

# PH 451: Capstone in Quantum Mechanics

## Homework 3

Due 1/25/08

1. (Goswami 7.8) (Think about a simple application of the quantum harmonic oscillator result.) Consider a proton as a bound oscillator with a natural frequency of  $3 \times 10^{21}$  Hz. What is the energy of its ground state? its first excited state? What is its classical oscillation amplitude?
2. (Goswami 7.5) What are the energy levels of a particle of mass  $m$  moving in the one-dimensional potential well defined by:

$$V(x) = \begin{cases} \frac{1}{2}m\omega^2 x^2 & \text{for } x < 0 \\ \infty & \text{for } x > 0 \end{cases}$$

(Hint: You don't need to do a lengthy calculation.)

3. (Goswami 7.A4) Suppose a particle is in the ground state of the oscillator potential

$$V_1(x) = \frac{1}{2}m\omega_1^2 x^2$$

Suddenly the potential changes to

$$V_2(x) = \frac{1}{2}m\omega_2^2 x^2$$

What is the probability that the particle will be in the ground state of the new potential?