MATERIALS PHYSICS II HOMEWORK ASSIGNMENT #1 15.9.2004

Return by Tuesday 14.9.2004 at 14:00 to Kimmo

1. Evaluate the total energy and pressure of the free-electron Fermi gas. (**1 point**)

2. Consider a square lattice (2D) with a lattice parameter of *a* and *m* electrons per unit cell. Calculate the radius k_F of the Fermi sphere (actually, Fermi "circle" in 2D). If *m*=4, up to which Brillouin zone does k_F extend? (**1 point**)

3. Derivation of the Hartree equations via variational principle (Marder, problem 9.1) (**2 points)**

4. Consider for simplicity a system of only two electrons. Approximate the total wave function with a Slater determinant. Derive the expectation value of the Hamiltonian, $F_H=\langle\Psi|H|\Psi\rangle$, apply the variational principle with Lagrange multipliers ε and recover Hartree-Fock equations. (**2 points**)