

Phys 971 Stat Mech: Homework 6

due 12/3/2013

1

(Patria 8.1) Let the Fermi distribution at low temperatures be represented by a straight line (shown in Fig. 8.11) that is tangent to the actual curve at $\epsilon = \mu$. Show that this approximate representation yields a “correct” result for the low-temperature specific heat of a Fermi gas, except that this numerical factor turns out to be smaller by a factor of $4/\pi^2$. Discuss, in a qualitative manner, the origin of the numerical discrepancy.

2

Pathria 8.14: Investigate the Pauli paramagnetism of an ideal gas of fermions with intrinsic magnetic moment μ^* and spin $J\hbar$ ($J = 1/2, 3/2 \dots$) and derive expressions for the low-temperature and high-temperature susceptibilities of the gas.

3

Compute the isothermal compressibility K_T for a van der Waals gas and show near the critical point $K_T \sim |T - T_c|^{-\gamma}$, where the critical exponent $\gamma = 1$.

4

Compute the susceptibility χ for the mean-field model of ferromagnetism considered in the class show near the critical point $\chi \sim |T - T_c|^{-\gamma}$, where the critical exponent $\gamma = 1$.