PROBLEMS

CHEMISTRY 163A

14. McQ #3-16

15. McQ #3-17;

Does σ_x^2 increase or decrease as n gets larger?

From "looking" at the dependence of PIB wave functions on n, comment on the behavior of σ_x^2 as $n \to \infty$.

16. McQ #3-26

17. *Translational motions of "real" atoms:*

A 1 liter cubic box contains He (g) at 300°K. To calculate the translational quantum states of the atoms of He(g) treat their potential energy as being zero inside the box and ∞ outside the container.

a. What is the <u>average</u> kinetic energy of a helium atom at this temperature (from thermodynamics class or be nice to your TA)?

b. What value of the quantum number n corresponds to the quantum state of a He atom with the above energy? [After choosing the appropriate box length, assume a state for which $n_x = n_y = n_z = n$.]

c. What is the ratio of the transition energy from state $n \to n+1$ to the translational energy of the atom for the "average energy" He atom at 300°K?

i.e. $\dfrac{\Delta E_{n \to n+1}}{E_n}$

(for E_{n+1}, $n_x = n+1$, $n_y = n$, $n_z = n$)

d. What is the "bottom line" which this result illustrates vis à vis quantum mechanics, classical mechanics, and translational energy?

_____ (bottom line)