Physics 418
Homework 5 - Due Wed., April 7, 2010

Problem 1: Patheria, 6.22

Problem 2: Patheria, 6.1

Problem 3: Consider a degenerate Fermi gas of non-interacting, non-relativistic, particles in two dimensions (such as found in a semiconductor two-dimensional electron gas).
a) Find the density of states $g(E)$.
b) Find the Fermi energy and the $T = 0$ energy density.
c) From the particle density n, find the chemical potential as a function of temperature, $\mu(T)$, for fixed density n, by doing the relevant integral exactly. You may have to look up the integral in a table or use a Mathematical program! Using the exact expression for $\mu(T)$, find a simpler approximation that holds at low $T \ll T_F = E_F/k_B$. Does $\mu(T)$ have a power series expansion in T at low T?

Problem 4: Work out the thermodynamics (as we did in class) for a Fermi gas at $T = 0$ of noninteracting, non-relativistic, particles in three dimensions. The gas is confined by a symmetric, harmonic potential: $V(q) = (1/2)m\omega^2|\mathbf{q}|^2$. How do your results differ from the gas-in-a-box case discussed in class?