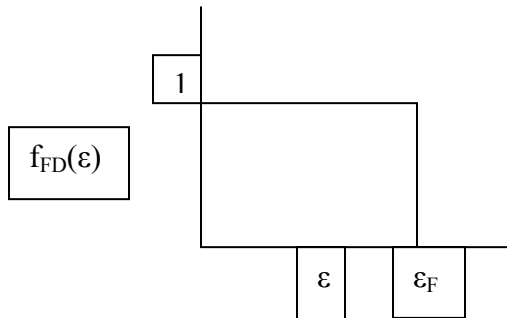


Phy 410

Quiz #9, April 10, 2009

(1) Plot the Fermi-Dirac distribution

function $f_{FD}(\epsilon)$ as a function of ϵ at $\tau = 0$ (zero temperature)



(2) The density of states for 3-dimensional ideal electrons confined in a cubic box of volume V is given by

$$D_3(\epsilon) = \frac{V}{2\pi^2} \left(\frac{2m}{\hbar^2} \right)^{3/2} \epsilon^{1/2}$$

Calculate the Fermi energy as a function of density $n = N/V$ and other fundamental parameters.

$$N = \int_0^{\infty} D_3(\epsilon) f_{FD}(\epsilon) d\epsilon = \text{At } \tau=0 \int_0^{\epsilon_F} D_3(\epsilon) \cdot 1 d\epsilon$$

$$N = \frac{V}{2\pi^2} \left(\frac{2m}{\hbar^2} \right)^{3/2} \int_0^{\epsilon_F} \epsilon^{1/2} d\epsilon = \frac{V}{2\pi^2} \left(\frac{2m}{\hbar^2} \right)^{3/2} \frac{\epsilon_F^{3/2}}{3/2}$$

$$\epsilon_F = \frac{\hbar^2}{2m} \left(3\pi^2 \frac{N}{V} \right)^{2/3}$$

