HW#3

7-15. A uniform plane wave propagate in the +z-(downward) direction into the ocean ($\epsilon_r = 72,\ \mu_r = 1, \sigma = 4\ S/m$). The magnetic field at the ocean surface(z=0) is $\mathbf{H}(0,t) = \boldsymbol{a_y} 0.3\cos 10^8 t \quad (A/m)$.

a) Determine the skin depth and the intrinsic impedance of the ocean water.
b) Find the expressions of $\mathbf{E}(z,t)$ and $\mathbf{H}(z,t)$ in the ocean.
c) Find the average power loss per unit area in the ocean as a function of z.

7-17. A right-hand circularly polarized plane wave represented by the phasor

$$\mathbf{E}(z) = E_0(\boldsymbol{a_x} - j\boldsymbol{a_y})e^{-j\beta z} \quad (V/m)$$

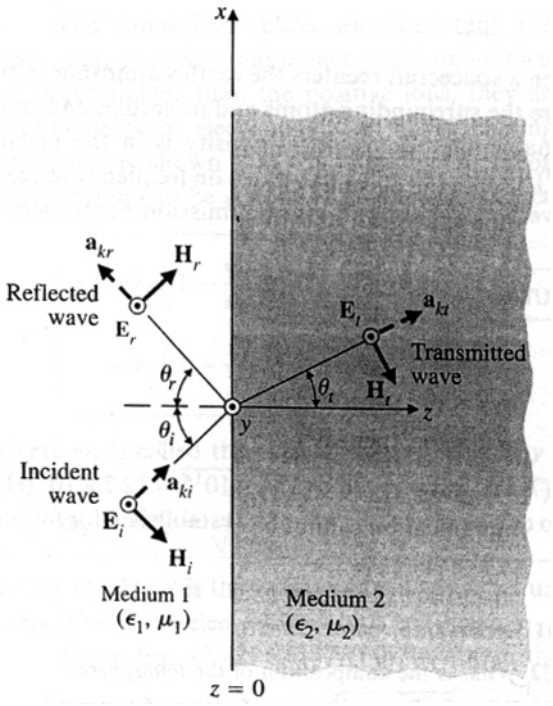
Impinges normally on a perfectly conducting wall at z=0.

a) Determine the polarization of the reflected wave.
b) Find the induced current on the conducting wall.
c) Obtain the instantaneous expression of the total electric intensity based on a cosine time reference.

7-19. A uniform plane wave in air with with $\boldsymbol{E}_i(z) = \boldsymbol{a_x} 10e^{-j6z}(V/m)$ is incident normally on an interface at z=0 with a lossy medium having a dielectric constant 2.25 and a loss tangent 0.3. Find the following:

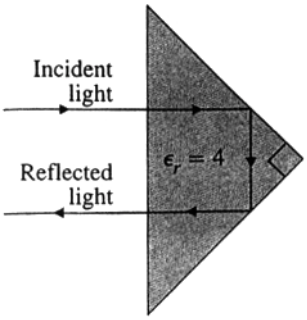
a) The phasor expressions for $\boldsymbol{E_r}(z)$, $\boldsymbol{H_r}(z)$, $\boldsymbol{E_t}(z)$, and $\boldsymbol{H_t}(z)$.
b) The standing-wave ratio for the wave in air.
c) The expressions for time-average Poynting vectors in air and in the lossy medium.

7-27. A uniform plane wave with perpendicular polarization represented by $\boldsymbol{E}_i(x,z) = \boldsymbol{a_y} E_{i0} e^{-j\beta_1(x\sin\theta_i + z\cos\theta_i)}$ and $\boldsymbol{H}_i(x,z) = \frac{E_{i0}}{\boldsymbol{\eta_1}}(-\boldsymbol{a_x}\cos\theta_i + \boldsymbol{a_z}\sin\theta_i)e^{-j\beta_1(x\sin\theta_i + z\cos\theta_i)}$ is incident on a plane interface at z=0, as shown in following figure. Assuming $\epsilon_2 < \epsilon_1$ and $\theta_i > \theta_c$, (a) obtain the phasor expressions for the transmitted field ($\boldsymbol{E}_t$, $\boldsymbol{H}_t$), and (b) verify that the average power transmitted into medium 2 is zero.



<problem 7-27>

7-30. Glass isosceles triangular prisms shown in following fig. are used in optical instruments. Assuming $\epsilon_r = 4$ for glass, calculate the percentage of the incident light power reflected back by the prism.



7-33. For an incident wave with parallel polarization, fine the relation between the critical angle θ_c and the Brewster angle $\theta_{B||}$ for two contiguous media of equal permeability.