

## Homework 10:

Do problem **6.2** in the text

**A.1 Isolated Einstein solids** List all of the possible microstates of an Einstein solid with the specified number of oscillators,  $N$ , and a given amount of energy  $E = qhf$ . Compare your answers in the list to the number of microstates given by

$$\Omega(N, q) = \binom{q + N - 1}{q}.$$

- (a).  $N = 3, q = 4$
- (b).  $N = 4, q = 2$
- (c).  $N = 1, q = \text{anything}$
- (d).  $N = \text{anything}, q = 1$

Calculate the multiplicity of an Einstein solid with 30 oscillators and 30 units of energy (don't make a table of all of the microstates!)

**A.2 Two Einstein solids in contact** Consider a system of two Einstein solids,  $A$  and  $B$ , each containing 10 oscillators, sharing a total of 20 units of energy. Assume that the solids are weakly coupled, and that the total energy is fixed.

- (a). How many different *macrostates* are available to the system?
- (b). How many different *microstates* are available to the system?
- (c). Assuming that this system is in thermal equilibrium, what is the probability of finding all the energy in solid  $A$ ?
- (d). What is the probability of finding exactly half of the energy in solid  $A$ ?
- (e). If, instead of 10 oscillators each, solids  $A$  and  $B$  had 5 and 15 oscillators respectively, at equilibrium how would the energy most likely be distributed among the two solids?
- (f). Under what circumstances would this system exhibit irreversible behavior?