Assignment 6

1. (a) Calculate the density of states for a system of free electrons in **two** dimensions.

   (b) Calculate the Pauli paramagnetic susceptibility for this system in two dimensions. Assume there are no electron interactions.

2. Given the density and atomic mass of Cu, find

   (a) the number density, n, of the electrons,

   (b) the rescaled Wigner-Seitz cell size, r_s,

   (c) Fermi energy, E_F, Fermi velocity, v_F, and Fermi temperature, T_F.

3. (a) Show your complete working in deriving the following relationship,

$$\frac{1}{|\vec{r}|} = \frac{4\pi}{V} \sum_{\vec{q}} \frac{1}{q^2} e^{i\vec{q}.\vec{r}},$$

   where V denotes volume. Describe how this expression is used to compute the Fourier coefficients, at momentum $\vec{q}$, of the Columbic interaction $V(\vec{r}_1, \vec{r}_2) = \frac{e^2}{4\pi\epsilon_o} \frac{1}{|\vec{r}_1 - \vec{r}_2|}$.

   (b) Show how the electron-ion interaction helps resolving the divergence at $\vec{q} = 0$ by subtracting the $\vec{q} = 0$ term from the sum. All this finally provides us with the Hamiltonian in the Hartree-Fock approximation.