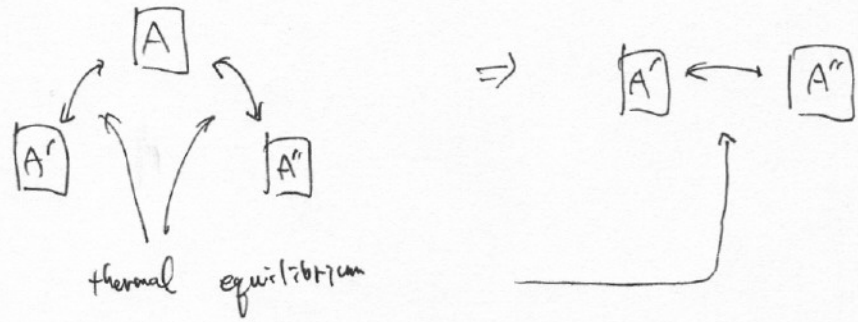
(3) Thermodynamic laws

0th :



1st :

isolated system → $\bar{E}$ = constant

interacting with other system → $\Delta\bar{E} = Q - W$

Q: absorbed heat

W: work done by system.

2nd.

thermally isolated system : $\Delta S \geq 0$

quasi static infinitesimal process : $ds = \frac{đQ}{T}$

3rd : $T \to 0+$, $S \to S_0$

Note : The above laws will be covered by Statistical mechanics. (Chap. 6)

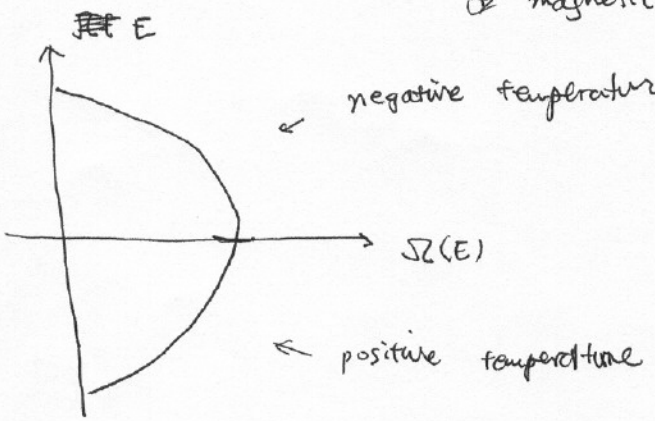
(4) Others.

① negative temperature

In usual situation where $\Omega(E) \sim E^f$

we have positive temperature.

But, in spin systems (spin degrees of freedom only)
④ magnetic field ④ spin-spin interaction is neglected.



(eg. three spins)

② Information theory / Quantum information theory. → more dissussion in the course 3. (?)

Another definition of entropy

$$S = -k \sum P_r \ln P_r . \qquad (\text{chap. } 6)$$

$\sum_{r=1}^{n} P_r \ln P_r$ can be used as a measure of

nonrandomness or information.

(ex) $P_r = \begin{cases} 1 & r = r' \\ 0 & \text{otherwise} \end{cases}$ $\Rightarrow$ $\sum P_r \ln P_r = 0$

$P_r = \frac{1}{n}$ for all r $\Rightarrow$ $\sum P_r \ln P_r = -\frac{1}{n} \ln n \times n$

$= -\ln n$

Quantum information : $S \sim$ measure of entanglement.

③ back to H theorem.