Soluzioni

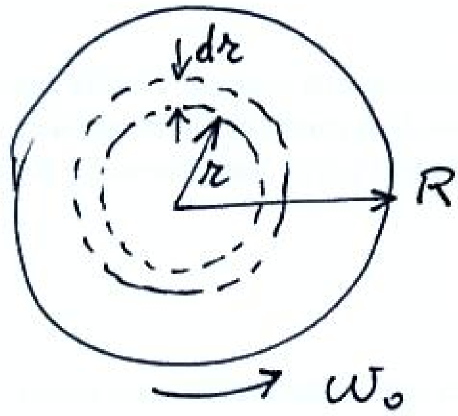
(1) $\sigma_p = P = \varepsilon_0 \chi E$

Gauss e simmetria cilindrica

$$E = \frac{\lambda}{2\pi \varepsilon_r \varepsilon_0 b} = \frac{\cancel{2\pi} a \cancel{h} \sigma / \cancel{h}}{\cancel{2\pi} \varepsilon_2 \varepsilon_0 b}$$

$$\sigma_p = \frac{(\varepsilon_2 - 1)\,\sigma a}{\varepsilon_2 b}$$

(2)



$dq = 2\pi r\, dr\, \sigma$

$i(r) = dq \frac{\omega_0}{2\pi} = \sigma \omega_0 r\, dr$ dove $\sigma = \frac{Q}{\pi R^2}$

$dB_0 = \frac{\mu_0 i(r)}{2r} = \frac{1}{2} \mu_0 \sigma \omega_0 dr$

$dm = \pi i(r) r^2 = \pi \sigma \omega_0 r^3 dr$

$$\begin{cases} B_0 = \int_0^R dB_0 = \frac{1}{2}\mu_0 \sigma \omega_0 R = \frac{\mu_0 Q \omega_0}{2\pi R} \\ m = \int_0^R dm = \frac{1}{4}\pi\sigma\omega_0 R^4 = \frac{1}{2} Q\omega_0 R^2 \end{cases}$$

$\perp$ e uscenti dal foglio.

(3) $q_0 = C f \qquad q(t) = q_0 e^{-t/\tau}$

$$\tau = C R_{TOT}$$

$$R_{TOT} = R_1 + \frac{R_2 R_3}{R_2 + R_3} = \frac{R_1 R_2 + R_1 R_3 + R_2 R_3}{R_2 + R_3}$$

$$V_D - V_E = -i \frac{R_2 R_3}{R_2 + R_3}$$

$$i = -\frac{dq}{dt} = \frac{q_0}{\tau} e^{-t/\tau} = \frac{f(R_2 + R_3)}{R_1 R_2 + R_1 R_3 + R_2 R_3} e^{-t/\tau}$$

$$V_D - V_E = -\frac{f R_2 R_3}{R_1 R_2 + R_1 R_3 + R_2 R_3} e^{-t/\tau} = -4{,}8\, e^{-t/\tau}\ V$$

(4) $i_2(t) = i_0 \sin \omega t$

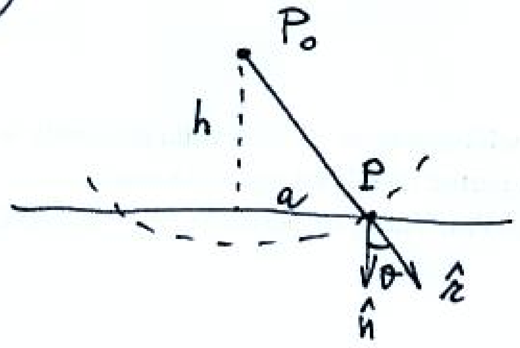
$$M = \frac{\Phi_1(B_2)}{i_2} = \frac{\Phi_2(B_1)}{i_1}$$

$$B_1(z) = \frac{\mu_0 R^2 i_1}{2(z^2+R^2)^{3/2}} \qquad \Phi_2(B_1) \simeq B_1 \pi r^2$$

$$M = \frac{\mu_0 \pi r^2 R^2}{2(z^2+R^2)^{3/2}} \Rightarrow f_1(t) = -M\frac{di_2}{dt} = -\frac{\mu_0 \pi r^2 R^2}{2(z^2+R^2)^{3/2}} \omega i_0 \cos(\omega t)$$

$$f_1(t) = -1.3 \cdot 10^{-4} \cos(\omega t) \ V$$

(5)



P_0 potenza emessa dalla lampadina.

$$P_0 = \Phi(I) = I\, 4\pi r^2 \Rightarrow I = \frac{P_0}{4\pi r^2}$$

nel punto P l'intensità luminosa è

$$L = I\cos\theta = \frac{P_0}{4\pi r^2}\cos\theta = \frac{P_0 h}{4\pi\left(\sqrt{a^2+h^2}\right)^2}$$

$$\frac{dL}{dh} = \frac{P_0}{4\pi r^5}(a^2 - 2h^2)$$

$$\Rightarrow L \text{ è massima per } h = \frac{a}{\sqrt{2}} = 35 \text{ cm}$$