PHYS 432 Extra Credit for H14 or H15 due 9 or 18 December 2013

Explain your reasoning clearly and show all work.

1. Consider a single one-dimensional simple harmonic oscillator (SHO) with oscillation frequency f, and allowed energies given by Eq. (7.69) on page 289. (See the bottom of page 53, including the footnote.) The one-SHO partition function is given by Eq. (7.70), and the average one-SHO energy is given by Eq. (7.71).

   (a)Write down the total thermal energy energy U for N independent *three*-dimensional SHOs by multiplying Eq. (7.71) by $3N$.
   (b) Using the thermal energy U from part (a) above, use Eq. (1.44) on page 28 to calculate the heat capacity C_V for an Einstein solid, and obtain Eq. (7.103).
   (c) Calculate the $T \to 0$ limit of C_V.
   (d) Calculate the $T \to \infty$ limit of C_V, and compare it to the rule of Dulong and Petit onpage 29.

2. Derive Eq. (7.117) on page 312 from Eq. (7.112) on page 310 using Eq. (1.44) on page 28.