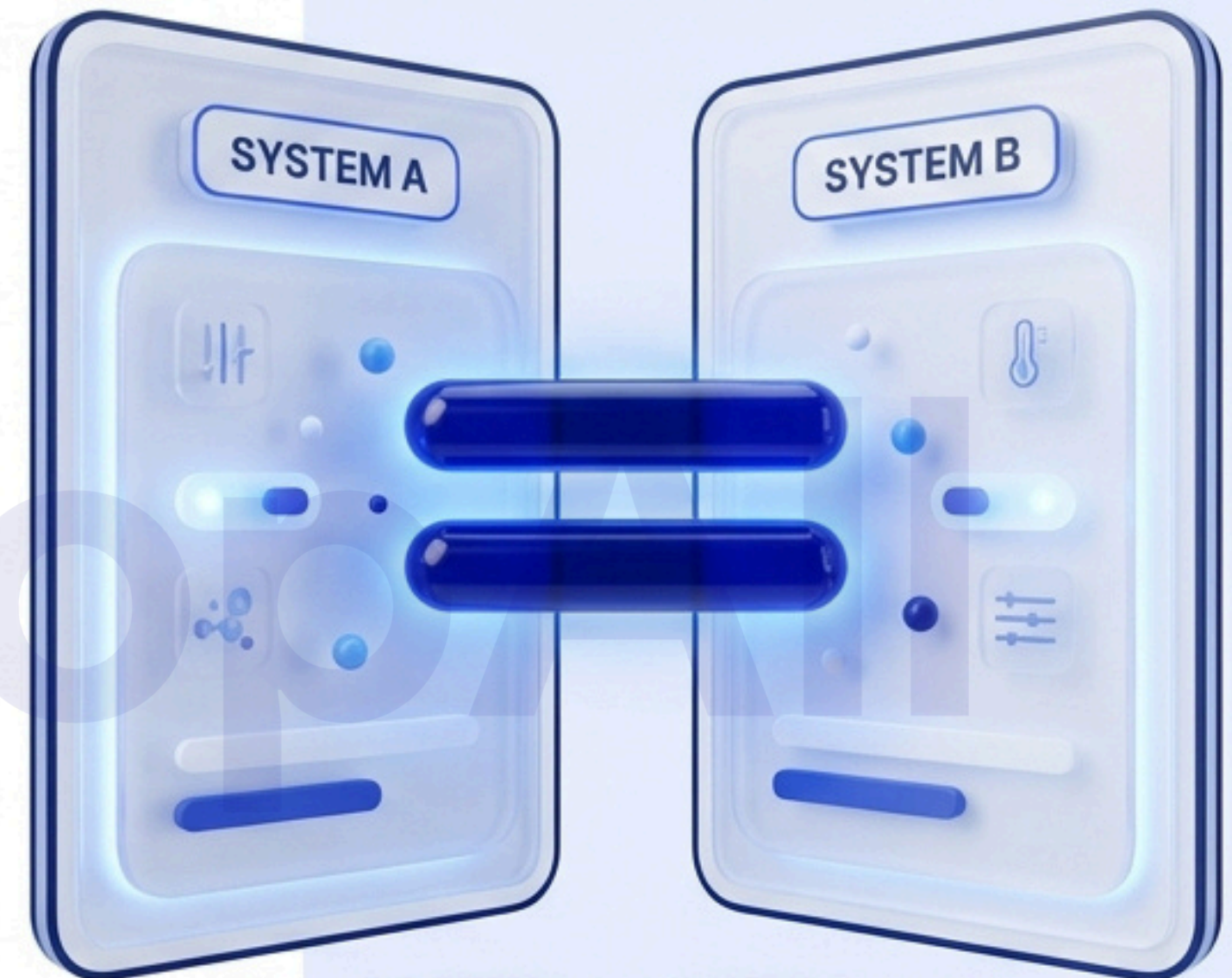


CHAPTER 11 • THERMODYNAMICS

11.2 Thermal Equilibrium

Understanding macroscopic variables, adiabatic vs. diathermic walls, and the conditions for equilibrium.

[Target: Class 11 | NEET / JEE]

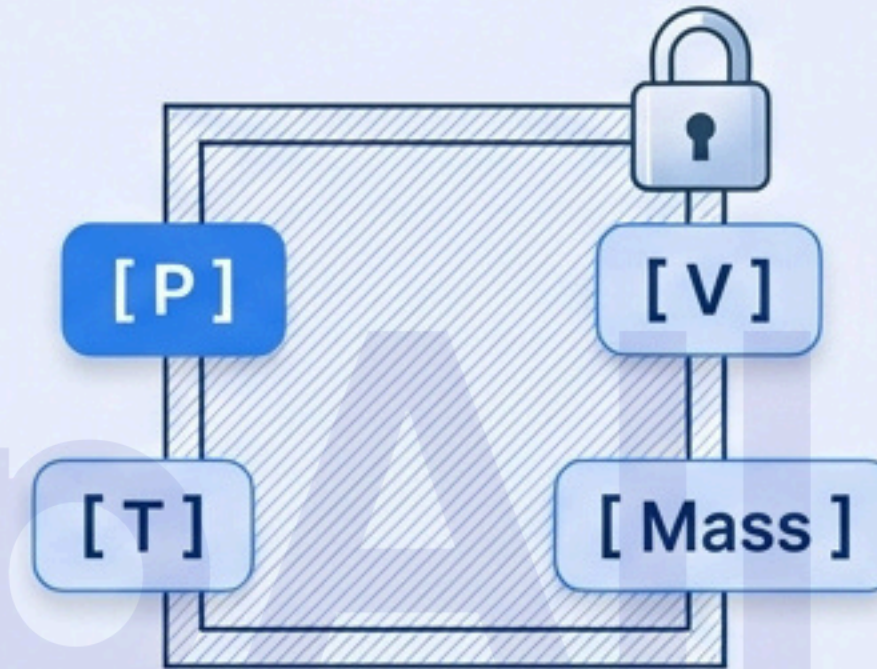


What is Thermodynamic Equilibrium?

A State of Unchanging Variables



In mechanics, equilibrium means net external force and torque are zero.



In thermodynamics, equilibrium means macroscopic variables do not change with time.

[EXAM TIP]

A gas completely insulated in a closed rigid container with constant P , V , T , and mass is in perfect thermodynamic equilibrium.

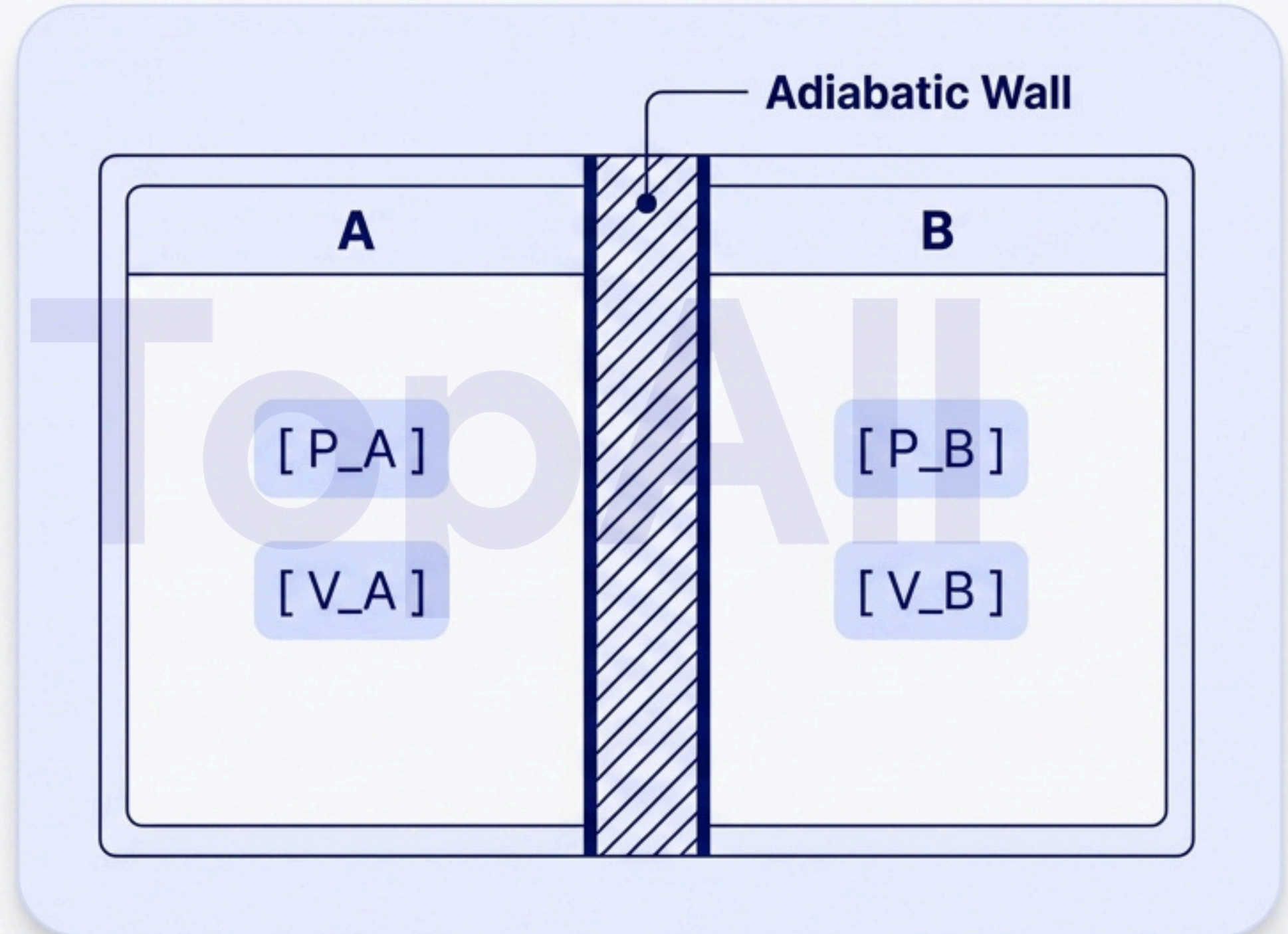
Systems Separated by an Adiabatic Wall

Total Thermal Isolation

Adiabatic Wall:

An insulating wall that does not allow the flow of energy (heat) from one system to another.

- ✓ Systems A and B are completely insulated from each other and the surroundings.
- ✓ Any possible pair of values (P_A , V_A) will remain in equilibrium alongside any possible pair of (P_B , V_B).





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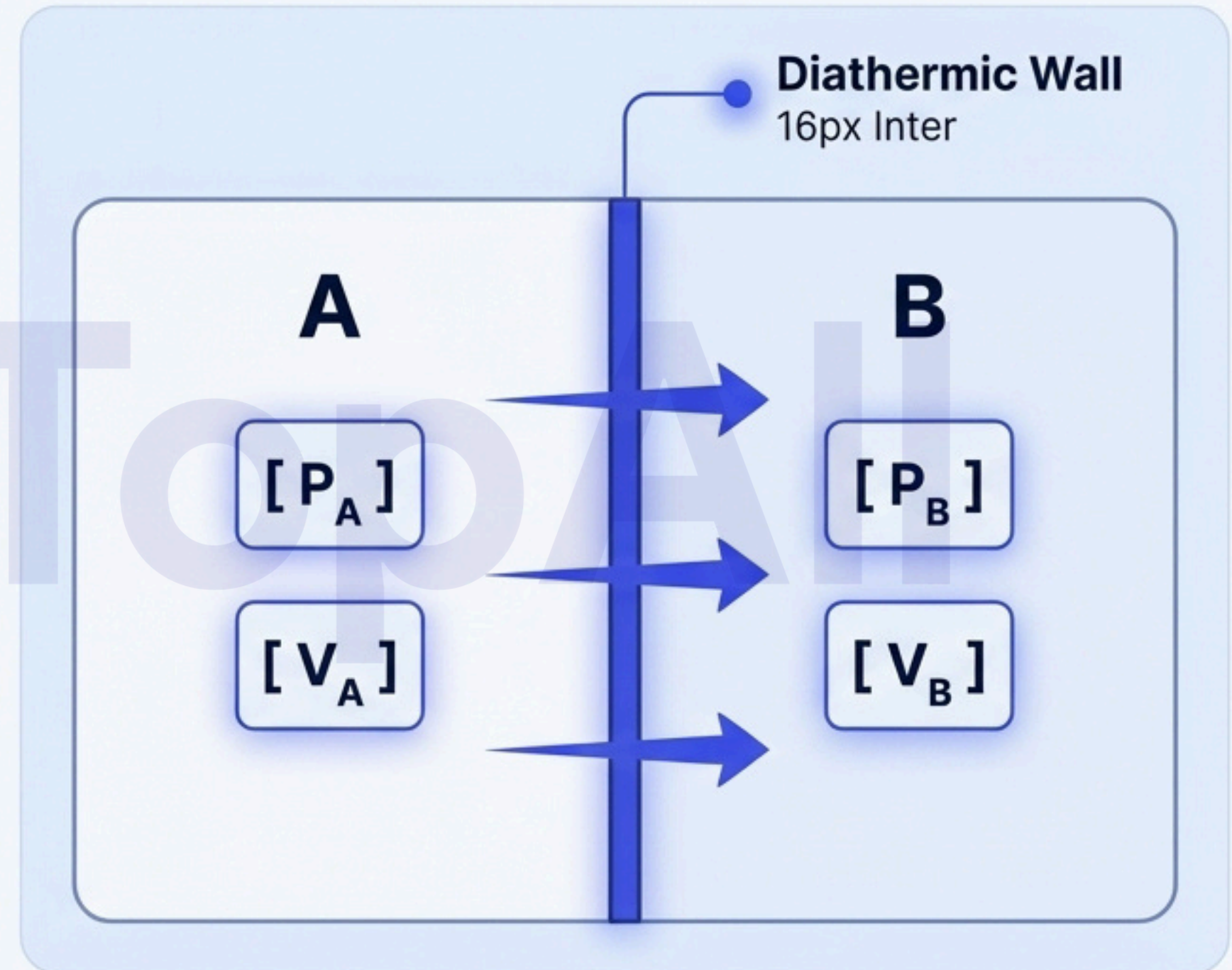
Systems Separated by a Diathermic Wall

Allowing Energy to Flow

Diathermic Wall:

A conducting wall that allows energy (heat) to flow from one system to another.

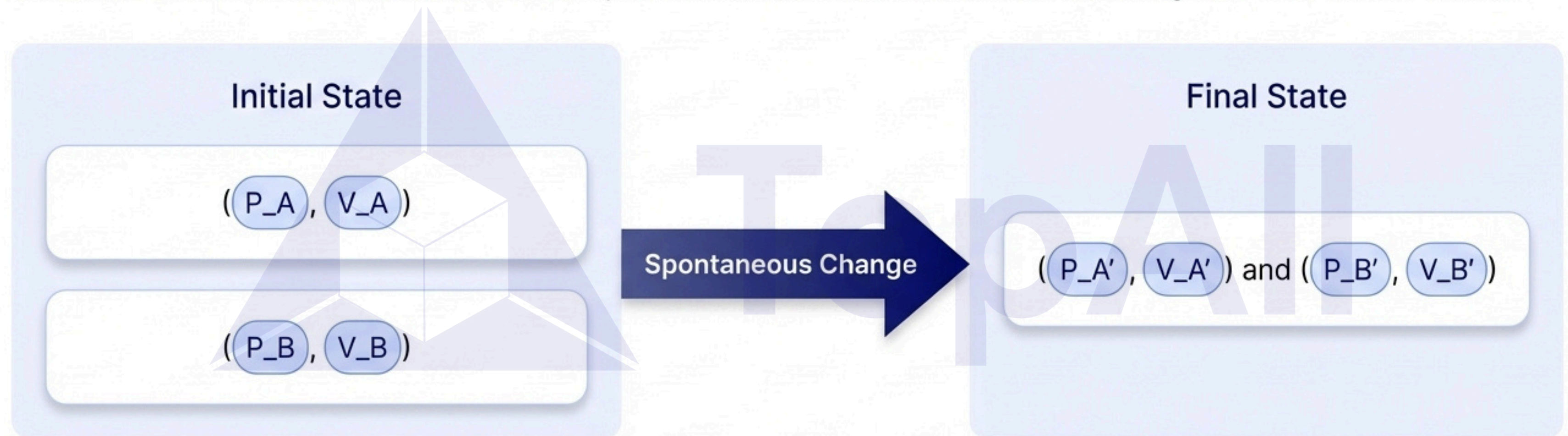
- ✓ The macroscopic variables of A and B will now change spontaneously.
- ✓ Energy flows until both systems attain a mutual equilibrium state.



The Transition to Thermal Equilibrium

Spontaneous Variable Shifts

When the diathermic wall is introduced, the pressure and volume variables of the two gases shift to new values:

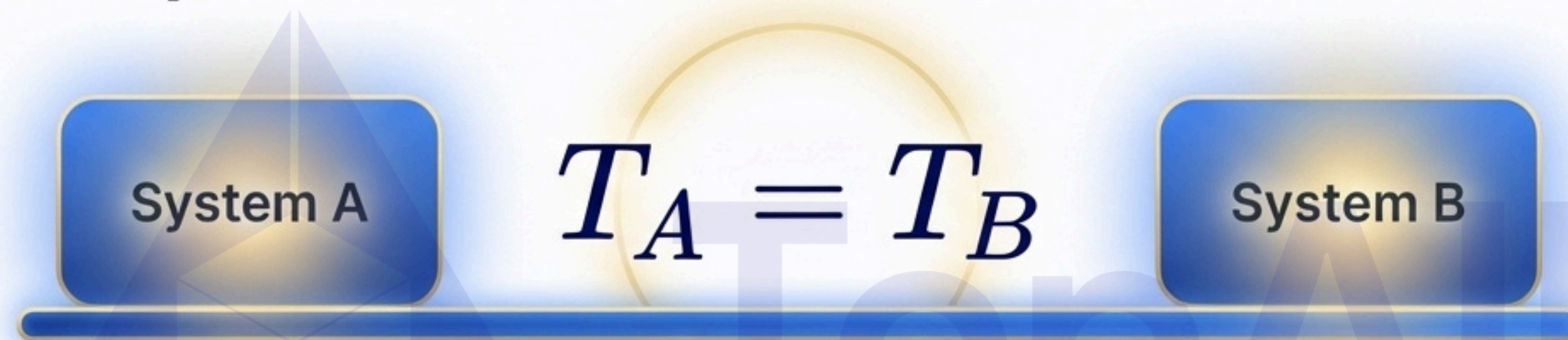


[NOTE]

Both variables need not change! If the containers have fixed volume, only the pressures will change to achieve equilibrium.

The Defining Condition of Equilibrium

Equal Temperatures



- The new states of A and B are in equilibrium with each other.
- There is no more energy flow from one system to another.

The Golden Rule:

In thermal equilibrium, the temperatures of the two systems are equal.

[**PREVIEW**] This equal-temperature concept is formally defined by the Zeroth Law of Thermodynamics.

Chapter 11.2 Summary

KEY TAKEAWAYS

- ✓ **Thermodynamic Equilibrium:** Macroscopic variables (P, V, T, mass) do not change with time.
- ✓ **Walls:** Adiabatic walls block heat flow; Diathermic walls allow heat flow.
- ✓ **Thermal Equilibrium:** Achieved when interacting systems reach equal temperatures ($T_A = T_B$) and energy transfer stops.



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