HW P1. Dispersion Revisited. Show that $n^2 = 1 + \frac{n_e e^2}{\varepsilon_o m(\omega_o^2 - \omega^2)}$ for

$\lambda >> \lambda_o = \frac{c}{f_o} = \frac{2\pi c}{\omega_o}$ can be put in the form $n^2(\lambda) = \alpha + \frac{\beta}{\lambda^2}$. Give the constants α and β in their simplest forms in terms of n_e, e, ε_o, m, c, and λ_o.

HW P2. Scattering. From class: $E_\theta = -\frac{ae\sin\theta}{4\pi\varepsilon_o c^2 r}$ and $x = -\frac{eE_o}{m(\omega_o^2 - \omega^2)} e^{i\omega t}$.

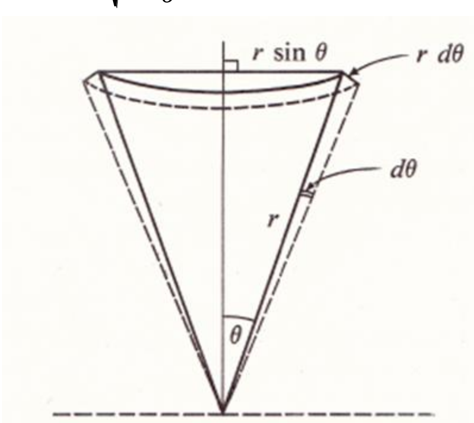
Show that the amplitude of the scattered wave is $\left|E_\theta\right| = \frac{e^2\omega^2 E_o \sin\theta}{4\pi\varepsilon_o c^2 rm(\omega_o^2 - \omega^2)}$.

Then show that the irradiance is $I = \frac{1}{2}\sqrt{\frac{\varepsilon_o}{\mu_o}} \frac{e^4\omega^4 E_o^2 \sin^2\theta}{(4\pi\varepsilon_o)^2 c^4 r^2 m^2 (\omega_o^2 - \omega^2)^2}$.

Show that for a ribbon area $dA = 2\pi r^2 \sin\theta d\theta$, the power radiated is given by

$dP = \frac{2\pi I_o e^4 \omega^4 \sin^3\theta}{(4\pi\varepsilon_o)^2 c^4 m^2 (\omega_o^2 - \omega^2)^2} d\theta$ where the initial incident irradiance

$I_o = \frac{1}{2}\sqrt{\frac{\varepsilon_o}{\mu_o}} E_o^2$. The power P is the reradiated power, the scattered power.



Integrate over the angle θ from $\theta = 0$ to $\theta = \pi$ and show that the total scattered power is

$$P = \frac{8\pi}{3} \left(\frac{e^2}{4\pi\varepsilon_o mc^2}\right)^2 \frac{\omega^4}{(\omega_o^2 - \omega^2)^2} I_o .$$