# Terms in Thermodynamics

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## Thermodynamics

- A phenomenological theory of matter, as it draws its concepts directly from experiments. The theory of the relations between heat and mechanical energy, and of the conversion of either into the other.

## Terms

- Thermodynamic system: any microscopic system.
- Thermodynamic parameters: measurable macroscopic quantities associated with the system, such as the pressure $P$, the volume $V$, the temperature $T$.
- Thermodynamic state: specified by a set of values of all the thermodynamics parameters necessary for the description of the system.

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- Thermodynamic equilibrium: when the thermodynamic state of the system does not changes with time.
- The equation of state: a functional relationship among the thermodynamic parameters for a system in equilibrium. If $P$, $V$, $T$ are the thermodynamic parameters of the system, the equation of state takes the form

$$f(P, V, T) = 0.$$

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- A heat reservoir: a system so large that the gain or loss of any finite amount heat does not change its temperature.
- Thermally isolated: if no heat exchange can take place between it and the external world.

## Thermodynamic transformation: a change of state

- Quasi-static transformation: if the external condition changes so slowly that at any moment the system is approximately in equilibrium.
- Reversible: if the transformation retraces its history in time when the external conditions retraces its history in time.
- Isothermal: temperature $T$ is constant.
- Isobaric: pressure $P$ is constant.
- Isochoric: volume $V$ is constant.
- Adiabatic: entropy $S$ is constant.
- Cyclic: internal energy $U$ is constant.

## Type of parameters

- Extensive (Additive quantity): if it is proportional to the amount of substance in the system. For example, $N$, $V$, $S$.
- Intensive: if it is independent of the amount of substance in the system. $\mu$, $P$, $T$.

## Equation of state for ideal gas

- $PV = Nk_B T$, where $k = 1.38 \times 10^{-16}$ erg/deg is called Boltzmann's constant.

## Reference


- K. Huang, *Statistical Mechanics*, John Wiley & Sons (1987).