Θεμα 1

(α)

$$\vec{E} = \hat{i}_x \begin{cases} -\frac{1}{2\epsilon_0}\Big[\sigma_1 + \sigma_2 + \frac{2d\rho_0}{\pi}\Big], & -\infty < x < -a - (d/2), \\ -\frac{1}{2\epsilon_0}\Big[-\sigma_1 + \sigma_2 + \frac{2d\rho_0}{\pi}\Big], & -a - (d/2) < x < (d/2), \\ +\frac{1}{2\epsilon_0}\Big[\sigma_1 - \sigma_2 + \frac{2d\rho_0}{\pi}\sin(\frac{\pi x}{d})\Big], & -(d/2) < x < +(d/2), \\ +\frac{1}{2\epsilon_0}\Big[\sigma_1 - \sigma_2 + \frac{2d\rho_0}{\pi}\Big], & +(d/2) < x < b + (d/2), \\ +\frac{1}{2\epsilon_0}\Big[\sigma_1 + \sigma_2 + \frac{2d\rho_0}{\pi}\Big], & b + (d/2) < x < +\infty. \end{cases}$$

(β)

$$\sigma_1 + \sigma_2 + \frac{2d\rho_0}{\pi} = 0$$

(γ)

$$W_e/S = \frac{d}{8\epsilon_0}[(\sigma_1 - \sigma_2)^2 + \frac{2d^2\rho_0^2}{\pi^2}]$$

(δ)

$$\vec{f} = \hat{i}_x \frac{2d\rho_0}{\pi}\frac{\sigma_1 - \sigma_2}{2\epsilon_0}$$

(ϵ)

$$\vec{f} = \hat{i}_x \frac{\sigma_2}{2\epsilon_0}\Big[\sigma_1 + \frac{2d\rho_0}{\pi}\Big]$$

Θεμα 2

(α)

$$\vec{K}_1 = \frac{I/2}{2\pi r_T}\hat{i}_{r_T},$$

$$I(z) = \frac{I}{2}\exp(-\alpha|z|),$$

$$\vec{J}(r_T, z) = \hat{i}_{r_T}\alpha\frac{I}{2}\frac{1}{2\pi r_T}\exp(-\alpha|z|).$$

(β)

$$\vec{H} = \hat{i}_\phi \begin{cases} -\dfrac{I}{2\pi r_T}, & \text{for } z > 0, \\ -\dfrac{I/2}{2\pi r_T}\exp(-\alpha|z|), & \text{for } z < 0. \end{cases}$$

(γ)

$$\vec{f} = -\hat{i}_z \frac{3\mu_0 I^2}{32\pi^2 r_T^2}$$

(δ)

$$W_m = \frac{\mu_0 I^2}{32\pi\alpha}\Big[1 - \exp(-2\alpha\ell)\Big]\ln(\frac{b}{a})\exp(-2\alpha d)$$

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

(α)

$$\vec{E} = \hat{i}_y \begin{cases} E_0\exp(-jk_1 z) + E_r\exp(+jk_1 z), & \text{for } z < 0, \\ E_1\exp(-jk_2 z) + E_2\exp(+jk_2 z), & \text{for } 0 < z < d. \end{cases}$$

(β)

$$\vec{H} = \hat{i}_x \begin{cases} -\dfrac{E_0}{Z_1}\exp(-jk_1 z) + \dfrac{E_r}{Z_1}\exp(+jk_1 z), & \text{for } z < 0, \\ -\dfrac{E_1}{Z_2}\exp(-jk_2 z) + \dfrac{E_2}{Z_2}\exp(+jk_2 z), & \text{for } 0 < z < d. \end{cases}$$

(γ)

$$E_0 + E_r = E_1 + E_2,$$

$$-\frac{E_0}{Z_1} + \frac{E_r}{Z_1} = -\frac{E_1}{Z_2} + \frac{E_2}{Z_2},$$

$$E_1\exp(-jk_2 d) + E_2\exp(+jk_2 d) = 0.$$

(δ)

$$\vec{K} = \hat{i}_y \frac{2E_0}{Z_1}\exp(-jm\pi),$$

$$\vec{K}(t) = \hat{i}_y \frac{2E_0}{Z_1}\cos(\omega t - m\pi).$$

(ϵ)

$$\vec{f} = \hat{i}_z \frac{\mu_0}{2} \big(\frac{2E_0}{Z_1}\big)^2 \cos^2(\omega t - m\pi),$$

$$\langle \vec{f} \rangle = \hat{i}_z \frac{\mu_0 E_0^2}{Z_1^2}.$$