Chemistry 342
Spring, 2001
Problem Set 1

Due Wednesday, August 29

Read pages 14-30 in Atkins. Do the following Problems in Chapter 1: 1, 2, 3, 4, 7, 10, 13, 14. Also, answer the following question:

The Maxwell-Boltzmann velocity distribution function that we learned about in class refers to the number density of particles, i.*e*., the number of particles per unit volume having a speed between v and v+dv: $\frac{n(v)dv}{n_0} = \frac{4n_0}{\sqrt{\pi}}\frac{v^2}{\alpha^2}e^{-v^2/\alpha^2}dv/\alpha,$ where n_0 is the number density of particles and $\frac{1}{2}m\alpha^2 = kT.$ Note that the speed can have values $0 \le v \le \infty$.

Another important distribution function is the flux density of particles (number of particles striking a target area per unit time), which is given by

$\frac{n_f(v)dv}{n_{f,0}} = C\frac{v^3}{\alpha^3}e^{-v^2/\alpha^2}dv/\alpha,$ where C is a normalization constant, and $n_{f,0}$ is the total flux of particles.

A. Evaluate the constant, C.
B. Determine the average speed for this distribution function.
C. Determine the most probable speed for this distribution function.
D. Determine the root mean square speed for this distribution function.

Express your answers to parts B-D as multiples of α.

Some useful integrals:

$$\int_0^\infty x^{2n}e^{-ax^2}dx = \frac{1\cdot 3\cdot 5\cdots(2n-1)}{2^{n+1}a^n}\sqrt{\frac{\pi}{a}}$$

$$\int_0^\infty x^{2n+1}e^{-ax^2}dx = \frac{n!}{2a^{n+1}}$$