WebAssign
Lab #14: Heat Capacity (Homework)

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PHYS 172-SPRING 2012, Spring 2012
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Current Score : 4 / 4 **Due :** Thursday, April 26 2012 11:59 PM EDT

1. 1/1 points | Previous Answers

Thermodynamics describes the effect of heating an object. An important thermal parameter for a material is its heat capacity (a measure of how much its temperature will rise for a given input of energy).

In this lab, you predicted the heat capacity as a function of temperature for Aluminum. In your model you made use of a number of things that you have learned throughout this course, e.g. the quantized energy of a quantum oscillator, the interatomic spring constant, etc.

Which of the following concepts/principles did you use to predict the heat capacity (Include concepts/principles you used as you studied the underlying phenomena, e.g. the interatomic spring constant)?

- [ ] The angular momentum principle.
- [x] Energy.
- [x] Statistical mechanics (entropy, temperature, ...).
- [x] Momentum.

2. 3/3 points | Previous Answers MI2 11.P.57

A nanoparticle containing 6 atoms can be modeled approximately as an Einstein solid of 18 independent oscillators. The evenly spaced energy levels of each oscillator are 3e-21 J apart. Use k = 1.4e-23 J/K.

(a) When the nanoparticle's energy is in the range 5(3e-21) J to 6(3e-21) J, what is the approximate temperature? (In order to keep precision for calculating the heat capacity, give the result to the nearest tenth of a degree.)

159.5 K

(b) When the nanoparticle's energy is in the range 8(3e-21) J to 9(3e-21) J, what is the approximate temperature? (In order to keep precision for calculating the heat capacity, give the result to the nearest tenth of a degree.)

202.1 K

(c) When the nanoparticle's energy is in the range 5(3e-21) J to 9(3e-21) J, what is the approximate

heat capacity per atom?

3.52e-23 ✔ J/K

Note that between parts (a) and (b) the average energy increased from "5.5 quanta" to "8.5 quanta". As a check, compare your result with the high temperature limit of $3k$, where k = 1.4e-23 J/K.