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1. $\vec{E}_i = 1000 \cos(10^8 \pi t - \beta_0 z)\, \hat{a}_x$ V/m

$\varepsilon_g = 5\, \varepsilon_0 \rightarrow \varepsilon_{rg} = 5$

$\mu_g = \mu_0 \rightarrow \mu_{rg} = 1$

$\sigma_g = 0$

a. $\beta_0 = \frac{\omega}{c} = \frac{\cancel{10^8}\pi}{3\times \cancel{10^8}} = \frac{\pi}{3} = 1,047$ rad/m

$\beta_g = \frac{\omega}{c}\sqrt{\mu_{rg} \cdot \beta_{rg}} = \frac{\cancel{10^8} \cdot \pi}{3\times\cancel{10^8}} \cdot \sqrt{1 \cdot 5} = 2,342$ rad/m

b. $\eta_1 = 120\pi = 377\ \Omega$

$\eta_2 = \eta_g = 120\pi\sqrt{\frac{\mu_{rg}}{\varepsilon_{rg}}} = 377\sqrt{\frac{1}{5}} = 168,6\ \Omega$

$\Gamma = \frac{\eta_2 - \eta_1}{\eta_2 + \eta_1} = \frac{168,6 - 377}{168,6 + 377}$

$\Gamma = -0,382$

$\Gamma = 0,382 \angle 180°$

$T = \frac{2\eta_2}{\eta_2 + \eta_1} = \frac{2 \cdot 168,6}{168,6 + 377} = 0,618$

c. $\vec{E}_i = 1000 \cos(10^8 \pi t - \beta_0 z)\, \hat{a}_x$ V/m

$\vec{H}_i = \frac{1000}{377} \cos(10^8 \pi t - \beta_0 z)\, \hat{a}_y$ A/m

$\vec{H}_i = 2,65 \cos(10^8 \pi t - \beta_0 z)\, \hat{a}_y$ A/m

$$\Gamma = \frac{\vec{E}_{or}}{\vec{E}_i}$$

$$\vec{E}_{or} = \Gamma . \vec{E}_i$$

$$= 0{,}382 \angle 180^\circ . 1000 \cos(10^8 \pi t - \beta_o z)$$

$$= 382 \, e^{j\pi} \cos(10^8 \pi t + \beta_o z) \, \hat{a}_x$$

$$= 382 \cos\left(10^8 \pi t + \frac{\pi}{3} z + \pi\right) \hat{a}_x \quad V/m$$

$$\vec{H}_{or} = \frac{382}{377} \cos\left(10^8 \pi t + \frac{\pi}{3} z + \pi\right) (-\hat{a}_y)$$

$$= -1{,}01 \cos\left(10^8 \pi t + \frac{\pi}{3} z + \pi\right) \hat{a}_y \quad A/m$$

$$\vec{P}_{or} = \vec{E}_{or} \times \vec{H}_{or}$$

$$= -385{,}82 \cos^2\left(10^8 \pi t + \frac{\pi}{3} z + \pi\right) (\hat{a}_x \times \hat{a}_y)$$

$$= -385{,}82 \cos^2\left(10^8 \pi t + \frac{\pi}{3} z + \pi\right) \hat{a}_z \quad W/m^2$$

$$T = \frac{\vec{E}_{oT}}{\vec{E}_i}$$

$$\vec{E}_{oT} = T . \vec{E}_i$$

$$= 0{,}618 . 1000 \cos(10^8 \pi t - \beta_g z) \, \hat{a}_x$$

$$= 618 \cos(10^8 \pi t - 2{,}342 \, z) \, \hat{a}_x \quad V/m$$

$$\vec{H}_{oT} = \frac{618}{168{,}6} \cos(10^8 \pi t - 2{,}342 \, z) \, \hat{a}_y$$

$$= 3{,}67 \cos(10^8 \pi t - 2{,}342 \, z) \, \hat{a}_y \quad A/m$$

$$\vec{P}_{oT} = \vec{E}_{oT} \times \vec{H}_{oT} = 2268{,}06 \cos^2(10^8 \pi t - 2{,}342 \, z) \, \hat{a}_z \quad W/m^2$$

2. $\vec{E}_i = 200 \cos(10^6 \pi t + \beta_1 y)\, \hat{a}_z$ V/m

$\varepsilon_{r1} = 4$ $\qquad$ $\varepsilon_{r2} = 8$ $\qquad$ $\hat{a}_z \times (\underset{-\hat{a}_x}{\underbrace{---}}) = -\hat{a}_y$

$\mu_{r1} = 1$ $\qquad$ $\mu_{r2} = 1$

$\sigma_1 = 0$ $\qquad$ $\sigma_2 = 0$

$$\eta_1 = 120\pi \sqrt{\frac{\mu_{r1}}{\varepsilon_{r1}}} = 377\sqrt{\frac{1}{4}} = 188{,}5\ \Omega$$

$$\eta_2 = 120\pi \sqrt{\frac{\mu_{r2}}{\varepsilon_{r2}}} = 377\sqrt{\frac{1}{8}} = 133{,}29\ \Omega$$

a. $$\vec{H}_i = \frac{200}{188{,}5} \cos(10^6 \pi t + \beta_1 y)(-\hat{a}_x)$$

$$= -1{,}06 \cos(10^6 \pi t + \beta_1 y)\, \hat{a}_x \ \text{A/m}$$

b. $$\beta_1 = \frac{\omega}{c}\sqrt{\mu_{r1} . \varepsilon_{r1}} = \frac{\cancel{10^6}\pi}{3 \times \cancel{10^8}_2}\sqrt{1.4} = \frac{2\pi}{300} = 0{,}021$$

$$\beta_2 = \frac{\omega}{c}\sqrt{\mu_{r2} . \varepsilon_{r2}} = \frac{\cancel{10^6}\pi}{3 \times \cancel{10^8}_2}\sqrt{1.8} = \frac{2\sqrt{2}\pi}{300} = 0{,}03$$

c. $$\eta_2 = 120\pi \sqrt{\frac{\mu_{r2}}{\varepsilon_{r2}}} = 377\sqrt{\frac{1}{8}} = 133{,}29\ \Omega$$

d. $\Gamma = \dfrac{\eta_2 - \eta_1}{\eta_2 + \eta_1}$

$= \dfrac{133,29 - 188,5}{133,29 + 188,5}$

$= -0,172$

$= 0,172 \angle 180^\circ$

$T = \dfrac{2\eta_2}{\eta_2 + \eta_1}$

$= \dfrac{2 \cdot 133,29}{133,29 + 188,5}$

$= 0,828$

$\Gamma = \dfrac{\vec{E}_r}{\vec{E}_i}$

$\vec{E}_r = \Gamma \cdot \vec{E}_i$

$= 0,172 \angle 180^\circ \cdot 200 \cos(10^6 \pi t - \beta_1 Y)\, \hat{a}_z$

$= 34,4\, e^{j\pi} \cos(10^6 \pi t - 0,021\, Y)\, \hat{a}_z$

$= 34,4 \cos(10^6 \pi t - 0,021\, Y + \pi)\, \hat{a}_z$ V/m

$\vec{H}_r = \dfrac{34,4}{188,5} \cos(10^6 \pi t - 0,021\, Y + \pi)\, \hat{a}_x$

$= 0,182 \cos(10^6 \pi t - 0,021\, Y + \pi)\, \hat{a}_x$ A/m

$\vec{P}_r = \vec{E}_r \times \vec{H}_r$

$= 6,261 \cos^2(10^6 \pi t - 0,021\, Y + \pi)\, \hat{a}_Y$ W/m^2

$T = \dfrac{\vec{E}_T}{\vec{E}_i}$

$\vec{E}_T = T \cdot \vec{E}_i$

$= 0,828 \cdot 200 \cos(10^6 \pi t + \beta_2 Y)\, \hat{a}_z$

$= 165,6 \cos(10^6 \pi t + 0,03\, Y)\, \hat{a}_z$ V/m

$$\vec{H}_T = \frac{165{,}6}{133{,}29} \cos\left(10^6 \pi t + 0{,}03y\right) (-\hat{a}_x)$$

$$= -1{,}24 \cos\left(10^6 \pi t + 0{,}03y\right) \hat{a}_x \quad A/m$$

$$\vec{P}_T = \vec{E}_T \times \vec{H}_T$$

$$= -205{,}344 \cos^2\left(10^6 \pi t + 0{,}03y\right) \hat{a}_y \quad W/m^2$$