Exam – FKA091/FIM530 Condensed Matter Physics

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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 specific heat of Fermi electrons.
   Explain the concept of "effective" electrons.   (4p)

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 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)