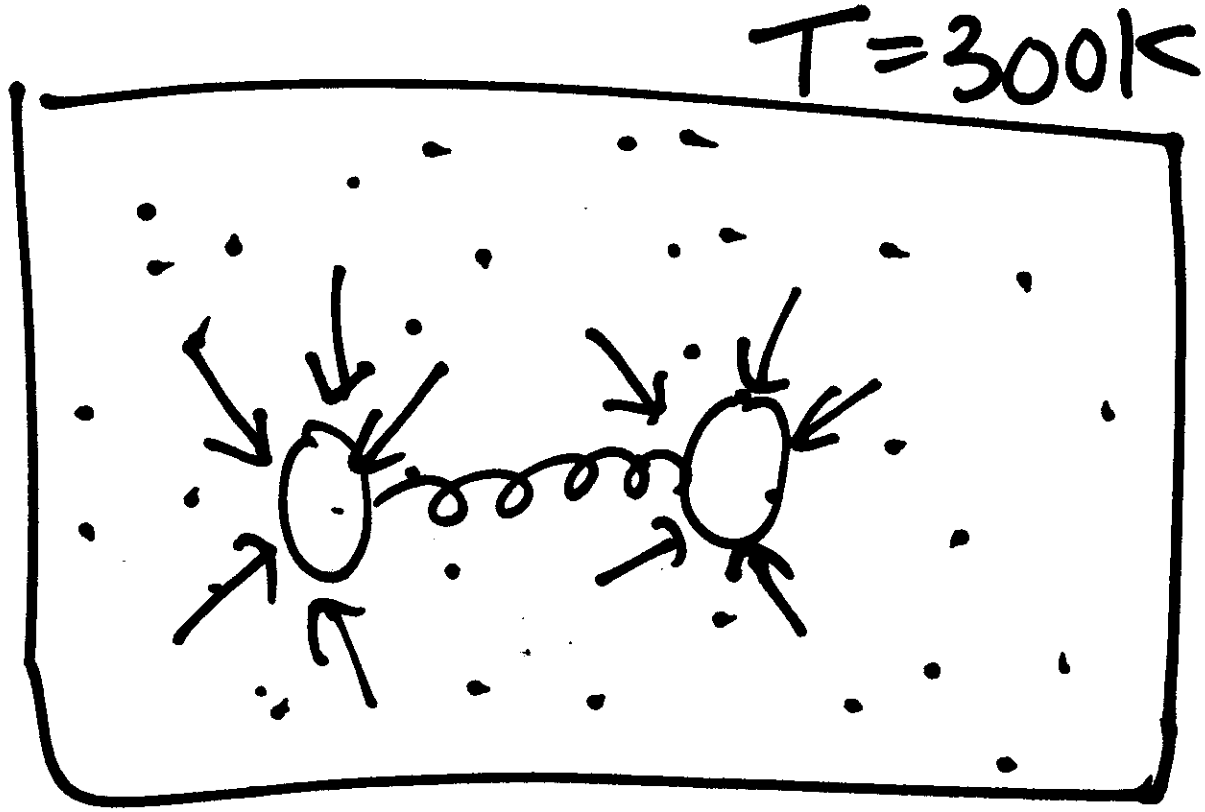
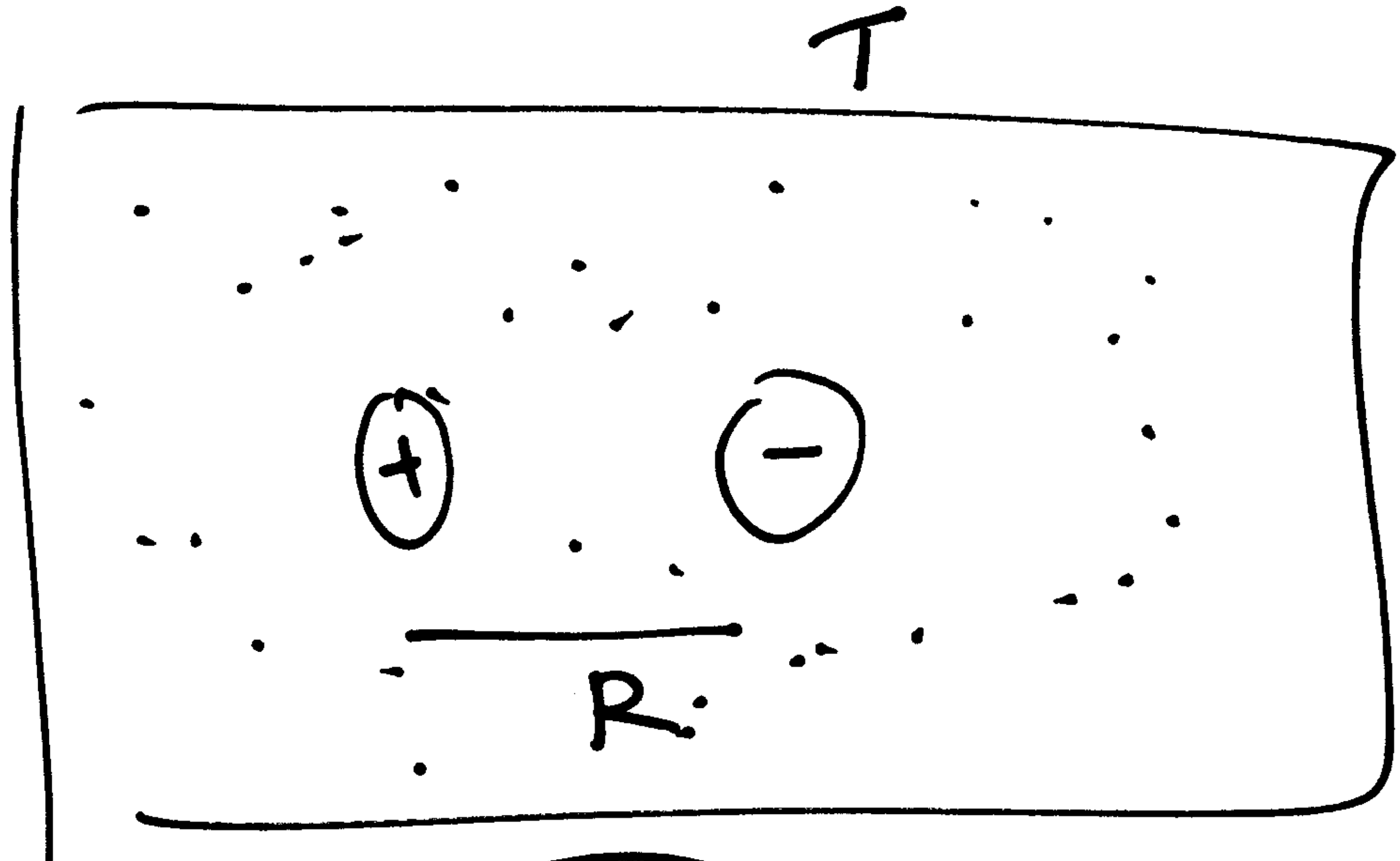


Brownian motion



$$E_c \quad \frac{q}{4\pi \varepsilon_0 \varepsilon_r R} = \frac{A}{R}$$

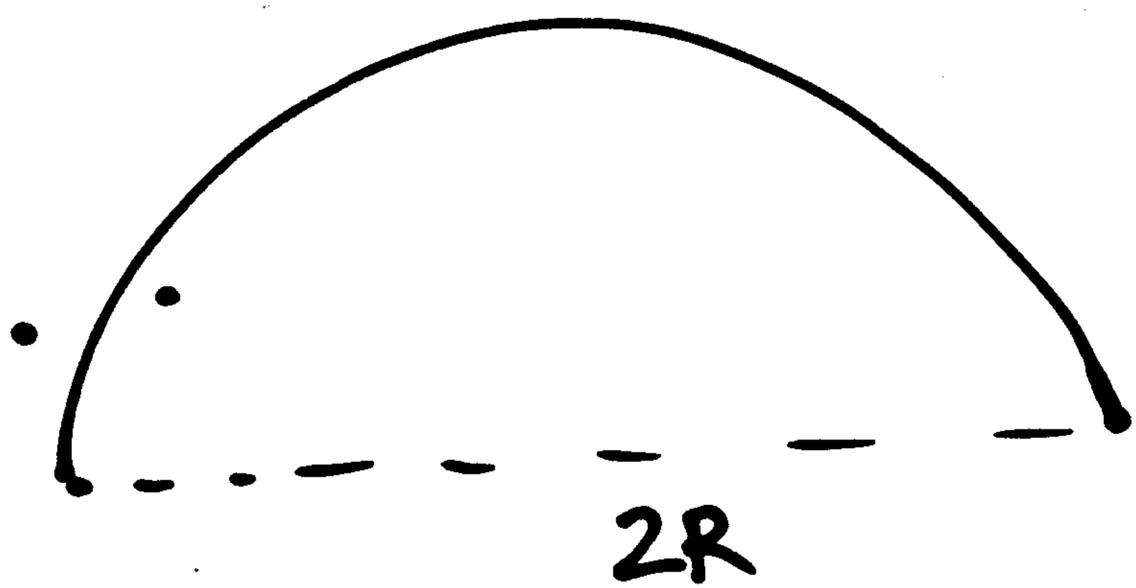
Thermal energy $= k_B T$

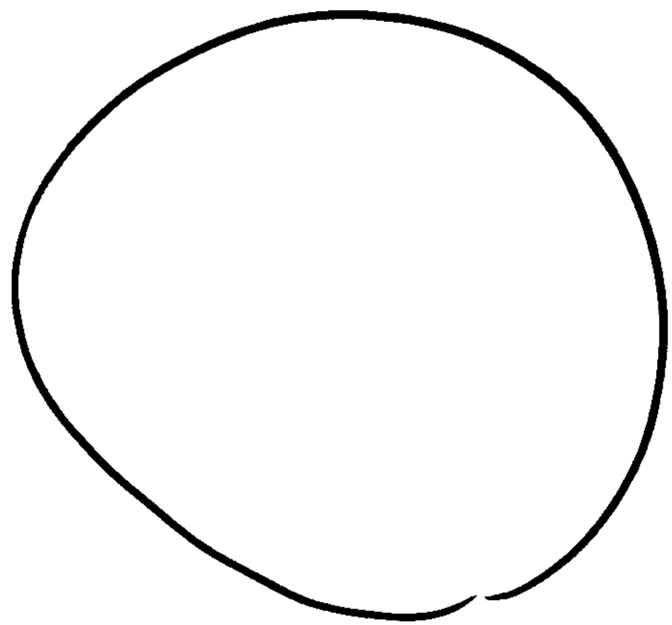
$$\frac{A}{R} = k_B T$$

when, $R = \dfrac{A}{k_B T}$, $E_c = E_T$

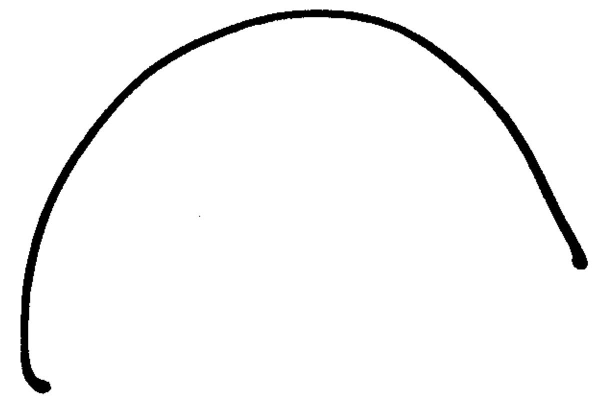
$R \approx nm$

$$K\left(\frac{1}{R}\right)^2 L = E_B \approx k_B T$$

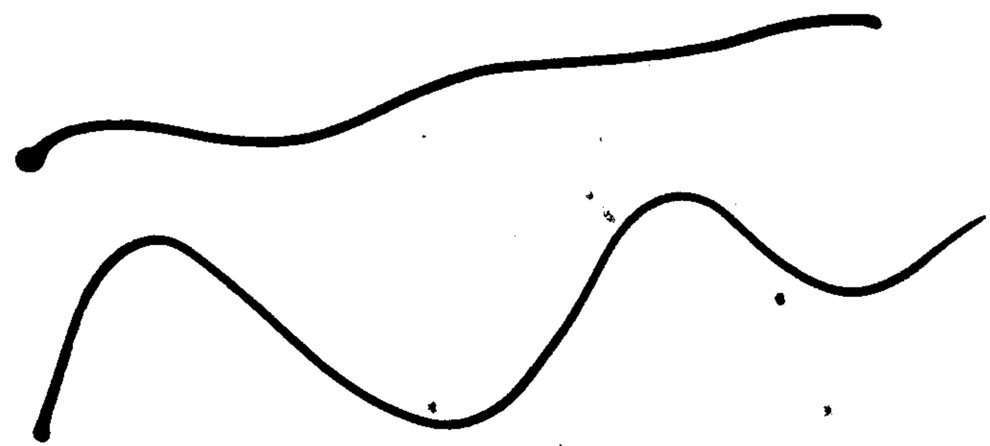


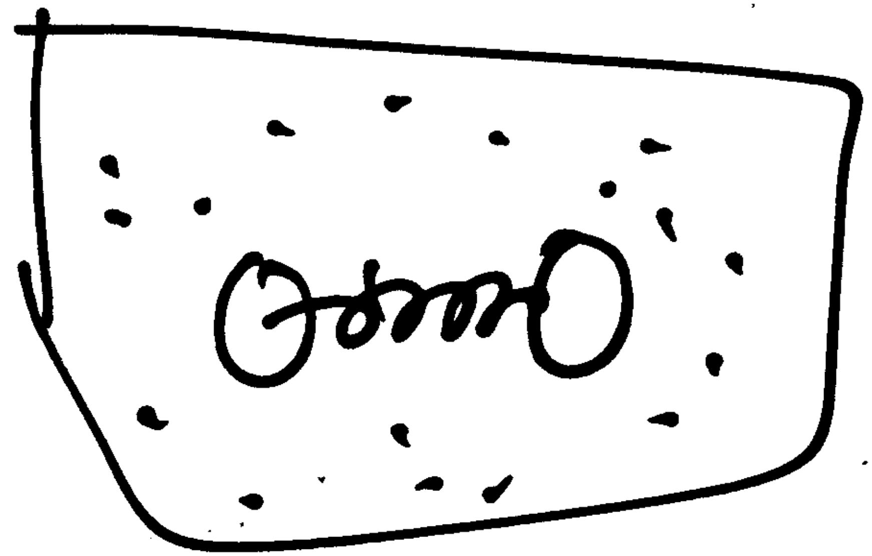


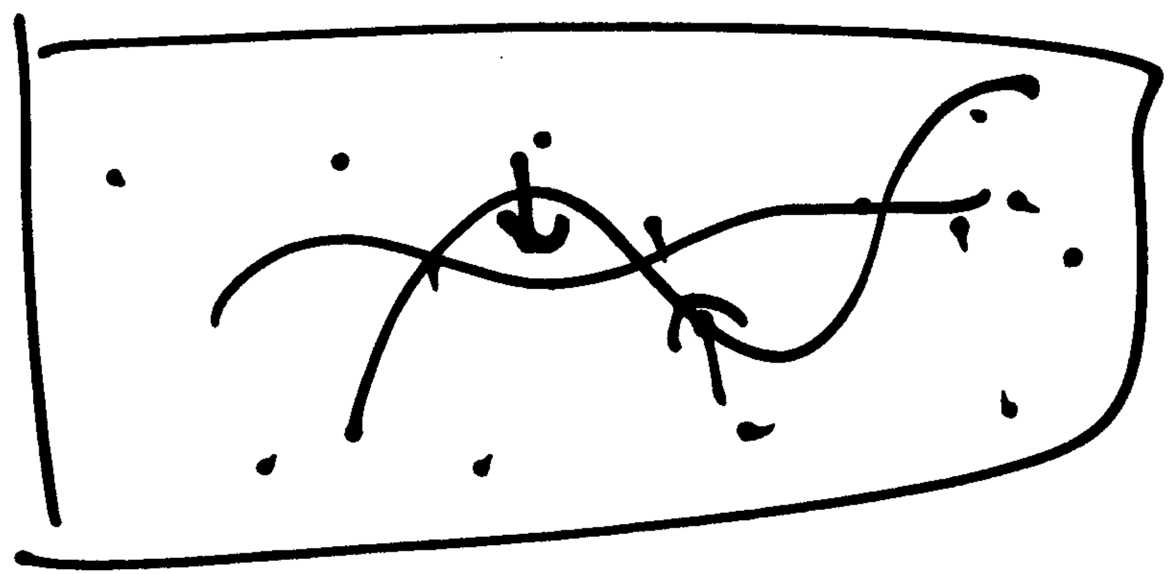
$R \approx 100\,nm$



$E_B \approx k_B T$

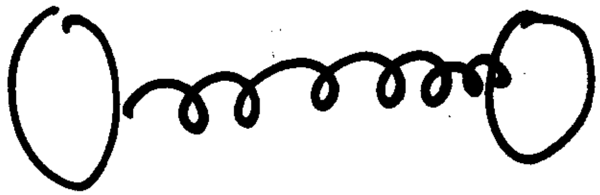






"Thermal fluctuation"

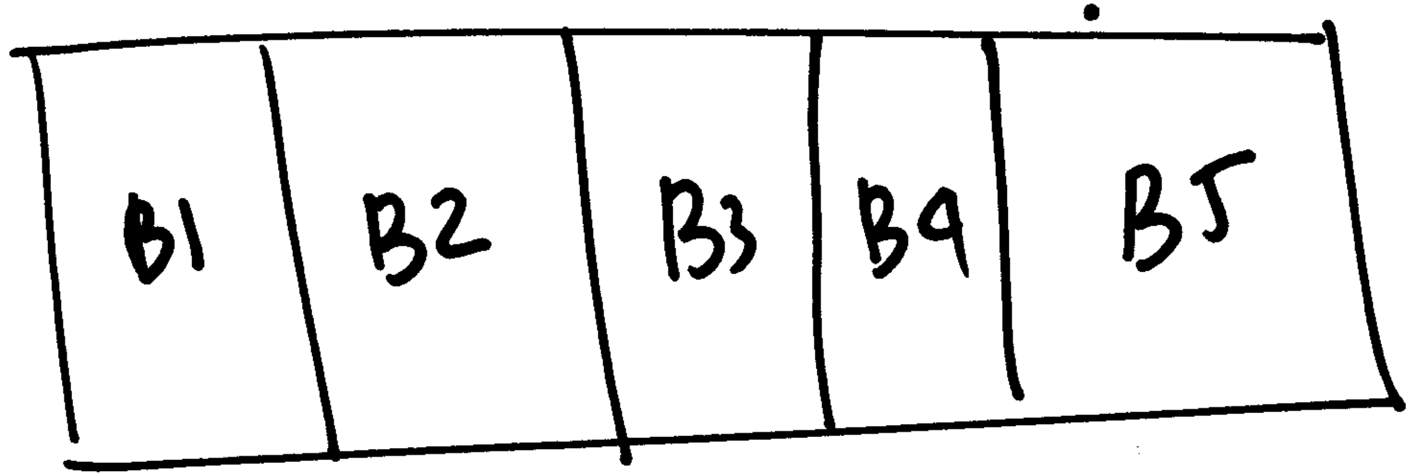
$\sim \frac{1}{R}$

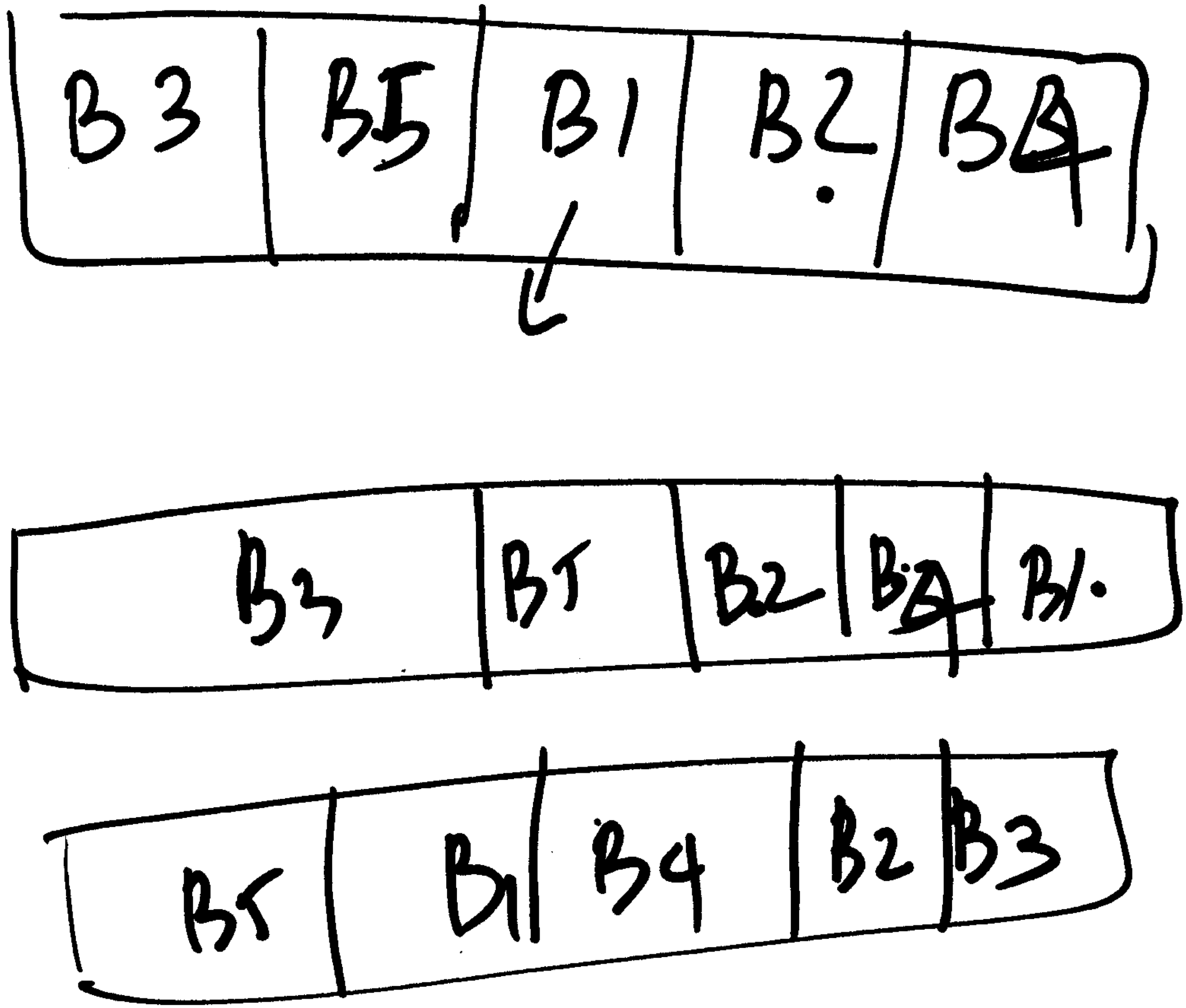


$\frac{1}{2} k R^2$

$E(R) \quad \frac{A}{R^{12}} - \frac{B}{R^6}$

E (R)


B1
B2
B3
B4
B5


B3
B5
B1
B2
B4
B3
B5
B2
B4
B1
B5
B1
B4
B2
B3

ordered. $B_1 \ B_2 \ B_3$: Lib.

Less ordered.

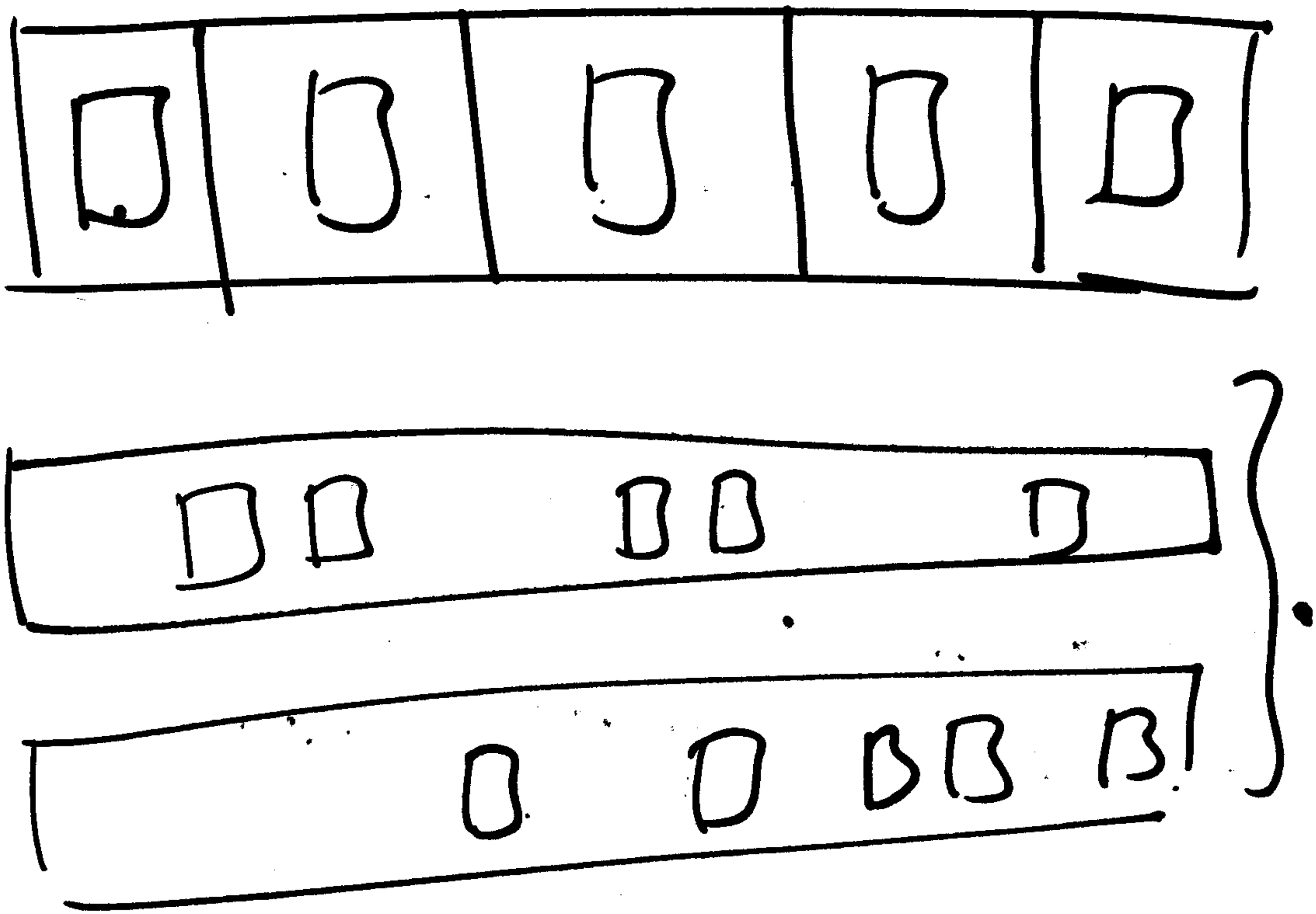
"states"

$$\left.\begin{array}{l} B_1 \ B_2 \ B_3 \\ B_1 \ B_3 \ B_2 \\ B_2 \ B_1 \ B_3 \\ B_2 \ B_3 \ B_1 \\ B_3 \ B_1 \ B_2 \\ B_3 \ B_2 \ B_1 \end{array}\right\} \text{Home shelf}$$

Entropy, $S \propto$ no. of possible arrangements

$$S = -k_B \ln \Omega$$

Ω: no of possible "states"



$S \propto$ no. of "states"

$$S = k_B \ln \Omega$$

$$\ln(AB) = \ln A + \ln B$$

Ω_1	Ω_2
H	1, 2, 3
T	4, 5, 6
2	6

$\Omega_1 \Omega_2 = 2 \cdot 6$

$= 12$

$S = -k$

$$S_{CD} = -k_B \ln(\Omega_1 \Omega_2)$$

$$= -k_B \ln \Omega_1 + -k_B \ln \Omega_2$$

$$S_{CD} = S_C + S_D$$

$P_1 \quad P_2 \quad P_3 \quad P_4$

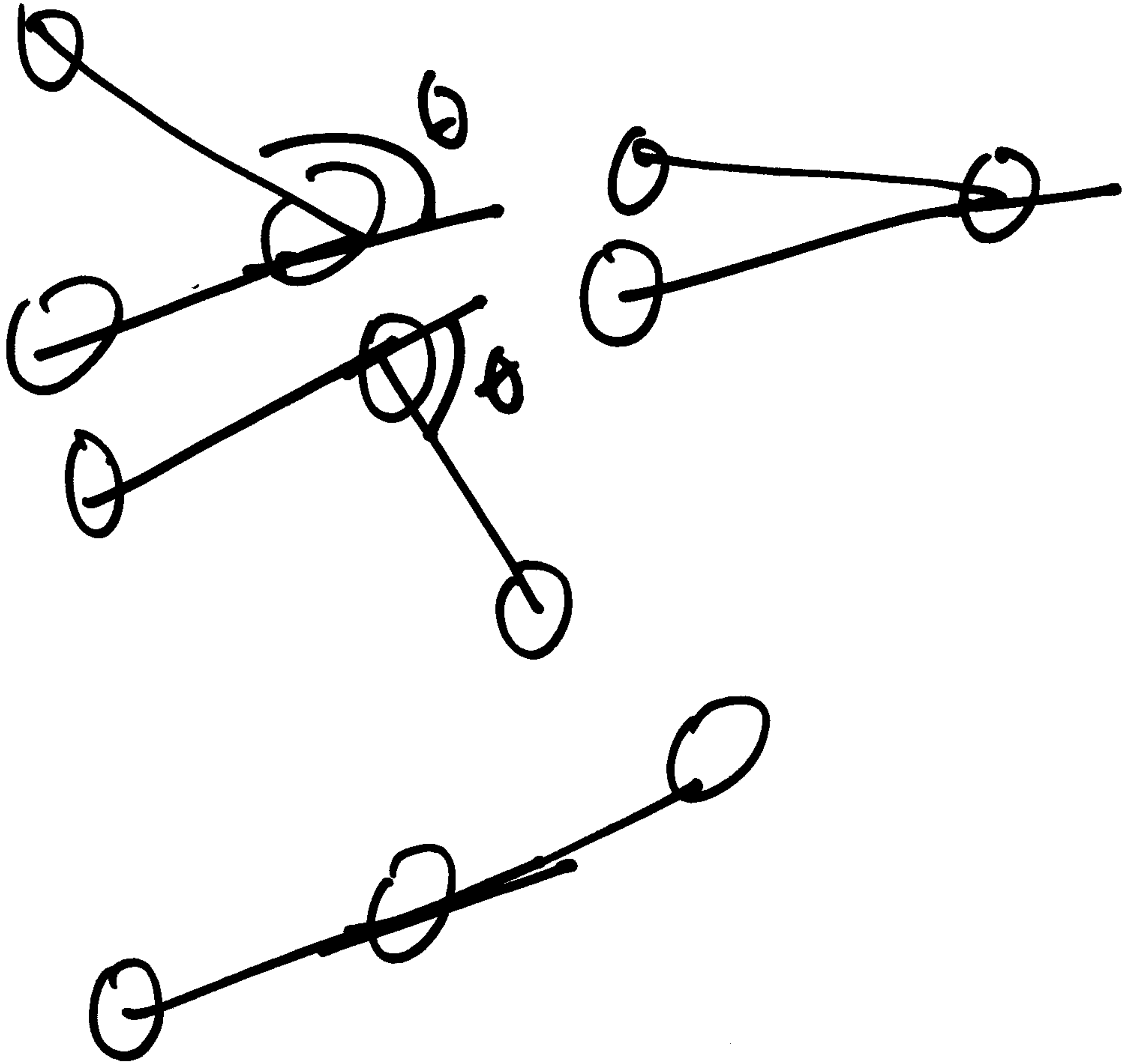
$P_5 \quad P_6$

$$\boxed{S = -k_B \sum_i P_i \ln P_i}$$

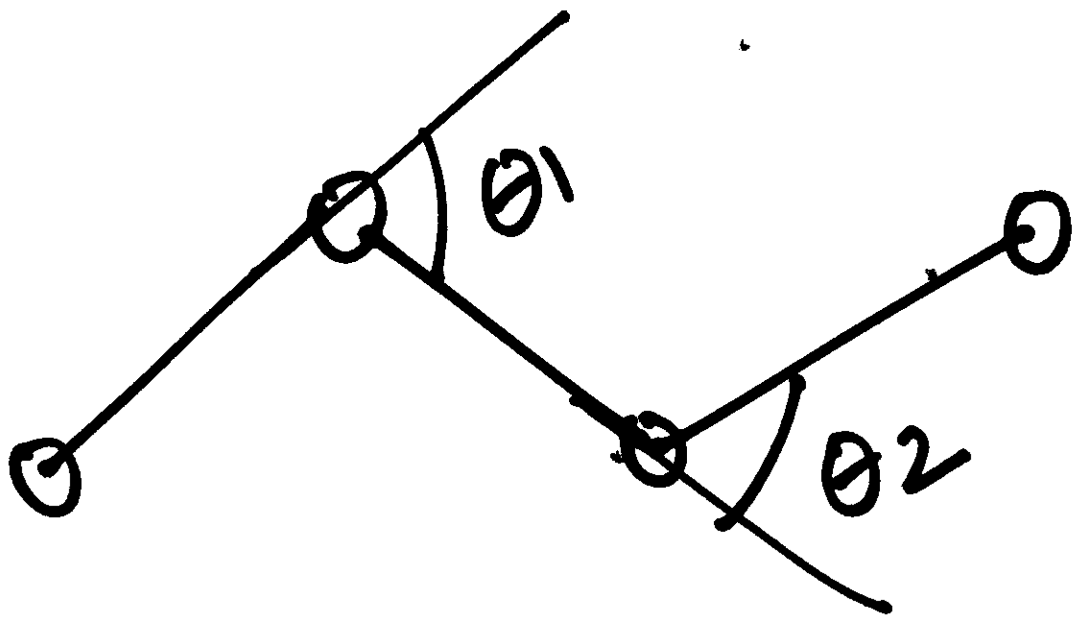
$$S = -k_B \cancel{\sum_i} \left[P_H \ln P_H + P_T \ln P_T \right]$$

$$p_H = p_T = \frac{1}{2}$$

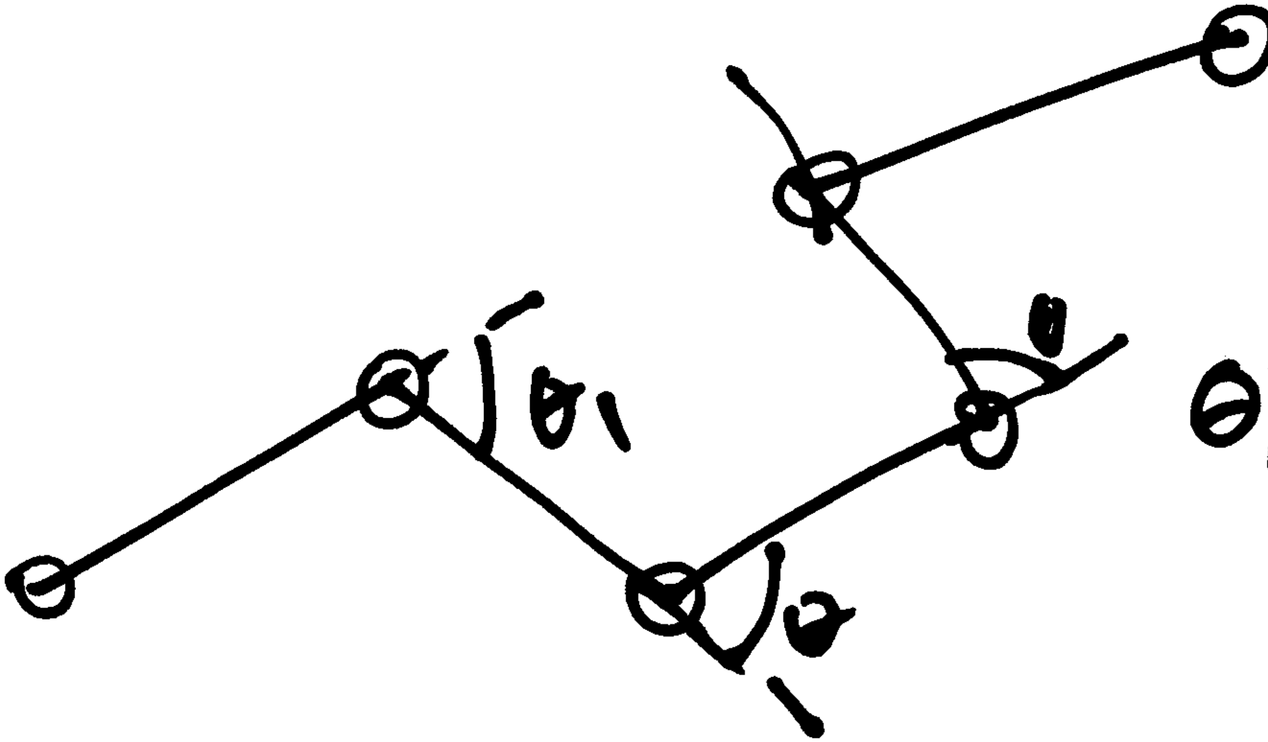
$$S = -k_B \ln\frac{1}{2} = \underline{\underline{+k_B \ln 2}}$$


θ
θ

$$S = \int_0^{2\pi} d\theta = 2\pi$$



$$S = \int_0^{2\pi} d\theta_1 \int_0^{2\pi} d\theta_2 = 2\pi \cdot 2\pi$$

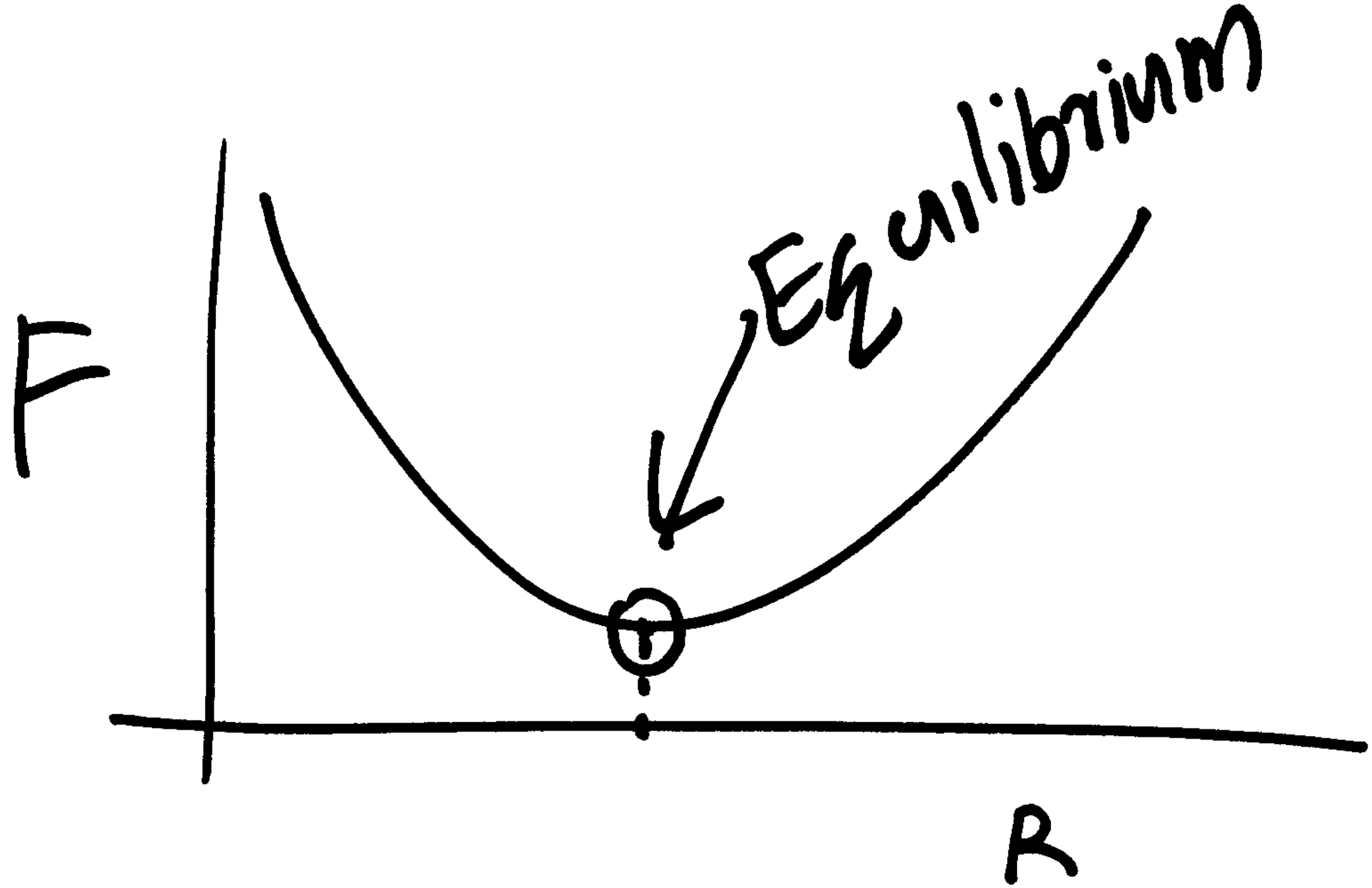


$\theta_1 \cdots\cdots \theta_N$

$$S = \int_0^{2\pi} d\theta_1 \int_0^{2\pi} d\theta_2 \int_0^{2\pi} d\theta_3 \cdots\cdots \int_0^{2\pi} d\theta_N = (2\pi)^N$$

$$F = E - TS$$

$$G =$$


F
R
Equilibrium