

Combinations and Einstein Solids

Thermodynamics

Winter 2025

College of the Atlantic.

1. There are 14 students in this class.
 - (a) Suppose the students decide to arrange themselves in a line. How many different ways are there to form a line with fourteen people?
 - (b) Suppose I need two students to help me with a dangerous thermodynamics demonstration. How many different possible pairs could I choose?
 - (c) Now suppose I need four students to help with the demonstration. How many different possible groups of four could I choose?
 - (d) Suppose I want to divide the class into two groups: one of six students and the other of eight students. How many different ways are there to do this?

2. Suppose there are six people in a room and there are four identical hats. How many different ways are there to distribute the hats among the people? (Assume that each person, having only one head, can wear only one hat.)

3. Consider an Einstein solid with $N = 3$ and $q = 4$.
 - (a) List all possible microstates, using the “dot and line” notation.
 - (b) Count the microstates, and verify the formula for the multiplicity:

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