$$\cancel{\frac{V_0^2R}{\alpha} = \frac{V_0^2R_2}{\alpha^2}R(R_0+R_1+R_2) \rightarrow \alpha = (R_2+R)(R_0+R_1)+R_2R = R(R_0+R_1+R_2)}$$

i_T PASSA IN $R_2' \rightarrow V_R = i_T R_2' = \frac{V_0(R+R_2)}{(R_2+R)(R_0+R_1)+R_2R}\,\frac{R_2R}{R_2+R} = \frac{V_0R_2R}{\alpha}$

$$P = i_R^2 R = \left(\frac{V_R}{R}\right)^2 R = \frac{V_R^2}{R} = \frac{V_0^2R_2^2R}{\alpha^2}$$

$$\frac{\partial P}{\partial R} = \frac{V_0^2R_2^2}{\alpha^2} + \left(-V_0^2R_2^2R\frac{R_0+R_1+R_2}{\alpha^3}2\right) = 0$$

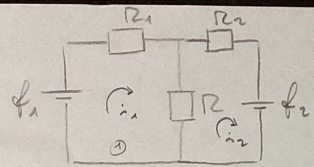
$$\frac{\cancel{V_0^2R_2^2}}{\cancel{\alpha^2}} = 2\frac{\cancel{V_0^2R_2^2}}{\alpha^{\cancel{3}1}}R(R_0+R_1+R_2) \rightarrow \alpha = 2R(R_0+R_1+R_2)$$

$$\left[R(R_0+R_1+R_2)+R_2(R_0+R_1)\right]^2 = 2R(R_0+R_1+R_2)$$

$$-R(R_0+R_1+R_2) = -R_2(R_0+R_1)$$

$$\Rightarrow \boxed{R = \frac{R_2(R_0+R_1)}{R_0+R_1+R_2}}$$

7|



$\mathcal{E}_1 = 10\,V$ $\quad \mathcal{E}_2 = 20\,V$ $\quad R_1 = 100\,\Omega$

$R_2 = 200\,\Omega$ $\quad R = 300$

$$\begin{cases} i_1(R_1 + R) - i_2 R_2 = \mathcal{E}_1 \\ i_2(R + R_2) - i_1 R_1 = -\mathcal{E}_2 \end{cases} \qquad \begin{cases} i_1 = \dfrac{\mathcal{E}_1 + i_2 R_2}{R_1 + R} \\ i_2(R+R_2) - \dfrac{\mathcal{E}_1 + i_2 R_2}{R_1 + R} R_1 = -\mathcal{E}_2 \end{cases}$$

$$i_2(R + R_2)(R + R_1) - (\mathcal{E}_1 + i_2 R_2)R_1 = -\mathcal{E}_2(R_1 + R)$$

$$i_2(R + R_2)(R + R_1) - i_2 R_1 R_2 = -\mathcal{E}_2(R_1 + R) + \mathcal{E}_1 R_1$$

$$i_2 = \frac{\mathcal{E}_1 R_1 - \mathcal{E}_2(R_1 + R)}{(R + R_2)(R + R_1) - R_1 R_2} = -0{,}039\,A$$

$$i_1 = \frac{\mathcal{E}_1 + i_2 R_2}{R_1 + R} = 5{,}5 \cdot 10^{-3}\,A = 0{,}0055\,A$$

8

$L = 26{,}7\ \text{Km}$ $\quad m_p = 11{,}5\cdot 10^{10}$ PROTONI $\quad t_0 = 25\ \text{ns}$ $\quad v \cong c$

$r = 16\ \mu\text{m}$

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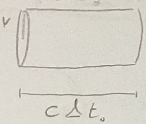
$\Sigma = \pi r^2 = 8\cdot 10^{-10}\ \text{m}^2$



$$i = \lim_{\Delta t \to 0} \frac{\Delta q}{\Delta t} = \frac{dq}{dt} \qquad \Delta q = m_p e \tau = m_p e c \Delta t_0 d\Sigma$$

$$\Rightarrow di = \frac{\Delta q}{\Delta t_0} = m_p e c\, d\Sigma$$

$$\Rightarrow i = m_p e c \pi r^2 = 4{,}4\cdot 10^{-9}\ A$$