

Physics 517: Pretest (26 October 2010)

Do not write your name on this pretest; it will *not* be graded.

In appropriately rescaled variables, the Hamiltonian operator describing the 1-d quantum simple harmonic oscillator is

$$H = \frac{\omega}{2}(p^2 + x^2), \quad \text{where} \quad [x, p] = i\hbar.$$

The energy eigenstates satisfy

$$H|E_n\rangle = |E_n\rangle E_n.$$

1. What is the Schrödinger equation satisfied by the position space wave function $\langle x'|E_n\rangle$?
2. What is the corresponding equation satisfied by $\langle p'|E_n\rangle$?
3. Sketch the form of $\langle x'|E_n\rangle$ for the lowest energy and first excited states. (These wavefunctions can be chosen real.)
4. Why are the energies E_n quantized?