Chem 534: Problem Set #9  (advisory only)

(1) The density of sodium metal at room temperature is 0.95 g/cm$^3$. Assuming that there is one conduction electron per sodium atom, calculate the Fermi energy and Fermi temperature of sodium.

(2) Show that at 3000 K, $\mu$ for aluminum differs from $\mu_0$ by less than 0.1% ($\mu_0$=11.7 eV). Note that,

$$\mu = \mu_0 \left\{ 1 - \frac{\pi^2}{12} \left( \frac{kT}{\mu_0} \right)^2 - \frac{\pi^4}{80} \left( \frac{kT}{\mu_0} \right)^4 + \cdots \right\}$$

(3) Given that the energy of an ideal Fermi-Dirac gas is given by

$$E = E_0 \left[ 1 + \frac{5\pi^2}{12} \eta^2 + \cdots \right],$$

where $E_0 = \frac{3}{5} N \mu_0$ and $\eta = \frac{kT}{\mu_0}$, find the contribution of the conductance electrons to the heat capacity in terms of $N$ and the Fermi temperature $T_F$. 