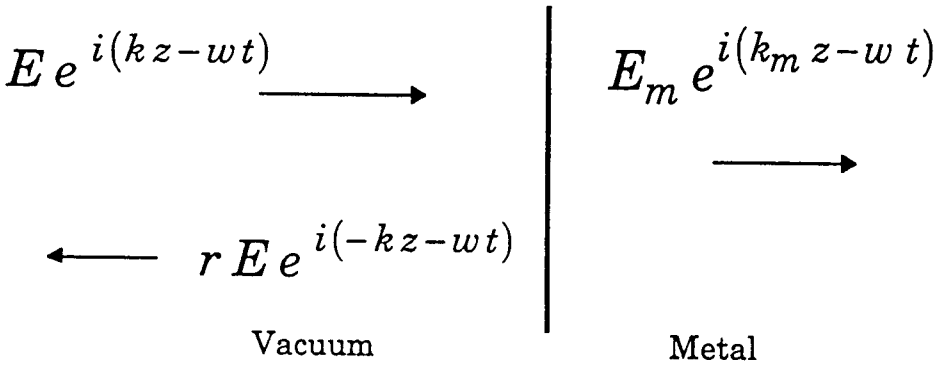
EMSpring97A

A plane electromagnetic wave of frequency $\omega$ is normally incident on a thick metal plate of unit area with conductivity $\sigma$. The incident electric field has amplitude $E$ and wavenumber $k$ and the reflected electric field has amplitude $r\ E$. The transmitted electric field has amplitude $E_m$ and wavenumber $k_m$.




(a) The momentum density of a plane wave is $1/c$ times the energy density, where $c$ is the speed of light in vacuum. Find the time averaged force on the plate in terms of $E$ and $r$.

(b) Find $E_m/B_m$ where $B_m$ is the magnetic field amplitude in the metal. Assume that the conductivity is large enough that the displacement current can be ignored. Assume that the metal is nonmagnetic so that $\mu = 1$ (Gaussian units) or $\mu = \mu_0$ (MKS units).

(c) Find $r$ by considering the boundary conditions at the plate and the result of part (b).