Università degli Studi Roma Tre
Dipartimento di Matematica

Appello B
FS2, Fisica 2
Elettromagnetismo
A.A. 2002/2003

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SOLUZIONI

1) $$\vec{E} = \frac{\vec{D}}{\varepsilon} = \frac{\sigma}{\varepsilon_0 (1+\chi)} \hat{n}$$

1-a) $$\vec{P} = \varepsilon_0 \chi \vec{E} = \frac{\sigma \chi}{(1+\chi)} \hat{n} = \frac{\sigma a x}{1 + a x}$$

1-b) $$\rho_{pol} = -\operatorname{div} \vec{P} = -\frac{\partial P_x}{\partial x} = -\frac{\partial}{\partial x}\left(\frac{\sigma a x}{1+a x}\right) = -\frac{\sigma a}{(1+a x)^2}$$

$$\sigma_{pol}(0) = -\vec{P} \cdot \hat{n} = -\left.\frac{\sigma a x}{1+a x}\right|_{x=0} = 0$$

1-c)

$$\sigma_{pol}(d) = \vec{P} \cdot \hat{n} = \left.\frac{\sigma a x}{1+a x}\right|_{x=d} = 0.35 \; {}^{pC}\!/_{m^2}$$

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2)

2-a) la spira deve essere posta ortogonalmente alla direzione di vibrazione di $\vec{B}$.

2-b) $B = B_0 \cos \omega t$

$$f = -\frac{d\Phi(\vec{B})}{dt} = -a b \frac{dB}{dt} = a b \omega B_0 \operatorname{sen} \omega t$$

$$B_0 = \frac{E_0}{c}; \qquad \omega = \frac{2\pi c}{\lambda};$$

$$f = a b \frac{2\pi c}{\lambda} \frac{E_0}{c} \operatorname{sen}\left(\frac{2\pi c}{\lambda} t\right) = a b \frac{2\pi}{\lambda} E_0 \operatorname{sen}\left(\frac{2\pi c}{\lambda} t\right) =$$

$$= 4 \cdot 10^{-1} \cdot 6 \cdot 10^{-1} \frac{2 \cdot 3.14}{15 \cdot 10^{-3}} 0.8 \cdot 10^{-6} \cdot \operatorname{sen}\left(\frac{2\pi 3 \cdot 10^8}{15 \cdot 10^{-3}} 10^{-2}\right) = 69.61 \; \mu V$$

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3) $$\oint \vec{E} \cdot d\vec{l} = \int_S \operatorname{rot} \vec{E} \cdot \hat{n} \, dS = \int_S -\frac{\partial \vec{B}}{\partial t} \cdot \hat{n} \, dS$$

$$\oint \vec{E} \cdot d\vec{l} = -\int_0^{r_1} \frac{d}{dt} B_0 \, e^{-k r} \cdot e^{i \omega t} \cdot 2\pi r \, dr = 2\pi \omega B_0 \operatorname{sen} \omega t \int_0^{r_1} e^{-k r} \cdot r \, dr =$$

$$= -2\pi \omega B_0 \operatorname{sen} \omega t \left[\left(r + \frac{1}{k}\right)\frac{e^{-k r}}{k}\right]_0^{r_1} = -2\pi \omega B_0 \operatorname{sen} \omega t \left[\left(r_1 + \frac{1}{k}\right)\frac{e^{-k r_1}}{k} - \frac{1}{k^2}\right] =$$

$$= -2 \cdot 3.14 \cdot 10^2 \cdot 3.14 \cdot 1 \cdot \operatorname{sen}\left(\frac{100\,\pi}{600}\right)\left[\left(5 \cdot 10^{-2} + \frac{1}{10^{-1}}\right)\frac{e^{-5 \cdot 10^{-3}}}{10^{-1}} - \frac{1}{10^{-2}}\right] = 1.23 \; V$$