Physics 213 **Problem 4** **Week 5**

Oscillators, Temperature and Equipartition

Consider a collection of ONE MILLION oscillators, each with energy-level spacing $\varepsilon = 10^{-23}$ J. Suppose there is 10^{-14} J of thermal energy in this system.

a) On the average, how many energy quanta does each oscillator get?

b) Is the collection near the $q >> N >> 1$ limit, in which classical equipartition applies? Below approximately what temperature does this fail? Note: q is not >> N if the oscillators have a small probability of $E > \varepsilon$? [HINT: Consider the Boltzmann factor.].

c) What is the heat capacity C of this system? [HINT: Use equipartition and remember that a 1-dimensional oscillator has two quadratic modes.]

d) What is the temperature, T?

e) What is the average energy of one of the oscillators?