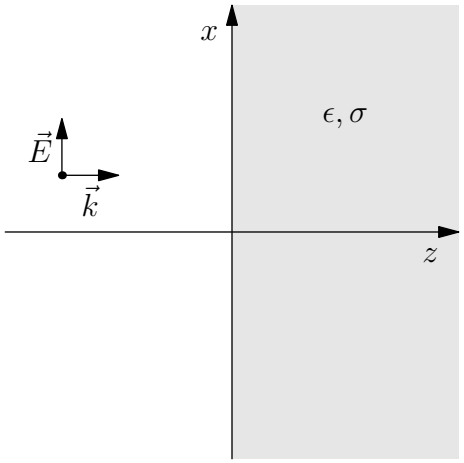
J98E.1—Electromagnetic Wave Incident on a Lossy Dielectric

Problem

A palne wave, $\vec{E} = E_0 \exp(ikz - i\omega t)\hat{e}_x$, is incident on a lossy dielectric that fills the space for $z > 0$ as shown in the figure. The dielectric is described by a real dielectric constant ϵ and conductivity σ. The space where $z < 0$ is a vacuum.



a) What is the dispersion relation, $k(\omega)$, in the dielectric?

b) At 2.5 GHz, what is the attenuation length of such a wave in a person?
($\mu = 1, \epsilon = 50, \sigma = 2 \times 10^{10}$ s^{-1}).