Thermal Physics Cheat Sheet

Thermodynamics

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Internal energy, U

$$dU = TdS - pdV \tag{1}$$

Enthalpy, H

$$H \equiv U + PV = \{(3)\} = H(S,p) \tag{2}$$

$$dH = \{(1)\} = TdS - pdV + pdV + VdP = TdS + Vdp \tag{3}$$

$$\Delta H = \begin{cases} exothermic & \Delta H < 0 \\ endothermic & \Delta H > 0 \end{cases} \tag{4}$$

Helmholtz function, F

$$F \equiv U - TS = \{(6)\} = F(T,V) \tag{5}$$

$$dF = \{(1)\} = TdS - pdV - TdS - SdT = -SdT - pdV \tag{6}$$

Gibbs function, G

$$G \equiv H - TS = \{(8)\} = G(T,p) \tag{7}$$

$$dG = \{(3)\} = TdS + VdP - TdS - SdT = -SdT + VdP \tag{8}$$

Maxwell Relations[16]

Derivation of generalized maxwell

$$df\,(x,y) = \left(\frac{\partial f\,(x,y)}{\partial x}\right)_y dx + \left(\frac{\partial f\,(x,y)}{\partial y}\right)_x dx \tag{9}$$

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Phase Transisions[28.1-3]

Toolbox

$$\left(\frac{\partial x}{\partial y}\right)_z \left(\frac{\partial y}{\partial z}\right)_x \left(\frac{\partial z}{\partial x}\right)_y = -1 \tag{10}$$

$$\left(\frac{\partial x}{\partial y}\right)_z \left(\frac{\partial y}{\partial z}\right)_x = -\left(\frac{\partial x}{\partial z}\right)_y \tag{11}$$

dS is an exact integral and thus only the start and end state needs to be calculated.

$$\left(\frac{\partial u(x,y), v(x,y)}{\partial x}\right)_y = \left(\frac{\partial f(u,v)}{\partial u}\right)_v \left(\frac{\partial u(x,y)}{\partial x}\right)_y + \left(\frac{\partial f(u,v)}{\partial v}\right)_u \left(\frac{\partial v(x}{\partial x}\right. \tag{12}$$

http://www.cheatsheet.jim.pm?subject=thermalphysics