MATERIALS PHYSICS II (FYSM400)   FALL 2010   2. EXAM 14.1.2011

Comment the steps in your derivations and calculations!
You can write the solutions either in Finnish or in English.
Points: 1: 10p, 2: 10p, 3: 10p, max=30p
Time: 4 hours

1. Explain briefly (with a few lines, with perhaps schematic drawings):
(a) Magnon
(b) Ferrimagnetic order
(c) Curie temperature
(d) Fluxon (or fluxoid)
(e) SQUID (Superconducting Quantum Interference Device)

2. The attached figure (turn page) shows the heat capacity c_V of a system as a function of temperature. Show that the shaded area A in the figure corresponds to the quantum mechanical zero-point energy using the following equations as the starting point.

$$A = \int_0^\infty [c_V(\infty) - c_V(T)]dT$$

$$u(T) = \sum_s \int_0^\infty g(w)\varepsilon_s(T)d\omega, \quad \varepsilon_s(T) = [n_s(T) + \frac{1}{2}]\hbar\omega, \quad c_V = \frac{\partial u}{\partial T}$$

3. Describe the microscopic theory of superconductivity (BCS theory) in 1-2 pages. A detailed mathematical treatment is not required, but you should discuss the basic assumptions and its central predictions. You can write formulas and sketch figures.

C_v

Dulong–Petit limit

A

T