M07E.3 - Plane Wave in a Conductor

Problem

A plane electromagnetic wave with electric field E_0 and frequency ω is incident at normal incidence on a metal film with conductivity σ, $\varepsilon = \varepsilon_0$ and $\mu = \mu_0$.

a)   Calculate the electric and magnetic fields as a function of distance x into the conductor.

b)   Show that the energy lost by the electromagnetic wave in a small distance Δx inside the conductor is equal to the ohmic heat deposited by the electromagnetic wave in that distance.