

Giancoli Ch20: Second Law of Thermodynamics

1 2nd law of thermodynamics

- 1st law of thermo \rightarrow directionless energy conservation
- 2nd law tells us that spontaneous process is irreversible
- for thermodynamical processes, **heat flows spontaneously from hot \rightarrow cold, not the reverse**
- more generally, in any type of processes, we can define 2nd law in terms of entropy

2 Heat Engines

- **Heat engine** : any device that change thermal energy \rightarrow mechanical work
- while $Q_H \rightarrow Q_L$, $Q \rightarrow W$: $Q_H = W + Q_L$
- W always positive
- consider cyclical system that return to initial every cycle
- ex) Steam Engine
 - working substance : material that is heated and cooled (e.g. steam)
 - similar design except work is done through different ways
 - Reciprocating type : W done to move piston
 - Turbine
- Internal Combustion engine: repeated four-stroke cycle of fuel mixture ignition and moving piston