

Statistical Mechanics of Pinto Beans and Chicken Eggs

Consider an egg carton with one dozen (i.e, 12) cups.



- 1) We first analyze the statistics of placing N pinto beans into this egg carton. Because pinto beans are small, you may assume that any number of beans can be placed in a given cup (like classical particles, or bosons in quantum states).
 - a) Calculate the number of ways of placing 2 beans in the 12 cups, assuming the beans are distinguishable.
 - b) Repeat the calculation for 7 beans in the 12 cup carton.
- 2) Now consider the statistics of placing N eggs into the carton. Eggs are large and fragile, so you may only place one egg per cup (like fermions in quantum states).
 - a) Calculate the number of ways of placing 2 eggs in the 12 cups, with only one egg per cup. (Assume the eggs are distinguishable).
 - b) Repeat the calculation for 7 eggs in the carton.
 - c) Repeat the calculation for 12 eggs.
 - d) Recalculate a), b), and c) for problem 2 using the approximation of Boltzmann statistics, valid in the limit that the number of cups is much larger than the number of eggs. Comment on the accuracy of this approximation in the three cases above.
 - e) Now consider the quantum chicken on the right, above. She lays indistinguishable eggs. Recalculate a), b), and c), taking into account the indistinguishability of the eggs.