

10.10: J- Thermodynamic Master Equations

$$E(S, V, N)$$

$$dE = TdS - pdV + \mu dN$$

$$F(T, V, N) = E - TS$$

$$dF = -SdT - pdV + \mu dN$$

$$H(S, p, N) = E + pV$$

$$dH = TdS + Vdp + \mu dN$$

$$G(T, p, N) = F + pV$$

$$dG = -SdT + Vdp + \mu dN$$

$$\Pi(T, V, \mu) = F - \mu N = -pV$$

$$d\Pi = -SdT - pdV - Nd\mu$$

$$p(T, \mu) \text{ [intensive quantities only]}$$

$$dp = SdT + \rho d\mu \quad [S = S/V, \quad \rho = N/V]$$

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