Exam – FKA091/FIM530 Condensed Matter Physics

December 13, 2010.
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No material is allowed.

You must answer in English. There are 8 problems worth a maximum of 28 points.

1. Calculate the pressure of a Fermi gas at T=0. (3p)

2. Compare the Sommerfeld and Bloch descriptions of electron states (3p)

3. Describe the motion of an electron in a 1D crystal in a constant electrical field.
   Derive the period and amplitude of the Bloch oscillations. (4p)

4. Discuss a structure of the Boltzmann equation.
   Derive an expression for the conductivity in the τ-approximation (4p)

5. What is Landau quantization? Derive the energy spectrum for free electrons in a magnetic field. (3p)

6. Describe the main properties of the superconducting state. (3p)

7. Discuss the London equation. Derive the expression for the penetration depth of the magnetic field. (4p)

8. Derive and compare the magnetic susceptibilities of itinerant and localized electrons. (4p)