Physics 831 Quiz #3 - Friday, Sep. 21

1. Consider a TWO-dimensional gas of MASSLESS spin-1/2 Fermions at temperature T confined to an area A. (Feel free to set $c = 1$)

   (a) Find the density of single-particle states $D(\epsilon)$. Express answer in terms of ϵ, A, and $\hbar$.

   (b) Beginning with:

$$\delta\rho = \frac{1}{A}\int d\epsilon\ D(\epsilon)\delta f(\epsilon), \qquad \delta f \equiv \frac{e^{-\beta(\epsilon-\mu)}}{1+e^{-\beta(\epsilon-\mu)}} - \Theta(\mu-\epsilon),$$

   derive the function $B(\epsilon_f)$ in the expression

$$\delta\rho = \frac{B(\epsilon_f)}{A}T^2,$$

   where T is small. Express B in terms of D and derivatives of D.

   (c) Find the the change of the chemical potential $\delta\mu$ necessary to maintain a constant density per unity area, ρ, while the temperature is raised from zero to T. Give answer to order T^2 as a function of D and derivatives of D.