Soluzioni

(1) Il modulo del momento di dipolo p :

$$p = P\tau = \varepsilon_0(\varepsilon_2 - 1) E S d_1 =$$

$$= \varepsilon_0(\varepsilon_2 - 1)\frac{\sigma}{\varepsilon_2 \varepsilon_0} S d_1 =$$

$$= \frac{(\varepsilon_2 - 1)}{\varepsilon_2} Q d_1 = \frac{\varepsilon_2 - 1}{\varepsilon_2} C \Delta V d_1$$

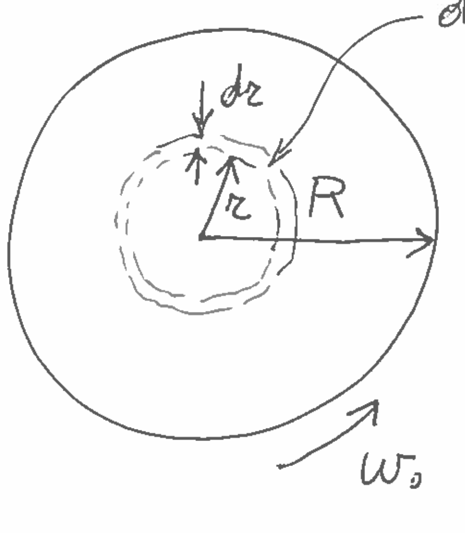
$$\frac{1}{C} = \frac{d_0}{\varepsilon_0 S} + \frac{d_1}{\varepsilon_0 \varepsilon_2 S} = \frac{\varepsilon_2 d_0 + d_1}{\varepsilon_2 \varepsilon_0 S}$$

$$p = \frac{\varepsilon_2 - 1}{\cancel{\varepsilon_2}} \frac{\cancel{\varepsilon_2} \varepsilon_0 S}{\varepsilon_2 d_0 + d_1} \Delta V d_1$$

(2)

$$dq = \sigma 2\pi r dr \; ; \; i(r) = dq \frac{\omega_0}{2\pi} = \sigma \omega_0 r dr$$

$$\sigma = \frac{Q}{\pi R^2}$$



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

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

$$B_0 = \int_0^R dB = \frac{1}{2}\mu_0 \sigma \omega_0 R = \frac{\mu_0 Q \omega_0}{2\pi R}$$

$$m = \int_0^R dm = \frac{1}{4}\pi\sigma\omega_0 R^4 = \frac{1}{4} Q \omega_0 R^2$$

(3) Energia magnetica a $t=0$:

$$U_M = \frac{1}{2} L i_0^2 \quad ; \quad i_0 = \frac{f}{r}$$

$$U_R = \left(\frac{1}{2} L \frac{f^2}{r^2}\right)\left(\frac{R}{r+R}\right)$$

(4) $$M = \frac{\Phi_{spira}}{I_{sol}} = \pi a^2 \mu_0 n \quad ; \quad I(t=0) = 0$$

$$RI = -M \frac{I_{spira}}{dt} - L\frac{dI}{dt}$$

$$RI = MK - L\frac{dI}{dt}$$

$$I = \frac{MK}{R} + A e^{\left(-\frac{R}{L}t\right)} \quad ; \quad A = -\frac{MK}{R}$$

$$I = \frac{\pi a^2 \mu_0 n K}{R}\left(1 - e^{-R/L\, t}\right);$$

5

$$\vec{\nabla} \times \vec{B} = \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$$

$$\left(\vec{\nabla} \times \vec{B}\right)_x = -\frac{\partial a x}{\partial z} = \mu_0 \varepsilon_0 \frac{\partial E_x}{\partial t} = 0$$

$$\left(\nabla \times \vec{B}\right)_y = -\frac{\partial(-a y)}{\partial z} = \mu_0 \varepsilon_0 \frac{\partial E_y}{\partial t} = 0$$

$$\left(\nabla \times \vec{B}\right)_z = \frac{\partial (a x)}{\partial x} + \frac{\partial (a y)}{\partial y} = 2a = \mu_0 \varepsilon_0 \frac{\partial E_z}{\partial t}$$

$$\Downarrow$$

$$E_x = E_y = 0 \quad e \quad E_z = \frac{2a}{\mu_0 \varepsilon_0} t$$

$\square$