Homework #7

Problem #1 (6.15 form Schroeder) (3 points)
Suppose you have 10 atoms of werebium; 4 with energy 0 eV, 3 with 1 eV, 2 with energy 4 eV, 1 with energy 6 eV.

(a) Compute the average energy of all atoms by adding up all their energies and dividing by 10.
(b) Compute the probability $P(s)$ that one of your atoms chosen at random would have energy E, for each of the four values of E that occurs
(c) Compute the average energy again using the formula $\langle E \rangle = \sum_s E(s)P(s)$

Problem #2 (6.17 from Schroeder but with an example form Problem #1 of this set) (3 points)
The most common measure of the fluctuations of a set of numbers away from the average is the **standard deviation** defined as follows

(a) For each atom of werebium from Problem #1, compute the deviation of the energy from the average energy, that is, $E_i - \langle E \rangle$, for i=1 to 10. Call these deviations ΔE_i.
(b) Compute the average of the *squares* of the ten deviations, that is, $\langle \Delta E_i^2 \rangle$. Then compute the square root of this quantity, which is the root-mean-square (rms) deviation, or standard deviation. Call this number σ_E. Does σ_E give a reasonable measure of how far the individual values tend to stray from the average?
(c) Prove in general that $\sigma_E^2 = \langle E^2 \rangle - \langle E \rangle^2$, that is the standard deviation squared is the average of the squares minus the square of the average. This formula usually gives the easier way of computing standard deviation.

Problem #3 (6.10 from Schroeder) (4 points)

Problem #4 (Extra Credit 3 points)
Gas-dynamical rifle can be represented as a thermally isolated cylinder filled with monoatomic gas and sealed with movable piston. Expanding gas accelerates the piston. Is it possible to carry out a process in which after gas volume increases n fold its temperature decreases n fold, $n^{1/2}$ fold?