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Course 565 / 665 Lecturer Prof. Cavagnero

Day 3.8.04 Date 9:55 am

Notes Taken By Jiang Hong Total Number of Pages

$F = F(N \cdot V \cdot T) = U - TS$

$$\left.\begin{array}{l} dF = du - Tds - sdT \\ du = Tds - pdV + \sum_{j=1}^{M} \mu_j dN_j \end{array}\right\} \Rightarrow dF = -sdT - pdV + \sum_{j=1}^{M} \mu_j dN_j$$

$H(N.p.S) = U + pV$

$$\left.\begin{array}{l} dH = du + pdV + Vdp \\ du = \cdots \end{array}\right\} \Rightarrow dH = Tds + Vdp + \sum_{j=1}^{M} \mu_j dN_j$$

Gibbs Free Energy $G(N \cdot T \cdot p) = U + pV - TS = H - TS = F + pV$

$dG_{sys} \leq 0$ good criterion for eq. for biochem. sys.

$$\left.\begin{array}{l} dG = du + pdv + vdp - Tds - sdT \\ du = \cdots \end{array}\right\} \Rightarrow dG = -sdT + Vdp + \sum_{j=1}^{M} \mu_j dN_j$$

from before

$$\left.\begin{array}{l} du_{sys} - TdS_{sys} \leq 0 \\ dH = du + pdV + Vdp \quad (\text{let } dp = 0) \end{array}\right\} \Rightarrow$$

$dH_{sys} - TdS_{sys} - p\,dV_{sys} \leq 0$ at const N T. p. ?

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Heat capacity: allows measuring U and S.

C_V: at constant V ; C_p: at constant p.

$C_V \equiv \left(\frac{\delta q}{\partial T}\right)_V$ amount of heat necessary to increase T by $1^\circ C$ at constant V.

$C_V = \left(\frac{\partial U}{\partial T}\right)_V$ (1st law)

$= T\left(\frac{\partial S}{\partial T}\right)_V$

$\Delta U = \int_{T_A}^{T_B} C_V(T)\,dT$

$\Delta S = \int_{T_A}^{T_B} \frac{C_V(T)}{T}\,dT$

at constant p: $dH = d(U+pV) = dU + pdV = \delta q + \delta w + pdV$

$dH = \delta q$ (only pV work $\delta w = -pdV$)

$C_p \equiv \left(\frac{\delta q}{\partial T}\right)_p = \left(\frac{\partial H}{\partial T}\right)_p = T\left(\frac{\partial S}{\partial T}\right)_p$

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