9th January 2024

⊛ Coarse ~~op~~ observation of a microscopic variables leads to macroscopic variables.

Last mode in last day's note is like a volume expansion (So?)

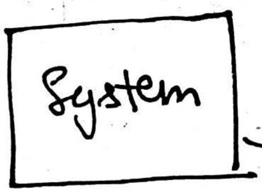
In his notation → Coarse graining = Observation with a least count greater than smallest modes of a system.

This is how the last mode leads to a macroscopic quantity like volume (length)

Δ Thermodynamic system —

Take a part of the universe that you want to study.

Universe



→ Boundary (used to classify system)

Δ **Isolated system** — No exchange of matter or energy.

⊛ In the context of thermodynamics we do not consider mass and energy equivalent.

Δ **Open system** — Exchange of matter and energy.

Δ **Closed system** — Allows energy exchange, but not matter.

Exchange of energy -

Heating the system

WORK

Relation of these two: 1st Law

Δ **Adiabatic wall** - No exchange of heat energy.

↳ Another way of saying 'thermally isolated'.

Δ **Diathermic wall** → Allow energy transfer.

Δ **State of a system**: Macroscopic variables describe this.

↳ Equilibrium values.

(*) Always only described at equilibrium ↙

↳ Something that is not changing with time.

Regardless of what happens in a process, thermodynamic variables are still related by thermodynamic relations.

Δ **Mechanical Equilibrium** -

Dictated by NLM,

$$\vec{F}_N = 0 \quad , \quad \vec{\tau}_N = 0$$

Δ **Chemical Equilibrium** -

No spontaneous change in chemical composition.

Δ **Thermal Equilibrium** →

$\boxed{A}$ → diathermic

Allow a system to evolve.

No change in properties.

If we have all three eqs, it is called **thermodynamic equilibrium**.

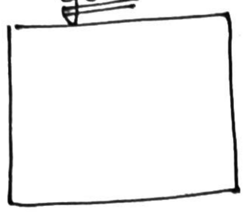
Macroscopic variables – (x, y, z) (Say)

Then $\exists\ f(x, y, z) = 0$

Equation of state → Empirical relation

⊛ Claim → (Later) the equations that relate these can be derived from microscopic physics.

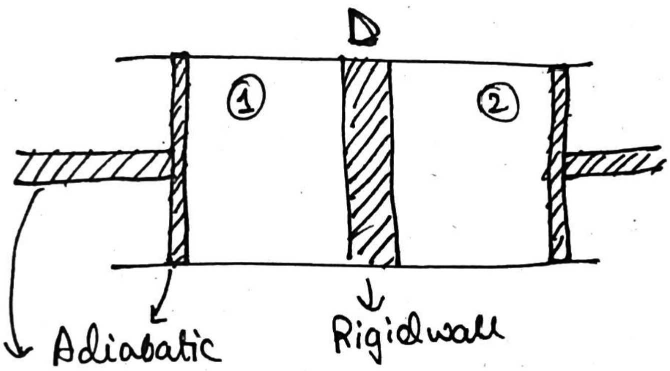
○ Thermal equilibrium and temperature →



→ $(P, V, m, \text{composition})$ is known

p and V can change independently

Self Note: n variables, p constraints ⇒ $n-p$ indep variables.



○ D is adiabatic, ⇒ ① and ② can coexist for any (P_1, V_1) and (P_2, V_2)

○ D is ~~diader~~ diathermic ⇒ (P_1, V_1) and (P_2, V_2) are not independent

⇒ ∃ a function $f(P_1, V_1, P_2, V_2) = 0$

Δ Thermal eq is a state achieved by two or more systems characterised by restricted state of parameters on having been separated by a diathermic wall.

⊛ Temp defined ∯ next class..