ΠΕΔΙΑ   Α   21/09/2009

Θεμα 1

(α)

$$\vec{E} = \begin{cases} \dfrac{\rho}{3\epsilon_0} d\hat{i}_y & \text{for } r_1 < \text{a and } r_2 < b, \\ \dfrac{\rho}{3\epsilon_0}(x\ \hat{i}_x + y\ \hat{i}_y + z\ \hat{i}_z) - \dfrac{\rho b^2}{3\epsilon_0}\dfrac{(x\ \hat{i}_x + (y-d)\ \hat{i}_y + z\ \hat{i}_z)}{[x^2+(y-d)^2+z^2]^{3/2}} & \text{for } r_1 < \text{a and } r_2 > b \\ \dfrac{\rho \text{a}^3}{3\epsilon_0}\dfrac{(x\ \hat{i}_x + y\ \hat{i}_y + z\ \hat{i}_z)}{(x^2+y^2+z^2)^{3/2}} - \dfrac{\rho b^2}{3\epsilon_0}\dfrac{(x\ \hat{i}_x + (y-d)\ \hat{i}_y + z\ \hat{i}_z)}{[x^2+(y-d)^2+z^2]^{3/2}} & \text{for } r_1 > \text{a and } r_2 > b \end{cases}$$

(β)

$$W_e = \frac{2\rho^2 d^2 b^3}{27\epsilon_0}$$

Θεμα 2

(α)

$$\vec{H}_{wire}(y,z) = \frac{I}{2\pi}\Big[\frac{z-\text{a}/2}{y^2+(z-\text{a}/2)^2}\ \hat{i}_y - \frac{y}{y^2+(z-\text{a}/2)^2}\ \hat{i}_z\Big]$$

$$\vec{H} = \Big(\frac{K}{2} - \frac{Ah^3}{24}\Big)(\cos\phi\ \hat{i}_x + \sin\phi\ \hat{i}_y) + \vec{H}_{wire}(y,z) \qquad \text{for } z > \text{a}$$

$$\vec{H} = -\Big(\frac{K}{2} + \frac{Ah^3}{24}\Big)(\cos\phi\ \hat{i}_x + \sin\phi\ \hat{i}_y) + \vec{H}_{wire}(y,z) \qquad \text{for } 0 < z < \text{a}$$

$$\vec{H} = -\Big(\frac{K}{2} + \frac{A(z+h/2)^3}{3}\Big)(\cos\phi\ \hat{i}_x + \sin\phi\ \hat{i}_y) + \vec{H}_{wire}(y,z) \qquad \text{for } -h < z < 0$$

$$\vec{H} = \Big(-\frac{K}{2} + \frac{Ah^3}{24}\Big)(\cos\phi\ \hat{i}_x + \sin\phi\ \hat{i}_y) + \vec{H}_{wire}(y,z) \qquad \text{for } z < -h$$

(β)

$$\vec{f}(z=\text{a}) = \frac{\mu_0 K}{2}\cos\phi\Big[-\frac{I}{2\pi}\frac{y}{y^2+(\text{a}/2)^2}\Big]\ \hat{i}_x +$$

$$\frac{\mu_0 K}{2}\sin\phi\Big[-\frac{I}{2\pi}\frac{y}{y^2+(\mathrm{a}/2)^2}\Big]\ \hat{i}_y +$$

$$\frac{\mu_0 K}{2}\Big[\frac{Ah^3}{12}+\frac{I}{2\pi}\frac{(\mathrm{a}/2)\sin\phi}{y^2+(\mathrm{a}/2)^2}\Big]\ \hat{i}_z$$

$$\vec{f}(z=\mathrm{a}, I=0) = \frac{\mu_0 K A h^3}{24}\ \hat{i}_z$$

(γ)

$$\vec{f}(x, y=0, z=\mathrm{a}) = \frac{\mu_0 K}{2}\Big[\frac{Ah^3}{12}+\frac{I\sin\phi}{\mathrm{a}\pi}\Big]\hat{i}_z$$

$$|\vec{f}(x, y=0, z=\mathrm{a})| = \Big|\frac{\mu_0 K}{2}\Big|\ \Big|\frac{Ah^3}{12}+\frac{I\sin\phi}{\mathrm{a}\pi}\Big|$$

$$|\vec{f}(x, y=0, z=\mathrm{a})| = 0 \Longrightarrow I = -\frac{Ah^3\pi\mathrm{a}}{12\sin\phi} \qquad \text{for } \phi\neq 0$$

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

(α)

$$\vec{k}_i = \omega\sqrt{\epsilon_0\mu_0}[\sin\theta_1\ \hat{i}_x + \cos\theta_1\ \hat{i}_z] = k_0\ [\sin\theta_1\ \hat{i}_x + \cos\theta_1\ \hat{i}_y]$$

(β)

$$\vec{E}_r = -0.6E_0\ \hat{i}_y\ \exp[-jk_0\ (x\sin\theta_1 - z\cos\theta_1)] \qquad \text{with } \theta_1 = 63.43495^\circ$$

$$\vec{E}_t = E_0[0.4472\ \hat{i}_x + 0.4\ \hat{i}_y - 0.2236\ \hat{i}_z]\ \exp[-j2k_0(x\sin\theta_2 + z\cos\theta_2)] \qquad \text{with } \theta_2 = 26.56505^\circ$$

(γ)

$$\vec{\mathcal{H}}_2 = \frac{E_0}{60\pi}\Big[-0.1789\ \hat{i}_x +\ \hat{i}_y + 0.0894\ \hat{i}_z\Big]\cos[\omega t - 2k_0(0.4472x + 0.8944z)]$$

(δ)

$$\vec{H}_1 = \frac{E_0}{120\pi}\Big[-0.4472\ \hat{i}_x +\ \hat{i}_y + 0.8944\ \hat{i}_z\Big]\exp[-jk_0(\sin\theta_1\ x + \cos\theta_1 z)] + -\frac{E_0}{120\pi}\Big[0.2683\ \hat{i}_x + 0.5367\ \hat{i}_z\Big]\exp[-jk_0(\sin\theta_1\ x - \cos\theta_1 z)]$$

(ϵ)

Incident Wave : Linear Polarization at $\vartheta = 45^\circ$ (measured from x-axis)

Reflected Wave : Linear Polarization at $\vartheta = 90^\circ$ (along y-axis)

Transmitted Wave : Linear Polarization at $\vartheta = 38.66^\circ$ (measured from x-axis)

$(\sigma\tau)$

$$\langle \vec{N}_2 \rangle = \frac{0.41|E_0|^2}{120\pi}(\sin\theta_2 \ \hat{i}_x + \cos\theta_2 \ \hat{i}_z)$$