3. A plane electromagnetic wave with $\vec{E} = E_i \exp(ikz - i\omega t)\hat{x}$ is incident from vacuum onto a weakly conductive medium with electrical conductivity σ, dielectric constant ϵ, and magnetic permeability μ. The medium extends through all space for $z > 0$.

   (a) Find the wavenumber $k(\omega)$ for the plane wave transmitted into the medium.

   (b) Find the electric field amplitude E_t of the wave transmitted into the medium at a distance $z = d$ inside the medium, accurate to first order in σ.