

7.8: Additional Problems

7.6 Spin waves

For harmonic lattice vibrations at low frequencies, $\omega = c_s k$. There are analogous excitations of ferromagnets called “spin waves” which, at low frequencies, satisfy $\omega = Ak^2$. Find the temperature dependence of the heat capacity of a ferromagnet at low temperatures. (Do not bother to evaluate constants. . . I am only looking for the functional form of the temperature dependence.)

7.7 Comparison of models

(This problem is stolen from a GRE Physics test.)

One feature common to both the Debye and Einstein models for the specific heat of a crystal composed of N identical atoms is that

- The average energy of each atom is $3k_B T$.
- The vibrational energy of the crystal is equivalent to the energy of $3N$ independent harmonic oscillators.
- The crystal is assumed to be continuous for all elastic waves.
- The speed of longitudinal elastic waves is less than the speed of transverse elastic waves.
- The upper cutoff frequency of elastic waves is the same.

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