HW 2

P2.3 $N = 10^{28}\ m^{-3}$ density of bound electrons in insulator $\omega_0 = 6 \cdot 10^{15}\ \frac{rad}{s}$ $\gamma = \omega_0/5$

$E_0 = 10^4\ V/m$

i) $\omega = \omega_0 - 2\gamma$

ii) $\omega = \omega_0$

iii) $\omega = \omega_0 + 2\gamma$

a.) $E_0 e^{i(kr - \omega t)}$, find charge displacement r_e

$$r_e = \left(\frac{q_e}{m_e}\right) \frac{E_0 e^{i(kr-\omega t)}}{\omega_0^2 - i\omega\gamma - \omega^2}$$

i.) $r_e = \left(\frac{q_e}{m_e}\right) \frac{\wedge}{\omega_0^2 - i\omega_0\gamma + 2i\gamma^2 - (\omega_0^2 - 4\omega_0\gamma + 4\gamma^2)}$

↳ $\omega_0\gamma(4 - i) - 2\gamma^2(2 - i)$

ii.) $r_e = \left(\frac{q_e}{m_e}\right) \frac{\wedge}{\omega_0^2 - i\omega_0\gamma - \omega_0^2}$

↳ $-i\omega_0\gamma$

iii.) $r_e = \left(\frac{q_e}{m_e}\right) \frac{\wedge}{\omega_0^2 - i\gamma\omega_0 - 2i\gamma^2 - (\omega_0^2 + 4\gamma\omega_0 + 4\gamma^2)}$

b.) $\chi(\omega) = \frac{\omega_p^2}{\omega_0^2 - i\omega\gamma - \omega^2}$ $\omega_p = \sqrt{\frac{Nq_e^2}{\varepsilon_0 m_e}}$

c.) $n = \sqrt{\frac{(1 + Re\{\chi\} + \sqrt{(1 + Re\{\chi\})^2 + (Im\{\chi\})^2}}{2}}$

$$\kappa = \frac{Im\{\chi\}}{2n}$$

2.4