University of California, Berkeley
Physics H7C Fall 1999 (*Strovink*)

PROBLEM SET 11

1.
Rohlf 8.41.

2.
Rohlf 9.3.

3.
Rohlf 9.10.

4.
Rohlf 9.25.

5.
Rohlf 9.31.

For those of you itching to do more, here is a preview of the first three problems in Problem Set 12:

1.
Rohlf 12.5.

2.
N electrons each of mass m are confined within a (formerly) cubic infinite potential well that has been "squashed" almost flat: $V = 0$ for ($0 < x < L$ and $0 < y < L$ and $0 < z < \epsilon L$), $V = \infty$ otherwise. Here $\epsilon \ll 1$ (cube is "squashed" in the z direction) and $N \gg 1$. The electrons do not interact with each other and are at very low temperature so that they fill up the available states in order of increasing energy. Take $\epsilon N \ll 1$, so that the z part of each electron's wavefunction may be assumed to be the same (lowest possible k_z). Thus the problem is *reduced to two dimensions*. Calculate the difference Δ between the energy of the most energetic electron (Fermi energy) and the energy of a ground state electron, using the approximation $N \gg 1$. Δ should depend on m, N, and L, but not ϵ.

3.
Write an integral equation for the fraction $\mathcal{F}$ of nonrelativistic fermions in a gas at *finite* temperature T which have energy *above* the Fermi energy E_F. The density of states is proportional to $E^{1/2}$ and the probability that a state is occupied is

$$\frac{1}{\exp\big(\beta(E - E_F)\big) + 1}$$

where $\beta = (kT)^{-1}$. You don't need to perform the integration, but you should set up the integral so that doing it would yield the correct answer without any additional physical reasoning.