

Week 4 Logic Questions

April 25, 2020

1. If a system is subjected to $\mathbf{E}(\mathbf{r}, t)$ and $\mathbf{B}(\mathbf{r}, t)$, the Runge-Gross theorem for the current density still applies, but with what freedom in potentials? (i.e. what is the analog of $c(t)$?)
2. If two initial noninteracting wavefunctions yield some $v_s(\mathbf{r}, t)$, what two initial conditions must they satisfy?
3. Is it possible to have two TDKS equations (in TDDFT) in which the current densities differ?
4. Using eq. (7.35), calculate how much oscillator strength is in the continuum for the ground state of a Hydrogen atom.
5. Draw the absorption spectrum of a harmonic oscillator. What is unusual about it?
6. Draw the absorption spectrum of a particle in a box. How much oscillator strength is in the first transition? In all the other?
7. In eq. (7.109), assume $K_{12,12}(\omega) = a \frac{\omega^2}{\omega^2 - b^2}$, where a and b are two fixed frequencies.
 - (a) Find exact formulas for all excitations.
 - (b) What happens in the adiabatic approximation?
 - (c) How accurate is the adiabatic approximation if:
 - i. $\omega_{12} = 1, a = 1, b = \frac{3}{2}$
 - ii. $\omega_{12} = 1, a = 0.1, b = \frac{3}{2}$
 - iii. $\omega_{12} = 1, a = 1, b = 4$

Can you give a general formula for when the adiabatic approximation should be accurate?