EEE 352A, Properties of Electronic Materials, Spring 2007

<u>Homework 3</u>

Due: Wednesday, February 7, in class

1. Problem 1.20 in Kasap (20 points).
2. Problem 1.22 in Kasap (20 points).
3. Problem 3.5 in Kasap (20 points).
4. (40 points) At temperature T, the probability for an atom to have energy in the small range $[E, E+dE]$ is $f_E(E)dE$, where the probability density function $f_E(E)$ is given by the following Maxwell-Boltzmann distribution:

$$f_E(E) = \frac{2}{\sqrt{\pi}}(\frac{1}{kT})^{3/2}\sqrt{E}\exp{(-\frac{E}{kT})}.$$

The average energy of the atom is

$$\bar{E} \equiv \int_0^\infty E f_E(E) dE. \tag{1}$$

- Let E_0 be the most probable value of energy defined by $df_E(E)/dE|_{E=E_0} = 0$. Find E_0.
- Without evaluating any integral explicitly, use Eq. (1) to argue that $\bar{E}$ is proportional to kT.
- Now evaluate the integral and find an explicit expression for $\bar{E}$ in terms of kT.
(Hint: $\int_0^\infty x^{3/2}e^{-x}dx = 3\sqrt{\pi}/4$).