

Assignment 5

March 9, 2021

1. The density of states for spin \uparrow (\downarrow) is given by $g_{\uparrow}(E) = g_{\downarrow}(E) = \frac{1}{2}CE^{\frac{1}{2}}$. Draw a sequence of diagrams showing spin-split bands at 0 K with
 - (a) Zero applied magnetic field.
 - (b) Applied field B with the density of states shifting before equilibrium is attained.
 - (c) The achievement of equilibrium.

Calculate the magnetization M and susceptibility χ using the relationship

$$\chi = \frac{M}{H} = \frac{\mu_0 M}{B}. \quad (1)$$

2. Find the density of states for quantized free electrons in a one dimensional and two dimensional solid. For two dimensions, show that the chemical potential (μ) is independent of T provided $T \ll \mu$.
3. Describe how the internal energy $U(T)$ depends on temperature $T > 0$. Use the Sommerfeld expansion. Derive the specific heat capacity $C_V = \left. \frac{\partial u}{\partial T} \right|_V$ from the expression deduced.