ECE 107, MS exam, Fall 2014

A plane wave is incident at an incident angle θ_i on the interface (at $z=0$) between two half-spaces. The left half space is filled with a medium with ε_1, μ_0. The electric field of the incident wave is given by

$$\mathbf{E}^i = E_0\left(\hat{\mathbf{x}}\cos\theta_i - \hat{\mathbf{z}}\sin\theta_i + \hat{\mathbf{y}}/\sqrt{2}\right)e^{-jk_1(x\sin\theta_i + z\cos\theta_i)},$$

such that the electric field vector of the incident wave has a $\pi/4$ angle with respect to the $x-z$ plane. Here, $\hat{\mathbf{x}}\cos\theta_i - \hat{\mathbf{z}}\sin\theta_i$ and $\hat{\mathbf{y}}$ field components correspond to the parallel and perpendicular polarizations, respectively.

a) The right half space is filled with a dielectric medium having ε_2, μ_0 (see Fig. a). Write an expression for the reflected and transmitted electric field. Give expressions for the Brewster angle and explain what it is.

b) Understanding that polarizing glasses are used to avoid light reflected from the ground from reaching into one's eye, explain how such glasses work and what polarization they should have to achieve the required operation.

c) Referring to item a, find the condition on θ_i under which the electric field vector of the reflected wave has an angle of $\pi/8$ with respect to the $x-z$ plane. Only set up the conditions without solving for the required θ_i.

d) Now, the right half space is filled with a perfect electric conductor (see Fig. b). Give the reflection coefficient and write an expression for the reflected electric field. Using the boundary conditions, give the surface current $\mathbf{J}_s$ on the conductor (at $z=0$).

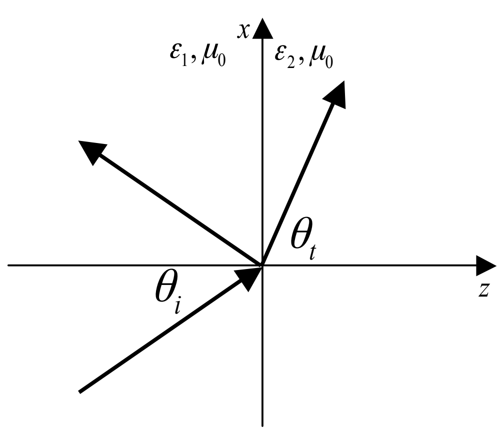

Figure a

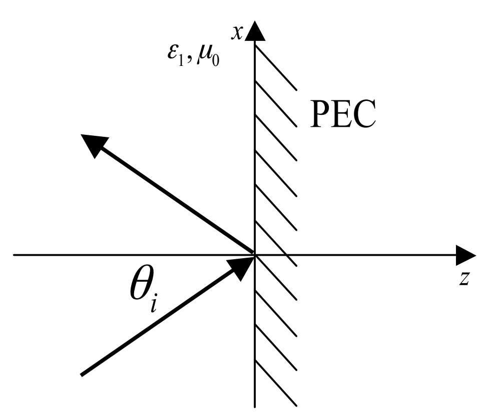

Figure b