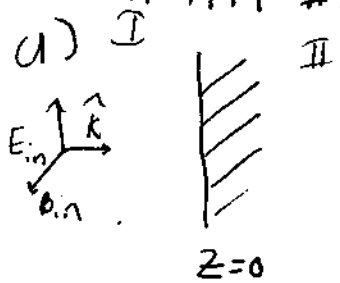
Fall 1999 #1

a)



only bound condition we need is

$$E_{\parallel}^{I} = E_{\parallel}^{II}$$

$$E_I = E_{in} e^{ikz-i\omega t}(\hat{x}) + E_{out} e^{-ikz-i\omega t}(\hat{x})$$

$$B_I = E_{in} e^{ikz-i\omega t}(\hat{y}) - E_{out} e^{-ikz-i\omega t}(\hat{y})$$

But since $E_{in} + E_{out} = 0$ $\quad E_{out} = -E_{in}$

$$\Rightarrow E_I = E_{in} e^{ikz-i\omega t}(\hat{x}) + E_{in} e^{-ikz-i\omega t}(-\hat{x})$$

$$B_I = E_{in} e^{ikz-i\omega t}(\hat{y}) + E_{in} e^{-ikz-i\omega t}(\hat{y})$$

$$\Rightarrow E_{reflected} = E_{in} e^{-ikz-i\omega t}(-\hat{x})$$

$$B_{reflected} = E_{in} e^{-ikz-i\omega t}(\hat{y})$$

b) Now, nonperfect conductor. $\vec{J} = \sigma \vec{E}$

$$\nabla \times H = \frac{4\pi}{c} J_f + \frac{1}{c}\frac{\partial D}{\partial t} = \frac{4\pi}{c}\sigma \vec{E} + \frac{\epsilon i\omega}{c}\vec{E} \qquad \vec{D} = \epsilon \vec{E}$$

$\Rightarrow$ to ignore displacement current $\quad 4\pi\sigma \gg |\epsilon i\omega|$

$$\sigma \gg \frac{\epsilon\omega}{4\pi}$$

$$\Rightarrow \sigma \gg \epsilon\omega$$

c) Now calculate reflected wave in that regime

$$E_{\parallel}^{1} = E_{\parallel}^{2} \Rightarrow E_{in} + E_{out} = E_T \qquad 1)$$

$$B_{\perp}^{1} = B_{\perp}^{2} \Rightarrow E_{in} - E_{out} = \frac{ck}{\omega} E_T \qquad 2)$$

add 1 + 2

$$2 E_{in} = E_T \left(1 + \frac{ck}{\omega}\right)$$

subtract 1-2

$$2 E_{out} = E_T \left(1 - \frac{ck}{\omega}\right)$$

$$2 E_{out} = \frac{2 E_{in}}{\left(1 + \frac{ck}{\omega}\right)} \left(1 - \frac{ck}{\omega}\right) \qquad \frac{\omega}{k} = V$$

$$E_{out} = \frac{E_{in} \left(1 - \frac{c}{V}\right)}{\left(1 + \frac{c}{V}\right)}$$

$\Rightarrow$ as $\sigma \to \infty$ $V = 0$ so $E_{out} = -E_{in}$