A/L Physics

Thermodynamics

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What is Thermodynamics?

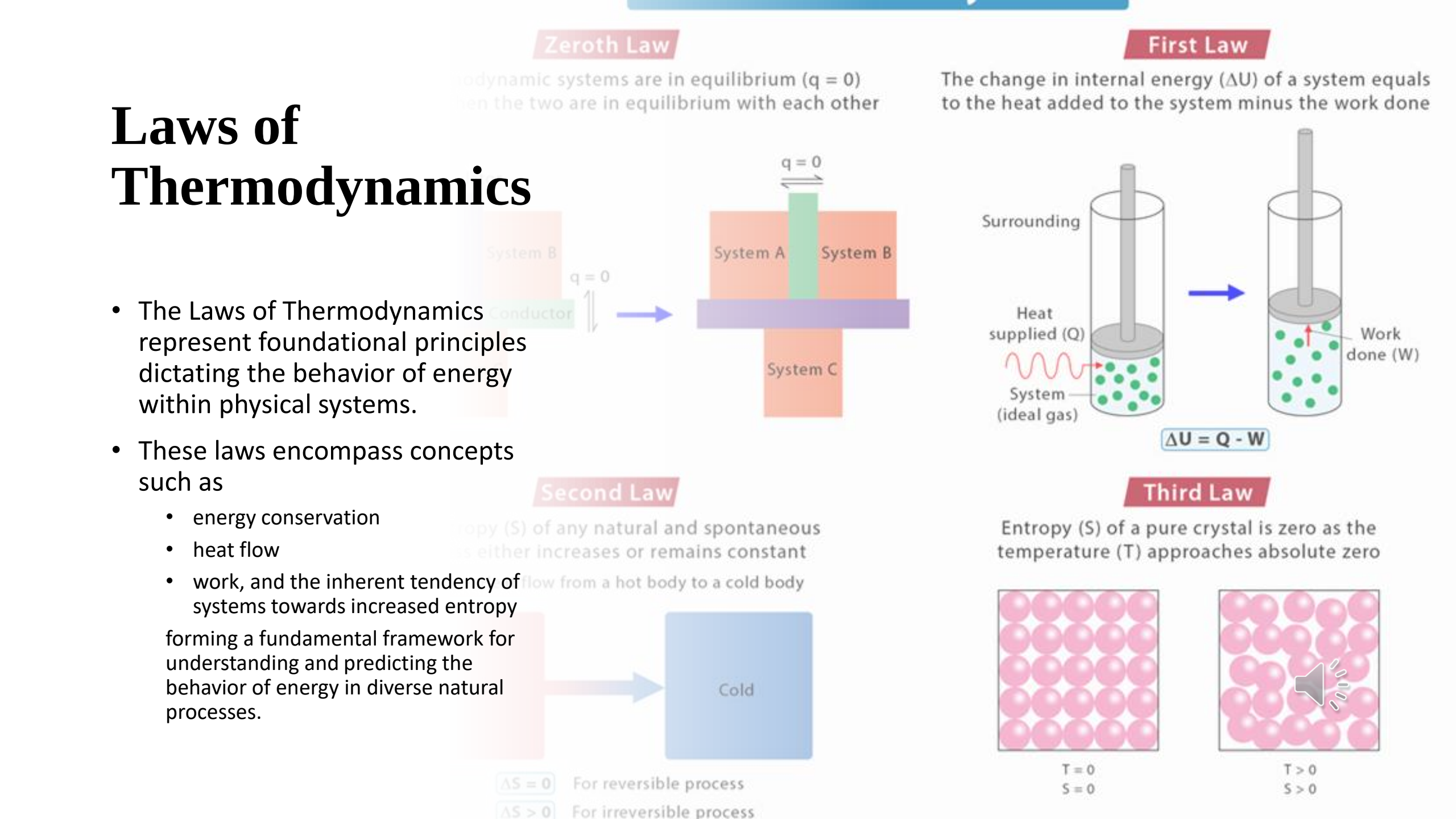
Thermodynamics is the branch of physics that deals with the relationships between heat, work, and energy.

It provides a framework for understanding and analyzing the behavior of systems involving the transfer of energy as heat or work.

Laws of Thermodynamics

- The Laws of Thermodynamics represent foundational principles dictating the behavior of energy within physical systems.
- These laws encompass concepts such as
  - energy conservation
  - heat flow
  - work, and the inherent tendency of systems towards increased entropy

  forming a fundamental framework for understanding and predicting the behavior of energy in diverse natural processes.



First Law of Thermodynamics (Law of Energy Conservation)

This law states that

"Energy cannot be created or destroyed in an isolated system.

The total energy of an isolated system remains constant; it can only change forms."

The first law is often expressed as the equation

$$\Delta U = Q - W$$

Where,

ΔU is the change in internal energy,

Q is the heat added to the system,

W is the work done by the system

Second Law of Thermodynamics

The second law deals with ***the concept of entropy***, which is a measure of ***the disorder or randomness*** in a system.

The law has two main statements:

1. *Heat naturally flows from regions of higher temperature to regions of lower temperature (heat transfer direction).*

2. *In any energy transfer or transformation, if no energy enters or leaves the system, the potential energy of the system will always be less than that of the initial state (entropy always increases)*

Third Law of Thermodynamics

The third law states that as the temperature of a system approaches ***absolute zero*** (0 Kelvin), the entropy of the system approaches a minimum or zero.

It is impossible to reach absolute zero in a finite number of steps.

Thermodynamic Processes

Isothermal Process: *A process that occurs at constant temperature.*

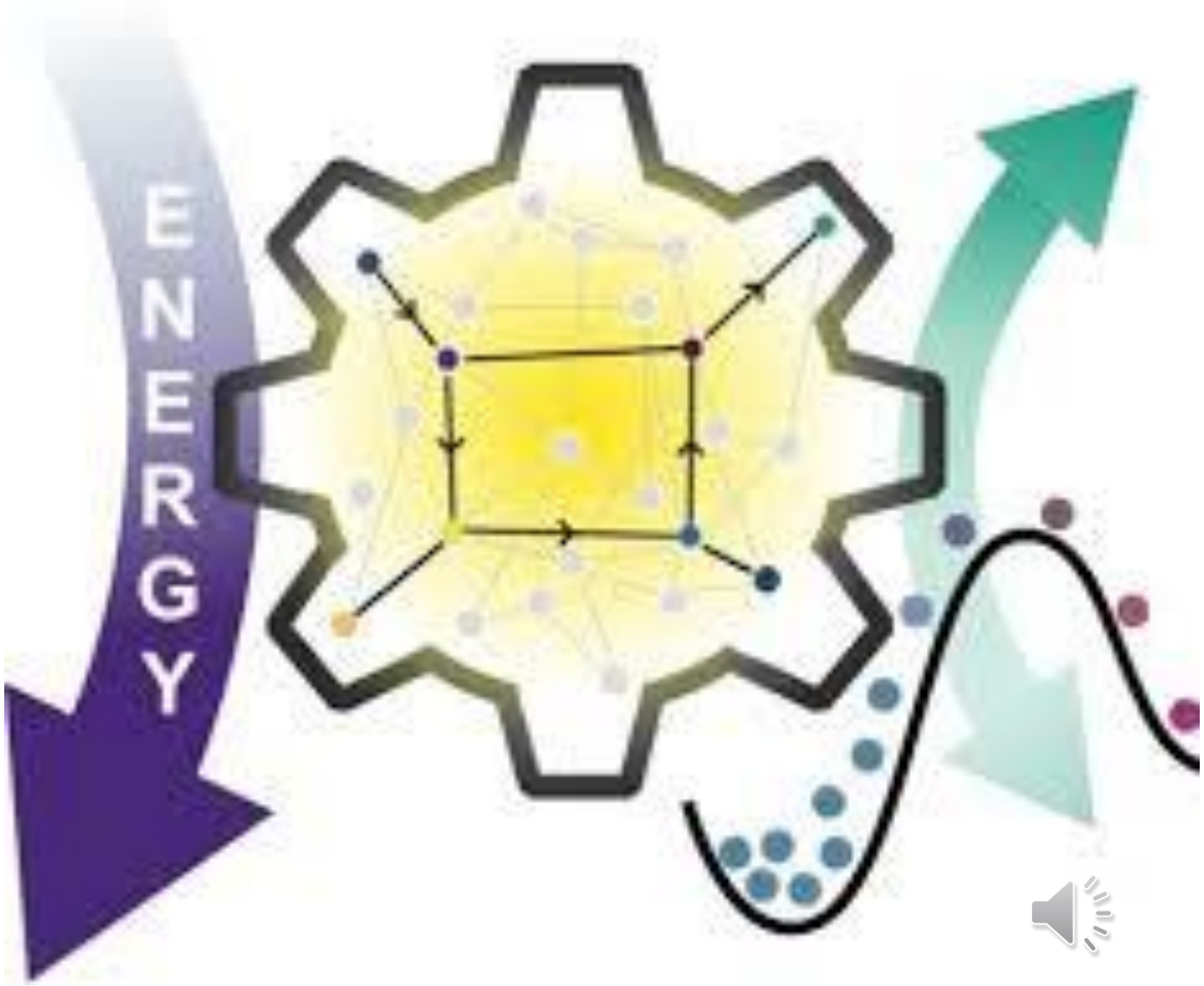
Adiabatic Process: *A process where there is no exchange of heat with the surroundings.*

Isobaric Process: *A process that occurs at constant pressure.*

Isovolumetric (or isochoric) Process: *A process that occurs at constant volume*

Thermodynamic Equilibrium

A system is in thermodynamic equilibrium when its macroscopic properties (temperature, pressure, etc.) do not change with time.



Applications of Thermodynamics:

Thermodynamics is essential in various fields:

- **Engineering:** In designing engines, refrigeration systems, and power plants.
- **Chemistry:** Studying reactions, phase transitions, and chemical equilibrium.
- **Environmental Science:** Analyzing energy transfer in natural systems.

Covered Points:

- Formal definition for Thermodynamics
- Laws of Thermodynamics
- Thermodynamic Processes
- Thermodynamic Equilibrium
- Applications of Thermodynamics

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