Classification of thermodynamic systems [tln10]

Criterion: Thermodynamic contact.

1. Mechanical interaction (with work source).
   Exchange of energy via work performance.
2. Thermal interaction (with heat reservoir).
   Exchange of energy via heat transfer.
3. Mass interaction (with particle reservoir).
   Exchange of energy via matter transfer.

Isolated system: contact 1.
Closed system: contacts 1, 2.
Open system: contacts 1, 2, 3.

Laws of thermodynamics

Zeroth law: Two systems, each in thermal equilibrium with a third system, are in thermal equilibrium with each other.

- Prerequisite for measurement of thermodynamic properties.
- Thermal equilibrium implies uniform temperature.
- Mechanical equilibrium implies uniform pressure.
- Chemical equilibrium implies uniform chemical potential.

First Law: Energy is conserved.

- Internal energy U is a state variable.
- Heat and work are not state variables.

Second Law: Heat flows spontaneously from high to low temperatures.

- Entropy S is a state variable.
- Efficiency of heat engines.
- Reversibility and irreversibility.
- Definition of absolute temperature T.

Third Law: $S \to 0$ as $T \to 0$.

- No cooling to $T = 0$ in a finite number of steps.