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Exercises to the lecture „Modern Experimental Physics II" in WS 2021/2022
Exercise sheet 1 – Exercise class on 28th of October 2021
ILIAS Password : keines

Problem 1 (4 point)

An acquaintance asks you to explore two different materials. You have determined at low temperatures the molar specific heat and plotted it as a function of temperature (see Fig. 1)

(a) What materials classification is each of the samples grouped into and what is the reason for this?

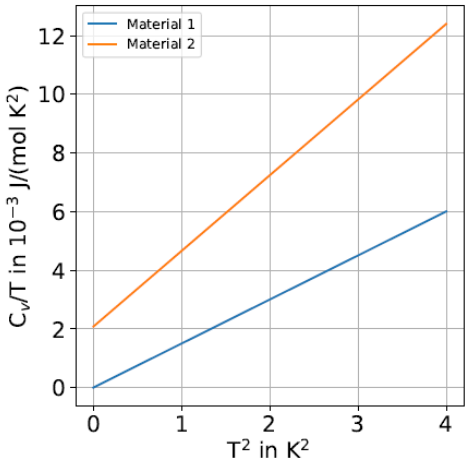

Figure 1: Molar specific heat vs. temperature

(b) What are these two materials?
Hint: you can assume that these two materials are elements from the periodic table. The low-temperature data are available online (i.e. in internet).

(c) Calculate the temperature at which the electronic part of the specific heat capacity is set equal to the lattice specific heat capacity.

Problem 2 (3 points)

Calculate the number of phonons in a crystal with a single-atomic Basis in the frequency interval f_1 = 4.0x10^6 1/s to f_2= 4.1x10^6 1/s at room-temperature. All the modes in the given frequency interval are occupied. The volume of the crystal is V = 1 cm^3, the sound velocity for all modes is v_s = 6.0X10^3 m/s.
Hint: use the density of states D(k) and the Debye approximation.

Problem 3 (3 points)

A monatomic, cubic material has lattice parameter a. The sound velocity for the longitudinal and transversal phonons are approximately equal, $c_T = c_L = c$ in an isotropic crystal for which the maximum phonon-frequency is ω^*.
What can be concluded about the Debye-frequency?