November 4, 2021

Homework 10
OPTI 507
(due November 16, 2021)

Problem 1:
Using Eq. (6.34) from "the book" and the absorption coefficient for the case without excitonic effects given in class (we can call it the "free" electron case), derive an expression for the Coulomb enhancement factor $C(\omega) = \alpha_{cont}/\alpha_{free}$ (assume $s_d = 2$).

(10 points)

Problem 2:
Solve Problem 6.2 from "the book."

(10 points)

Problem 3:
The Schroedinger equation for an electron-hole pair reads

$$\left\{ -\frac{\hbar^2 \vec{\nabla}_e^2}{2m_e} + E_g - \frac{\hbar^2 \vec{\nabla}_h^2}{2m_h} - \frac{e^2}{\varepsilon_b |\vec{r}_e - \vec{r}_h|} \right\} \Phi(\vec{r}_e, \vec{r}_h) \;=\; \varepsilon \, \Phi(\vec{r}_e, \vec{r}_h)$$

Show that this problem can be separated into two separate Schroedinger equations, one for the center-of-mass motion and one for the relative motion. Specify both of these Schroedinger equations and give the solution for the center-of-mass wave function.

(10 points)