1. Medium A $(4\varepsilon_0, \mu_0)$ berbatasan dengan medium B $(9\varepsilon_0, \mu_0, x > 0)$. Gelombang datang medan listrik dengan persamaan seperti dibawah menumbuk perbatasan.

$$\vec{E} = 100 \cos\left(2\pi.10^8 t - \beta x + \frac{4\pi}{3}\right)\vec{a}_y \rightarrow \vec{E}^+$$

Tuliskan persamaan gelombang pantul dan diteruskan untuk medan listrik dan medan magnet dalam bentuk real time dan phasor

$$\sqrt{\frac{\mu_0}{\varepsilon_0}} = 120\pi$$

$\varepsilon_A = 4\varepsilon_0$ $\quad \varepsilon_B = 9\varepsilon_0$

$\mu_A = \mu_0$ $\quad \mu_B = \mu_0$

$$\eta_A = \sqrt{\frac{\mu_A}{\varepsilon_A}} = \sqrt{\frac{\mu_0}{4\varepsilon_0}} = \frac{1}{2}\sqrt{\frac{\mu_0}{\varepsilon_0}} = \frac{1}{2}.120\pi = 60\pi$$

$$\eta_B = \sqrt{\frac{\mu_B}{\varepsilon_B}} = \sqrt{\frac{\mu_0}{9\varepsilon_0}} = \frac{1}{3}\sqrt{\frac{\mu_0}{\varepsilon_0}} = \frac{1}{3}120\pi = 40\pi$$

Gel. Pantul

$$\Gamma = \frac{\eta_B - \eta_A}{\eta_B + \eta_A} = \frac{40\pi - 60\pi}{40\pi + 60\pi} = -0,2 = 0,2 \angle 180^\circ$$

$$\vec{E}^- = \Gamma . \vec{E}^+$$

$$\vec{E}^- = (0,2 \angle 180^\circ).\ 100 \cos\left(2\pi.10^8 t - \beta x + \frac{4\pi}{3}\right)\vec{a}_y \ V/m$$

$$\vec{E}^- = 20 \cos\left(2\pi.10^8 t - \beta x + \frac{4\pi}{3} + 180^\circ\right)\vec{a}_y \ V/m$$

$$\vec{E}^- = 20 \cos\left(2\pi.10^8 t - \beta x + \frac{4\pi}{3} + \pi\right)\vec{a}_y \ V/m$$

$$\vec{E}^- = 20 \cos\left(2\pi.10^8 t - \beta x + \frac{7\pi}{3}\right)\vec{a}_y \ V/m$$

$$\vec{H}^- = \frac{20}{\eta_A}\cos\left(2\pi.10^8 t - \beta x + \frac{7\pi}{3}\right)\vec{a}_z$$

$$\vec{H}^- = \frac{20}{60\pi}\cos\left(2\pi.10^8 t - \beta x + \frac{7\pi}{3}\right)\vec{a}_z$$

$$\vec{H}^- = 0{,}106 \cos\left(2\pi \cdot 10^8 t - \beta x + \frac{7\pi}{3}\right) \vec{a}_z \ A/m$$

Gel. Transmisi

$$T = \frac{2\eta_B}{\eta_B + \eta_A} = \frac{2 \cdot 40\pi}{60\pi + 20\pi} = \frac{80\pi}{100\pi} = 0{,}8$$

$$\vec{E}^{2+} = T \cdot \vec{E}^{+}$$

$$\vec{E}^{2+} = (0{,}8) \cdot 100 \cos\left(2\pi \cdot 10^8 t - \beta x + \frac{4\pi}{3}\right) \vec{a}_y$$

$$\vec{E}^{2+} = 80 \cos\left(2\pi \cdot 10^8 t - \beta x + \frac{4\pi}{3}\right) \vec{a}_y \ V/m$$

$$\vec{H}^{2+} = \frac{80}{\eta_B} \cos\left(2\pi \cdot 10^8 t - \beta x + \frac{4\pi}{3}\right) \vec{a}_z$$

$$\vec{H}^{2+} = \frac{80}{40\pi} \cos\left(2\pi \cdot 10^8 t - \beta x + \frac{4\pi}{3}\right) \vec{a}_z$$

$$\vec{H}^{2+} = 0{,}637 \cos\left(2\pi \cdot 10^8 t - \beta x + \frac{4\pi}{3}\right) \vec{a}_z \ A/m$$

2. Medium A $(4\varepsilon_0, \mu_0)$ berbatasan dengan medium B $(9\varepsilon_0, \mu_0)$. Gelombang datang medan listrik dengan persamaan seperti dibawah menumbuk perbatasan.

$$\vec{E} = 100 \cos\left(2\pi.10^8 t + 2\pi x + \frac{4\pi}{3}\right)\vec{a}_y$$

Tuliskan persamaan gelombang pantul dan diteruskan untuk medan listrik dan medan magnet dalam bentuk real time dan phasor

Jawaban sama dengan soal no. 1, tapi nilai β diganti 2π

Gel. pantul

$$\vec{E}^- = 20 \cos\left(2\pi.10^8 t - 2\pi x + \frac{7\pi}{3}\right)\vec{a}_y \ V/m$$

$$\vec{H}^- = 0{,}106 \cos\left(2\pi.10^8 t - 2\pi x + \frac{7\pi}{3}\right)\vec{a}_z \ A/m$$

Gel. Transmisi

$$\vec{E}^{2+} = 80 \cos\left(2\pi.10^8 t - 2\pi x + \frac{4\pi}{3}\right)\vec{a}_y \ V/m$$

$$\vec{H}^{2+} = 0{,}637 \cos\left(2\pi.10^8 t - 2\pi x + \frac{4\pi}{3}\right)\vec{a}_z \ A/m$$

3. Medium A $(4\varepsilon_0, \mu_0, \sigma = 0{,}1)$ berbatasan dengan medium B $(9\varepsilon_0, \mu_0)$. Gelombang datang medan listrik dengan persamaan seperti dibawah menumbuk perbatasan.

$$\vec{E} = 100\ \cos\left(2\pi.10^8 t - \beta x + \frac{4\pi}{3}\right)\vec{a}_y$$

Tuliskan persamaan gelombang pantul dan diteruskan untuk medan listrik dan medan magnet dalam bentuk real time dan phasor

$\eta_B = 40\pi$ → sama dengan no. 1

$$\frac{\sigma_A}{\omega.\varepsilon_A} = \frac{\sigma_A}{\omega.4\varepsilon_0} = \frac{0{,}1}{2\pi.10^9.4.8{,}85\times10^{-12}} = 4{,}49\ldots$$

karena $\frac{\sigma_A}{\omega.\varepsilon_A} > 1$, maka

$$|\eta_A| = \sqrt{\frac{\omega.\mu_A}{\sigma_A}} = \sqrt{\frac{2\pi.10^9.4\pi\times10^{-7}}{0{,}1}} = 88{,}86$$

$\theta_{\eta_A} = 45^0$

$$\eta_A = -|\eta_A|\left(\frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}\right) = -88{,}86\left(\frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}\right)$$

Gel. Pantul

$$\Gamma = \frac{\eta_B - \eta_A}{\eta_B + \eta_A} = \frac{40\pi - \left[-88{,}86\left(\frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}\right)\right]}{40\pi + \left[-88{,}86\left(\frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}\right)\right]} =$$