PROBLEM SET 5 Due Friday February 22

Physics 140A– WINTER 2013

Analytic:

[1.] The specific heat C of a two level system goes to zero at high T, but the specific heat of a classical (or quantum) oscillator remains finite no matter how high T gets. What property of the energy levels of a system determines whether C vanishes at high T or not? Interpret your answer in terms of the formula dE = C dT.

[2.] The specific heat C of a two level system goes to zero exponentially at low T. How does the specific heat C of a quantum oscillator of frequency ω_0 go to zero at low T? In class we saw that a 3D set of oscillators with a linear dispersion relation $\omega(q) = vq$ has a low T specific heat which vanishes as a power law $C(T) = AT^3$. What property of the energy levels of a system determines whether C(T) is exponentially small at low T vs some less rapidly decaying function like T^{α} ?

Numeric:

[3.] Make sure your disk placement program is working. (If it is not, come talk to me or Matt to get it running.) Then build on it by adding a section which moves the disks around. Specifically, select a disk at random and suggest a random shift in its position. Check to make sure the disk is still in the box, and also it doesn't overlap any of the other (hard) disks. Do this many times. In the next problem set we will finish the code up by measuring g(r) and obtain the structure that Sidebottom said we would get. (IMPORTANT: When you modify/extend a working code, always make a copy/ new version of it and modify the copy so you don't break something which is already debugged. So be sure not to destroy your disk placement code as you build on it.)