PHY 3106, Fall 2017, Homework #10

due Monday, Dec. 11, by 5 pm (e.g., the night before the final!!!)

1.) An electron is confined to a quantum dot. If the transition between states with the lowest energy gives off a photon of wavelength 400 nm, what is the size of the quantum dot (e.g., the length of a side of a cubical box containing the electron)?

2.) A helium atom in an excited state is trapped in a cubical box of side L. The wavefunction is given by $\psi(x,y,z) = \left(\frac{2}{L}\right)^{3/2} \sin\frac{2\pi x}{L} \sin\frac{\pi y}{L} \sin\frac{2\pi z}{L}$. Calculate the probability of finding the atom in the region $\frac{L}{3} < x < \frac{2L}{3}, \frac{L}{3} < y < \frac{2L}{3}, 0 < z < \frac{L}{2}$.

3.) Calculate the probability that the electron is found inside the Bohr radius of a_0 for the ground state of hydrogen (e.g. R_{10}). Remember to use $d^3x = r^2 \sin\theta \; dr \; d\theta \; d\varphi$ in your integral. [Hint: $R_{10} = 2{a_0}^{-3/2} e^{-\frac{r}{a_0}}$. I used integration by parts twice on this problem.]