1. **Reflection from a boundary.**

Consider the two media separated by a boundary located along the $xy$-plane. The dielectric constants for the first and second media are $\varepsilon_1$ and $\varepsilon_2$. The magnetic permeability for both of them is same $\mu_1 = \mu_2$. A plane wave of frequency $\omega$ travelling in media 1 approaches the boundary having the angle $\theta_i$ with the $z$-axes. The wave is linearly polarized perpendicular to the plane of incidence. (This means that if we presume that the direction of propagation of the wave lies in the $xz$-plane, then the electric field is in the $y$ direction.) Imposing the boundary conditions, derive the Fresnel equations for the amplitudes of the reflected $E_{0r}$ and transmitted waves $E_{0t}$. Prove that the reflected wave is never zero (except for the trivial case $\varepsilon_1 = \varepsilon_2$, when the two media are indistinguishable).

2. **Reflection from a metal.**

Show that the skin depth in poor conductors (in which $\sigma / \varepsilon_0 \ll \omega$) is

$$d = \frac{2\varepsilon_0 c}{\sigma}$$

and is therefore independent of $\omega$. Find the skin depth for pure water, which has the resistivity $2.5 \cdot 10^5 \ (\Omega \cdot \text{m})$. 