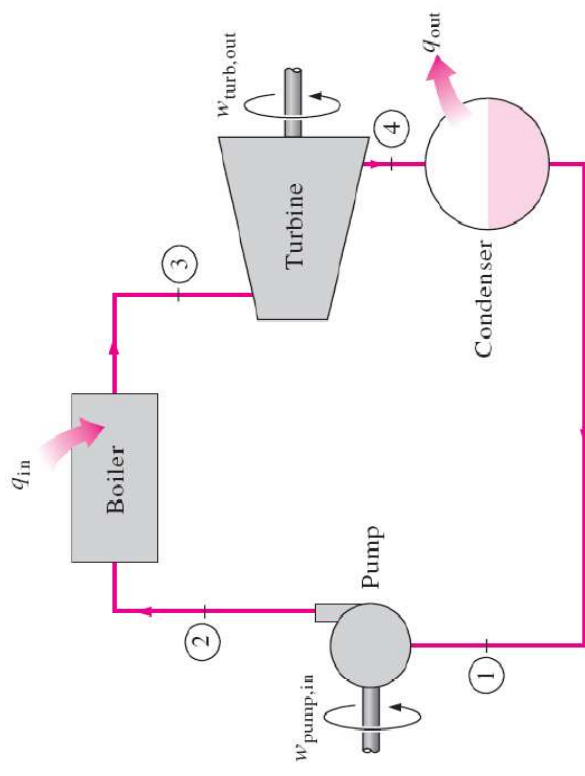




What is Thermodynamics?

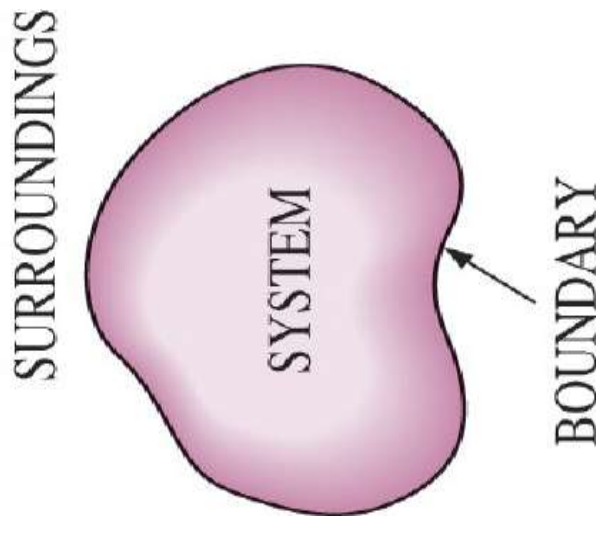
- ❖ The science of energy, that concerned with the ways in which energy is stored within a body.
- ❖ Energy transformations – mostly involve **heat** and **work** movements.
- ❖ The Fundamental law is the *conservation of energy* principle: energy cannot be created or destroyed, but can only be transformed from one form to another.





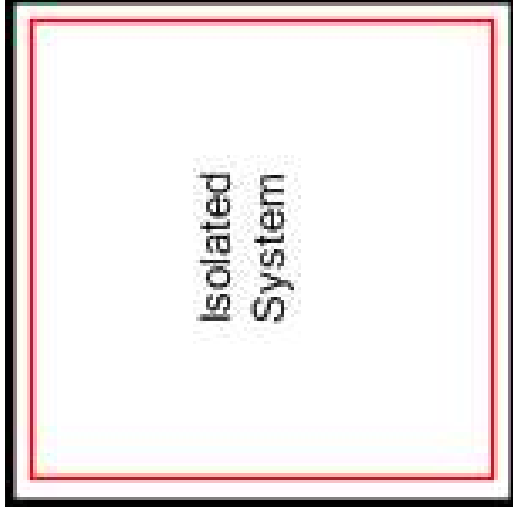
System, surroundings and boundary

- ❖ **System:** A quantity of matter or a region in space chosen for study.
- ❖ **Surroundings:** The mass or region outside the system
- ❖ **Boundary:** The real or imaginary surface that separates the system from its surroundings.





Type of system (isolated system)

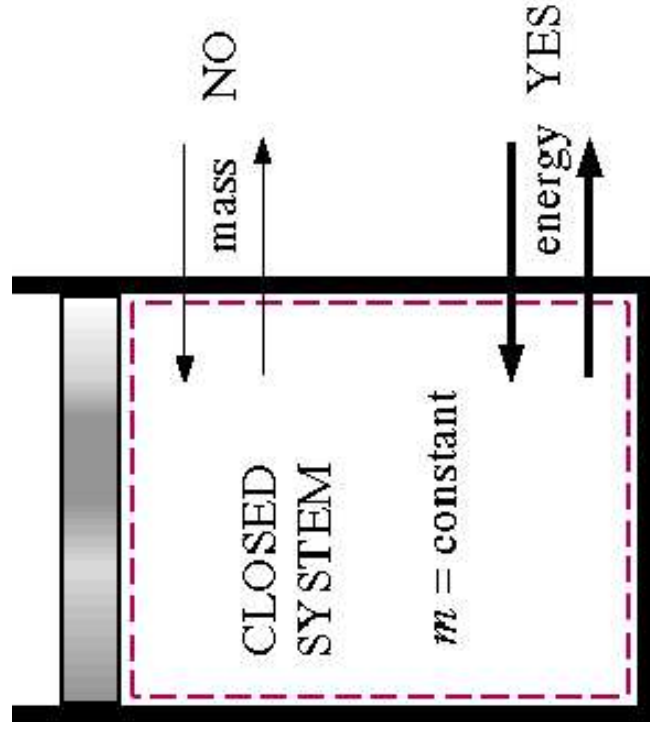


- ❖ **Isolated system** – neither mass nor energy can cross the selected boundary
- ❖ Example (approximate): coffee in a closed, well-insulated thermos bottle



Type of system

(Closed system)

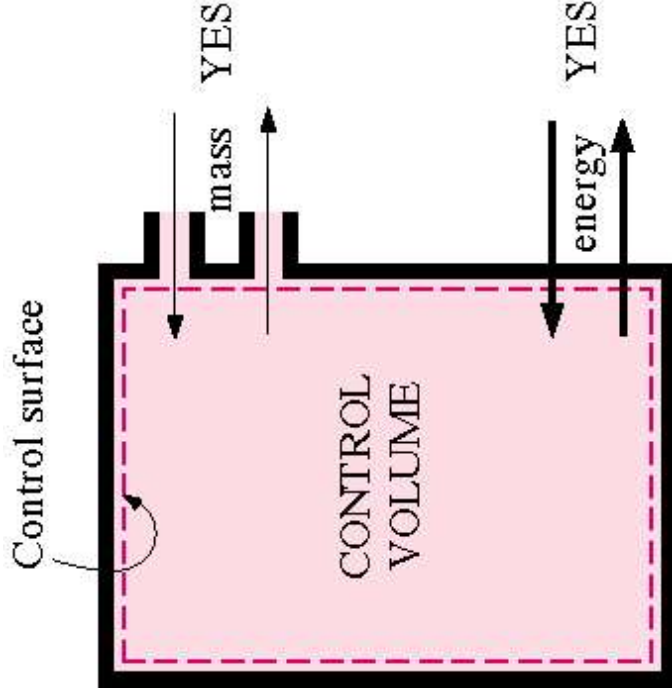


❖ **Closed system** – only energy can cross the selected boundary

❖ Examples: a tightly capped cup of coffee



Type of system (Open system)



- ❖ **Open system** – both mass and energy can cross the selected boundary
- ❖ Example: an open cup of coffee

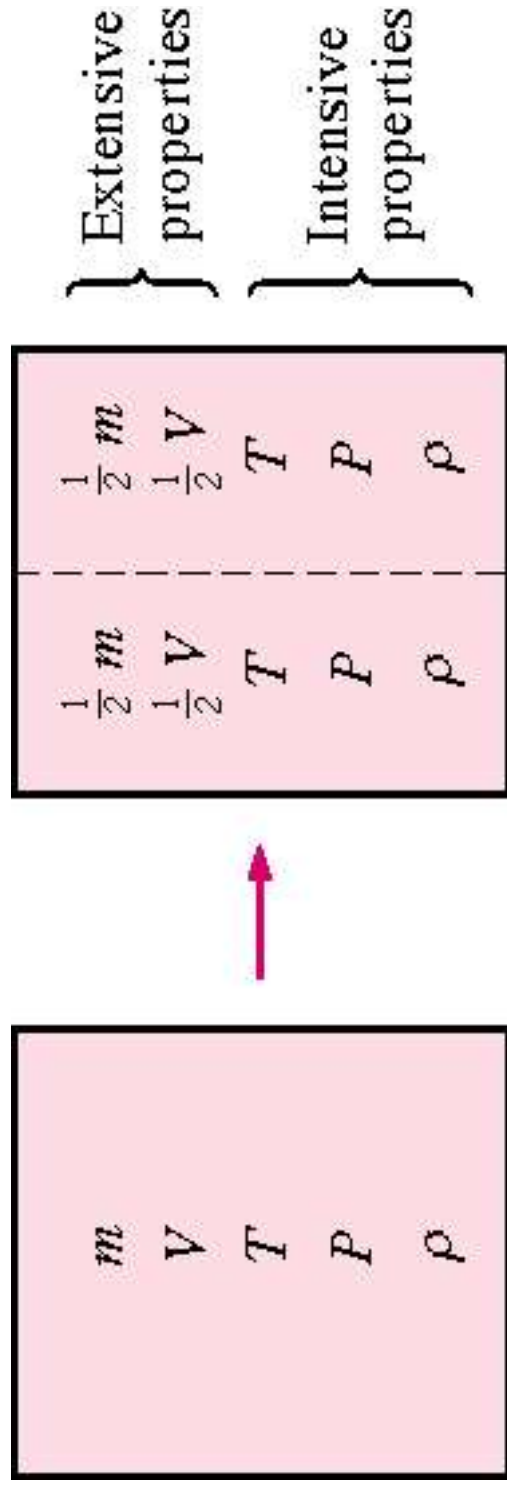


Properties of a system

Properties of a system is a measurable characteristic of a system that is in equilibrium.

Properties may be intensive or extensive.

- ❖ **Intensive** – Are independent of the amount of mass:
e.g: Temperature, Pressure, and Density,
- ❖ **Extensive** – varies directly with the mass
e.g: mass, volume, energy, enthalpy





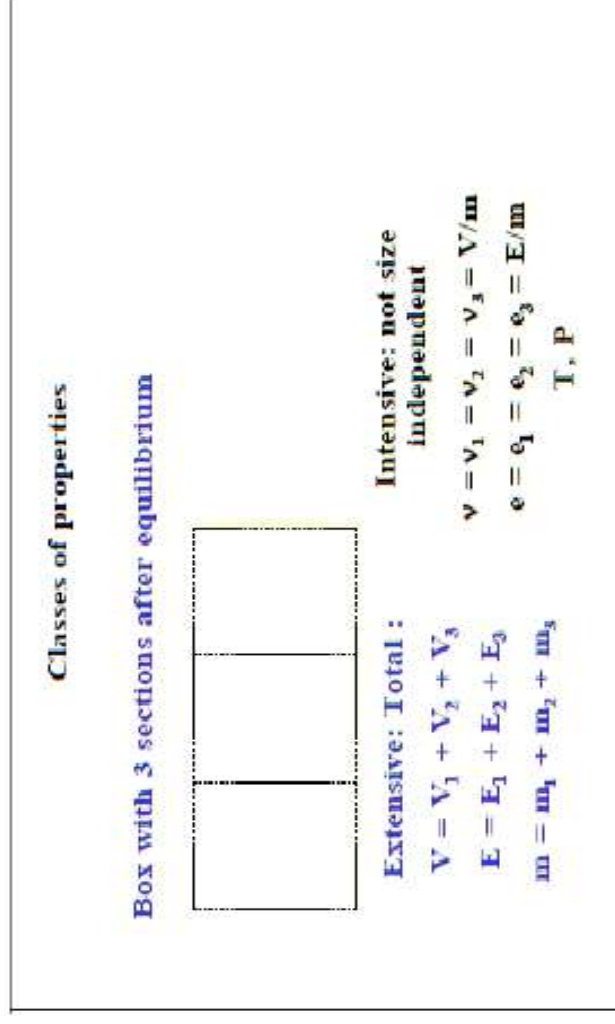
Properties of a system

Specific properties – The ratio of any extensive property of a system to that of the mass of the system is called an average specific value of that property (also known as intensives property)

$$\text{Specific Volume} \quad V/m = v \quad m^3 / \text{kg}$$

$$\text{Total Energy} \quad E/m = e \quad J / \text{kg}$$

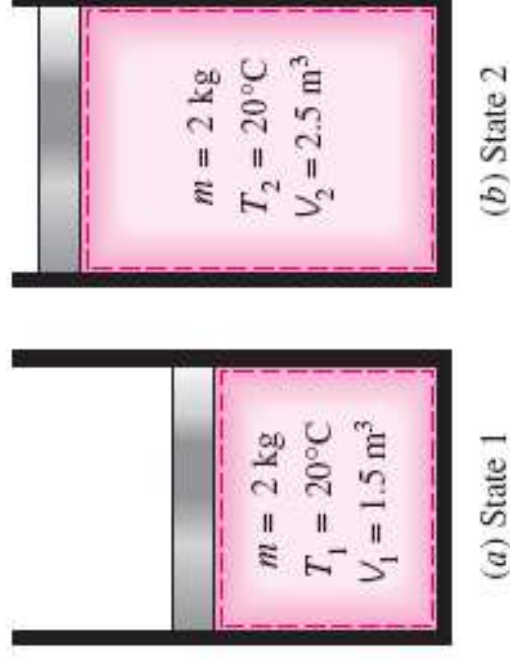
$$\text{Internal Energy} \quad U/m = u \quad J / \text{kg}$$





State, Equilibrium and Process

- ❖ **State** – a set of properties that describes the conditions of a system. Eg. Mass m , Temperature T , volume V
- ❖ **Thermodynamic equilibrium** - system that maintains thermal, mechanical, phase and chemical equilibriums.

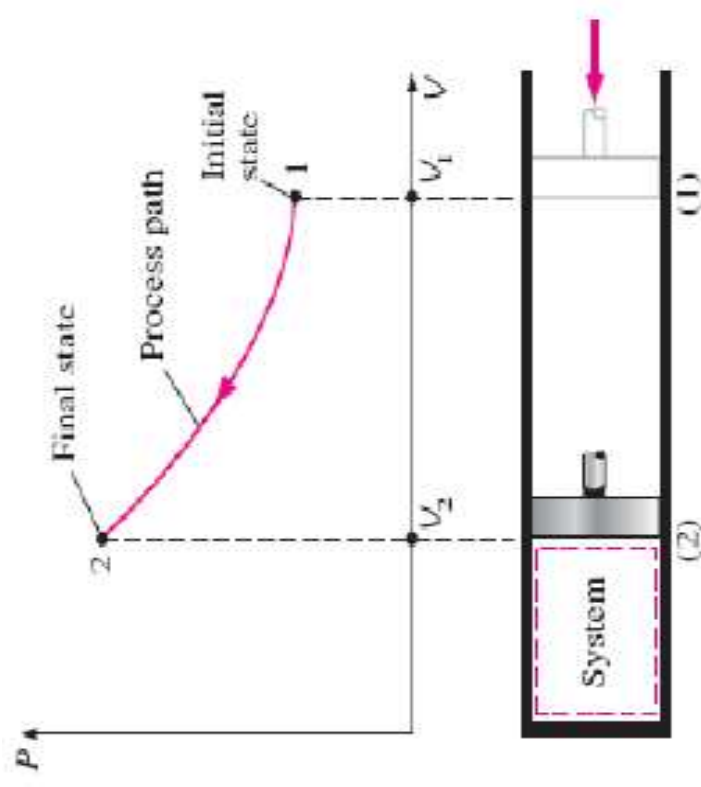




State, Equilibrium and Process

- ❖ **Process** – change from one equilibrium state to another.

Process	Property held constant
isobaric	pressure
isothermal	temperature
isochoric	volume
isentropic	entropy



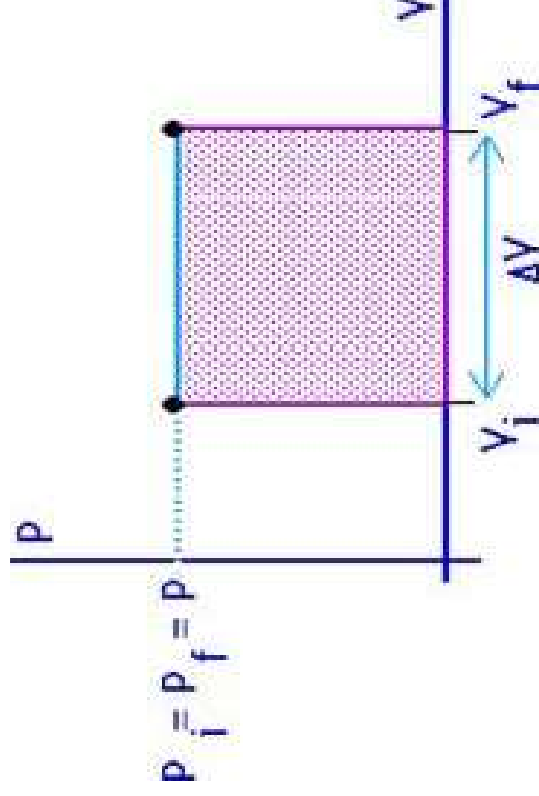


State, Equilibrium and Process

The prefix *iso-* is often used to designate a process for which a particular property remains constant.

Isobaric process: A process during which the pressure P remains constant.

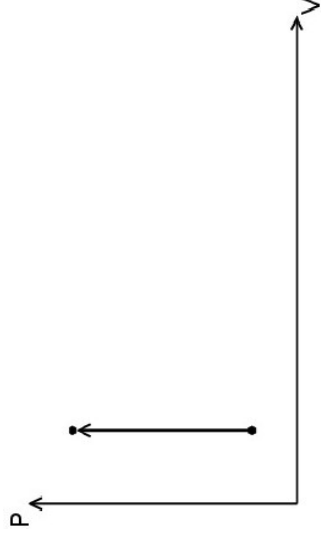
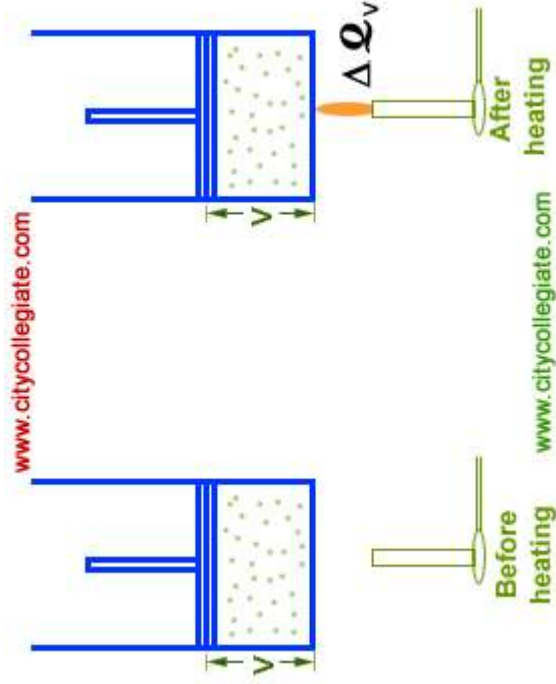
Pressure is Constant ($\Delta P = 0$)



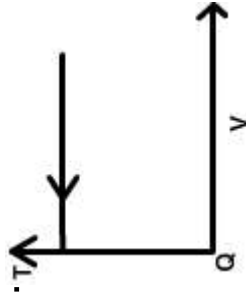


State, Equilibrium and Process

Isochoric (or isometric) process: A process during which the specific volume v remains constant



Isothermal process: A process during which the temperature T remains constant.

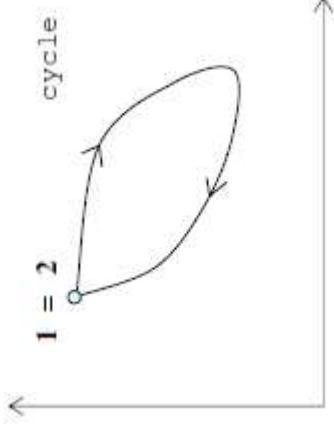


Process	Property held constant
isobaric	pressure
isothermal	temperature
isochoric	volume
isentropic	entropy



Types of Thermodynamics Processes

❖ **Cyclic process** - when a system in a given initial state goes through various processes and finally return to its initial state, the system has undergone a cyclic process or cycle.



❖ **Reversible process** - it is defined as a process that, once having take place it can be reversed. In doing so, it leaves no change in the system or boundary.

❖ **Irreversible process** - a process that cannot return both the system and surrounding to their original conditions



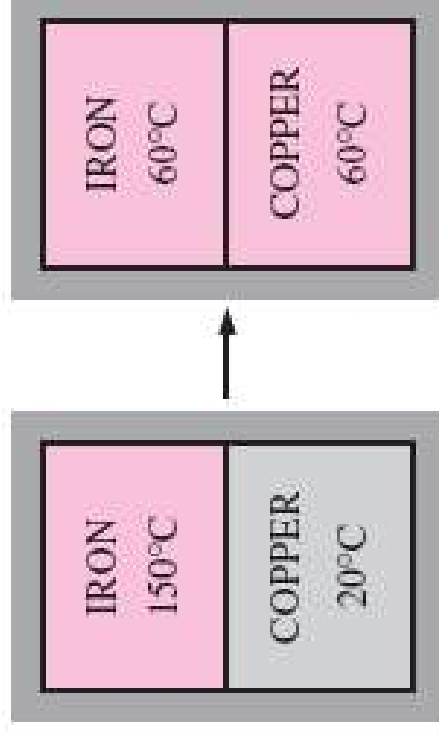
Types of Thermodynamics Processes

- ❖ **Adiabatic process** - a process that has no heat transfer into or out of the system. It can be considered to be perfectly insulated.
- ❖ **Isentropic process** - a process where the entropy of the fluid remains constant.
- ❖ **Polytropic process** - when a gas undergoes a reversible process in which there is heat transfer, it is represented with a straight line, $PV^n = \text{constant}$.
- ❖ **Throttling process** - a process in which there is no change in enthalpy, no work is done and the process is adiabatic.



Zeroth Law of Thermodynamics

“If two bodies are in thermal equilibrium with a third body, there are also in thermal equilibrium with each other.”



Two bodies reaching thermal equilibrium after being brought into contact in an isolated enclosure.