Maxwell's relations [tln17]

inferred from second partial derivatives of thermodynamic potentials with respect to two different natural independent variables

Fluid system:

$$dU = TdS - pdV \quad \Rightarrow \quad \left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial p}{\partial S}\right)_V$$

$$dE = TdS + Vdp \quad \Rightarrow \quad \left(\frac{\partial T}{\partial p}\right)_S = \left(\frac{\partial V}{\partial S}\right)_p$$

$$dA = -SdT - pdV \quad \Rightarrow \quad \left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial p}{\partial T}\right)_V$$

$$dG = -SdT + Vdp \quad \Rightarrow \quad \left(\frac{\partial S}{\partial p}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_p$$

Magnetic system:

$$dU = TdS + HdM \quad \Rightarrow \quad \left(\frac{\partial T}{\partial M}\right)_S = \left(\frac{\partial H}{\partial S}\right)_M$$

$$dE = TdS - MdH \quad \Rightarrow \quad \left(\frac{\partial T}{\partial H}\right)_S = -\left(\frac{\partial M}{\partial S}\right)_H$$

$$dA = -SdT + HdM \quad \Rightarrow \quad \left(\frac{\partial S}{\partial M}\right)_T = -\left(\frac{\partial H}{\partial T}\right)_M$$

$$dG = -SdT - MdH \quad \Rightarrow \quad \left(\frac{\partial S}{\partial H}\right)_T = \left(\frac{\partial M}{\partial T}\right)_H$$