

# Exam – FKA091/FIM530 Condensed Matter Physics

15 Dec 2009 - 14:00, Hörsalar på Hörsalsvägen

Lärare: Leonid Gorelik, extension 3143, mobile 073-775 9572

*No material is allowed.*

You must answer in English.

There are 8 problems worth a maximum of 28 points.

1. What is the ground state of the degenerate electron gas?  
What is Fermi energy? Fermi momentum? (3p)
2. Compare the Sommerfeld and Bloch descriptions of electron states (3p)
3. a) What is the Boltzmann equation? Discuss its structure. (3p)  
b) Derive an expression for the conductivity in the relaxation time approximation. (2p)
4. a) What is the Fröhlich (electron-phonon) Hamiltonian?  
Discuss all its components. (3p)  
b) What processes are responsible for the effective electron-electron interaction? (2p)
5. What is Landau quantization?  
Derive the energy spectrum for free electrons in a magnetic field. (2p)
6. Describe the main properties of the superconducting state. (3p)
7. Discuss the London equation for the supercurrent. (2p)  
Derive the expression for the penetration depth of the magnetic field. (2p)
8. What is a most important interaction for magnetic ordering? (1p)  
Compare the Stoner and Curie-Weiss theories of the ferromagnetism. (2p)