

Homework 8, PHY 7500, Fall 2007 (due on November 4, 2007)

1. Find the first temperature dependent term in the paramagnetic susceptibility of a degenerate electron gas.
2. Consider a gas of N free spin 1/2 particles of mass m on a planar surface of area A . Obtain an explicit expression for the chemical potential of this gas as a function of temperature.
3. Consider photoelectric emission. Prove that at high field frequency the photocurrent does not depend on temperature.
4. **#1, 8.6.** The velocity of sound in a fluid is given by the formula

$$w = \sqrt{(\partial P / \partial \rho)|_s} = \sqrt{1 / (mn\kappa_S)}$$

where $\kappa_S = 1/n(\partial n / \partial P)_z$ is the adiabatic compressibility. Show that the velocity of sound w in an ideal Fermi gas is given by

$$w^2 = \frac{5kT}{3m} \frac{f_{5/2}(z)}{f_{3/2}(z)} = \frac{5}{9} \langle u^2 \rangle, \quad (1)$$

where $\langle u^2 \rangle$ is the mean square speed of the particles in the gas. Evaluate w in the limit $z \rightarrow \infty$ and compare it with the Fermi velocity u_F .