

Thermodynamic system/description

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Checked version of the article can be found here (https://www.wikilectures.eu/index.php?title=Thermodynamic_system/description&oldid=18555).

See also comparison of actual and checked version (https://www.wikilectures.eu/index.php?title=Thermodynamic_system/description&diff=-&oldid=18555).



Thermodynamic system

A thermodynamic system is a macroscopic region of the universe under study, with a quantity of matter of fixed identity. It is defined by boundaries, which control the transfers between the system and the surroundings (everything which is outside the boundary). The types of transfers that can occur in a thermodynamic process are mass and energy (work and heat).

Classification

A thermodynamic system can be classified as open, closed or isolated, according to the exchanges that can occur with the surroundings.

Closed system- exchanges of energy but not of matter;

Open system- exchanges of energy and matter;

Isolated system- does not exchange energy or matter.

Description

State of system: condition of system which is described by measurable properties: state variables.

State variables: macroscopic parameters that describe the properties of the system, when it is in equilibrium: temperature (T), pressure (P), volume (V). The state variables have the same value in every part of the system.

State equations: mathematic relations between the state variables. For example: $P = P(v, T)$ or $T = T(P, v)$

State function: properties whose values depend only of the state of the system and not of the path by which the state was reached: pressure, volume, temperature, internal energy.

The state of system changes when a process occurs.

Types of processes that can occur in a thermodynamic system:

- Isothermal: occurs at constant temperature;
- Isochoric: occurs at constant volume;
- Isobaric: occurs at constant pressure;
- Adiabatic: occurs without loss or gain of energy as heat;
- Isentropic: occurs at constant entropy;
- Isenthalpic: occurs at constant enthalpy;

The processes can be reversible or irreversible, and spontaneous (as the flow of heat from a hot body to a cold body), or non-spontaneous (as the flow of heat from a cold body to a hot body).

Cyclic processes are processes that can be repeated indefinitely without changing the final state of the system.

A system is in equilibrium when the properties have definite, unchanged values in time.

Thermodynamic quantities

Internal Energy (U): amount of energy inside the system which depends on various factors as temperature, pressure and chemical nature of the substance.

Change in internal energy: $\Delta E = E(\text{products}) - E(\text{reactants})$

Enthalpy (H): the heat content of a system. It is the sum of internal energy and the product of its pressure and volume.

$$H = U + PV$$

Change of enthalpy: $\Delta H = H(\text{products}) - H(\text{reactants})$

Entropy (S): measure of disorder of the system. The greater the disorder, the greater the entropy. Is minimum in solid state and maximum in gaseous state. Depends on temperature and increases with increase in temperature. Melting of ice is an example of increasing entropy.

Change of entropy: is equal to heat absorbed isothermally and reversibly, during a process, divided by absolute temperature at which heat is adsorbed

$$\Delta S = q_{\text{rev}}/T$$

References

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