Θεμα 1

(α)

$$\vec{E} = \begin{cases} \left[-\frac{\rho_0}{2\epsilon_0}d + \left(-\frac{\rho_0 \mathrm{a}^2}{2\epsilon_0} + \frac{\lambda_0}{2\pi\epsilon_0}\right)\frac{x}{x^2+(y-y_0)^2}\right]\ \hat{i}_x + \left[\left(-\frac{\rho_0 \mathrm{a}^2}{2\epsilon_0} + \frac{\lambda_0}{2\pi\epsilon_0}\right)\frac{y-y_0}{x^2+(y-y_0)^2}\right]\ \hat{i}_y & \text{for } x < -d/2, \\ \left[\frac{\rho_0}{\epsilon_0}x + \left(-\frac{\rho_0 \mathrm{a}^2}{2\epsilon_0} + \frac{\lambda_0}{2\pi\epsilon_0}\right)\frac{x}{x^2+(y-y_0)^2}\right]\ \hat{i}_x + \left[\left(-\frac{\rho_0 \mathrm{a}^2}{2\epsilon_0} + \frac{\lambda_0}{2\pi\epsilon_0}\right)\frac{y-y_0}{x^2+(y-y_0)^2}\right]\ \hat{i}_y & \text{for } -d/2 < x < +d/2 \text{ and } r_T > \mathrm{a}, \\ \left[\frac{\rho_0}{2\epsilon_0}x + \left(\frac{\lambda_0}{2\pi\epsilon_0}\right)\frac{x}{x^2+(y-y_0)^2}\right]\ \hat{i}_x + \left[-\frac{\rho_0}{2\epsilon_0}(y-y_0) + \frac{\lambda_0}{2\pi\epsilon_0}\frac{y-y_0}{x^2+(y-y_0)^2}\right]\ \hat{i}_y & \text{for } -d/2 < x < +d/2 \text{ and } r_T < \mathrm{a}, \\ \left[\frac{\rho_0}{2\epsilon_0}d + \left(-\frac{\rho_0 \mathrm{a}^2}{2\epsilon_0} + \frac{\lambda_0}{2\pi\epsilon_0}\right)\frac{x}{x^2+(y-y_0)^2}\right]\ \hat{i}_x + \left[\left(-\frac{\rho_0 \mathrm{a}^2}{2\epsilon_0} + \frac{\lambda_0}{2\pi\epsilon_0}\right)\frac{y-y_0}{x^2+(y-y_0)^2}\right]\ \hat{i}_y & \text{for } x < -d/2. \end{cases}$$

(β)

$$\lambda_0 = \rho_0 \pi \mathrm{a}^2$$

(γ)

$$W_e = S\frac{\rho_0^2 d^3}{24\epsilon_0}$$

(δ)

$$\vec{F} = 0$$

Θεμα 2

(α)

$$K(r_T) = \quad (1-k)\frac{I_0}{2\pi r_T}$$

$$J(r_T, z) = \quad k\gamma\frac{I_0 e^{-\gamma z}}{2\pi r_T}$$

$$K_1(z) = \quad (1-ke^{-\gamma z})\frac{I_0}{2\pi \mathrm{a}}$$

(β)

$$\vec{H}(r_T,z) = \hat{i}_\phi \begin{cases} \dfrac{I_0}{2\pi r_T} & z<0 \\[2ex] \dfrac{kI_0 e^{-\gamma z}}{2\pi r_T} & z>0 \ \text{ and } \ r_T < \text{a}, \\[2ex] \dfrac{I_0}{2\pi r_T} & z>0 \ \text{ and } \ r_T > \text{a} \end{cases}$$

(γ)

$$\vec{f}_{z=0} = \hat{i}_z \frac{(1-k^2)I_0^2\mu_0}{8\pi^2 r_T^2}$$

$$\vec{f}_{r_T=\text{a}} = -\hat{i}_{r_T} \frac{(1-k^2 e^{-2\gamma z})I_0^2\mu_0}{8\pi^2 \text{a}^2}$$

<u>$\Theta\epsilon\mu\alpha$ 3</u>

(α)

$$\vec{k}_i = \omega\sqrt{\epsilon_0\mu_0}[\sin\theta\ \hat{i}_x + \cos\theta\ \hat{i}_y] = k_0\ [\sin\theta\ \hat{i}_x + \cos\theta\ \hat{i}_y]$$

(β)

$$\vec{E}_r = E_0[-\cos\theta\ \hat{i}_x + j\ \hat{i}_y - \sin\theta\ \hat{i}_y]\ \exp[-jk_0\ (x\sin\theta - z\cos\theta)]$$

$$\vec{E}_t = 0$$

(γ)

$$\vec{H}_1 = \frac{2E_0}{Z_0} e^{-jk_0\sin\theta\ x}\Big\{ j\cos\theta\cos(k_0\cos\theta\ z)\ \hat{i}_x + \cos(k_0\cos\theta\ z)\ \hat{i}_y - \sin\theta\sin(k_0\cos\theta\ z)\ \hat{i}_z \Big\}$$

(δ)

$$\vec{\mathcal{K}} = \frac{2E_0}{Z_0}\Big\{ \cos(\omega t - k_0\sin\theta\ x)\ \hat{i}_x + \cos\theta\cos(\omega t - k_0\sin\theta\ x - \pi/2)\ \hat{i}_y \Big\}$$

(ϵ)

$$\vec{f} = \vec{f}_e + \vec{f}_m$$

$$\vec{f}_e = -\hat{i}_z 2\epsilon_0 E_0^2 \sin^2\theta\cos^2(\omega t - k_0\sin\theta\ x)$$

$$\vec{f}_m = \hat{i}_z 2\mu_0 \frac{E_0^2}{Z_0^2}\Big\{ \cos^2\theta + \sin^2\theta\cos^2(\omega t - k_0\sin\theta x) \Big\}$$

$$\langle\vec{f}\rangle = \hat{i}_z 2\epsilon_0 E_0^2 \cos^2\theta$$