purpose: the heat flow

Premise:

0: T 1: U 2: S 3: entropy's value (absolute 0)

1: energy conservation

2: there are all kinds of energy. but only high temperature heat source is useful ; if you want to change heat to work with 100% efficiency, T must be 0 or you'll waste a part of heat

3: T cannot be reached.

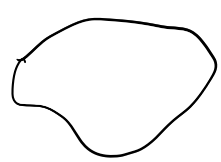
$H = U + PV$

PV → the work needed to bring gas into the space.

U → its own internal energy.

H → the space's energy.

F :



→ all kinds of energy

only F can be used to do work on the outside

① for isolated system $dS \geq 0$

in outside environment $dS_{system} + dS_{environment} \geq 0$

② $dS_{env} = \delta Q_{env}/T = -\delta Q_{sys}/T = -(dU + \delta W)/T$

(δW: work on env done by sys   law 1: $dU = \delta Q_{sys} - \delta W$)

③ $dS_{sys} \geq (dU + \delta W)/T \Rightarrow \delta W \leq -(dU - T_{env}\, dS_{sys})$

④ if for environment $T_{ini} = T_{last}$

$\delta W \leq -d(U - TS_{sys}) = -dF$ (*) ↗ = : reversible

(*): during the process of isothermy, the maximum work an isolated system can do equals to its F.

G: isothermy. constant pressure. process

vertible : $-\Delta G = W$ W : work unrelated to the volume.

invertible : $-\Delta G < W$

U H F G : · thermodynamic potential with different variables.

· by doing Legendre transformation on first law of thermodynamics.

· different variable different potential

eg · variables : S & P

potential : H

with constant pressure energy exchange by $V\uparrow$ or Q shift

equals to H

△1 $dU = -PdV + TdS$

variable : V . S   isolated system

△2 $F = U - TS$ $dF = -PdV - SdT$

variable : V. T

△3 $G = F + PV$ $dG = VdP - SdT$

△4 $dG = VdP - SdT + \mu dN$