

1.4 Second Axiom of Thermodynamics: Irreversible Processes exist

- A System never changes by its own into a less probable state
- There exists no perpetuum mobile of second kind
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$$\delta Q/T \leq dS \quad \delta Q_{rev}/T = dS \quad S : \text{Entropy} \quad (1.4)$$

Into first axiom:

$$dU = TdS - dW \quad (1.5)$$

- S is a state variable
- U is a potential $U(S, \dots)$ for reversible processes
- dU is a total differential
- S increases until thermodynamic equilibrium is reached and afterwards it always has its maximal value; thermodynamic potentials only apply for equilibrium

This knowledge opened the way to heat transforming machines \Rightarrow optimization of the efficiency

Thermodynamic is a "perfect mathematical game": Based on a minimal set of axioms many results are concluded (many different relations contain the same physical information)

\Rightarrow "Everybody has his own definition of entropy"
BUT all are equivalent