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Physics 211A - Solid State Physics
Fall Quarter 2007

Problem Set 4.

Problem 14.

Prove that Bloch's theorem is valid even for states with arbitrary degeneracy.

Problem 15.

Calculate the electronic contribution to the low temperature, specific heat in the nearly free electron approximation.

Problem 16.

Suppose a potential of the type

$$V(x) = -V_o \sum_n \delta(x - na)$$

Derive the ϵ vs k relation.
(Take the appropriate limit of square wells).

Problem 17.

In a metal the maximum amount of disorder can be obtained when "every atom is out of its equilibrium position."

Calculate the resistivity in this situation for a metal in 3 dimensions and in 2 dimensions. Calculate actual number in $\mu\Omega\text{cm}$. Do you find anything unusual or interesting from these results?

This is the so-called Ioffe-Reggel limit.

Problem 18.

Find the low temperature thermal and electrical conductivity for the noble groups IIB and IV metals. Take the ratio of these two quantities at some fixed (but low temperature).

Do you find anything interesting?

Calculate the low temperature thermal conductivity assuming only electronic thermal conductivity.

Take the ratio of this to the electrical conductivity and compare to your "experimental" findings.