Physics 471 – Fall 2008

Homework #11, due Wednesday, November 26

(Point values are in brackets for each problem.)

1. [6] Griffiths problem 4.22. After you finish part (c), instead of comparing your result with problem 4.5 (which you haven't done), write down the normalization factor for the three cases l=1, l=2, and l=3, and compare your results with those in Table 4.3.

2. [2] Griffiths problem 4.24, part (a) only.

   In the original part (b), Griffiths wanted you to say that the angular eigenfunctions are just the spherical harmonics $Y_l^m(\theta,\phi)$. Since the energy depends only on l, the degeneracy of each energy level is $(2l + 1)$. (Griffiths uses n instead of l for the main rotational quantum number in this problem.)

   Add the following part (b): The two nitrogen atoms in an N_2 molecule are separated by about 110 pm. (That's picometers, in case you weren't sure.) Estimate the energy difference between the rotational ground state and the first excited rotational state of the N_2 molecule. Express your answer in both Joules and in electron Volts.

3. [6] Griffiths problem 4.21. Note: If you get bogged down in the math of part (a), go on to part (b), which is considerably easier.

4. [6] Griffiths problem 4.3.