Tfy-3.461 Materiaalifysiikka II
Midterm exam, 9.12.2004,
2.

1. a) Explain the main steps for deriving the Lyddane-Sachs-Teller equation for the longitudinal and transversal optical phonon modes in insulators! (3 p)
   b) Explain the formation and properties of the Mott-Wannier exciton! (2 p)
   c) Describe different methods to measure phonon dispersion relations! (3 p)
   Be in keshe

2. a) Atomic diamagnetism. Explain the main principles! (2 p)
   b) Pauli paramagnetism for the free electron gas. Explain the main principles! (2 p)
   c) Mean-field theory for ferromagnets. Explain by using equations the principles and derive the Curie-Weiss law for the susceptibility $\chi = C/(T - \Theta_{CW})$. Hint: Use the magnetization for the paramagentic gas of spin-1/2 particles, i.e., $M(B) = n\mu_B \tanh(\mu_B B/k_B T)$. For a small x, $\tanh(x) \approx x$. (4 p)

3. a) Explain the behaviour of the specific heat capacity in the superconducting transition! (2 p)
   b) Josephson DC effect. Explain the principles on the basis of the Ginzburg-Landau theory! (2 p)