Review I

Massachusetts Institute of Technology
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Prof. Bawendi, Prof. Nelson

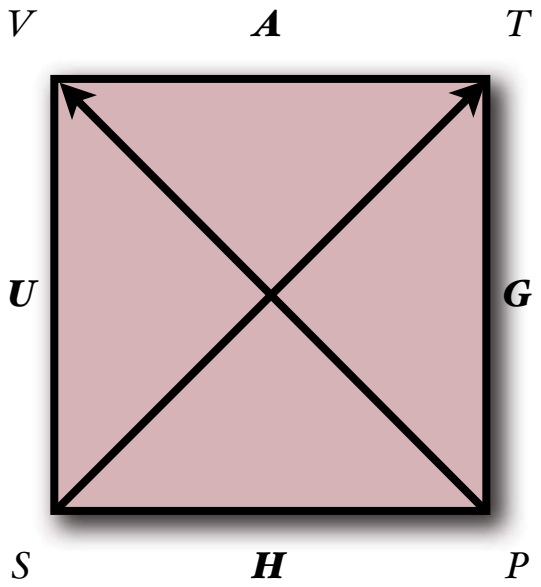
References, Tables, Diagrams

Thermodynamic Potentials

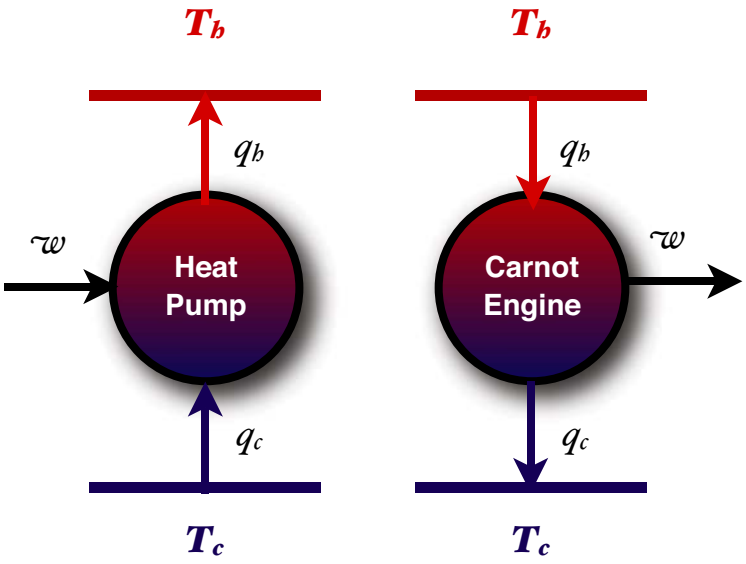
Name	Symbol	Definition	Natural Variables	Fundamental Equation	Maxwell Relation
Internal Energy	U	$q + w$	S, V	$\boldsymbol{dU = TdS - pdV}$	$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial p}{\partial S}\right)_V$
Enthalpy	H	$U + pV$	S, p	$\boldsymbol{dH = TdS + Vdp}$	$\left(\frac{\partial T}{\partial p}\right)_S = \left(\frac{\partial V}{\partial S}\right)_p$
Helmholtz Free Energy	A	$U - TS$	T, V	$\boldsymbol{dA = -SdT - pdV}$	$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial p}{\partial T}\right)_V$
Gibbs Free Energy	G	$H - TS$	T, p	$\boldsymbol{dG = -SdT + Vdp}$	$\left(\frac{\partial S}{\partial p}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_p$

Note: When natural variables of potential X are held constant, $dX < 0$ is the criterion for spontaneous change

Thermodynamic Square



Carnot Engines/Heat Pumps



Efficiency

Pump: q_h/w Fridge: q_c/w Engine: w/q_h