

Definition 5

treat the system like a
block box.

Thermodynamics - phenomenological
description of equilibrium properties
of macroscopic systems.

do not change with time (scale dependent)

Statistical Mechanics - probabilistic
approach to equilibrium phenomena
with a large number of degrees of
freedom.

Heat - energy that flows spontaneously
from hot to cold.

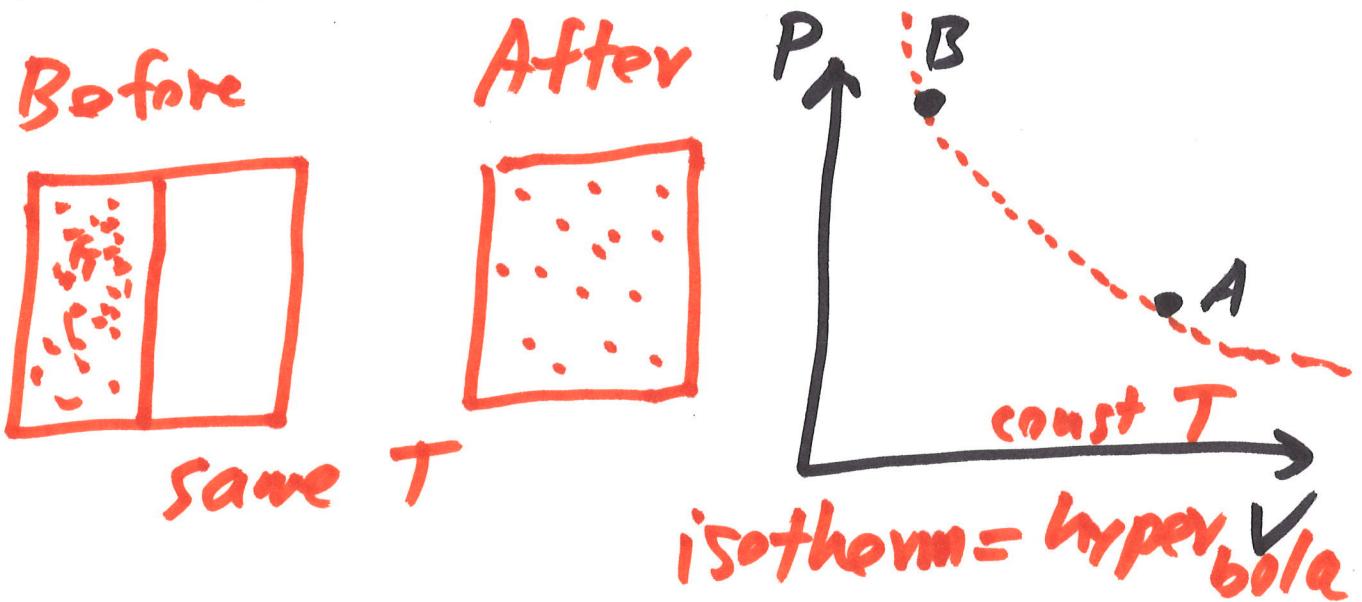
Adiabatic
(walls) - insulating - do not permit
heat flow. opposite is diathermal
(process) - maybe slow (scale
dependent), maybe reversible.

- sometimes "adiabatic" means h , heat flow: $Q=0$

The system is always near an
equilibrium state.

Non-adiabatic process

Joule-Kelvin (Thomson) Expansion



Laws of Thermodynamics

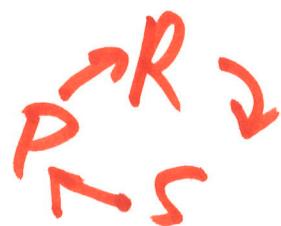
Zeroth Law - If two systems A and B are each separately in thermal equilibrium with a third system C, then A is in thermal equilibrium with B ~~and vice versa.~~ ~~and vice versa.~~

Equivalence relation

If $T_A = T_C$ and $T_B = T_C$, then $T_A = T_B$
transitive, symmetric, reflexive
 $T_B = T_A$ $T_A = T_A$

Non-transitive

Rock > Scissors > Paper



Third Law Walter Nernst 1906-12

- It is impossible to reach absolute zero ($0K$) in a finite number of steps.

- Heat capacity $C_x \rightarrow 0$ as $T \rightarrow 0K$

First Law Conservation of Energy

If we do not allow heat exchange nor particle exchange and if only conservative forces act,

Then $dU = dW$

\uparrow \uparrow
total mechanical
energy work

Can integrate to find $U(P,V,\overset{\mu}{N})$
 $U(P,S,N)$