**Homework #1**

1. In class, we worked out the distribution function that describes the probability of finding a particle whose velocity vector $\vec{V} = V_x\hat{x} + V_y\hat{y} + V_z\hat{z}$ has components within the intervals $[V_x, V_x + dv_x], [V_y, V_y + dv_y], [V_z, V_z + dv_z]$ in "velocity space". This is:

$$f(\vec{v}) = \left(\frac{m}{2\pi kT}\right)^{3/2} \exp\left(\frac{-mV^2}{2kT}\right)$$

a) What is the distribution function that describes the probability of finding a particle with ***speed*** $V$ within the interval $[V, V + dV]$?

b) Use the result of (a) to calculate the most probable speed $V_p$, the average speed $\bar{V}$, and $V_{rms}$. Express these in terms of $\sqrt{kT/m}$.

c) Suppose a sample of helium gas at $T = 300K$ contains $10^6$ atoms, each of mass $m = 6.65 \times 10^{-27}\, kg$. What is $V_p$? Estimate how many atoms in the sample have speeds in the interval $[V_p, V_p + 40\ m/s]$ and in the interval $[10V_p, 10V_p + 40\ m/s]$.

2. Show that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}.$

3. Let

$$I(n) = \int_0^\infty e^{-ax^2} x^n dx.$$

a) Evaluate $I(0)$ and $I(1)$.

b) Calculate $\frac{\partial I}{\partial a}$ and obtain a recurrence relation.