

## 10/19 Lecture outline

- Another example on  $\Delta S$  and energy usefulness degradation: Carnot engine where heat is delivered at temperature below that of the boiler (because of some cooling in the process of heat conduction).

- Entropy and molecular disorder:  $S = k \ln \Omega$ . More on arrow of time.

- More on  $T$ - $S$  diagrams. Slope of isochoric and isobaric curves.

- $dU = TdS - PdV$  and conjugate variables  $S \leftrightarrow T$  and  $P \leftrightarrow V$ . Expressions for  $T$  and  $P$  from  $U(S, V)$ .

- Enthalpy  $H(S, P) = U + PV$ ; Helmholtz free energy  $F(T, V) = U - ST$ ; Gibbs function  $G(T, P) = U + PV - ST$ . Expressions for the conjugate variables in each case.

- Back to entropy and energy degradation. System with  $P, V, T$ , in surroundings  $P_0, T_0$ . Expression for maximum mechanical work  $\Delta W_{mech}$ .