FIRST LAW OF THERMODYNAMICS

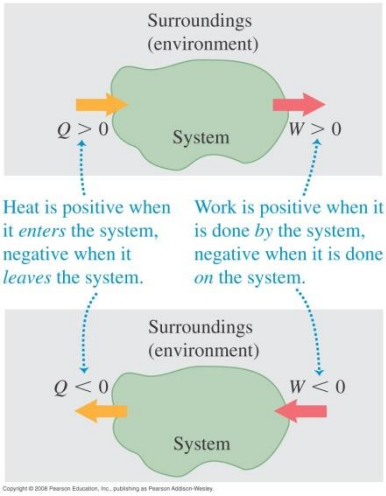
Thermodynamics is the study of heat, mechanical energy, work, and the exchange of energy between different systems and the environment.

Signs for Heat and Work in Thermodynamics

We describe the energy relationships in any thermodynamic process in terms of the quantity of heat **Q** *added* to a system and the work **W** *done by* the system.

A *thermodynamic system* is a system that can interact (and exchange energy) with the environment (surroundings).

1. Q and W can be positive, negative, or zero.
2. If Q >0 $\Rightarrow$Heat flows into the system. Energy is transferred **into** the system.
3. If Q <0 $\Rightarrow$Heat flows out the system. Energy is transferred **out** of the system.
4. If W >0 $\Rightarrow$Work done **by** the system **on** the environment. Energy **leaving** system.
5. If W <0 $\Rightarrow$Work done **by** the system **on** the environment. Energy **entering** the system.

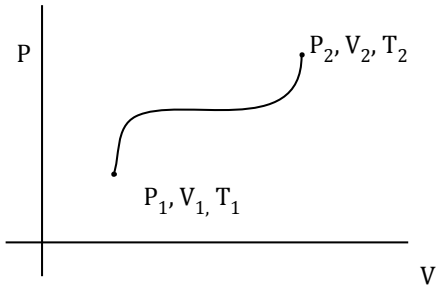


Work Done During Volume Changes

1. The state of a system is described by state variables such as P,V,T,n and U.
2. The relationship among the state variables is called the equation of state.

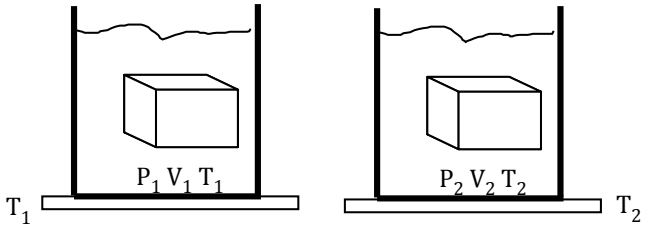
   Ex. pV = nRT

3. A macroscopic state of an isolated system can be specified only if the system is in thermal equilibrium internally. Ex. P and T are constants throughout the gas.
4. A quasi-state process is one in which the system remains in thermal equilibrium.



The change of the state of the system is described by a continuous curve.

Ex. A gas sample immersed inside a large water reservoir.



If the temperature is raised very slowly in a quasi-state process, then the water and gas will be in thermal equilibrium.

5. A quasi-state process is a reversible process.
6. A non quasi-state is an irreversible process.