D12-2 - QUANTUM MECHANICS - DUE MARCH 2, 2000

1. Consider the weakly anharmonic oscillator in one dimension with the Hamiltonian

$$H = \frac{p^2}{2m} + \frac{1}{2} m \omega_0^2 \, x^2 + \lambda \, x^4 \, . \tag{1}$$

   Calculate the change in the zero point energy resulting from the anharmonic term in the Hamiltonian to leading order in λ. Calculate the change in the r.m.s vibrational amplitude, i.e. $\Delta x_{rms} = \langle \, 0 \, | x^2 | \, 0 \, \rangle^{1/2}$, also to leading order in λ.

2. Work out the Stark effect to lowest non-vanishing order for the $n = 3$ levels of Hydrogen. Ignore relativistic corrections to the level structure. Label each of the levels in terms of the quantum numbers of the unperturbed Rydberg states.