Chapter 2 → 2^{nd} Law → Entropy

Combinatorics

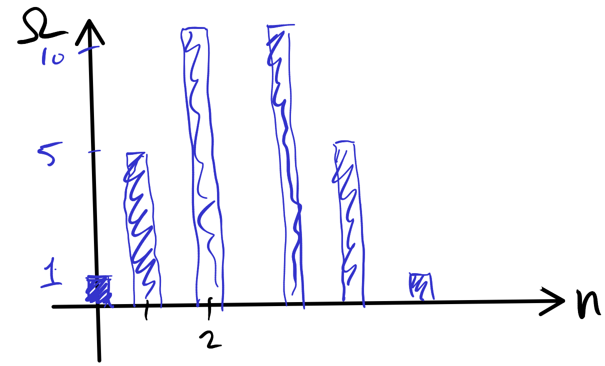
coin flips → 5 coins

H H T T H ← microstate

T H H H H

3 heads ← macrostate

4 heads



How many microstates are in a macrostate?

↳ multiplicity $\Omega(n) = \dfrac{5!}{n!(5-n)!}$ ← combinations

# of heads

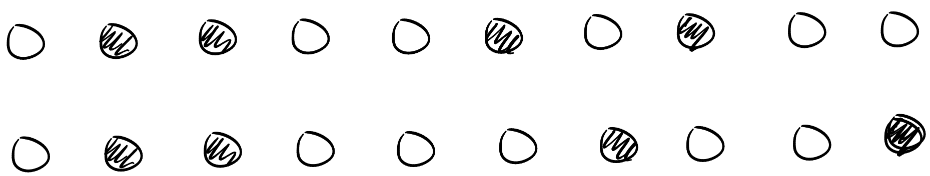
$\dfrac{5!}{3!\,2!} =$

$\Omega(N,n) = \dfrac{N!}{n!(N-n)!} \leftarrow \dbinom{N}{n}$

# of coins   # of heads

10 atoms → each one can have 0 or 1 energy units.

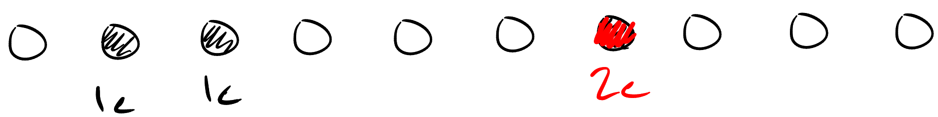
So how many ways are there of arranging 4 units of energy? (10 units of energy)



← microstate

4 energies vs. 10 energies ← macrostate

What if an atom can have more than 1?

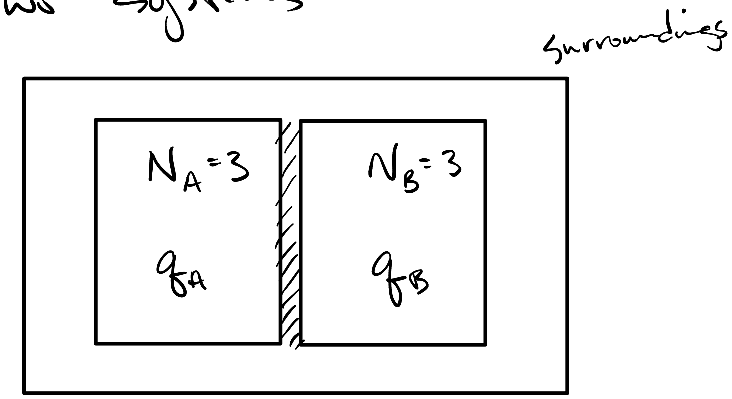


→ need to update the formula

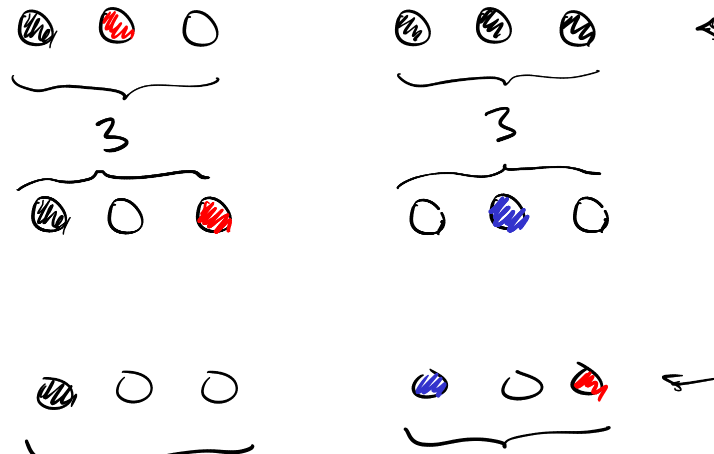
$$\Omega(N,q) = \frac{(q+N-1)!}{q!\,(N-1)!}$$

This idea of treating a solid like this is known as an <u>Einstein solid</u>

Two systems



$q = 6$ ← six quanta of energies that can be shared



← microstate w/i the same macrostate

macrostate 1 energy

$\Omega_A(1) = 3$

macrostate of 5 energy

$\Omega_B(5) = 21$

$$\Omega_{total} = \Omega_A \cdot \Omega_B = 63$$