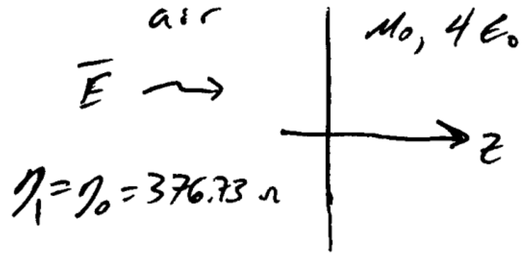
10.53 The plane wave $\mathbf{E} = 30\cos(\omega t - z)\mathbf{a}_x$ V/m in air normally hits a lossless medium $(\mu = \mu_o, \varepsilon = 4\varepsilon_o)$ at $z = 0$. (a) Find Γ, τ, and s. (b) Calculate the reflected electric and magnetic fields.



$$\eta_2 = \sqrt{\frac{\mu_o}{4\varepsilon_o}} = \sqrt{\frac{4\pi\times10^{-7}}{4(8.854187\,8\times10^{-12})}} = 188.3651569\ \Omega$$

a) (10.91a) $$\Gamma = \frac{\eta_2 - \eta_1}{\eta_2 + \eta_1} = \frac{188.365 - 376.73}{188.365 + 376.73}$$

$$\Gamma = -0.\overline{333}$$

(10.92a) $$\tau = \frac{2\eta_2}{\eta_2 + \eta_1} = \frac{2(188.365)}{188.365 + 376.73} \Rightarrow \tau = 0.66\overline{6}$$

(10.100) $$s = \frac{1+|\Gamma|}{1-|\Gamma|} = \frac{1+0.\overline{33}}{1-0.\overline{33}} \Rightarrow s = 2$$

b) (10.91b) $E_{ro} = \Gamma E_{io} = -0.\overline{33}(30) = -10$ V/m

& reflected wave propagates in −z-direction

$$\bar{E}_r = -\hat{a}_x 10\cos(\omega t + z)\ \text{V/m}$$

use (10.106), to get $\bar{H}_r$

$$\bar{H}_s = \frac{\hat{a}_k \times \bar{E}_s}{\eta} = \frac{-\hat{a}_z \times -\hat{a}_x 10 e^{+jz}}{376.7303}$$

$$= \hat{a}_y\, 0.026544\, e^{jz}$$

$$\bar{H} = \mathrm{Re}\{\bar{H}_s e^{j\omega t}\} = \mathrm{Re}\{\hat{a}_y\, 0.026544\, e^{jz} e^{j\omega t}\}$$

$$\bar{H} = \hat{a}_y\, 26.544\cos(\omega t + z)\ \text{mA/m}$$