Chemistry 881 Practice Exam #3
October 19, 2001

1. (10 points) Show that $Y_1^{-1}(\theta,\phi)$ is normalized and that it is orthogonal to $Y_2^1(\theta,\phi)$.

2. (20 points) Calculate the probability that an electron described by a hydrogen atomic 1s function will be found within one Bohr radius of the nucleus.

3.(20 points) Calculate the radius of the sphere that encloses a 90% probability of finding a hydrogen 1s electron. You do not have to get a numerical result but you do have to state clearly and completely how you would go about finding the numerical result.

4.(10 points) What does one mean by a linear variational trial function and how is it used?

5. (20 points) Consider a particle confined between $x = 0$ and $x = a$ along the x axis. Estimate the lowest energy using the variation method and the trial function $\tilde{\psi} = x(a - x)$. Compare this estimate with the exact result.

6.(20 points) Use first-order perturbation theory to calculate the energy of a particle in a one dimensional box from $x = 0$ to $x = a$ with a slanted bottom, such that

$$V(x) = V_0 x / a \qquad 0 \le x \le a$$