Problem 4) Ignoring the Clausius-Mossotti local field correction, a medium containing K Lorentz oscillators will have the following dielectric susceptibility:

$$\chi_e(\omega) \approx C_K(\omega) = \sum_{k=1}^{K} \frac{f_k \omega_p{}^2}{\omega_{0k}{}^2 - \omega^2 - \mathrm{i}\,\gamma_k \omega}\,.$$

a) $\chi_e(\omega = 7\times10^{14}) = 10^{30}[0.1/(16\times10^{28} - 49\times10^{28} - \mathrm{i}\,7\times10^{26}) + 0.25/(10^{30} - 49\times10^{28} - \mathrm{i}\,21\times10^{26})]$

$= -10/(33 + \mathrm{i}\,0.07) + 25/(51 - \mathrm{i}\,0.21)$

$\approx -(10/33)(1 - \mathrm{i}\,0.0021) + (25/51)(1 + \mathrm{i}\,0.0041)$

$\approx 0.187 + \mathrm{i}\,0.0026.$

b) $\chi_e(\omega = 10^9) = 10^{30}[0.1/(16\times10^{28} - 10^{18} - \mathrm{i}\,10^{21}) + 0.25/(10^{30} - 10^{18} - \mathrm{i}\,3\times10^{21}) - 1/(10^{18} + \mathrm{i}\,10^{22})]$

$\approx (10/16) + (0.25) - 10^8(0.0001 - \mathrm{i})$

$\approx -10^4 + 10^8\mathrm{i}.$