

# Phys 771

## Condensed Matter Physics

### Problem Set # 4

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1. Marder 6.1
2. Marder 6.2
3. Marder 6.3
4. Marder 6.4 (modified) : The density of single particle states of free electron gas in  $d$  dimensions is given by  $D(\varepsilon) = \frac{2}{(2\pi)^d} \int dq^d dk^d \delta(\varepsilon - \varepsilon_p)$ , where  $\varepsilon_p = \frac{\hbar^2 k^2}{2m}$  is the energy of free electron and the factor 2 accounts for the two spin states of electron ( $2s + 1 = 2$ , where  $s = 1/2$ )
  - (a) Calculate the density of states, Fermi energy, energy per electron, and pressure for an electron gas confined to an area A at zero temperature
  - (b) Calculate the density of states, Fermi energy, energy per electron, and pressure for an electron gas confined to a line of length L at zero temperature
5. Marder 6.8
6. Derive an explicit expression for the chemical potential of an electron gas in 2D. Discuss the low and high temperature limits and plot the behavior of  $\mu$  vs  $T$ .  
*Hint: the Sommerfeld expansion formula does not work in 2D*