Exam – FKA091/FIM530 Condensed Matter Physics

April 17, 2009, at 14.00 – 18.00 in VV-salar
Lärare: Leonid Gorelik, extension 3143, mobile 073-775 9572

The following text books are allowed: N.W. Ashcroft and N.D. Mermin: Solid State Physics; M.P. Marder: Condensed Matter Physics; C. Kittel: Introduction to Solid State Physics (any edition). *No other material, such as lecture notes or other notes, is allowed .*

You must answer in English. There are 8 problems worth a maximum of 25 points.

1. Calculate the pressure of a Fermi gas at T=0. (2p)
2. Compare the Sommerfeld and Bloch descriptions of electron states. (3p)
3. Describe the motion of an electron in a crystal in a constant electrical field. Derive the period and amplitude of the Bloch oscillations. (3p)
4. a) What is the Boltzmann equation? Discuss its structure. (2p)
   b) Derive an expression for the conductivity in the τ-approximation (3p)
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 for the supercurrent. Derive the expression for the penetration depth of the magnetic field. (3p)
8. Explain the concept of spin-waves. What is meant by magnons? Derive the magnon spectrum for a 1D system with spin one half. (3p)